51st SASAS CONGRESS
BOOK OF ABSTRACTS

EMS building, University of the Free State
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PREFACE

The 51st SASAS Congress with the theme "**Managing the ecological footprint of livestock through efficient production**" are held from 10 to 12 June 2019 at the University of the Free State in Bloemfontein.

Major challenges are associated with climate change and the environmental impact of the agricultural sector. Concerns are frequently raised about the role of modern technology in animal production, welfare and ethical treatment of animals, the degradation of natural vegetation and loss in biodiversity, use of water in a water-scarce country, impact of livestock products on human health, and more recently - the contribution of livestock to greenhouse gas emissions.

While these aspects might shed a "long shadow" on livestock production, it is indisputably clear that the world will need almost double the current food supply by 2050 to feed the ever increasing human population. This improved production outputs needs to be achieved by using less land, water and available energy, while ensuring that the degradation and pollution of natural resources are limited. The Agriculture sector must thus comply with a phenomenon called the "Great Balancing Act" by supporting further economic development and uplifting the nutritional status of approximately 100 million undernourished people in the Southern African Development Community (SADEC). Given these multi-disciplinary challenges within the Agricultural industry, it is clear that a scientific approach would be the only viable option to improve the efficiency of livestock production.

The increased number of popular media platforms could dually function as either an opportunity or a threat by spreading information in public domain that could provoke emotional biasness in terms of the ecological footprint of livestock. Confronting the impact of livestock production in the ecology would thus require critical thinking and objective rationale, as well as the willingness to adopt new strategies – all aspects that the new generation of Animal Scientist need to be prepared for. The theme of the congress therefore aims to address these effects within welfare, ethical and climate constraints.

A special thanks to the sub-editors and reviewers for their help and guidance with the abstract review process. Your inputs made it possible to accomplish a congress program of high scientific standard.

Yours sincerely,

G.C. Josling
Editor-in-Chief: 2019 SASAS Congress
buitendachgc@ufs.ac.za

WELCOME MESSAGE - SASAS PRESIDENT

Prof. Este Van Marle-Köster

The 51st Congress of the South African Society for Animal Science (SASAS) will be held in the Free State where we will be looking at Animal Science in Practice. These congresses are important events in the calendar of the animal science discipline. Interaction with other animal scientists is the lifeline of animal scientists and this is the ideal opportunity to interact with fellow scientists. You are all encouraged to diarize this important event so that you are available to attend it. I hope to see you all at the 2019 Congress, it promises to be a great success. We look forward to hosting you.

Congress Organizing Committee

Congress Editorial Board and Reviewer Panel

Effect of β-carotene supplementation on production and reproduction traits in Merino ewes (*Ovis aries*)

O.M.M. Ahmed[1], A. Hassen[1] & K.C. Lehloenya[2]
[1]Department of Animal and Wildlife Sciences, University of Pretoria, South Africa, [2]Department of Agriculture, University of Zululand, South Africa.
osmanmma@gmail.com

Background: The body overproduces oxidants during the pathophysiological conditions but also during normal conditions such as breeding, pregnancy, parturition and lactation. Antioxidants such as β-carotene are expected to ultimately downstream the oxidative stress and hence affects positively on the reproductive performance of farm animals. However, the literature on the effects of β-carotene supplementations on reproduction is contradictory and very few studies were conducted in ewes.

Aim: To determine the effect of β-carotene supplementation during breeding, pregnancy, parturition and lactation on the production and reproduction traits of Merino ewes.

Methodology: Ethical approval was obtained from the Animal Ethics Committee, University of Pretoria (EC056-17). The trial was conducted at the experimental farm of the University of Pretoria from September 2017 to May 2018. Hundred and four Merino ewes were divided into four groups based on live weight (63.53 ± 0.84 kg), and age (4.3 ± 0.17 years): A1 (n=25), A2 (n=26), A3 (n=27) and C (n=26). Animals were grazed on Kikuyugrass (*Pennisetum clandestinum*) during the day and kept on the sheds during the night. Group A1, A2 and A3 were daily drenched with 50 mg, 75 mg and 100 mg of β-carotene per ewe while group C represented the control treatment. The treatments were provided for a total of 120 days divided into two 60 days periods. The first period was subdivided into 28 days before oestrous synchronisation; 14 days during oestrous synchronisation and hand-mating; and 18 days post-hand-mating. The second period was subdivided into 30 days before lambing and 30 days after lambing. Ewes were teased two times per day for three days after the withdrawal of the controlled internal drug release (CIDR) to determine oestrous response; onset and duration. The ultrasonography tests were performed to determine the corpus luteum size on day 12 post-hand-mating and pregnancy on day 35 post-hand-mating. Data were analysed using one-way ANOVA and Chi-Square test of SPSS 11.5 for Windows.

Results and Discussion: Supplementation of ewes with β-carotene had no effect ($P>0.05$) on body weight (65.82 ± 1.05 kg), oestrus response (99.0%), oestrus duration (45.02 ± 1.45 hrs), oestrus onset (18.98 ± 1.00 hrs), conception rate (97.1%) and corpus luteum size (9.27 ± 0.38 mm). Although the quadruplets were observed only in group A2 and A3 (11.5 % and 4.0%, respectively), the differences in the litter size between the groups were not statistically significant (1.64 ± 0.15, 1.85 ± 0.18, 1.64 ± 0.13 and 1.76 ± 0.13 for group A1, A2, A3 and C, respectively). This might be due to the small number of ewes replicated in each group. Supplementation of ewes with β-carotene had no effect on the mortality rate (11.8%) of the lambs, weight at birth (3.63 ± 0.07 kg) or at 15 days old (7.18 ± 0.17 kg).

Conclusion/recommendations: Supplementation of ewes with β-carotene had no effect on production and reproduction traits. However, more studies are needed to investigate the effect of β-carotene supplementation on litter size using a larger number of ewes.

Storage did not affect plant extracts potency on methane reduction and *in vitro* organic matter digestibility but efficacy is substrate dependent

A.M. Akanmu[1] & A. Hassen[1]
[1]Department of Animal and Wildlife Sciences, University of Pretoria, Pretoria, South Africa.
Abubeker.hassen@up.ac.za

Background: Different plant extracts have different concentrations of numerous phytochemicals which in turn influences the extent of ruminal modulation functions. Previous studies revealed that some of these plant extracts are effective in reducing methane from low quality roughage.

Aim: The study compared the effect of stored vs. freshly extracted *Aloe vera* (AV), *Azadirachta indica* (AZ), *Moringa oleifera* (MO), *Jatropha curcas* (JA), *Tithonia diversifolia* (TD) and *Carica papaya* (CP) plant extracts on *in vitro* gas and methane production, organic matter digestibility (IVOMD) and volatile fatty acids (VFA) when added to total mixed ration- (TMR), Lucerne- and *Eragrostis curvula* substrates, respectively. This study also compared the methane reducing potential of plant extracts vs. the antibiotic growth promoter (monensin) commonly used in animal feeding.

Methodology: This study was approved by the Animal Ethics Committee of the University of Pretoria (Ref No: EC030-14). Plant extracts of AV, AZ, MO, JA, TD and CP were prepared using 100% methanol. The extracted crude products were freeze-dried to remove any moisture present and later stored at 4°C for 12 months before the study. Fresh extracts were processed from the same batch of plant material which remained frozen at −20°C a few days before the experiment and stored under refrigeration. Both stored and fresh plant extracts of AV, AZ, MO, JA, TD and CP were reconstituted by dissolving 50 mg crude extract of each in 1000 mL distilled water. Four ml of reconstituted plant extract solution was added to incubation vials which already contained 400 mg TMR, Lucerne or Eragrostis hay. Using standard procedures, data were collected on *in vitro* gas and methane production, VFA and organic matter digestibility. Five independent runs were carried out, and each treatment replicated 4 times. Data were analysed using the GLM procedure of SAS statistical software.

Result and Discussion: Storing plant extracts for 12 months had no effect ($P<0.05$) on total gas and methane production for all substrates tested in this study. Generally, increased IVOMD was recorded for all plant extracts on TMR, but no significant differences were observed for TGP and CH_4. Plant extracts used in this study performed better than the antibiotic treated group in terms of increased total volatile fatty acids, improved digestibility (except for Lucerne), and reduced methane production. Storing the plant extracts or plant material for up to one year did not compromise the efficacy of these plant extracts as there were no difference ($P>0.05$) between the stored and fresh extracts. Results also showed that plant extracts were more effective in reducing methane and improving organic matter digestibility of poor quality roughage (Eragrostis).

Conclusion/recommendations: Extracts of AV, AZ, MO, JA, TD and CP performed better than the control and monensin treated groups. It can be established that the plant extracts used in this study are potent methane reducing agents even after 12 months of storage. Furthermore, the effectiveness of these plant extracts is substrate dependent, as all plant extracts used in this study effectively reduced methane production from Eragrostis when compared with Lucerne and the TMR.

Effect of dietary finisher energy reshuffling on growth performance and nutrient intake of broiler chickens in isonitrogenous diets

O.F. Akinmoladun[1,2] & V. Muchenje[1]

[1]Department of Livestock and Pasture Science, Faculty of Science and Agriculture, University of Fort Hare, Alice 5700, Eastern Cape South Africa, [2]Department of Animal and Environmental Biology, Faculty of Science, Adekunle Ajasin University Akungba-Akoko, Ondo-State, Nigeria.
festus.akinmoladun@aaua.edu.ng

Background: Apart from being one of the major contributing ingredients in term of cost, dietary energy represents one of the most variable components in poultry ration and optimum energy level is important for profit maximization. Such variations in dietary energy are attributable to efforts geared at managing stress imposed on broiler chickens either from changes in environment temperature to feed quality and nutrient densities. Documented reports regarding the influence of energy and/or protein density on growth and carcass yield are in abundant, however, results, especially dietary energy, are controversial and open for review.

Aim: The aim of the study was to first assess (Experiment 1) the growth response and nutrient intake of broiler chickens(D1-27) fed different levels of dietary energy starter diets and secondly (Experiment 2) to re-assess their growth response and nutrient intake when redistributed (or re-shuffled) to different levels of finisher energy diets (D28-50).

Methodology: All experimental procedures involving animal care and management were in accordance with and approved by the animal care ethics (clearance number: ONB021100) of The Federal University of Technology Akure, Nigeria. In experiment 1 (D1-27), a total of 384 unsexed day-old Anak broiler chicks were randomly assigned to three experimental treatments, varying in their dietary energy levels (11.67 (LSE); 12.62 (OSE) and 13.62 (HSE) MJ AME/kg DM), with replicated per treatment of 32 birds/replicate (n=128/treatment).In experiment 2(D28-50), all individual birds from experiment 1were re-assigned and randomly re-allocated to each of the three dietary finisher diets (11.60 (LFE); 12.40 (OFE) and 13.19 (HFE) MJ AME/kg DM), with four replicates per treatment of nine birds each (n=36 birds/treatment). Both the starter and finisher diets were formulated to be isonitrogenous. Body weight and feed intake of each replicate group were measured every week and the feed conversion ratio (feed intake/weight gain) calculated. On D27 and D50 of age, final body weight was recorded to calculate performance characteristics (i.e. weight gain, average daily weight gain, total feed intake, daily intake). Data were statistically analysed ($P<0.05$) using a fully randomized one-way ANOVA.

Results and Discussion: At the end of the starter period (D27), birds fed the HSE diets recorded higher ($P<0.05$) growth performance indices (FLW, FCR, WG). At the end of the 2nd study (D50 of age) the FLW, TWG, TFI, and FCR were not influenced ($P>0.05$) by the finisher energy levels. Total protein intake increase with a decrease in dietary energy content, while total energy intake (TEI) increased as the dietary energy increases ($P<0.05$) for both phases.

Conclusion/recommendation: Increasing the dietary energy content of broilers during the finisher phase had no significant influence on growth performance. However, the performance of slow-growing chickens can be optimized by shifting to a higher energy diet during transition phases (i.e. from starting or growing to finishing period).

Effect of varying levels of dietary fibre and enzyme supplementation on egg quality and haematological traits of Shaver brown hens

E.A. Akuru[1, 2], A.O. Ani[1], A.G. Ezekwe[1], W.N. Nwokolo[1], C.E. Oyeagu[2] & V. Muchenje[2]
[1]Department of Animal Science, University of Nigeria, 41000, Nsukka, [2]Department of Livestock and Pasture Science, Private Bag X1314, University of Fort Hare, Alice, 5700, South Africa.
eunice.iloh@unn.edu.ng

Background: Conventional feed ingredients are usually very expensive to procure, hence the need to explore non-conventional feedstuffs like Bambara (*Voandzeia subterranea Thouars*) waste as substitutes. Using non-conventional feedstuffs in poultry rations is often limited by their high fibre content. Consequently, exogenous enzymes are included in poultry diets to improve nutrient utilization and health status of the birds. There is still limited literature on the effects of varying dietary Bambara nut waste and enzyme (Roxazyme G®) levels on the egg laying performance and blood bio-marker traits of Shaver brown hens.

Aim: The aim of the study was to determine the effects of varying dietary Bambara nut waste and enzyme (Roxazyme G®) levels on egg quality and haematological traits of Shaver brown hens.

Methodology: This 10-wk feeding trial was conducted following the ethical procedures outlined for the use of animals for Biomedical Research by the Animal Ethics Committee (Ethical clearance number; ANI271NWO10UNN) at the University of Nigeria Nsukka. One hundred and sixty-eight Shaver brown hens that were 24 weeks-old were randomly divided into eight groups of 21 birds each. Each treatment was replicated three times with 7 birds per replicate. The birds were assigned to eight isocaloric (12.84 MJ/kgME) and isonitrogenous (170 g CP/kg DM) diets in a 4×2 factorial arrangement that involved four dietary fibre levels (0.0, 3.0, 6.0, and 9.0 g CF/kg DM) and two Roxazyme inclusion levels (0 and 10 g/kg DM). Raw bambara nut were processed into Bambara nut offal (BNO) by toasting it in an open-cast iron dry pan already set over fire for 30 minutes at 100^0C. The resulting BNO was incorporated into the diets. The birds received the experimental diets from 24 to 34 weeks of age. During weeks 30, 31, 32, 33 and 34, fifteen (15) eggs were randomly selected for egg quality (egg weight, egg length, egg width, albumen weight, albumin height, yolk weight, yolk height, haugh unit) analysis. On the last day of the feeding trial, blood was collected from the wing veins of birds in each replicate (21 birds/treatment) and used for determining full blood count. Data was analyzed using a 4×2 factorial arrangement in a completely randomized design.

Results and Discussion
Results showed that as the fibre level increased beyond 6 % in the diet, there was a significant ($P<0.05$) decrease in final body weight (FBW) and body weight gain (BWG). While total feed intake increased significantly ($P<0.05$) as the fibre level in the diet increased beyond 3 %, daily feed intake increased ($P<0.05$) at 9 % DF inclusion level. Bambara nut offal and supplementary enzyme levels had an effect ($P<0.05$) on egg weight, egg length, egg shape index, egg shell weight, albumen weight and yolk weight. Egg width, shell thickness, albumin height, yolk diameter, yolk height and haugh unit were not affected ($P>0.05$) by dietary treatments. Notably, egg weight was increased ($P<0.05$) at 9 % level bambara nut offal with supplementary enzyme, and albumen weight increased ($P<0.05$) at all the bambara nut offal level with enzyme inclusion. Dietary treatments only had significant ($P>0.05$) effect on mean corpuscular volume (MCV) and lymphocytes. Addition of enzyme to 6 % level of bambara nut offal resulted in significant ($P<0.05$) increase in lymphocyte level while MCV was lowest for 9 % bambara nut inclusion level without enzyme inclusion.

Conclusion/recommendations: It was concluded that up to 6 % level of bambara nut offal with supplementary enzyme can be included in the diet of Shaver brown hens.

Feeding ecology of caracal and black-backed jackal in livestock areas – implications for predation management

N.L. Avenant
[1]Department of Mammalogy, National Museum, Bloemfontein, [2]Centre for Environmental Management, University of the Free State, Bloemfontein.
navenant@nasmus.co.za

Background: The diets of caracal *Caracal caracal* and black-backed jackal *Canis mesomelas*, and their roles in agri-ecosystems, are highly controversial in Southern Africa's livestock areas. These topics have also been understudied for years. Since *c.* 2010, however, a number of ecological studies in farming areas have contributed information that may be valuable in the development of farm and predation management plans.

Aim: To collate and review existing information on the feeding ecology of caracal and black-backed jackal with a view to contribute towards the management of these two mesopredators in stock farming areas.

Results and Discussion: Between 1960 and 2010 a number of studies have been conducted on the ecology of caracal and black-backed jackal in Southern Africa (*c.* 28 and 45, respectively). Of this, only a few were done in farming areas, and depredation claims by farmers remained basically unsubstantiated. These studies were further These studies were furthermore simplistic in that they were not linking different ecological aspects, such as linking prey availability with diet composition, the timing of reproduction, home-range size and use, activity patterns, and feeding strategy. This made it almost impossible to use any of the published information for predation management purposes. The drive to actively develop an understanding of the above-mentioned problem led to a more holistic approach and buy-in from scientists, as well as from the national departments of Environmental Affairs (DEAT) and Agriculture (DAFF). A relatively large number of universities became involved with caracal and black-backed jackal related research on farms, and in collaboration with the farmer(s). In the last 9 years (since 2010) the number of peer-reviewed scientific publications on the ecology of caracal (>20 papers) and black-backed jackal (>50 papers) from southern Africa have increased exponentially, while others have come from elsewhere in Africa, the middle East and India. In addition, the large number of related studies on conspecifics (e.g. coyote *Canis latrans*; dingo *Canus lupus dingo*) from other continents are also informative and serve to alleviate the dearth of information on these topics. The increase in research publications is also accompanied by relatively new field and laboratory methods (camera traps, satellite collars, night vision, isotope analyses, doubly labelled water energy expenditure technique, etc.), and new statistical analyses and data modeling methods. Most of these papers/projects also link more than one ecological aspect. The result is that our eyes are literally opening like never before, allowing conclusions that become more and more useful for predation management purposes. The following are but some of the questions that are relevant: What do these two carnivores eat, and do they have foraging preferences? How do they forage / move through the different habitats? How is their activity patterns and social, ranging, foraging, reproduction and territorial behaviours related to prey availability and distribution? How is the above influenced by the activities and management strategies of man? How do they share their prey base with other predators? How do they interact with one another, with their prey, and with other syntopic carnivores?

The relevancy of these questions, and the possible impact of the information already obtained, will be discussed in more detail during the contribution at the SASAS 2019 congress.

New economic pathways through green agricultural value chains with particular reference to the wool industry in South Africa

K. Badenhorst

Sustainability Research Unit, Nelson Mandela University, Saasveld Campus, George.
karin.badenhorst@mandela.ac.za; karinb@iafrica.com

Two key drivers enabling new economic pathways as opportunities for responsible and sustainable job creation in South Africa

The first driver:
The paradigm shift we need to make in general from unsustainable extractive, potentially destructive brown economies to sustainable green economies, in response to the risks threatening the sustainability of our planet and its inhabitants, including biodiversity loss, climate change, pollution and the eradication of our natural resources, as per the 2019 WEF Global Risks Report, and more specifically in South Africa, the latest Institute of Risk Management (IRMSA) Risk Report.

Context
Our late Minister of Environmental Affairs, Edna Molewa, ensured that South Africa was one of the first nations in the world to join the global programme, Partnership for Action on Green Economy (PAGE), in 2017 - a United Nations (UN) programme which was launched in 2013 as a direct response by the UN system to the 2012 Rio+20 Declaration, "*The Future We Want*", and the Sustainable Development Goals (SDGs). PAGE is a programme which brings together expertise of five UN agencies to support nations and regions in addressing one of the most pressing challenges of the 21st century, i.e. transforming economies into drivers of sustainability and social equity. A study was done to assess South Africa's potential within this framework - an analysis focused on the development of new trade opportunities from the perspective of green industrial development. South Africa has embraced the shift to the green economy to attain inclusive, equitable and sustainable growth and development. From a trade and industry perspective specifically, the transition materializes through two complementary streams, which go hand in hand: *the development of new, green industries* and *the greening of existing, traditional industries.*

The second driver:
Revolutionising and greening of agricultural value chains - as an example the traditional wool value chain - addressing current and potential future challenges and turning these into economic growth opportunities.

Context
The suspension of South Africa's wool imports by the Chinese authorities because of the foot-and-mouth disease outbreak earlier in the year is a key concern. Wool is an important commodity in the South African agricultural sector, ranked the sixth largest exportable commodity after oranges, wine and apples in 2018. In the same year, wool accounted for 4% of South Africa's agricultural exports of US$10.6 billion. It not resolved, the South African wool growers and the broader industry would be seriously affected as over 90% of production is exported either as greasy wool or in semi-processed form as scoured and wool top. (*Wandile Sihlobo, Agbiz, 25 February 2019*). The wool value chain in South Africa has changed from a combination of local processing, semi-processing and manufacturing of wool products, and export of raw and semi-processed wool as a commodity to manufacturing countries, to one where very little wool is processed locally, and the subsequent reduction in jobs in this industry. This industry has not yet utilised the extensive job creation opportunities that the "greening" of wool growers practices, agro-processing, and the manufacturing and export of wool products pose.

Within the above two contexts, the presentation will further elaborate on the challenges, constraints, opportunities, as well as new philosophies and enabling mechanisms to create new economic pathways to achieve sustainable economic growth and job creation, both at the national and local level, more specifically, as an example, through greening of an extended wool value chain in South Africa.

Modelling alternative herd production models for the smallholder dairy production system in South Africa

C.B. Banga[2], S. Abin[1] & C. Visser[1]
[1]Department of Animal and Wildlife Sciences, University of Pretoria, South Africa, [2]Agricultural Research Council, Animal Production, Private Bag X2, Irene, 0062, South Africa.
Cuthbert@arc.agric.za

Background: Smallholder dairy production, which is mainly characterised by a low input–low output production system, currently makes an insignificant contribution to the South African dairy industry. Several reasons can, however, be advanced to motivate the development of this sector. In Sub-Saharan Africa, in general, the performance of smallholder dairy cows is poor, suggesting low herd profitability. In order to develop the smallholder dairy sector, it is therefore important to identify herd production models or management strategies that would improve herd profitability.

Aim: To evaluate the potential impact of alternative herd management practices and levels of cow performance, on smallholder dairy herd profitability, in South Africa.

Methodology: A normative and deterministic smallholder dairy herd model developed by Abin *et al.* (2018), was used as a base for determining the impact of different alternative production models on herd profitability. The model was composed of three components, depicting a typical smallholder dairy herd in South Africa. These components were: (i) biological sub-model simulating herd structure, cow performance and animal live weights; (ii) sub-model for nutrient requirements, estimating nutrient requirements for maintenance and growth of cows and replacement heifers, pregnancy, and lactation and (iii) economic sub-model calculating gross margins for the base situation and alternative production models.

Results and Discussion: Gross margins in the base situation (i.e. average herd) were R978.20 per cow in the herd per year. Increasing production resulted in an increase in profit, while higher cow live weight caused lower gross margins. The break-even point for milk yield was 3 505 kg per lactation. Cow mature live weight higher than 495 kg resulted in negative gross margins (i.e. unprofitability). An increase in herd size had a positive effect on gross margins. This was due to revenue increasing at an exponential rate, while the corresponding increase in costs was curvilinear. Substantial gains in profit were achieved with reductions in age at first calving and calving interval (i.e. improved reproductive performance). Increased replacement rates led to a significant erosion of profit, with rates above 30% leading to unviability of the enterprise.

Conclusion/recommendations: Results indicate that current smallholder dairy farming in South Africa is viable, although there is extensive room for improving profitability. Higher profitability levels could be achieved by increasing production per cow, using smaller framed cows, improving reproductive performance, and reducing culling rates.

Comparing milk production efficiency of Holstein and Jersey cows in a kikuyu pasture-based system

N.M. Bangani[1], K. Dzama[1], C.J.C. Muller[1], F.V. Nherera-Chokuda[2] & C.W. Cruywagen[1]

[1]Department of Animal Sciences, Stellenbosch University, Stellenbosch, 7600, South Africa, [2]National Emergent Red Meat Producers' Organisation, Pretoria, South Africa.
13240854@sun.ac.za

Background: Holsteins and Jerseys are the most popular dairy breeds in South Africa. Jerseys produce milk high in solids, while Holsteins produce high volumes of milk at a lower solid content. Research has shown that the milk production efficiency, defined as milk yield (MY) per unit of dry matter intake (DMI) or per unit of body weight (BW) varies between the two breeds, seemingly being affected by production system. However, in some long-term studies results are often confounded by environmental and management factors.

Aim: To compare the milk production efficiency of Holstein and Jersey cows maintained under similar environmental conditions and management practices.

Methodology: Data consisted of lactation records of 122 Holstein and 99 Jersey cows from the dairy herds at the Elsenburg Research Station of the Western Cape Department of Agriculture from October 2005 to September 2014. Data records included cow birth date, calving dates, lactation numbers, animal weights, as well as MY and its milk solid (MS) components measured according to standard milk recording procedures. Cows were kept on kikuyu pasture and received 7 kg of concentrate (as-fed) daily, containing 19% crude protein, throughout the lactation period. The concentrate was fed twice daily in equal portions after each milking. The total dry matter intake (TDMI) was estimated using the National Research Council (NRC, 2001) method and the pasture intake was estimated as the difference between TDMI and concentrate DMI. Cows were grouped by breed, and production trends were analysed per parity and stage of lactation. Production efficiency was calculated as kg MY or MS/kg DMI or MY and MS/kg BW. Milk was also corrected for its fat and protein content to energy-corrected milk (ECM) using the equation by Tyrell & Reid (1965). Production efficiency on ECM yield basis was similarly determined. Data were analysed using the repeated measure methods available in the PROC MIXED of SAS Enterprise Guide.

Results and Discussion: Holstein and Jersey cows weighed on average 567±47 and 411±36 kg, respectively. As expected, Holsteins had higher TDMI (17.8±2.6 vs. 14.4±2.1 kg/day) than Jersey cows, however, the proportion of DMI /kg BW was lower ($P<0.05$) for Holsteins than Jerseys, i.e. 3.1% vs. 3.5%, respectively. The MY of Holsteins and Jerseys over all lactations was 22.8±6.2 and 17.0±4.4 kg/day, respectively. This resulted in a higher ($P<0.05$) MY/kg DMI (1.36 vs. 1.27 kg) although at a lower ($P<0.05$) MS/kg DMI ratio (0.16 vs. 0.17) in Holsteins compared to Jerseys. The ECM (22.7±5.1 vs. 19.4±4.3 kg/day) was higher ($P<0.05$) for Holsteins while the ratio of ECM/kg DMI and ECM/kg BW was higher ($P<0.05$) for Jerseys, being 1.30 vs. 1.36 kg and 4.0 vs. 4.7 kg, respectively. Milk yield increased ($P<0.05$) with parity reaching levels 35% and 27% higher than milk yield in first lactation for Holsteins and Jerseys, respectively. This may indicate that a larger proportion of nutrients are channelled to milk production as growth requirements decrease with advancing maturity.

Conclusion/recommendations: Milk production efficiency differs between breeds. For maximum benefit, the choice of breed based on profitability and market demand is ideal.

Variance components and genetic parameters for reproductive traits in Afrikaner cattle

N.P. Bareki[1] & S.D. Mulugeta[2]

[1]Department of Rural, Environment and Agricultural Development, Research and Technology Development, Animal Science Division, Private Bag X804 Potchefstroom, 2520, South Africa, [2]Department of Animal Science, North-West University, Mafikeng Campus, Private Bag X2064, Mmabatho, 2735, South Africa.
nbareki@nwpg.gov.za

Background: Variance components can change over time within a population due to changes in allele frequencies. It is therefore imperative to conduct periodic estimation of variance components and genetic parameters for traits of economic importance. Studies that reported on genetic parameters for reproductive traits in Afrikaner cattle are scarce in recent years.

Aim: To estimate (co)variance components and genetic parameters for selected reproductive and productive traits in Afrikaner cattle.

Methodology: Data were sourced from the Integrated Recording and Genetic Information Systems (INTERGIS) and originated from records collected between 1966 and 2017 from a population of 260 789 animals. After editing, the pedigree information used consisted of 56 980 animals that ranged nine generations back. These animals were the progeny of 3 513 sires, 25 501 dams, 2 425 sires of dams and 11 289 dams of dams. The traits included in this study were age at first calving in months (AFC), calving interval (CI) in days and accumulated productivity (ACP) in kilograms. The ACP index indicates the productivity of the dam, expressed in kilograms of calf weaned per year. AFC and ACP were analysed using an animal model fitting only the additive genetic (animal) effect as random. CI was analysed using a repeatability model, where the additive genetic (animal) and permanent environmental effects were fitted as random. Fixed effects included were determined by using the general linear model (GLM) procedure of SAS (2010) and tested at (P <0.05). The (co)variance components were estimated with the ASREML package (Gilmour *et al.*, 2009) using univariate and bivariate models for all traits.

Results and Discussion: The additive genetic variance accounted for the smallest proportion of the phenotypic variance for AFC and CI, resulting in low heritability estimates for these traits. Heritability estimates for AFC and CI were 0.093 ± 0.01 and 0.096 ± 0.03, respectively. This is attributable to the high phenotypic variances arising from high non-genetic influences (environment etc.) on these traits. The results for CI are comparable to recent estimates in literature. The heritability estimate for ACP was of a moderate to high magnitude 0.39 ± 0.02 and higher than those reported in literature. The genetic correlation between AFC and CI was positive and low 0.079 ± 0.059, indicating a positive but very weak genetic association between the two traits. The estimates of genetic correlations between ACP and AFC as well as CI were -0.409 ± 0.055 and -0.524 ± 0.032, respectively. The moderate and negative genetic correlation between ACP and CI in this study indicates that cows with lower CI are producing more kilograms of calf weaned per year.

Conclusion/recommendations: The ACP index in this population indicates the existence of an additive genetic component as demonstrated by a moderate heritability estimate. This implies that genetic improvement can be achieved by considering ACP in the selection criteria for Afrikaner cattle breeding programmes.

Using pelvic area measurements in the selection for reduced dystocia rates in Sussex heifers- *preliminary results*

L. Bila & P.J. Fourie

Department of Agriculture, Central University of Technology, Free State, Private Bag X20539, Bloemfontein, 9300, Republic of South Africa.
Bilalubabalo94@gmail.com.

Background: Dystocia is defined as prolonged or difficult parturition and it is a condition in which the first or, especially the second stage of parturition was markedly prolonged for more than six hours and the cow required assistance. Dystocia occurs when there is a failure in one or more of the three main components of birth: expulsive force, birth canal adequacy and fetal size or position. Heritability of pelvic area is relatively high, therefore, it makes sense to include pelvic area as a selection criterion to reduce dystocia in beef herds.

Aim: The aim of this study is to use pelvic area (PA) measurements and external body measurement in selection to reduce dystocia rates amongst the Sussex heifers in perspective with their calving ease.

Methodology: One hundred and thirty-five first calf Sussex heifers *ca* 24 months old weighing approximately 350kg from the Rhys Evans Group farm, Free State were used in this study. The heifers used in the study were in good body condition.
All animals were measured with a rice pelvic meter rectally in a comfortable standing position after faeces have been removed from the rectum. The meter was thoroughly disinfected after each measurement to ensure that no diseases were transferred. Pelvic width (PW), pelvic height (PH) and the width between pin bones were measured. The π (PH/2)*(PW/2) formula was used to calculate PA. The PA were correlated with certain external body measurements such hip height, rump length, chest depth, body length and rump slope.

Results & Discussion: Results revealed a negative correlation (-0.26; P <0.05) between calving ease score (CES) and PA. These results show that as the PA increases, the lower the chances of heifers to experience dystocia. The value of R^2 is 0.071 indicating that 7.1% of the variation in CES can be explained by the PA. A negative correlation of (-0.40; P <0.05) between CES and PH was recorded, revealing that as the PH increases the lesser the chances for a heifer to experience dystocia. The R^2 is 0.17 indicating that 17% of the variation in CES can be explained by the PH. The results further indicate a significant correlation (0.35) between CES and calf gender. Therefore, chances of a heifer to experience dystocia are more when a male calf is born compare to females. The R^2 of 0.13 indicates that 13% of the variation in CES can be explained by the calf's gender. The results also indicate a significant correlation (0.31) between CES and BW. Therefore, the higher the calf's birth weight, the higher the probability of a heifer to experience dystocia. Chest depth made a significant contribution into the regression model by predicting approximately 34% of the variability in the PA.

Conclusion: As the PA and pelvic height increases, the lower the chances of heifers to experience dystocia. It can be concluded that pelvic measurements in heifers may be a valuable tool to reduce dystocia in beef heifers.

The effect of dietary ascorbic acid on colour and oxidative stability of broiler breast meat

R. Binneman[2], J.D. Lemmer[1], A. Hugo[2] & F.H. de Witt[1]

[1]Department of Animal, Wildlife and Grassland Sciences, [2]Department of Microbial, Biochemical and Food Biotechnology, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa.

jarred843@gmail.com

Background: The use of antioxidants in animal feed to reduce the effect of heat stress on animal health and meat quality is well documented. Ascorbic acid (AA) is effective in reducing the effect of heat stress in chickens, while also stabilising the colour and oxidative stability of broiler meat. The use of dietary supplementary AA remains debatable due to its heat sensitivity and needs further investigation.

Aim: To determine the effect of dietary supplemental ascorbic acid levels on broiler breast meat colour and oxidative stability during storage.

Methodology: Experimental procedures were approved by the Animal Ethics Committee (AEC) of the University of the Free State – UFS-AED2018/0008. A total of nine hundred and sixty (n=960) day old as-hatched broiler chicks of the Arbor Acres genotype was obtained from a hatchery and randomly allocated (n=192/treatment) to each of the five dietary treatments. Experimental diets consisted of a negative control (0 mg ascorbic acid/kg), with coated AA (Halor C™) included incrementally at 100 mg, 200 mg, 300 mg and 400 mg ascorbic acid/kg in the other four treatments. At D35 of age, a total of 180 birds (36 birds/treatment) were randomly selected and slaughtered. Carcasses were weighed and cut into eight (8) piece portions. A total of 12 carcasses per treatment (n=24 breast fillets/treatment) were selected for the meat colour and lipid oxidation measurements. Breast fillets (n=12 fillets/treatment) used for meat colour determination were individually placed in polystyrene trays with absorbent pads, before being overwrapped with semi-permeable PVC wrap and stored for a maximum of 8 days at 4°C under fluorescent light. Breast colour were determine on D0, D4 and D8 of refrigerated storage by using a Minolta CR400 chromometer (L*, a*, b*). Colour values were assessed in six-fold on each breast fillet. The other breast fillet (n=12 fillets/treatment) were dark stored in household freezer bags at -18°C for 3 months. A 5 g lean meat breast fillet sample of the various storage times (D0 & D8 at 4°C; 3 months at -18°C) were analysed for lipid oxidation stability (TBARS) according to the aqueous acid extraction method. Data were analysed using a fully randomized analysis of variance (ANOVA).

Results and Discussion: Increased dietary inclusion levels of AA had no effect (P >0.05) on the dressing percentage of birds or the meat yield (%) of the various carcass portions. An increase in storage time resulted in a lower (P <0.05) L* and a* colour of breast meat. However, the higher AA inclusion level (400 mg AA/kg) resulted in a higher (P <0.001) a* colour (>2 *vs.* <1.0) and a lower (P =0.018) Hue value (75) for breast fillets at eight days of refrigerated storage. Results indicate that higher levels of AA have a protective effect on colour pigments during oxidation. An increase in storage time resulted in an increase of lipid oxidation as measured by TBARS. Dietary AA inclusion level had no effect (P >0.05) on the lipid oxidation of breast fillets at D0, D8, or 3 months of frozen storage. Cold room storage (4 °C) of breast fillets for more than 4 days is undesirable due to an unacceptable high TBARS (2.0 – 2.5 mg malonaldehyde/kg meat).

Conclusion/recommendations: Results of the present study indicated that although higher dietary ascorbic acid levels (400 mg AA/kg) improve the redness of breast fillet after 8 days of cold storage, it generally had no significant influence of carcass traits and lipid oxidation stability of broiler breast meat.

Objective home range analysis of GPS collared livestock using plants and soils as potential prediction indicators

W.J. Black[1], F. Deacon[1] & P. Zietsman[2]
[1]Department of Animal and Wildlife and Grassland Sciences, Faculty of Natural and Agricultural Sciences, University of the Free State, PO Box 339, Bloemfontein, 9300, Republic of South Africa, [2]Pieter Zietsman: National Museum, P.O. Box 266, Bloemfontein, 9300, Republic of South Africa.
Deaconf@UFS.ac.za

Background: Our estimation of rangeland condition is closely tied to plant production and a plants' response to grazing. Most of the rangeland condition assessment methods are highly subjective and have an unhealthy viewpoint bias. Our knowledge of the palatability of plants differs vastly from region to region and the same plant species which occurs in a variety of soil types may differ substantially in an animal's acceptance towards it. Thus, soils and their associated characteristics may have a far greater effect on a plants eventual acceptance to the animal than we ever previously imagined.

Aim: This study aims to connect the above ground rangeland condition and associated plant characteristics with the below ground soil characteristics. It looks to do this by identifying if soils play a major role in an animal's selection criteria of plants in an area and do the characteristics of soils determine the plants nutritional and structural composition.

Methodology: To be as objective as possible, Springbok, cattle, sheep and goats were collared using GPS collars in the Northern Cape Province. The data was expressed as heat maps of preferred and avoided areas. On these preferred and avoided areas, the top 10 plant species and soil samples were collected for analysis and a variety of both ecological and agricultural vegetation surveys were done.

Results and Discussion: Early results from the study indicate that there is no correlation between the preferred and avoided areas and the condition of the veld in those areas. The density of woody plant species plays an enormous role in determining whether sheep, springbok and cattle will prefer an area regardless of the plant species which occur there. Annual grasses and herbs are more favoured by sheep, goats and springbok than previously thought, and our knowledge of rangeland condition and our idea of what good and bad veld looks like is severely limited as the areas the animals preferred were not from an ecological or agricultural view point the most desirable.

Conclusion/recommendations: The knowledge gained from this study will help to better predict which areas goats, sheep, springbok and cattle will prefer, which can aid farmers to better manage their veld, animals and camp systems.

Genetic parameters for docility and fear responses in South African Merino sheep

M. Bonato[1], J.J.E. Cloete[2], A.C.M. Kruger[3] & S.W.P. Cloete[1]

[1]Department of Animal Sciences, University of Stellenbosch, Matieland 7600, South Africa, [2]Elsenburg Agricultural Training Institute, Private Bag X1, Elsenburg 7607, [1,3]Directorate Animal Sciences: Elsenburg, Private Bag X1, Elsenburg 7607, South Africa.
mbonato@sun.ac.za

Background: Poor temperament has been associated with reduced performance, impaired health, and compromised carcass quality in various livestock species. Therefore the identification and selection of animals with a temperament that will improve their welfare and productivity within their production environment is becoming increasingly important. The South African Merino breed is the most important wool breed in South Africa yet limited information is currently available on whether temperament is heritable and amenable for use in ovine genetic evaluation.

Aim: To estimate the genetic parameters of a South African Merino sheep flock using two behavioural tests.

Methodology: Behavioural reactivity and fear responses in a South African Merino sheep (N = 1472) were investigated using a docility test and a 'scale-test' from 2014 to 2019. In the first test, an individual animal was moved to the test pen by an experienced farm worker. Then an unfamiliar or familiar human entered the test pen and tried to encourage the animal to move into a marked square area for 3 minutes. The test was terminated if the animal could not be moved within 3 minutes, came out of the marked area or if the animal could be contained in the marked area for 30s. The time taken by the animal to enter and be contained in the square area was recorded as well as whether the animal was bleating during the test. In the 'scale-test' the behaviour response of animals was recorded using a 5-point score system (1 = calm; 5 = wild) at weighing, while spending 30 seconds on the scale. Bleating during the test was also recorded. Genetic parameters (heritability estimates, genetic and phenotypic correlations) were estimated in a 5-trait analysis in ASREML. Ethical clearance was granted by the Western Cape Department of Agriculture (R12/57 and S12/58)

Results and Discussion: All traits were heritable, estimates (±SE) amounting to 0.19±0.05 for the time taken to enter the square, 0.12±0.04 for successfully containing the animal on a all-or-none scale, 0.27±0.06 for the number of bleats during the docility test, 0.16±0.05 for agitation during the scale test and 0.25±0.05 for the number of bleats during the scale test. Yearlings entering the square early in the test were more likely to be successfully contained (r_g=-0.98±0.07) and animals with a high bleating rate in the docility test also bleated more during the scale test (r_g=0.43±0.14). The latter correlation, however, did not support a contention that bleating rate during the docility and scale tests were genetically the same trait, as the correlation was significantly below unity. Phenotypic correlations between the traits were in the same direction but smaller in magnitude (respectively -0.55±0.02 and 0.22±0.03).

Conclusion/recommendations: These results indicate that selection for an improved docility is possible in South African Merino sheep. Further research is thus needed to evaluate whether selection to improve temperament will also result in higher lamb survival, improved reproduction and enhanced product quality.

Kick back, relax and love your ostriches: advances in ostrich welfare research

M. Bonato[1], C.K. Cornwallis[2] & S.W.P. Cloete[1,3]

[1]Department of Animal Sciences, University of Stellenbosch, Private Bag X1, Matieland, 7602, South Africa, [2]Department of Biology, Lund University, Lund, Sweden, [3]Directorate Animal Sciences, Western Cape Department of Agriculture, South Africa;
mbonato@sun.ac.za

Background: Livestock enterprises need to scale-up production to feed an ever-growing world population. However, discerning consumers prefer products that were derived from sustainable and ethical production systems. Research to address welfare concerns in ostriches has only recently commenced. With 90% of the ostrich products exported to the European Union, where animal welfare is a major concern for consumers, it is important to identify ways to reduce stress while improving reproductive performance of the birds as well as the occupational health and safety of the stockpersons.

Aim: To review and discuss recent research initiatives aimed at improving ostrich welfare, human-bird interactions and production.

Discussion: Research taking place at the interface of animal behaviour, physiology, reproduction, ecology and genetics have confirmed the impact of management practices on farmed ostrich welfare. For instance, the integration of regular and positive interactions with humans during day-to-day management of ostrich chicks has resulted in the improvement of crucial determinants of successful chick rearing (i.e. early growth, survival, immune competence and resistance to short- and long-term stress). Birds that were exposed to a more hands-on approach as chicks were also more likely to associate with a familiar human when they reach the juvenile stage, which could potentially facilitate handling procedures. Reproduction at sexual maturity was also not compromised as previously suggested. At the flock mating level, a preference for a specific mating partner was demonstrated and resulted in higher egg and chick production. In addition, substantial improvements to the reproductive output could be made by reducing the narrow 6:10 male to female ratio to 1:3 or 1:4. This was demonstrated to improve fertility rates, chick production and alleviate male harassment of females, which often resulted in the injury and/or death of females. A thorough knowledge of the degree of relateness of males and females in flock camps could also facilitate reproductive output and ostrich female welfare. Preliminary studies indicated that an optimal group structure would comprise of related males and unrelated females. Such a system would minimize female harrassment by males whilst maximizing female competition and chick production. Alternatively, assisted reproductive technology has been proposed as a viable way to overcome all major challenges faced by the industry, essentially because it is founded on a sound knowledge of ostrich behaviour and reproductive physiology. Substantial progress has been made in semen collection and preservation as well as in stress-free insemination procedures. Hence, if this technology become available, this could alleviate problems often associated with artificial mating of incompatible partners such as poor fertility and welfare issues.

Conclusion/recommendations: Management practices currently in place would benefit from a better understanding of the behavioural and physiological needs of ostriches. Investment in practices fostering positive human-animal interactions could also alleviate constraints associated with ostrich farming. In addition, more research should focus on assessing different levels of ostrich welfare in the current production systems. The cost of implementing animal-friendly husbandry practices should be evaluated to determine the financial viability of alternative production systems where animal welfare is promoted.

Correlation of ADG derived from partial and full body weights as recorded by the GrowSafe® system

M.E. Bopape[1,2], G.M. Pyoos[1,3], M. Mabelebele[2], M.M. Scholtz[1,3] & M.D. MacNeil[1,4]
[1]Agricultural Research Council, Animal Production Institute, Irene 0062, South Africa. [2]School of Agriculture and Live Sciences, UNISA, Florida, 1709, South Africa, [3]University of the Free state, Department of Animal, Wildlife and Grassland Sciences, PO Box 339, Bloemfontein, South Africa.
[4]Delta G, 145 Ice Cave Road, Miles City, MT 59301, USA.
mosibudieuginia@gmail.com

Background: Traditionally, the ARC-AP made use of the old-fashioned manual Calan gate feeding system to measure feed intake, and growth rate from which Average Daily Gain (ADG) is estimated. However, the ARC acquired the GrowSafe® feeding system in 2017, which was imported from Canada through the NRF's National Equipment Programme. At present, both systems are still used. The GrowSafe® system allows for the real-time recording of more animals with better monitoring and less human interference. The system also measures a partial body weight every time an animal consumes water. This data, coupled with recorded feed intake, may facilitate studies on efficiency, intake and growth as well as the behaviour of different genotypes under different climatic conditions.

Aim: To investigate the correlation of ADG derived from partial and full body weight as recorded by the GrowSafe® system.

Methodology: A total of 31 animals from the following genotypes were used: Nguni (n = 4), Afrikaner (n = 3), Bonsmara (n = 4), Afrikaner x Nguni (n = 4), Afrikaner x Bonsmara (n = 4), Nguni x Angus (n = 4) and Bonsmara x Simmentaler (n = 4), Afrikaner x Angus (n=4). Fresh feed and water are available in the GrowSafe® system ad libitum at the ARC-AP, Bull Testing Station. Data was analysed using Microsoft Excel for Windows 10, and a paired two-tailed t-test was carried out. In this pilot study, we examined the correlation of ADG derived from full body weights collected at 2 week intervals over a 14 week period with ADG derived from partial body weights that were summarized over the same periods. The GrowSafe® Beef system measures a partial body weight every time an animal consumes water. This data, coupled with recorded feed intake, may facilitate studies of feed efficiency. Previous research has shown a test period of 70 d (10 weeks) may be required for determining average daily gain (ADG) when the full body weight is measured.

Results and Discussion: A paired two-tailed t-test indicates ADG derived from full and partial body weights are clearly different (P < 0.001). For the individual 2 week periods the correlations of the ADG measures ranged from 0.32 to 0.76. However, considering longer test periods the correlation between ADG measures reached approximately 0.89 after 8 weeks, 0.90 after 10 weeks and 0.96 at the end of the 14 week test period. Thus, it appears ADG may be measured from partial body weights over a test period of 8 weeks. However, an adjustment may be necessary to estimate the equivalent ADG based on full body weights.

Conclusion/recommendations: There is a significant difference between the correlations of ADG derived from partial and full bod weights over shorter test trials, yet when measuring ADG of either estimates over longer test trials, the correlation is high. However, an adjustment may be necessary to estimate the equivalent ADG based on full body weights.

A preliminary study on time intervals between stages of the hatching sequence of ostrich chicks

M. Brand[1,4], Z. Brand[1], S.W.P. Cloete[2,3] & C.J. Smit[4]

[1]Directorate: Animal Sciences, Western Cape Department of Agriculture, PO Box 351, Oudtshoorn, 6220, South Africa, [2]Directorate: Animal Sciences, Western Cape Department of Agriculture, Private Bag X1, Elsenburg, 7607, South Africa, [3]Department of Animal Sciences, University of Stellenbosch, Private Bag X1, Matieland, 7602, South Africa, [4]Department of Agriculture and Animal Health, University of South Africa, PO Box 392, UNISA, 0003, South Africa.
madelib@elsenburg.com

Background: Studies have been done to investigate factors influencing fertility, hatchability and incubation in ostriches, but a more detailed investigation into the hatching proses is necessary. The high levels of hatching failure in ostrich eggs needs to be addressed for the ostrich industry to become more profitable. A better understanding of the hatching sequence will potentially help to increase chick production and consequently benefit the ostrich industry.

Aim: The aim of the present study is to have a better understanding of the events' during the hatching process and to be able to stipulate norms and abnormalities.

Methodology: The eggs used during this trial were collected during the 2018 – 2019 breeding season from the commercial, pair-bred ostrich flock at the Oudtshoorn Research Farm. Project was submitted to DECRA for ethical approval. Eggs (n=262) were handled according to standard hatchery practices, this include the weighing of all eggs set. On day 35 of incubation, all fertile eggs were moved from the setters to a hatcher, which operated at 36 °C and 24% RH. On days 39, 40, 41 and 42 of incubation, eggs showing signs of internal pipping were monitored to note the tempo of pipping relevant to the six stages of hatching: Stage A – first signs of internal pipping; Stage B – finals signs of internal pipping; Stage C – moment of external pipping; Stage D – 90° cross diagonal turn inside egg; Stage E – head breaks free from shell and Stage F – chick breaks free completely and dries off. Observations were done hourly to determine the tempo of the hatching sequence and during this time the embryo's position were noted. The data were subjected to standard factorial analyses of variance (Snedecor & Cochan, 1968). Least significant differences were derived to compare treatments, provided that it is protected by a significant F-value in the ANOVA.

Results and Discussion: Data from 262 individual eggs were collected throughout this study. Much variation exists in term of time interval between the different stages, with the biggest intervals recorded between stages A throughout to stage D (between 0.42 and 68.3h). The frequency of pipping accelerated for the final two stages (E to F) and ranged between 0.63 and 19.3h. The total pipping interval was between 44.7h and 90.5h. The approximate time intervals added to the different stages will be used to give an indication of the normal approximate time intervals of these stages. These time intervals will be adapted and refined before being used in further trials to determine for how long it is in the chicks' interest to allow it to struggle through the stages on its own without interference before the struggle has a negative outcome.

Conclusion/recommendations: Since artificial incubation has become an essential part of commercial ostrich farming in South Africa, it is critical to understand the hatching proses of a viable chick. This knowledge will help in the creation of guidelines for hatcheries to increase chick production and consequently benefit the ostrich industry as a whole.

Monitoring the growth performance of replacement heifers using a simple system

M. Burger[1], C.J.C. Muller[2] & J.A. Botha[1]

[1]Western Cape Department of Agriculture, Directorate Animal Sciences, Elsenburg, 7607, [2]Department of Animal Sciences, University of Stellenbosch, Stellenbosch, 7602.
marlineb@elsenburg.com

Background: Monitoring the growth rate of replacement heifers is an essential part of a dairy herd towards optimum production. Heifers need to grow at breed specific growth rates to reach target live weights at first service and first calving. Extending age at first calving increases the rearing cost of replacement heifers.

Aim: This study describes a simple method of monitoring the growth performance of dairy heifers.

Methodology: Heifers are weighed once a month and compared to a breed-specific expected live weight trend from birth to first calving. Differences between actual and expected live weights give an indication of the standard of the heifer rearing feeding programme.

Results and Discussion: For a specific weighing event, the actual and expected live weights of heifers differed by -3 and +8kg for heifers between birth and 3 months, as well as 3-6 months of age, respectively. The differences between actual and expected live weights of heifers between 6-12, 12-18 and 18-24 months were +22, +32 and +37kg, respectively, indicating higher growth rates than is required. For heifers older than 24 months of age, the difference between actual and expected live weight were -39kg, indicating that these heifers may have lost weight after 24 months of age because of poor feeding during the late pregnancy stage.

Conclusion/recommendations: Results of the current study suggest that corrective measures would include feeding a lower concentrated feed after 6 months of age, while improving feeding conditions of heifers older than 24 months of age.

The blue water footprint of primary beef production systems in South Africa

N.T. Chabalala[1,2], M.M. Scholtz[1,3] & S.M. Grobler[1]
[1]ARC-Animal Production, Private Bag X2, Irene 0062, South Africa, [2]School of Agriculture and Live Sciences, UNISA, Florida, 1709, South Africa; [3]Department of Animal, Wildlife and Grassland Sciences, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa.
ChabalalaN@arc.agric.za

Background: Livestock is often accused of using large quantities of water, with claims of 15 500 L/kg beef produced, which is based on questionable assumptions. In South Africa agriculture is consuming 74.5% of the rainfall, of which 60% is utilized by the natural vegetation, 12% by dry land crop production and 2.5% by irrigation. The natural vegetation and dry land crop production use only "green" water. It is called "green" water because only plants growing in the soil can utilise this water stored in the soil. In extensive grazing systems the natural vegetation serving as livestock fodder uses only "green" water that cannot be used for crop production, since crops will not survive or produce economically. Green water can thus only be used for the production of meat or other animal produce on natural rangelands and the quantity of water used is therefore irrelevant.

Aim: This study was conducted to estimate the blue water footprint of primary beef production systems in South Africa, where blue water was identified as the water consumed during the whole production cycle.

Methodology: The easiest method of calculating the blue water footprint of beef is to use Large Stock Units (LSU) as a reference. A general guideline for water intake is that for every kg of dry feed intake a ruminant animal needs 4 litres of water, but it can be increased by 50 % when it is hot. Therefore an average of 5 litres was used. A LSU needs 9kg dry feed per day and therefore 45 litres of water per day. Average LSU values were assumed for beef cattle at different ages and physiological stages (e.g. dry, pregnant or lactating). A weaner calf production system, an 18 month production system and feedlot system were simulated. Furthermore, weaning percentages of 60% and 80% were simulated and a 20% replacement rate was assumed.

Results and Discussion: Using this the simulations described, it was estimated that the blue water footprint at weaning is 265 L per kg beef with a weaning percentage of 60% and it decreases to 240 L per kg beef at weaning percentage of 80%. When the feedlot phase is added, the blue water footprint is 195 L and 160 L for weaning percentages of 60% and 80% respectively. In an ox production system (marketing at 18 months of age), the requirement is 225 L and 240 L of water per kilogram beef for weaning percentages of 60% and 80%, respectively. These figures exclude the water use in abattoirs, processing and packaging plants, which seems to be an additional 10%.

Conclusion/recommendations: From these simulations it was estimated that the blue water footprint of beef production in South Africa varies from 160 L to 265 L of water per kilogram beef, depending on the weaning percentage and production system. The effects of production system, weaning percentage and replacement rate all influence the water usage of beef. It is therefore essential that a total life cycle analyses is done to accurately estimate the water footprint of beef.

Making the Global Cow Local: The case of South Africa

L. Chavinskaia[1] & V. Ducrocq[2]

[1]Interdisciplinary Laboratory Science Innovation Society (LISIS), University Paris-East Marne-la-Vallée and INRA Jouy-en-Josas, [2]Animal Genetic and Integrative Biology (GABI), INRA Jouy-en-Josas.
lidia.chavinskaia@gmail.com

Background: After a historical upheaval at the end of last century, the South African state is in a deep societal re-making. Its national agro-industry faces numerous socio-economic conflicts as well as numerous impacts of the global climate change. The latest technologies are mobilised in order to increase farmers' profit, to improve efficiency and sustainability of production systems and to make the country more competitive on the global market. The genomic breeding technology promises to accelerate genetic progress of farm animals, to make them produce more, sooner and cheaper and from the environmental point of view to build more ecology-friendly animal for more sustainable livestock production systems. For decades, the improvement of livestock productions consisted in adapting the environment to animals. It is well-known now: the better the genetics of farm animals is adapted to their environment, the more efficient the production systems are.

Aim: The aim of the present study is to investigate on the mechanisms of localization of the 'global' industrialized animal – the Holstein cow – in the South-African context.

Methodology: The investigation is based on the sociological method of qualitative analysis: interviews and participant observation. The theoretical framework is provided by STS (Science and Technology Studies), an interdisciplinary scientific subfield of Social and Human Sciences.

Discussion: The case of South Africa illustrates how new (developing, non-hegemonic) countries can grasp the "global" technology; how they use "universal" scientific knowledge to make it "situated" (local, particular) and to mobilise it politically. Two techno-political regimes are competing and draw two different ways for the country to join the global market. One, promoted by short term logic of industrial actors, uses genetic resources produced and evaluated in hegemonic countries to increase local productions (from global value to local application). The other, based more on long term scientific logic, creates genetic value locally and brings it to the global market on a "fair" basis (from local value to global application). It can be argued that the only element basically necessary to distinguish these two regimes is a scientific statement about the existence of genotype by environment interaction effect (G*E) within the biological nature of evaluated animals. Accounting for or ignoring this knowledge is a matter of political choice which results on a complete "re-arrangement" of the elements in breeding system. Drawing on previous investigations and on Michel Callon's idea of science as a source of technological diversity, specific attention was paid to an international collective of geneticists who mobilise G*E especially in their collaborations with developing countries "to fight against market forces of irreversibility and convergence".

Conclusion: In the given pure breed framework of the dairy cattle genetic improvement, the localization of the global breed (Holstein) has to account for a double sustainability: (i) sustainability of the global pool of genetic resources and (ii) sustainability (economic, social and environmental) of the local cattle breeding industry. Both of these forms of sustainability address the question of diversity which is translated into the language of breeding evaluation by the accounting for the G*E effect.

Determination of optimum inclusion level of red grape pomace in feedlot lamb diets

O.C. Chikwanha[1], V. Muchenje[2], J.E. Nolte[3], M.E.R. Dugan[4] & C. Mapiye[1]

[1]Department of Animal Sciences, Stellenbosch University, P Bag X1, Matieland 7602, Stellenbosch, 7600, South Africa, [2]Department of Livestock and Pasture Science, University of Fort Hare, P. Bag X1314, Alice, 5700, South Africa, [3]Meadow Feeds, PO Box 262, Paarl, 7620, South Africa, [4]Lacombe Research and Development Centre, Agriculture and Agri-Food Canada, AB T4L 1V7, Lacombe, Alberta, Canada.
cmapiye@sun.ac.za

Background: In pursuit of sustainable and economically viable livestock feeds, farmers worldwide are under increasing pressure to maximise the use of available fruit by-products. Grape pomace (GP), a by-product of the wine industry has for a long time been undervalued and treated as a waste material in South Africa. It offers promising potential to the meat industry as a feed supplement rich in fibre, polyunsaturated fatty acids, and natural biopreservatives. Incorporation of GP in ruminant diets with moderate levels of polyphenols is likely to improve efficiency of ruminant production systems through the reduction of feed costs and problems associated with disposal of this abundant waste material.

Aim: The present study evaluated growth performance, carcass and meat quality traits of feedlot lambs fed finisher diets containing increasing levels of grape (*Vitis vinifera* cv. Pinotage) pomace.

Methodology: All experimental procedures were approved by the Animal Ethics Committee at the Stellenbosch University (SU-ACUD16-00143).Three-month-old Dohne Merino wether lambs with average body weight (BW) of 32 ± 1.7 kg were fed isonitrogenous and isoenergetic pelleted total mixed rations with 0, 5, 10, 15 and 20% GP for 42 days (n=8 lambs/ treatment) following a 14-day adaptation period. The GP was sun-dried for seven days, milled and replaced mainly fibrous ingredients in lamb diets. Individual daily feed intake and weekly BW were recorded. At slaughter, carcass traits were recorded. The left *Longissimus thoracis* was removed from each carcass 24 h post-slaughter for meat quality tests. Growth performance, carcass and meat quality traits were analysed using RSREG procedures of SAS® v 9.4. PROC RSREG allows for the determination of an optimum inclusion level for each parameter. The effects of increasing levels of GP in the diet were tested for linear and quadratic components by means of orthogonal polynomials.

Results and Discussion: Dry matter intake (DMI) increased quadratically with an optimum inclusion level of 11.3% of GP ($P<0.05$). Quadratic responses were observed for average daily gain (ADG), live BW, hot and cold carcass weights with optimum inclusion levels at 9.6, 9.7, 12.2 and 12.1%, respectively ($P<0.05$). Overall, meat quality traits were not negatively affected by GP inclusion ($P>0.05$). Gross profit was influenced by diet, with an optimum inclusion level at 12.2% (quadratic; $P<0.05$). The quadratic response observed for carcass traits and gross profit with increasing GP could be attributed to a similar pattern for DMI and subsequently higher ADG. The high DMI observed up to the 11.3% GP inclusion may be attributed to the substitution of oat bran and wheat bran middlings with GP. This may possibly be related to improved palatability or perhaps increased rate of passage and reduced gut fill. While the quadratic ADG may be related to changes in DMI, and the combined effects of high crude protein and moderate proanthocyanidin contents for the 5 and 10% GP diets.

Conclusion/recommendations: This study clearly demonstrates that sun-dried red GP may be adopted as a feed ingredient in feedlot lamb diets at 12.2% as a strategy to improve production, while decreasing feeding costs. Further studies should be conducted to assess the effects of graded levels of sun-dried GP on the shelf life of lamb meat and its sensory quality.

Contamination of the environment by pathogenic bacteria in the University of Limpopo livestock farm

T. Chitura[1], K. Shai[1], I. Ncube[2] & H. van Heerden[3]

[1]Department of Agricultural Economics and Animal Production, University of Limpopo, Private Bag X1106, Sovenga, 0727, Republic of South Africa, [2]Department of Biochemistry, Microbiology and Biotechnology, University of Limpopo, Private Bag X1106, Sovenga, 0727, Republic of South Africa, [3]Department of Veterinary Tropical Diseases, University of Pretoria, Private Bag X04, Onderstepoort, 0110, Republic of South Africa.
Kamogelo.shai@ul.ac.za

Background: The high prevalence of livestock diseases in South Africa is a major challenge particularly to the resource limited smallholder farmers in communal areas. Various researchers reported livestock mortalities and their economic impact on small scale farmers. However, information on the association of disease outbreaks and environmental contamination is scanty.

Aim: The study was conducted to carry out a farm level investigation of the occurrence and diversity of pathogenic bacteria in the environment at the University of Limpopo experimental farm.

Methodology: A total of hundred and seventy environmental samples (soil and faeces) were collected from three sampling locations: cattle camp (CC), sheep camp (SHC), and goat camp (GC), Hundred soil samples comprising of sixty CCS, twenty SHCS and twenty GCS were collected according to the procedure described by Brooks (2016). Seventy faecal samples comprising of thirty CCS, twenty SHCS and twenty GCS were collected. Cattle faecal samples were collected as cowpats on grazing land, while sheep and goat faecal samples were collected as pellets. Approximately 100-200-gram environmental samples were collected in sterile sealable plastic bags around the livestock resting points and common pastures. The samples were then transported on ice, in a Styrofoam cooler box and transported to University of Limpopo, Biotechnology Laboratory for microbial analysis. Identifications were done with Matrix Assisted Laser Desorption Ionisation Time of Flight Mass Spectrometry (MALDI-TOF MS) using the simplified-on plate technique. The colony forming unit formula per gram of environmental sample (CFU/g) determined total bacterial counts.

Results and Discussion: Of the 170 environmental samples collected 108 were successfully analysed and the isolates were identified with MALDITOF-MS. High bacterial counts were observed in CC and low counts in SHC for both soil and faecal samples. *Bacillus* species were the most dominant across the sampling locations for soil samples. *Bacillus cereus* occurred in 36 samples (33%), however, the frequency of isolation dominated in the CC with (44.4%), GC (22.2%) and SHC (13%). *Staphylococcus aureus* had the least frequency (2.2%) followed by *Listeria monocytogens* (4.4%). In faecal samples, the occurrence and level of contamination with bacterial species varied across sampling locations with *Escherichia coli* dominating in the CC with 20% frequency, and absent from SHC and GC.

Conclusion/recommendation: This study demonstrated contamination by opportunistic, food-borne bacteria like *B. cereus* and *L. monocytogenes* in the experimental farm environment. These results alarms a need for good hygiene practices to prevent its entry into the food chain. Rapid microbial identification is necessary for quick implementation of relevant disease management strategies at farms. The findings of this study show that MALDI-TO MS can identify bacteria rapidly in environmental samples. This method can be used to identify potential disease risk in an environment and allow for appropriate control measures.

Influence of socioeconomic factors on indigenous goat value and sales in selected rural areas of South Africa

T.C. Chokoe[1,2], T.C. Matelele[1], A. Maqhashu[3], F.V. Ramukhithi[4], T.D. Mphahlele[1], T.J. Mpofu[5], K.A. Nephawe[5] & B.J. Mtileni[5]

[1]Genetic Resources, Department of Agriculture, Forestry and Fisheries, Private bag X 973, Pretoria, 0001, South Africa. [2]School of Agriculture & Environmental Sciences, Private bag X 1106, University of Limpopo, Sovenga, Polokwane, 0727,South Africa, [3]Department of Wildlife and Animal Sciences, University of Pretoria, Pretoria, 0002, South Africa, [4]Agricultural Research Council, Private Bag X2, Irene, 0062, Pretoria, South Africa, [5]Faculty of Science, Department of Animal Science, Private Bag X680, Tshwane University of Technology, Pretoria, 0001, South Africa.
TlouC@daff.gov.za

Background: Goat production is an integrated component of nearly all-rural households in communal areas and accounts for more than 60% of the total goat population in South Africa. Indigenous goats have important socio-economic roles in the livelihood strategies of the poor farmers, especially those in rural and hard-to-reach areas. Indigenous goats are use as savings, insurance, security, accumulation and diversification of assets, social and cultural functions. They are also valued for their productive performance, adaptation and disease resistance.

Aim: To determine the influence of socioeconomic factors on indigenous goat value and sales in selected rural areas of South Africa.

Methodology: The study was carried out in four randomly selected provinces of South Africa; namely Limpopo (LP), Gauteng (GP), North West (NW) and Free State (FS) respectively. A total of 241 farmers were interviewed using semi-structured questionnaire In each district municipality, between 7 and 70 farmers with indigenous goats were randomly selected. Farmers were specifically asked about their socio-economic profile which included the following: Age, Farm size, Production system, Goat housing, Mating system, Internal parasite control, External parasite control, Accessibility of vet and extension services, Availability of supplementary feed, Belong to union, Belong to production organization and Source of breeding bucks. Ordinal logistic regression procedure of SAS were used to predict the odds of a household for value (yes or no) and sales (occurance or non occurance) of the indigenous goats.

Results and Discussion: Youth–headed indigenous goat farmers practicing uncontrolled mating in semi-intensive production system, controlling external parasites and belonging to producer organization had high probability [odds ratio (1.03 – 1.71), 95 % confidence interval] of valuing the indigenous goats. Odds ratios for selling goats were high for the following predictors; age of the head of household, farm size, production system, mating system, external parasite control, belong to a union and using own breeding bucks [odds ratio (1.04 – 1.93), 95 % confidence interval].

Conclusion/recommendations: It has been observed that production system, type of goat housing, source of breeding bucks and belonging to a production organization are the main predictors of value of indigenous goats. Selling goats were high for the following predictors; age of the head of household, farm size, production system, mating system, external parasite control, belong to union and source of breeding bucks. To improve indigenous goat production, it is, therefore, critical to consider producers' socio–economic profiles.

The effects of controlled and notifiable diseases on sheep production

D.D. Claassen[1], J.F. van den Heever[1] & K.J. Mojapelo[1]
[1]Free state Department of Agriculture and Rural Development, Veterinary Services.
didi.jv.rensburg@gmail.com ; fritz@fs.agric.za

Background: Excluding diseases never reported in South Africa (e.g PPR), there are 39 controlled diseases and 6 notifiable diseases listed in terms of the Animal Diseases Act, 1984 (Act no.35 of 1984) in South Africa. Eleven of these diseases affect sheep directly. The recent outbreak of Foot and mouth disease in cattle in the Limpopo province resulted in the termination of all trade of animals and animal products arising from cloven hooved animals, which included the export of wool. The South African government had to renegotiate the export terms and conditions with several trade partners, China being the most recent, to open their borders to wool from South Africa. This took more than five months from the date of the first outbreak. At time of press, the negotiations were still on going for the export of beef to China. The outbreak highlighted the importance of effective disease prevention and control, particularly of trade sensitive diseases, as outbreaks of these diseases can affect trade and production in the entire country.

Aim: To review the importance and effect of controlled and notifiable diseases on sheep production in South Africa.

Discussion: The suspicion of any controlled or notifiable disease must be reported to the state veterinarian in the area. The state authorities will investigate the case and in some instances foot the bill for the diagnostic procedure. The necessary control strategies will be implemented. All the listed diseases have a potential effect on trade or is zoonotic or both. Failure to report these diseases is a contravention of the Animal diseases act and legal action could be taken. This includes not reporting the presence any wool disturbances in a herd.

The listed diseases affecting sheep are Foot-and-mouth disease (FMD), Johne's disease, anthrax, *Brucella melitensis*, scrapie, rabies, sheep scab, other wool disturbances, tuberculosis, bluetongue and Rift valley fever. Any disease that results in a fever, weight loss and death will also indirectly affect wool production in the long run. The presence of diseases such as FMD, anthrax, Rift valley fever (RVF) and bluetongue in an area has an effect on the export of any wool from said area, even if the animals producing the wool are not affected by these diseases.

Prevention and control measures are in place to manage the controlled diseases. The two notifiable diseases (Bluetongue and RVF) cannot be controlled as they are vector borne; however, there are vaccines available to prevent these diseases from spreading. It is pivotal that registered vaccines are administered in the prescribed manner and the courses completed. Strict biosecurity measures on farms are the foundation of the prevention of any disease.

In 2018, two cases of anthrax were reported (Northern Cape province (NCP) and Kruger National Park (KNP)); six cases of FMD in the protection zone; one case of RVF was reported in the Free state province; 9 cases of rabies in sheep nationally of which 4 occurred in the Free State province, 52 cases of sheep scab and 26 cases of bluetongue was reported nationally. Bluetongue is gravely under reported.

Conclusion/recommendations: Effective biosecurity measures, accurate and timely reporting of controlled and notifiable diseases, and efficient implementation of control strategies are the foundations of disease prevention and control. When all the stakeholders work together the effects of controlled and notifiable diseases on sheep production will be minimal.

Resources: http://nahf.co.za/wp-content/uploads/CONT-NOTIFIABLE-DISEASE-POSTER.pdf

Arena behaviour of Merino is heritable and affected by divergent selection for lambs weaned per ewe mated

S.W.P. Cloete[1,2], J.J.E. Cloete[1,3], M. Burger[1], A.C.M. Kruger[2] & A.J. Scholtz[2]
[1]Department of Animal Sciences, Stellenbosch University, Private Bag X1, Matieland, 7602, South Africa,
[2]Directorate Animal Sciences, Western Cape Department of Agriculture, South Africa, [3]Cape Institute for Agricultural Training: Elsenburg, Private Bag X1, Elsenburg 7607, South Africa.
schalkc2@sun.ac.za

Background: Temperament is the behavioural response of an animal to a stimulus that induces stress. Such responses can be facilitated by genetic as well as permanent environmental effects inherent to animals. It may also involve the behavioural expression of fearfulness when an animal is being handled or is in contact with a human. Ease of handling in both open and more restricted situations are important to producers during routine husbandry operations. Temperament was in the past also linked to production traits of economic importance such as growth of lambs and rearing ability of ewes.

Aim: To assess the response of sheep to a contrived situation involving flock separation and fearfulness towards a human in an arena test.

Methodology: Data of 6- to 8-month-old Merino weaners from two divergently selected lines at Elsenburg were used to evaluate the genetics of the response of lambs to a human. The High (H) line was selected upwards and the Low (L) line were selected downwards for number of lambs weaned per ewe mated (NLW) from 1986 to the present. The animals were maintained on dryland and irrigated pastures at Elsenburg. Traits recorded were the distance from the human seated between the test animal and its flock mates, the distance covered in the arena as well as the number of bleats and urination and defecation events. The data were subjected to a five-trait analysis in ASREML to obtain heritability estimates and correlations. Ethical clearance for the work was provided by the Departmental Ethical Committee for Research on Animals (R12/57).

Results and Discussion: Animals from the H line (selected for reproduction) came closer to the human operator seated in the arena between the tested animal and its contemporaries. They were also less likely to urinate and defecate, while they travelled longer distances based on the number of squares crossed in the arena, than their L line contemporaries (all *P*<0.05). The distance the lambs maintained from the human operator (0.08±0.03), urinating events (0.13±0.03), and defecating events (0.04±0.02) were all lowly heritable. However, the number of lines crossed (0.22±0.04) and the number of bleats (0.35±0.05) were both moderately to highly heritable. Both the genetic (0.39±0.18) and the phenotypic (0.22±0.02) correlations suggested that those animals that maintained a larger distance from the human operator covered a greater distance in the arena. Genetic trends indicated that, over time, L line animals increased their distance from the human operator while they also urinated and defecated at a higher frequency. H line animals, in turn, exhibited fewer urination and defecation events with time.

Conclusion/recommendations: Selection for NLW in the H line resulted in a range of behaviours that indicate lower levels of stress when interacting with a human in the arena test. Animal welfare is facilitated by lower levels of stress as well as good animal-stockperson relations during unfamiliar procedures. Future research should focus on the relationship of arena traits with other traits of economic importance, such as reproduction as well as product output and quality.

An insight into the breeding practices and marketing channels of smallholder pig farmers in the rural areas of the Western Cape, South Africa

M. Cupido[1], L.C. Hoffman[1,2] & A.H. Molotsi[1]

[1]Department of Animal Sciences, University of Stellenbosch, Private Bag X1, Matieland, Stellenbosch, 7602, South Africa, [2]Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland, Australia.

louwrenshoffman@uq.edu.au

Background: Agriculture is a major tool that could be used to escape poverty and food insecurity in rural households. Studies have shown that pig farming plays a significant role in the livelihoods of people living in rural areas, however very little is known about the smallholder pig farming sector of the Western Cape of South Africa.

Aim: This study aimed to determine if the breeding and marketing practices of smallholder pig farmers differed between three communal farming sites in the Western Cape.

Methodology: The study was conducted in three separate communal farming sites in the Western Cape; Mamre, Malmesbury and Khayelitsha. With the help of extension officers (EO) and the SPCA, these sites were visited to meet and interact with the farmers. Ethical clearance was obtained (Social Ethics Committee of Stellenbosch University: ANI-2018-6868). Farmers were interviewed face to face or telephonically. The snowball technique was applied until sufficient farmers were interviewed - 75 farmers in total were interviewed; 27 from Khayelitsha, 26 from Mamre, and 22 from Malmesbury. Survey data was captured in Microsoft Excel. Data were statistically analysed ($P<0.05$) using descriptive statistics and ANOVA. A focus group was held with four representatives from each area to gain more insight into their activities.

Results and Discussion: Farmers mostly bred landrace and large white crosses. In the focus group, farmers unanimously agreed that no one in their surrounding areas bred with pure breeds. Occasionally boars with duroc characteristics were used to reduce inbreeding. The number of breeding boars owned did not differ ($P>0.05$) between the three areas (2.32±2.16) neither did the breeding sows. Breeding sows and gilts ranged from farmers owning two to 83 (12.19±2.54). Most farmers obtained their breeding stock from within the area mainly from other smallholder farmers. This could lead to inbreeding depression which could result in lower outputs and weaker piglets. Boars were more likely to be obtained outside the herd through neighbors (55%). Sows were mostly obtained from within the herd (48%) or neighbors (40%). Sixty-four percent of farmers stated that they would sell to anyone. The main marketing channel used between the three areas differed significantly ($P<0.0.5$) due to 58% of farmers in Mamre selling to a personal buyer who bought in weaner stock, while farmers in Khayelitsha and Malmesbury sold mostly to anyone willing to buy (84% and 65%, respectively) and mainly sold growers (81% and 41%). Other markets included selling to neighbors (23%), or to the informal market (10%) which included buyers living in informal settlements. Without a specific market, farmers aren't assured of a consistent monthly income.

Conclusion/recommendations: Smallholder pig farmers in communal farming sites farm with crossbreeds, mainly between the landrace and large white breeds. Breeding stock are usually obtained from within the area farmed in. Sixty-four percent of farmers did not have a specific market. Further investigation into improving the reproductive management and marketing channels used by these farmers is required.

In vitro methane and gas production characteristics of *Eragrostis curvula* hay supplemented with seven South African plant extract additives

J.M. Davis[1], A. Hassen & A.M. Akanmu[1]
[1]Department of Animal and Wildlife Sciences, University of Pretoria, Pretoria 0002
Republic of South Africa.
abubeker.hassen@up.ac.za

Background: The search for alternative feed additives for ruminants became essential due to EU restrictions on the use of antibiotics and synthetic growth promoters in the livestock industry. In addition there is extensive pressure on farmers to reduce methane emissions whilst maintaining production levels. Plant extracts show potential as additives in ruminant feeds mainly due to their ability to act as rumen modifiers by means of their secondary compound's activity.

Aim: This study was conducted to screen extracts from seven South African plant species for their potential to modify rumen fermentation charactertics using *in vitro* techniques.

Methodology: Ethical approval for all *in vitro* tests in this study was granted by the Animal Ethics Committee of University of Pretoria (Ref No: ECO36-17). Fresh plant material from *Combretum erythrophyllum, Dodonaea viscosa, Heteropyxis natalensis, Sclerocarya birrea, Erythrina lysistemon, Searsia chirindensis* and *Halleria lucida* was collected and freeze dried prior to extraction by methanol. Plant extract from each species was reconstituted with distilled water to a concentration of 5 mg/kg DM. Treatments consisted of a negative control whereby no plant extract was added, plant extracts from each species tested at 50mg/kg DM and blank bottles containing no *E. curvula* hay, buffer and/or plant extract. A 4 mL solution of plant extract(s) was added to 400 mg of *E. curvula* hay and incubated with 40 mL of rumen buffered solution (Goering & Van Soest, 1970) at 39°C for 48 hours. Both CH_4 and gas rumen fermentation characteristics were evaluated at 2, 4, 8, 12, 24 and 48 hours post *in vitro* incubation. A total of 3 independent *in vitro* runs with 4 replications per treatment were performed. *In vitro* organic matter digestibility was determined for each plant extract using a two-stage digestion technique developed by Tilley & Terry (1963) with two independent runs and 4 replications per treatments.

Results and Discussion: All plant extracts increased the volume and the rate of gas production with significant increases *(P < 0.05)* occurring with plant extracts from *H. lucida* at 4 to 24 hours of incubation, *C. erythrophyllum* at 12 and 24 hours of incubation and *S. chirindensis* at 24 hours of incubation compared to the negative control. In conjunction with the increased rate of gas production, plant extracts from *H. lucida* generally reduced *(P > 0.05)* the proportion of CH_4 per unit of gas produced. There were no significant differences (*P > 0.05)* between the treatments in terms of IVOMD. Generally, compared to the negative control rumen fermentation characteristics were not significantly improved when plant extracts from *D. viscosa, H. natalensis, S. birrea* and *E. lysistemon* were tested at a dose level of 50 mg/kg DM.

Conclusion/recommendations: Supplementation with plant extracts from *H. lucida, C. erythrophyllum* and *S. chirindensis* at a 50 mg/kg DM dose level may be potentially beneficial as rumen modifiers to ruminants by improving the proportion of available energy from the ruminant diet. However, further testing of plant extracts from *H. lucida, C. erythrophyllum* and *S. chirindensis* at multiple dose levels in the range of 50 mg/kg DM is recommended to fully elude their optimal dose level and/or potential as feed additives in ruminant feed.

The effect of diet neutral-detergent fibre content on the meat quality of finishing lambs

I. De Klerk[1], O.B. Einkamerer[1], A. Hugo[2], A.V. Ferreira[3] & M.D. Fair[1]

[1]Department of Animal, Wildlife and Grassland Sciences, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa, [2]Department of Microbial, Biochemical and Food Biotechnology, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa, [3]RCL FOODS, South Africa. PO Box 2734, Westville, KwaZulu-Natal, South Africa.
ilinde@countrybird.co.za

Background: The quantity of dietary fibre (roughage:concentrate ratio) affecting ruminant meat fatty acid (FA) composition was extensively researched, but the specific effect of neutral detergent fibre (NDF) content of these diets were never referred to nor focused on. Hence, dietary NDF was used as the independent variable to evaluate the use thereof and possibly predict its effect on ruminant meat FA composition.

Aim: This study was conducted to evaluate the response of incrementally decreasing diet NDF content on meat quality of South African Mutton Merino wether lambs.

Methodology: All experimental procedures were approved by the Animal Ethics Committee at the University of the Free State (Animal Experiment No. 15/2014). Five dietary treatments were formulated differing only in respect to the NDF (hence energy) content thereof: 37.9% (NDF1), 31.4% (NDF2), 25.1% (NDF3), 19.2% (NDF4) and 14.3% (NDF5) NDF on a dry matter (DM) basis, respectively. Lucerne hay was used as the main fibre source. The production study consisted of 50 South African Mutton Merino (SAMM) wether lambs (29.1±1.66 kg; mean±SD) and was conducted over a period of 61 days (including a 10-day adaptation period). The lambs were assigned at random to the five dietary treatments (n=10 lambs per treatment). All lambs were slaughtered (48.0±2.97 kg) at the end of the production study. Lipid from the *Longissimus thoracis* muscle and subcutaneous fat were extracted for FA analysis. Meat stability, colour and malonaldehyde content were also determined. The data was subjected to analysis of variance using the General Linear Model procedures of the Statistical Analysis System (SAS) program (SAS, 1999). Regression analysis to determine linear and quadratic models for treatment affects were done using PROC REG of SAS (1999). Significance and regression estimates were tested at the 5% probability level ($P<0.05$).

Results and Discussion: Muscle stearic acid (C18:0) content decreased linearly, whereas palmitoleic acid (C16:1, cis-9), vaccenic acid (C18:1, trans-11) and n-6:n-3 ratio increased linearly ($P<0.0001$) following decreased dietary NDF content. Subcutaneous lipid tissue was more extensively affected by dietary treatment. Apart from a similar linear effect ($P<0.0001$) on adipose stearic and vaccenic acid content, compared with that of muscle tissue, total mono-unsaturated fatty acid, poly-unsaturated fatty acid (PUFA), unsaturated fatty acid, total n-6, n-6:n-3 ratio and PUFA:saturated FA (SFA) ratio increased linearly ($P<0.0001$) following decreased dietary NDF content. In contrast, total SFA content decreased linearly ($P<0.0001$) following decreased dietary NDF content. Noteworthy, is the lack of treatment effect ($P>0.05$) on both conjugated linoleic acid (C18:2 cis-9, trans-11) and total n-3 content of muscle and adipose tissue which is contradictory to literature. A limited effect on lamb meat colour was recorded, with no effect ($P>0.05$) on the oxidative stability thereof.

Conclusion/recommendations: The potential advantage of feeding a highly digestible and low-NDF diet seems to have the desired effect on lamb carcass FA composition.

The need for coordinated predation management in South Africa – quo vadis?

H.O. de Waal

Department of Animal, Wildlife and Grassland Sciences, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa.
dewaalho@ufs.ac.za; dewaalho0@gmail.com

Ruminants utilise veld (natural pasture or rangeland) as a major feed source. Veld comprises about 80% of available agriculture land in South Africa and is utilised by ruminants (i.e. domesticated cattle, sheep and goats, and indigenous wildlife) and other herbivore species (i.e. domesticated equines and several wildlife species). These animal species play an important role in the livelihood of people and providing food security for the nation.

Predators are also part of the South Africa landscape, but the negative impact of predation losses on livestock farms and wildlife ranches are poorly quantified. Recent studies estimated annual predation losses at more than ZAR1.39 thousand million for sheep and goats and more than ZAR 383 million for beef cattle; with substantial losses also on wildlife ranches. These predation losses are ascribed to black-backed jackal, caracal, leopard, brown hyaena, cheetah and vagrant dogs.

The current approach to predation management is fragmented and uncoordinated. Solutions to manage human-wildlife conflict call for a South African institutional memory. Currently, official information is stored in different databases by a national and nine provincial departments, without being integrated. The vast majority of information on predation and hunting of predators is held by specialist predator hunters and farmers, also without integration of the private and public sources.

In a system of coordinated predation management (CPM) farmers and government are equal partners, each with specific responsibilities. The government is responsible for policy, coordination, extension, training, research, monitoring and effective communication, while the livestock farmers and wildlife ranchers must protect their animals and control predators. An important element of the system is an institutional memory and management information system (MIS). This is the common centre for information, planning, leadership and guidance with predation management and also to prevent fragmented and uncoordinated actions. This system of CPM should form part of the official structures of the departments of agriculture (national and provincial), with good liaison and coordination with their national and provincial counterparts in environmental affairs.

Information must be collated and analysed continuously and made available in the MIS to inform and guide the specialists in predation management more effectively. The MIS is a national asset and the information at the centre must be readily available for all users. The institutional memory and MIS serve as information source and must quickly provide practical answers on the following type of requests:

- In which areas is predation losses reported (species involved)?
- Is there a relation between reported cases of predation and the predation management?
- Is there a decline in reported cases of predation following predation management?
- What are the results achieved with different predation management methods?
- Which relevant questions must be resolved through directed scientific research?
- Who are the recognised and proven role players (e.g. specialists in managing predators)?

The MIS must accommodate, integrate and maintain information sets (electronic/hard copy) and is the basis for a continuous assessment of biological, physical, economic and social factors to make meaningful adjustments to the different elements of a system of coordinated predation management. It also serves as common information source to identify and prioritise research needs requiring urgent scientific answers. Relevant information from the MIS is quickly and directly communicated with all relevant role players for further action and application.

Utilising invasive spiny cactus pears (*Opuntia ficus-indica* and *O. engelmannii*) as processed livestock feed and as a means of mechanical control

H.O. de Waal
Department of Animal, Wildlife and Grassland Sciences, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa.
dewaalho@ufs.ac.za; dewaalho0@gmail.com

Major advances was made in utilising spineless cactus pears (*Opuntia ficus-indica* and *O. robusta*) as multi-use crops for humans and livestock. In addition to conventional uses of the cactus pear fruit, cladodes and fruits are processed as livestock feed.

The invading alien spiny cactus pears (e.g. the spiny form of *O. ficus-indica* and the spiny *O. engelmannii*) are well-known in South Africa. Indications are that they were introduced by seafarers to the Cape of Good Hope about 300 years ago and later transported to the interior of the subcontinent. Over time spiny cactus pears formed dense, impenetrable thickets in some regions, especially the Eastern Cape Province. By the 1950's about 1 million ha in South Africa had been invaded by the aliens. Infestations of the spiny form of *O. ficus-indica*, so-called sweet prickly pear, severely impacted on agriculture, despite it being utilized by people and livestock.

Prior to developing a wind turbine farm in the Eastern Cape Province, the construction footprint had to be cleared of its heavily invaded spiny cactus pears, i.e. *O. ficus-indica* and *O. engelmannii*. Local expertise and knowledge was called to deal with the spiny cactus pears.

Invasive alien plants (IAP) pose a direct threat to South Africa's biological diversity, water security, the ecological functioning of natural systems and productive use of land. The IAP's are controlled with mechanical, chemical, biological and integrated control methods. In this initiative mechanical control is used to harvest and process the plant material as livestock feed.

Harvesting and processing spiny cactus pear plants are fairly simple, although it requires a good measure of physical strength, perseverance and the necessary protective clothing for workers. Harvesting and processing comprises three successive stages, namely:
- harvesting spiny cactus pear plants,
- cutting (shredding) and drying cladodes strips in the sun for about 10-14 days, and
- grinding coarsely in a hammer mill.

The long spines are sufficiently degraded by grinding the sun-dried spiny cactus pear cladode strips in a hammer mill before including it in balanced livestock diets. Except for the long spines, of fresh material, the chemical composition of the sun-dried, coarsely ground spiny cactus pears compare favourably with similarly processed spineless cactus pears.

The processed cactus pear material can be included at levels of 25-30% in balanced diets for ruminants by substituting a conventional feed source such as ground lucerne hay. The diets must be balanced with the inclusion of an appropriate nitrogen source, such as natural protein or non-protein nitrogen (i.e. feed grade urea).

This initiative was launched in the Eastern Cape Province by setting a baseline standard and creating an opportunity to manage the massive farmland areas of infestations by alien spiny cactus pears with mechanical control.

In addition to the utilisation of processed spiny cactus pears as feed for livestock, the initiative will ensure that valuable and underutilised farmland revert back to natural grazing for livestock.

Cactus pears in human food: conventional and unconventional applications

M. de Wit[1], **A. du Toit**[2], **H.J. Fouché**[3] **& A. Hugo**[1]

[1]Department of Microbial, Biochemical and Food Biotechnology, [2]Department of Consumer Science, [3]Animal Production Institute, Agricultural Research Council, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa.
dewitm@ufs.ac.za

Background: The cactus pear plant has long been valued in South Africa as cattle feed, as well as for its delicious, healthy fruit. The effect of declining water resources and increasing desertification on food security prompted the exploration of the highly water-efficient, drought-tolerant spineless cactus pear (*Opuntia ficus-indica* and *O. robusta*) as a commercial crop for the food industry in South Africa. Both *O. ficus-indica* and *O. robusta* are undervalued food sources, which have health-promoting properties that should be brought into the public domain. The entire plant has value as a food source with nutraceutical properties.

Aim: This paper focuses on the uses of the cactus pear plant (fruit and cladodes) and its components as both functional and nutraceutical agents in food. Research on all human food application aspects of this multi-functional plant is reported.

Methodology: Research on cactus pears at the University of the Free State (UFS) is in collaboration with the South African Agricultural Research Council (ARC). Plant material from 42 cultivars was collected from an experimental orchard outside Bloemfontein as well as from the UFS west campus. Functional properties explored included colourants from the fruit as well as mucilage from the cladodes. Nutraceuticals investigated included seed oils and fatty acids, antioxidants as well as insoluble- and soluble fibres.

Results and Discussion: During conventional uses of the fruit, e.g. fresh, frozen, juiced, heat-treated, preserved and dried, the eating quality, sensory quality as well as the nutraceutical quality (antioxidants) were established. This also included the application of the natural betalain colourants which are also powerful antioxidants. Unconventional applications included the use of cladodes and fruit waste products. From cladodes, functional properties such as increased fibre content and fermentation ability of flour as well as water binding, emulsification, gelation, foaming and fat replacement of mucilage were investigated. Seed (usually discarded as waste) oils proved to be a good source of antioxidants and essential fatty acids.

Conclusion/recommendations: Cactus pear plants are a valuable resource and should be seriously considered as an alternative crop for the semi-arid regions to broaden the food base as well as to open up economic opportunities not only for the small scale producer but to the food industry as a whole.

Social dominance in South African indigenous rams (Zulu sheep): Effect of body measurements on dominance

M.Z. Dlomo[1] & N.W. Kunene[1]
[1]Department of Agriculture, Private bag X1001, University of Zululand, KwaDlangezwa, 3886, South Africa.
Dinangwe.mhle@gmail.com

Background: Social ranking animals is usually caused by the limited access to resources such as feed and water, as well as mating partners. In rams social dominance is mostly related to physical traits such as body weight, horn size, body length and scrotal circumference. Few studies have been done related to social behaviour and physical traits of rams. Social dominance relationships have been studied in other breeds but not in rams of Zulu sheep. Most studies have focused on body weight as the most common determinant of social rank, but in this study, the effect of body measurements was investigated.

Aim: The main objective of the study was to determine how the physical traits of Zulu sheep rams relate to the establishment of social rankings.

Methodology: All experiments were approved by University of Zululand Research Ethics Committee (UZREC 171110-030 PGM 2015/234). Eight rams of same age were used (3 years). To determine the social rank the feed competition test was used. Water was provided *ad libitum*. Physical traits such as body weight, chest girth, horn length, scrotal circumference and withers height were recorded for each ram. For simplicity, animals were recorded by CCTV cameras for a clear view. Position and time spent at the feeder for each ram was later analysed. Number of contests between rams were recorded with the dominant and subordinate ram identified. A Pearson correlation analysis was used to test the relationship between body measurements, proportions of wins and minutes spent at the feeder for each ram.

Results and Discussion: Physical traits such as body weight, chest girth, horn length, scrotal circumference and withers height were recorded for each ram. There was no significant correlation between time spent at the feeder and social rank ($r=0.4339$, $p>0.05$). Significant positive correlations were established between scrotal circumference and horn length ($r=0.696$, $p<0.05$), and body weight and chest girth ($r=0.639$, $p<0.05$). Social dominance was not determined by body physical measurements.

Conclusion/recommendations: Findings of the present study propose that the rearing of many rams in a single flock might lead to aggressive behaviour and possible injuries to subordinate rams.

Effects of extensive-intensive feeding system on gonadal development, scrotal fat deposition and semen quality of Döhne Merino, Merino and SA Mutton Merino rams

A.M. du Preez[1], E.C. Webb[1] & W.A. van Niekerk[1]
[1]Dept. of Animal Science, University of Pretoria, Pretoria 0002, South Africa.
amelia.may.dp@gmail.com

Background: Different practices for rearing and conditioning breeding rams for auction are used. Rams are either raised extensively, enter a veld ram club (on extensive pasture for 70 days, followed by intensive feeding for 60 days), or are intensively fed. Rams fed a concentrate diet at an older age (such as done in veld ram clubs) may cause excessive fat deposition in the scrotum, which may impair thermoregulation with negative effects on semen quality.

Aim: This study investigated the effects of finishing systems for young breeding rams of Merino breeds (5-12 months old) on gonadal development, scrotal fat accumulation and semen quality.

Methodology: Growth, size, scrotal measurements, semen quality and *post mortem* gonadal measurements were recorded. Data was analyzed by GLM ANOVA procedures and differences between means were tested by Bonferroni's multiple range test ($P<0.05$). Regression analyses and partial correlations were calculated by controlling for initial weight. Research was approved by the Animal Ethics committee of the university of Pretoria, reference number EC027-08.

Results and Discussion: Regression analyses confirmed that higher weight gains resulted in more scrotal fat ($R^2=0.14$, $P<0.05$) and increased immotile/dead sperm ($R^2=0.16$, $P<0.05$). More subcutaneous fat resulted in more scanned scrotal neck fat (SSNF) ($R^2=0.35$, $P=0.001$). Subcutaneous fat layer thicker than 2cm resulted in decreased mass motility ($R^2=0.20$, $P<0.05$) and progressive motility ($R^2=0.21$, $P<0.05$), as well as increased aberrant motile sperm ($R^2=0.20$, $P<0.05$) and immotile/dead sperm ($R^2=0.21$, $P<0.05$). An increase in scrotal fat caused a decrease in semen colour ($R^2=0.17$, $P<0.05$) and mass motility ($R^2=0.13$, $P<0.05$). In the extensive-intensive feeding system, Döhne Merino (DM), South African Mutton Merino (SAM) and Merino (M) rams gained respectively 38.5kg, 35.3kg and 34.6kg. Subcutaneous fat of M, DM and SAM were 1.5cm, 1.8cm and 2.2cm respectively. Merino rams had less SSNF (1.4cm) than DM (1.7cm) and SAM rams (1.8cm) ($P<0.05$), but M rams had more scrotal fat (52.5g) than DM (45.4g) and SAM rams (46.3g). No differences ($P<0.05$) in semen quality were observed between breeds. Semen volume, progressive motility, aberrant motile sperm, immotile/dead sperm and %NS of the breeds varied between 2.1-2.7ml, 75-78%, 9-11%, 12-14%, and 80-83% respectively.

Conclusion/recommendations: Regression analyses show that there is a threshold for fat accumulation and if exceeded, semen quality may be adversely affected. All three breeds exceeded the weight gain and the scrotal fat thresholds, while SAM rams also exceeded the subcutaneous fat threshold. Semen analyses results do not show poorer semen quality in any of the rams, but semen samples were taken at the end of the two months intensive feeding period when the effects of fat accumulation were not yet be observed. The consequences of excess scrotal fat accumulation may be more prominent in subsequent spermatogenic waves due to compromised thermoregulation based on results from regression analyses. This extensive-intensive system may increase the risk of excess scrotal fat accumulation and should therefore be managed carefully regardless of Merino breed type.

Young cladodes from cactus pears (*Opuntia ficus-indica*) as a viable food source

A. du Toit[1], M. de Wit[2], O. Mpemba[1], T. Colbert[1], Y. Huang[1] & A. Hugo[2]

[1]Department of Consumer Science, [2]Department of Microbial, Biochemical and Food Biotechnology, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa.

Dutoita1@ufs.ac.za

Background: The cactus pear plant is a nutritious, sustainable, underutilized food source with high biomass production which could alleviate food security by broadening the food base in Africa. Young cladodes (nopalitos) are a part of Mexican cuisine and is enjoyed as a tasty and nutritious fresh vegetable. Consumers select thin, bright green, firm nopalitos which are not too sour. However, the ideal cultivar for nopalito production in South Africa and the optimal cooking methods is unknown. Moreover, recipes which are acceptable in the South African culture is unavailable.

Aim: This study was conducted to learn more about the ideal cultivar, harvest size, harvest time for nopalitos to obtain the most desirable eating quality characteristics. Nopalitos had to be compared to popular vegetables to describe the taste and texture. Preparation techniques, cooking instructions, and recipes which suit the local palate had to be developed, evaluated in sensory tests and made available to South African consumers.

Methodology: Six nopalitos of two selected cultivars (Morado and Fusicaulis) were evaluated based on harvest size (9, 12, 15, 18, 21, 24 cm), harvest season (post-fruit harvest & spring growth) to determine the optimal nopalito quality characteristics and eating quality. The weight, colour, firmness, compressibility, titratable acidity, pH, mucilage content and viscosity, moisture content and total soluble solids were tested and compared to well-known vegetables. Moist heat (boiling, microwave cooking) and dry heat (baking and shallow-frying) cooking methods were tested and compared to green pepper. Several recipes which included preserved products, side dishes, and main meals were developed. The prepared nopalitos were evaluated by consumer panels consisting of ten members using 9-point hedonic scale tests. The panelists completed a questionnaire to reflect their attitudes as consumers.

Results and Discussion: Nopalitos harvested during both growth seasons (post-fruit and spring growth) showed no significant differences in terms of their physicochemical properties. Thus both cultivars demonstrated good eating quality characteristics, provided they were harvested at an immature stage, preferably below 20 cm. Morado produced thinner, brighter green nopalitos which had lower mucilage content and was more tender than Fusicaulis. The acidity of nopalitos (pH 4.21, 4.15) was comparable to the pH of tomato (4.17). The sugar content (5.9 °Brix) was similar to that of green pepper (5.6 °Brix). Nopalitos (68.84 10^{-1} mm) were as firm as cucumber (61.1 10^{-1} mm) and as tender (27.21 10^{-1} mm) as baby marrow (25.7 10^{-1} mm). Nopalitos could be described as sour as tomatoes, similar in flavour to green pepper, as firm as cucumber and as tender as baby marrow. Boiling and shallow frying proved to be the best cooking methods for eating quality characteristics. The sensory analysis and questionnaire showed the nopalito-based meals, side dishes and confections were highly acceptable to consumers.

Conclusion/recommendations: The study showed that nopalitos offer a viable food source to South African consumers because of similarities in texture and flavour to other popular vegetables. Both the cultivars included in the study are recommended for use as a fresh vegetable source. A website containing the recipes for nopalito meals, side-dishes and confections will be launched shortly.

Sire evaluation based on cow production and reproduction performances in official milk recording herds in South Africa

J. du Toit[1], G. Buchanan[2], M.J. Viljoen[1] & H.L. de Waal[1]
[1]ARC-Animal Production Campus, Private Bag x5013, Stellenbosch, 7599, South Africa, [2]ARC-Animal Production Campus, Private Bag x2 Irene, 0062, South Africa.
dtoitj@arc.agric.za

Background: The intensive dairy production systems demand creative, dynamic and interactive reports, to ensure economic sustainability. The emphasis in reporting on results based on official milk recording has shifted from the phenotypic performance of individual cows used in genetic evaluation programs, to focus more on information regarding the relationship between phenotypic values, health traits and nutritional requirements. Information captured in INTERGIS addresses the demands in herd production and reproduction tendencies.

Aim: To sustain, improve and develop information on dairy performance recording captured in INTERGIS to address the demands in herd production tendencies, milk composition and quality, as well as production efficiency.

Methodology: HTML 5 and Google visualization technology was used in developing advanced functionalities for the Livestock Manager programme in INTERGIS. Production and reproduction traits were calculated for each cow in the herd. Production traits include 305-day milk yield and combined fat and protein yield, lactation index, lactation persistency and somatic cell count (SCC). Reproduction traits include Lifetime Production Efficiency (LPE) for milk and solids combined, calving interval (CI) and age at first calving (AFC). A herd summary for all sires used in the herd is presented based on their daughters' performance within parity 1, 2 and 3+, respectively. Parity groups include all daughters with completed lactations. The average performance of all the daughters of each sire is summarized, which is an indication of the performance of each sire in the herd.

Results and Discussion: An important and useful development revolves around the evaluation and comparison of sires used in the herd. Dual screens, based on the performance of their daughters for specific traits, assist managers to identify bulls with superior performing progeny. New developments also include the opportunity to identify poor performing (below average breed performance) cows for culling. Top performing cows can also be identified to be used as bull mothers for home use or for the artificial insemination industry. Colour keys are used to identify top performing cows. A similar system is used for somatic cell count (SCC) and milk urea nitrogen (MUN).

Conclusion/recommendations: The variety of reports offer the opportunity for animal scientists, feed consultants, veterinarians and extension officers to assist dairy farmers on aspects that influence herd efficiency and productivity.

Genomic evaluations in cattle: past, present and future

V. Ducrocq[1]

[1]GABI, AgroParisTech, INRA, Université Paris-Saclay, 78350 Jouy-en-Josas, France.
vincent.ducrocq@inra.fr

Background: Genomic selection (GS) is a concept which emerged with the landmark paper of Meuwissen, Hayes and Goddard (2001), at a moment when large scale genotyping was still science-fiction. In 2007, the development of assays revealing at a relatively low cost the actual status of thousands of SNPs evenly spaced over the genome transformed this concept into an applicable technique. The dairy cattle breeding structure in large countries offered the optimum context needed to implement GS: large reference populations (RP) consisting of AI bulls accurately evaluated on many traits, long generation intervals due to costly progeny testing, etc. A multitude of genomic evaluation methods were proposed. The most popular are extensions of BLUP (Genomic BLUP or GBLUP) and Bayesian methods with various assumptions about the distribution of SNP effects on the phenotypes.

Past: GBLUP proved to be simpler and nearly as efficient as other approaches, when the RP is large enough and when an extra "residual polygenic effect" is included to account for additive genetic variance not explained by SNPs. The GBLUP mixed model equations include only animals that have been genotyped. Therefore, a two-step approach is required: first, a regular genetic evaluation is performed, using of all phenotypes and pedigree information to estimate environmmental effects and estimated breeding values (EBV). Corrected performances are then used as phenotypes, to compute genomic EBVs (gEBV) of animals from the RP and young genotyped candidates. When information is scarce, EBV and gEBV are often blended together (e.g., in beef cattle).

Present: It has been shown that GBLUP suffers from several important limitations. In particular: a) it assumes that all SNPs impact the phenotypes in a similar way; b) GBLUP becomes computationally challenging when the number of genotyped animals is larger than the number of SNPs; c) When GS is intense, BLUP assumptions are violated and regular EBV become biased, eventually affecting the quality of gEBV. Ways to circumvent these limitations exist: some SNP corresponding to (or close to) causative mutations can receive a higher variance. Approximations of the inverse of the genetic relationship matrix have been proposed, decreasing computational burden. Alternatively, SNP effects can be estimated directly (SNP-BLUP), allowing for fast intermediate genomic evaluations (e.g., once a week). Single-Step (SS) approaches combining genetic and genomic evaluations into a single analysis properly account for GS and lead to nearly unbiased EBV.

Future: AI bull RPs are progressively replaced by very large (in dairy cattle), possibly multi-breed (in beef cattle) RPs. In some countries, the number of genotyped animals is growing fast, sooner or later reaching more than a million. Several research groups are developing powerful hybrid Single Step approaches combining SNP-BLUP with complex (multiple trait) genetic models. Accuracy of GS may also be increased by including some causative mutations or non additive effects. All these advances will strongly impact breeding programs and international comparisons. Selection for new traits will no longer require data collection at national level.

Conclusion: These fast computational developments reinforce the importance of a careful modelling of phenotypes, in particular properly accounting for genotype by environment interactions.

Growing out and finishing beef steers on tall fescue pasture

T.J. Dugmore, J. Mann & A.M. Pienaar
Livestock Science Research Services, KZN Department of Agriculture and Rural Development,
Cedara Campus, P. Bag X 9059, Pietermaritzburg, 3200, Republic of South Africa.
trevor.dugmore@kzndard.gov.za

Background: Pasture finishing of beef steers is an alternative to feedlotting where land and water resources are available. Pasture finishing of beef steers would be more suited to a beef farmer adding value to his product, rather than a feedlot owner. Pasture finishing of cattle is independent of maize price fluctuations that feedlots deal with on an on-going basis. The need for maize for human consumption and the consumer demand for "grass fed" beef will put further pressure on feedlots. An alternative to feedlotting animals would be to finish them off grass. For grass finishing of steers to be successful, certain optimal carcass characteristics need to be have met; 180 to 250 kg carcass mass and sufficient, even fat cover (A2) for the South African market.

Aim: To evaluate the growth performance of beef steers grazing tall fescue and to determine if beef steers finish adequately (a fattened carcass) while grazing tall fescue.

Methodology: Ethical clearance was granted (AS 2016/01C) by the Departmental Research Committee. Twelve Hereford and twelve yearling Nguni steers started the trial at the end of August on fescue pasture fertilised with 300 kg N, split into 10 dressings and applied after each grazing rotation (30 kg N per dressing). The end date was early May, giving a grazing season of 259 days for year 1 and 248 days for year 2. The end date was determined by when the abattoir could accommodate the slaughtering. The size of the daily allocation of grass was approximately 100 m^2 per steer in a 24 day grazing cycle. The two treatments applied to the steers were: Control (no growth stimulant) and a Growth stimulant (Revalor G) implanted in the ear. The first implant was done in September (2 weeks into the trial). And the second implant was done in early January (19 weeks into the trial). The statistical design comprised a Randomised complete block design with the data analysed using ANOVA for weight gain, average daily gain (ADG), carcass weight, dressing percentage, block test score and conformation score and by regression for ADG over season, leaf stage versus ADG, disc meter height versus ADG, Acid Detergent Fibre (ADF) versus ADG and Neutral Detergent Fibre (NDF) versus ADG.

Results and Discussion: The ADG for the control was 0.77 & 0.70 kg/d and a significantly higher (p<0.05) ADG of 0.85 & 0.80 kg/d for the Revalor G treatment, was recorded in year 1 and 2 respectively. In terms of breed, the Nguni gained 0.68 and 0.60 kg/d, while the Hereford gained 0.93 and 0.71 kg/d in years 1 and 2 respectively. A significant improvement in performance for the Revalor G treatment was observed in the carcass weight (223 vs 231 kg for the control and Revalor respectively) of the steers. No improvement was observed in the conformation score of the carcass for the Revalor G treatment. Except for one steer in each year, all the other steers finished as an A2 fat grade. A treatment by breed interaction was observed for dressing percentage with the Revalor G Nguni treatment having a significantly (P<0.05) lower dressing percentage (by 2%) than the Revalor G Hereford treatment. The cost of a box of Revalor G was R2688.04 (24/07/2017). The cost per treatment for the trial being R53.76 (two implants). The rate of return of the Revalor G growth implant was 13:1, which is sufficient to warrant the use of Revalor G.

Conclusion/recommendations: The steers finished sufficiently off tall fescue and received premium prices at the abattoir. The final carcass mass (238 kg for Herefords and 206 kg for Nguni steers) and fat grades (mostly A2 except one steer was A3) were attained. The block test results were excellent for pasture finished animals and were reflected as such in the ranking of the block test. Interesting to note is how well the Nguni steers did in the block test score.

Can animal welfare contribute to improved production efficiency?

C.M. Dwyer[1,2]

[1]Animal Behaviour and Welfare Team, Department of Animal and Veterinary Sciences, SRUC, Edinburgh, Scotland UK, [2]Jeanne Marchig International Centre for Animal Welfare Education, Royal (Dick) School of Veterinary Studies, University of Edinburgh, UK.
Cathy.dwyer@sruc.ac.uk

Background: Globally we need to feed an increasingly urban and expanding population with a growing demand for meat, milk and eggs, against a background of reducing the carbon footprint of food production. Under these conditions is farm animal welfare a luxury that cannot be sustained?

Animal Welfare and Production: Animal welfare has been characterised in a number of different ways: to include aspects of the animal's biological functioning, ability to live a natural life, and affective state. The oldest conception of animal welfare is the Five Freedoms, which has been adapted to the Five welfare Needs for a suitable environment, a suitable diet, to be able to exhibit normal behaviour patterns, to be with, or apart from, other animals and to be protected from pain, injury, suffering and disease. In lowly productive extensive livestock production systems, animals are often kept in conditions of variable nutrition, and experience high mortality and morbidity from preventable disease. For these systems animal welfare can be improved through actions which will simultaneously improve productivity (e.g. vaccination against disease, education in animal hygiene and management, and provision of improved nutrition, such as improved grassland management). Under these conditions animal welfare improvements are an integral part of improving production efficiency, and can benefit humans and animals simultaneously. Highly productive, intensive systems have increasing control of nutrition and health of the animals, and high productivity but reduce the space and opportunity for animals to express highly motivated behaviour (such as dust-bathing in chickens, or exploration in pigs). Under these conditions productivity gains have been achieved with animal welfare costs. However, these systems often have high inputs, require the use of antibiotics to sustain growth, and may have detrimental impacts on the immune function, fertility and longevity of animals within these systems. Paying attention to the needs of the animal can have both welfare and production efficiency benefits. For example, pigs given enrichment have a more robust immune system and deal more efficiently with PRSSV infection. Treating lameness in dairy cows through reducing stocking density can be more efficient and cost effective through the increased milk production of cows that are not in pain.

Conclusions: These, and other, studies demonstrate that animal welfare can be an important and effective part of production efficiency, and that animal welfare should be seen as an integral component in improving sustainability of livestock production.

Re-evaluating ideal drinking water pH for improved broiler performance and the effects thereof on the gastrointestinal tract pH

K.J. Edwards[1], C. Jansen van Rensburg[1] & F. Crots[2]
[1]Department of Animal Sciences, Faculty of Natural and Agricultural Sciences, University of Pretoria, Private Bag X20, Hatfield, Pretoria, 0028, South Africa; [2]AFGRI Animal Feeds, 12 Byls Bridge Boulevard, Highveld Ext 73, Centurion, 0046.
kyle.edwards@afgrifeeds.co.za

Background: Alternatives to antibiotics are constantly being studied and one such alternative is organic acids. Organic acids can lower the pH in the gastrointestinal tract (GIT), rendering the environment unfavourable to pathogenic bacteria, thus resulting in a healthier GIT. This can enhance nutrient digestion, absorption and utilisation, as well as enhanced growth and efficiency of the bird.

Aim: The main objective of this study was to assess the optimal pH of drinking water for broilers and its effect on the GIT and broiler performance. The second objective was to compare water acidification and feed acidification, as well as a combination thereof on GIT pH and broiler performance.

Methodology: [The trial was conducted in accordance with ethical guidelines followed by AFGRI Feeds as set out by the South African National Standard for the care and use of animals for scientific purposes (SANS 10386; 2008)]: Two different feeds and five different water pH levels were fed to 7200 Ross 308 broilers, randomly allocated to 120 pens, with 12 replicates per treatment and 60 birds per pen. The broilers were fed a five-phase diet, from pre-starter to post-finisher, with feed 1 considered as 'standard', whilst feed 2 was considered as 'acidified', containing 0.30% Formi (40% formic acid product). The five water pH levels tested were 3.0, 3.8, 5.5, 6.5 and tap water (pH of 7.9). Broiler performance was measured per pen and pH in various GIT segments were measured weekly. Three birds were randomly selected from each treatment and humanely euthanised via cervical dislocation to conduct pH measurements in the crop, gizzard, proventriculus, duodenum, jejunum, ileum, ceca and colon. A general linear model (GLM) was used to determine significant $(P <0.05)$ differences between treatments. Means, standard error, and significance of differences between means were determined by Tukey HSD test at a 95% confidence level.

Results and Discussion: The standard feed performed better $(P <0.05)$ than the acidified feed, irrespective of water pH. Standard feed resulted in higher $(P <0.05)$ bodyweight (BW) and European performance efficiency factor (PEF) at weekly weighing intervals from D7-35 of age, as well as lower $(P <0.05)$ feed intakes (FI) and feed conversion ratio (FCR).Water pH showed clear trends and differences $(P <0.05)$ amongst the various treatments, irrespective of the feed used. Any level of drinking water acidification proved better than pure tap water, with significantly higher $(P <0.05)$ BW and PEF at most weekly recordings, as well as lower $(P <0.05)$ FI and FCR. Water intake was higher $(P <0.05)$ at a water pH of 3.8 when compared to tap water. When comparing the different drinking water pH levels across the two feeds, broiler performance always favoured the standard feed, irrespective of water pH. In all cases, mortality was not affected $(P >0.05)$ and the results of the GIT pH was highly variable, showing no clear trends.

Conclusion/recommendations: Results of this study indicated that feed acidification is not as effective as water acidification and that a lower drinking water pH can significantly improve economically important measurements, such as BW and FCR. It can also be concluded that neither the dietary nor water pH treatment levels could be used to predict the effects exhibited on the pH of various GIT segments. Based on the present results, there is no clear benefit in combining feed and water acidification, whilst a drinking water pH of 3.0 – 3.8 is recommended.

The effect of diet acid-detergent fibre content on the production performance of finishing lambs

O.B. Einkamerer[1], A. Hugo[2], A.V. Ferreira[3] & M.D. Fair[1]

[1]Department of Animal, Wildlife and Grassland Sciences, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa, [2]Department of Microbial, Biochemical and Food Biotechnology, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa, [3]RCL FOODS, South Africa. PO Box 2734, Westville, KwaZulu-Natal, South Africa.
einkamererob@ufs.ac.za

Background: Fibre quality is a concept that is not particularly defined. Its digestibility, consumption and ability to provide nutrients are closest related to its quality, and is even more important within intensive feeding conditions. Fibre quality as a spesific term is rarely referred to in research, where its acid detergent fibre (ADF) content is mostly referred to.

Aim: This study was conducted to evaluate the effect of incrementally increasing the ADF content of low-fibre finishing diets on diet digestibility and production performance of South African Mutton Merino wether lambs.

Methodology: All experimental procedures were approved by the Animal Ethics Committee at the University of the Free State (UFS-AED2016/0038). Four similar dietary treatments were formulated differing only in respect to its ADF content: 4.68% (ADF1), 5.93% (ADF2), 6.38% (ADF3) and 7.99% (ADF4) ADF on a dry matter (DM) basis, respectively. Wheat bran (low ADF) and soybean hulls (high ADF) were used as the only fibre sources. A production study was conducted over a period of 67 days. Sixty South African Mutton Merino (SAMM) lambs (27.4 ± 3.2 kg; mean±SD) were randomly allocated to the four dietary treatments (n=15 lambs per treatment). For the digestibility study (*in vivo*), 32 additional lambs (42.5 ± 4.1 kg) were randomly allocated to dietary treatments (n=8 lambs per treatment). At the end of the production study all lambs (47.95 ± 2.97 kg) were slaughtered and carcass parameters measured. The data was subjected to analysis of variance using the General Linear Model procedures of the Statistical Analysis System (SAS) program (SAS, 1999). Tukey's honest significant difference test was used to identify significant differences between treatments. Significance was tested for at the 5% probability level ($P<0.05$).

Results and Discussion: From the results of the present study it seemed that by increasing the ADF content of low-fibre diets positively influenced the ADF (0.64 *vs.* 0.33, 0.40 and 0.43 for ADF4 and ADF1, ADF2 and ADF3, respectively) and neutral-detergent fibre (NDF) (0.59 *vs.* 0.42, 0.43 and 0.47 for ADF4 and ADF1, ADF2 and ADF3, respectively) digestibility thereof ($P<0.05$). Diet DM intake and metabolizable energy (ME) content were, however, not affected ($P>0.05$). The low diet ADF content (ADF1) increased ($P<0.05$) lamb growth efficiency (feed conversion ratio; 4.30 *vs.* 4.87 for ADF1 and ADF4, respectively] and ME used for live weight gain (44.0 *vs.* 49.5 and 51.5 MJ ME/kg gain for ADF1 *vs.* ADF2 and ADF4, respectively]. Carcass characteristics were unaffected by treatment ($P>0.05$).

Conclusion/recommendations: Fibre (NDF and ADF) digestibility of low-fibre finishing lamb diets were significantly influenced by a high ADF content (in relation to a similar NDF content) and positively related within the feed sources used in this study. This is in contrast to most literature. Hence, it is unfounded to assume that a fibre source high in ADF will result in decreased fibre digestibility. Fibre quality is therefore a complicated definition and its influence seems unpredictable. Animal production was, however, more effective with a low diet ADF content.

Genetic parameters for mature ostrich traits

A. Engelbrecht[1], C.K. Cornwallis[2], M. Schou[2] & S.W.P. Cloete[1,3]

[1]Directorate Animal Sciences, Western Cape Department of Agriculture, South Africa, [2]Department of Biology, Lund University, Lund, Sweden, [3]Department of Animal Sciences, Stellenbosch University, South Africa.

anele@elsenburg.com

Background: Limited pedigree and performance data are available in the ostrich industry, mostly as a result of the communal flock breeding systems commonly used. The pedigree information and production data recorded at the Oudtshoorn Research farm are unique in this respect, probably being the only source of reliable data for ostriches that can be used to estimate genetic parameters. With feather income becoming an increasingly important part of the ostrich industry's revenue, it is important to consider genetic improvement of feather quality as a selection objective. It is therefore important to consider the genetic correlation of feather traits with other traits of economic importance. Weight is an important determinant of feather income, since producers are paid per kilogram. It is also an objective indication of quality because flue length, width and density, as well as high fat content, determine feather quality and will all increase feather weight.

Aim: Genetic parameters for mature ostrich traits were estimated to determine genetic correlations among ostrich reproduction, live weight and feather weight traits.

Methodology: Data of pair-bred South African Black ostriches recorded from 1990 to 2018 on the Oudtshoorn Research Farm were used. The birds were paired off annually as single pairs over a 7- to 8-month breeding season. Repeated records (n=3023) for egg production (EP) and chick production (CP), adult weight (AW, n=6292) and mature feather weight (MFW, n=2787) were analysed in a four-trait analysis. Mature feather weight was derived by totalling the weights of six types of feathers, namely wing plumes, floss, long upper wing coverts, hard bodies, soft bodies and tail feathers, that were gathered from individual adult birds.

Results and Discussion: Heritability estimates for reproduction traits were moderate at 0.18±0.05 for EP and 0.12±0.04 for CP. AW and MFW were highly heritable at 0.37±0.04 for AW and 0.22±0.04 for MFW. Animal permanent environment affected all of the traits, with estimates ranging from 0.14 for EP to 0.30 for AW. Service sire effects for egg and chick production were low at 0.04 and 0.05, respectively. The only significant genetic correlation found was among EP and CP (0.98), indicating that these traits were very similar on the genetic level. The direction of the genetic correlations of MFW with EP, CP and AW were consistently unfavourable, albeit not significant due to large standard errors. However, the environmental and phenotypic correlations between MFW and the other traits were significant and negative, ranging between -0.19 and -0.22. While the present study confirms earlier findings that female reproduction traits, AW and MFW in ostriches are variable and heritable, there are also indications of potential unfavourable genetic correlations between AW and MFW, as well as between these reproduction traits and MFW.

Conclusion/recommendations: All traits studied were heritable and it should thus be feasible to improve these traits by directional selection, using conventional means. More data are needed to verify the indications of unfavourable correlations of feather weight with other mature ostrich traits. The correlation of feather weight with feather quality traits also needs investigation.

Effect of feed additive supplementation on rumen bacterial amino acid profiles in dairy cows

L.J. Erasmus[1] & C. de Vos[1]
[1]Department of Animal & Wildlife Sciences, Private bag X20, University of Pretoria, Pretoria, 0028, South Africa.
lourens.erasmus@up.ac.za

Background: To maximise production dairy cow diets are balanced for amino acids (AA) through the use of feed formulation programmes. An inherent limitation of such programmes is that the bacterial AA profile used is fixed and based on mixed ruminal bacteria. However, research has shown the AA profile to differ between the fluid-associated bacteria (FAB) and particle-associated bacteria (PAB) and to be variable in response to factors such as diet composition, feed intake, protein source and thus potentially feed additives.

Aim: This study was conducted to determine the effect of dietary feed additives on the AA composition of the fluid- and particle- associated fractions of ruminal bacteria.

Methodology: Experimental procedures were approved by the Animal Ethics Committee at the University of Pretoria (Project No. EC016-16). Four Holstein-Friesian cows were utilised in a 4 x 4 Latin square design, comprised of 25 day periods, during which whole rumen contents were collected over four sampling days for the isolation and determination of the AA profile of the ruminal FAB and PAB. The basal diet fed was a total mixed ration (TMR) comprised of 400 g/kg high quality lucerne hay and 600 g/kg concentrates. Treatments were: (1) control diet (C), (2) control diet plus 90 g/day of the calcareous marine algae buffer Acid Buf 10 (Celtic Sea Minerals) (AB10), (3) control diet plus 10 g/day of the direct-fed microbial Achieve[FE] (MicroBasics Inc.) (DFM) inserted directly into the rumen daily, and (4) control diet plus 250 mg/day of monensin sodium (Rumensin 200, Elanco Animal Health) (MON). Cows were fed their respective TMR *ad libitum* twice daily, with the DFM product being placed directly into the rumen daily prior to the morning feeding. Whole rumen content collected underwent fractionation and differential centrifugation for the isolation of the ruminal bacteria, isolated bacteria were freeze-dried and ground for the determination of AA composition via high-performance liquid chromatography (HPLC). Data were statistically analysed as a Latin square design using the GLM analysis of variance, factorial contrasts were applied to compare the control to each dietary treatment. Significance of difference between means was declared at $P<0.05$ and a tendency at $P≤0.10$.

Results and Discussion: Feed additives were shown to alter the AA composition of the ruminal bacteria. For the FAB, Met and Val content were altered by AB10, Lys, Met and Val were altered by the DFM and MON altered Val and Glu ($P<0.05$). Whereas, for the PAB, AB10 failed to alter the AA content ($P>0.05$), with the DFM and MON treatments altering that of His, Gly, Tyr, and Lys, Asp, Glu, Gly and Ser, respectively ($P<0.05$). The AA content of the two bacterial fractions were shown to differ ($P<0.05$) for the following; Leu, Lys, Arg, Asp, Pro, Ser and Glu. Overall, MON appeared to have the greatest capability to alter the AA composition of both bacterial fractions.

Conclusion/recommendations: Results suggest that feed additives have the potential to modify the AA composition of the ruminal bacteria but further research on the potential changes in the microbial populations within the microbiome and the AA profiles of the various populations are needed to enable us to predict with more accuracy which AA will be affected and to what extent.

Bacteriological assessment and antibiotics susceptibility profile of water from fish gut, skin and pond water in Ile-Ife, Osun State, Nigeria

C.N. Fakorede[1], P.B. Kantiok[1], E. N. Fatokun[1], C.J. Iwu[2] & I.F. Jaja[3]

[1]Department of Biological Science, Ramon Adedoyin College of Natural and Applied Sciences, Oduduwa University, Ipetumodu, Ile-Ife, Osun State, Nigeria, [2]Department of Global Health, Faculty of Medicine and Health Sciences, Stellenbosch University, Cape Town, 7505, [3]Department of Livestock and Pasture Science, Faculty of Science and Agriculture, University of Fort Hare, Alice, 5700.
ijaja@ufh.ac.za

Background: Aquaculture fish production in Nigeria has grown from 0.1% to 0.4% from 1995 to 2016. The FAO estimates an increase in fish production in Nigeria by 2030 to about 18.2%, while export will increase by about 6.6%. These figures show the importance of fish to nutrition and food security. However, recent reports on fish meat safety have heightened consumers fear regarding fish meat and fish products.

Aim: This study aims to isolate, characterise, and tentatively identify bacteria and to determine the antibiotic profile of some bacteria from various fish ponds in Ile-Ife Osun State.

Methodology: Bacteriological studies of selected concrete, earthen and tank ponds in Ile-Ife, Osun Nigeria were investigated to evaluate the water quality of the ponds. During this study, nutrient agar, Eosine methylene blue agar and Salmonella-Shigella agar were used. The susceptibility of the isolates was tested using the Kirby-Bauer disc diffusion method on Mueller Hinton agar. The zone of inhibition around the disc was measured, and the result was interpreted as resistance or susceptible based on the interpretative standard according to the Clinical and Laboratory Standards Institute guidelines.

Results and Discussion: The temperature value of the pond water sample from all sampling stations throughout the study period values ranged from 25°C to 28°C. The mean values of the bacteria count for the six sampling stations from C1 to T2 were 4.9×10^4, 4.9×10^4, 5.4×10^4, 2.5×10^4, 2.2×10^4, and 1.9×10^4 CFU/ml respectively. A total of forty (40) isolates were isolated from the water samples of which (5) species were Gram Positive bacteria representing two genera, and 35 species of Gram Negative bacteria representing four (4) genera were isolated from the water samples of the six sampling points. All isolates were 100% resistant to ceftazidime, cefuroxime and augmentin. Moreover, resistance to cefixime (80%) and gentamicin (73.3%) and nitrofurantoin (66.7%) was recorded. However, only 16.6% and 8.3% of the isolates were resistant to ciprofloxacin and ofloxacin respectively. The multiple antimicrobial resistance index (MARI) ranged from 0.5 to 0.9. Bacteria of public health importance (*Salmonella* spp. and *E. coli*) were also recovered from the fish gut and skin.

Conclusion/recommendations: The concrete pond (C1 and C2), and earthen (E1) pond had the highest load of heterotrophic and coliform bacteria. The water quality parameters (temperature and pH) and the type of bacteria detected in all pond type did not differ significantly. The study also revealed that all the ponds were contaminated with potentially pathogenic bacteria that could affect fish health and fish product. Hence the regular monitoring of pond water for microbial contamination is necessary to maintain fish and public health. Good agricultural practices; such as the use of good quality water, regular draining of pond water after a specific period, closure of ponds to the public will aid in preventing pond water contamination.

The feed and anthelmintic potential of *Kigelia africana* fruit harvested at KwaDlangezwa, Zululand

F.N. Fon[1] & K.C. Ndwandwe[1]
Department of Agriculture, Faculty of Science and Agriculture, Private Bag X 1001, Kwa Dlangezwa, 3886, University of Zululand, South Africa.
FonF@unizulu.ac.za

Background: Meeting ruminant's nutritional requirements has been the primary goal for livestock farmers. Any compromise to this may result in massive production losses. Absorption of nutrients in the animal body is largely affected by digestibility of that particular feedstuff. Our previous study on *Kigelia Africana* chemical constituents showed that it contains relatively higher energy value in ruminants in addition to higher moisture content which animals can benefit from during water shortages in winter. Therefore, there is a need to investigate the digestibility of any potential feed and not just the chemical composition therof.

Aim: The study investigated the feed potential (the *in vitro* digestibility) and anthelmintic value of *Kigelia africana* fruit for domesticated ruminants.

Methodology: Fresh *Kigelia Africana* fruits were harvested at the University of Zululand premises, separated into five portions (parts) called Exocarp (Ex), Endocarp plus Seeds (En+SS), Endocarp (En), Seeds (SS) and Whole fruit (Wf). *In vitro* digestibility was done using a Daisy incubator from ANKOM Technology with inoculum from rumen fluid, incubated with 54 samples (10 replicates per treatment and 4 controls) at 38ºC in an anaerobic chamber for 72h. Apparent (APD) and True (TD) degradability and microbial yields (MY) were measured. For anthelmintic activity, a helminth motility test was conducted with extracts of phenolic compounds from Ex, En, Wf and SS using Baerman's technique and L3 larva was observed at 10x magnification. Each extract was dosed at four treatment levels Viz. 5, 10, 15 and 20 g. ANOVA of SPSS was used to analyse the samples where differences were observed at $P<0.05$. Ethical clearance number was UZREC 171110-030 PGM 2016/262.

Result and Discussion: There were differences ($P<0.05$) in TD values among *Kigelia africana* portions with En and En+S having the highest values (539.32g/kg and 554.46g/kg respectively) while the least was observed in Ex and SS (321.00g/kg and 252.62g/kg, respectively). MY was significantly higher for En and En+SS: 163.57g/kg and 161.67g/kg respectively. Though there were no differences ($P>0.05$) in larva mortality between *Kigelia africana* treatments, treatments displayed 96% mortality rate on average when compared to the control. The strong anthelmintic properties displayed by *Kigelia africana* treatments were associated with high concentration of CT as earlier anticipated but may be linked to other unknown secondary compounds in the extracts that need to be explored.

Conclusion/recommendation: Apart from providing moisture and nutrients, this fruit also showed strong anthelmintic properties which surpass some of the widely used vermifuges that are expensive yet have gradual inefficiency due to parasite resistance. All treatments (from 5 g) were active. Hence, it was recommended that more investigation should be done on dosage application to ascertain the right dosage and dosing frequencies on farm.

The value of cactus pear as alternative fodder

H.J. Fouché[1], M. de Wit[2], G.M. & Coetzer[3]

[1]Animal Production Institute, Agricultural Research Council. [2]Department of Microbial, Biochemical and Food Biotechnology, [3]Department of Soil, Crop and Climatic science, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa.
fouchehj@ufs.ac.za

Background: The occurrence of droughts, climate change and the shifting of rainfall seasons are some of the threads of the animal producer in South Africa. The introduction alternative crops that could mitigate these effects are of utmost importance.

Discussion: Cactus pear, as one of the most versatile crops in terms of its use, has proved over time to be a successful candidate to do just that. Cactus pear was planted for many years as drought fodder in the arid regions. Many orchards were neglected and only some was used in periods of fodder shortages. This low production, cochineal invested plantings have a negative impact on the popularity of this once wonder crop.

Cactus pear has proven in many countries that the opposite is true. Research has shown that the crop has the potential of high productions even in drought conditions. A new approach of high input and high output was followed and productions of between 20 and 40 t DM ha^{-1} was measured. In Brazil productions as high as 80 t DM ha^{-1}was measured. This calls for a new look into the available cultivars, planting density, diseases resistance and the production practices.

The utilization of cactus pear trees is not a recommended practice in South Africa, although it is a common practice in Brazil to utilize orchards on a rotational basis where the whole plant is grazed down in a short period of time and a rest for a period of one to two seasons.
Although cactus pear is not a balanced feed, it is a valuable fodder when used with dry hay. It furthermore has 75% of the energy of maize grain, and produced about twenty time more in semi-arid regions. Brazil dairy farmers makes extensive use (70%) of cactus pear. This is unknown for the local dairy farmers.

Conclusion: The challenge now is to put all this good attributes in a well-adapted fodder program where we can reduce costs and stabilize and increase animal production for the different regions of South Africa. If we succeed we could revolutionize animal droduction.

Effects of sprouting or roasting cowpeas (*Vigna unguiculata*) on dry matter digestibility of cowpea-maize diets by indigenous, exotic and crossbred growing pigs

F. Fushai[1], M.W. Lubisi[1], R. Thomas[2] & J.J. Baloyi[1]

[1]Department of Animal Science, School of Agriculture, University of Venda, Private Bag X5050, Thohoyandou, Limpopo, 0950, [2]ARC-Animal Production Institute, P/Bag X2, Irene, 0062, South Africa.
felix.fushai@univen.ac.za

Background: Increasing human demand and adverse climate-change effects are disrupting global stock feed markets, forcing producers to seek alternative pig feeds. Indigenous legume grains can replace soybean in pig diets. Variation in legume antinutritional factors (ANF) and potentially different ANF tolerance pigs of different genotypes justify investigation of protocols which are tailored to specific legumes and pig genotypes.

Aim: The aim of the study was to evaluate the efficacy of sprouting or roasting cowpeas to improve the nutritive value of cowpeas for Windsnyer, Large White X Landrace and crossed indigenous-exotic type growing pigs.

Methodology: Experimental procedures complied with the University of Venda research ethics policy (SARDF/17/ANS/07/0412). Cowpeas were either soaked in water (SCP) to sprout over four with daily sampling, or roasted (RCP) over 30 minutes, with sampling at 5-minute intervals. Standard procedures were employed to determine nutrients, fibre, and trypsin inhibitor activity (TIA). Raw and processed cowpeas (14 replicates) were digested at 39°C within Ankom F57 filter bags in a 3-step (gastric-ileal-colonic), 39° C porcine digestion model as per following procedures; step 1; 0.1M, pH 2 phosphate buffer ± pepsin (2-hours); step 2; 0.2 M, pH 6.8 phosphate buffer ± pancreatin (5-hours), step 3; 0.1 M, pH 4.8 phosphate buffer ± viscozyme (24-hours). Raw (control), 4-day SCP, 20-minute RCP were used to constitute 140 crude protein g/kg dry matter (DM) maize-based growing pig diets, which were similarly digested *in vitro,* and in an *in vivo* study in which the 3 diets were fed *ad libitum* to 9 weaner pigs (12.8 ± 1.64 kg initial live weight) in a 3 (diet) × 3 (genotype) factorial experiment within a triplicate Latin Square design. I*n vitro/in vivo* DM digestibility were respectively subjected to One-Way and Factorial ANOVA using the GLM of MINITAB software (Version 17.0).

Results and Discussion: Nutrients, fibre composition and TIA numerically indicated best quality in 4-day SCP and 20-minute RCP. Sprouting days and roasting intensity affected ($P<0.05$) buffer-only and enzymatic partial cowpea DM digestibility at steps 2 and 3, which cumulatively affected ($P<0.05$) the total *in vitro* DM digestibility. In buffer-only media, the SCP diet had low partial DM digestibility at step 2, and both SCP and RCP diets had higher ($P<0.05$) total DM digestibility compared to the control, with greater ($P<0.05$) effect on the SCP diet. Viscozyme partial DM digestibility was highest ($P<0.05$) on the RCP diet. Variation in buffer-only DM digestibility was attributed to altered endogenous enzymatic, and, or non-enzymatic macro-molecular hydrolysis. Variable exogenic enzymatic digestion likely confoundedly reflected the quantum of residual insoluble substrates, enzyme-substrate affinity, and enzyme inhibition by antinutritional factors. The 4-day SCP and 20-minute RCP similarly reduced ($P<0.05$) dietary *in vivo* DM digestibility, which was attributed to the relatively high dietary fibre, which suggested excessive processing, thereby increasing the indigestible compounds through biomolecular crosslinking (roasting) or non-starch polysaccharide synthesis (sprouting). The pig genotype did not ($P>0.05$) affect DM digestibility.

Conclusion/recommendations; Chemical components, TIA and *in vitro* DM digestibility indicated best quality in 4-day SCP and 20-minute RCP, which, however, reduced the apparent *in vivo* DM digestibility of the processed, relative to the raw cowpea diet, with similar effect between different pig genotypes. Further research is recommended to evaluate the effects of roasting or sprouting cowpeas in different pig genotypes based on specific, key nutrient extraction and metabolism.

Effect of heat stress on calving percentage of beef cattle in the Central Bushveld Bioregion

S.M. Grobler[1], M.M. Scholtz[1,2] & F.W.C. Neser[2]

[1]Agricultural Research Council, Private Bag X05, Lynn East 0039, [2]University of the Free State, P.O. Box 339, Bloemfontein 9300.

mgrobler@arc.agric.za

Background: It has been noted worldwide that the effects of climate change together with increasing temperatures have different effects on livestock in different parts of the world based on diverse farming systems and climatic conditions. Although heat stress in beef cattle is usually considered less severe than in dairy cattle, compensation for increased body temperature is well documented and may have a profound effect on reproduction. Little research on this topic has been done locally in the sub-tropical summer rainfall area of the Central Bushveld Bioregion, even though the annual breeding season of this region coincide with the warmest months of the year (December to February).

Aim: A study was conducted at the ARC-AP Roodeplaat farm over a seven-year period to investigate the effect of heat stress just before and in the breeding season on the subsequent calving percentage of extensively managed beef cattle.

Methodology: Approximately 100 multiparous Bonsmara type cows on the ARC-Roodeplaat research farm were naturally bred over a 3-month breeding period (January – March) over a seven-year period (2009–2015). Average monthly minimum- and maximum- temperature (°C) and average monthly minimum- and maximum relative humidity (%) was used to calculate a monthly discomfort index. An index value above 90 was considered very uncomfortable, relating to heat stress. The number of months with a discomfort index above 90 was taken into account for the following periods: Two months prior to the breeding season (November-December), three months within the breeding season (January to March) and two months after the breeding season (April and May) over the seven-year project period. Average monthly minimum- and maximum-temperature (°C), average monthly minimum- and maximum relative humidity (%), total monthly precipitation (mm) and discomfort index were taken into account performing forward stepwise regression procedures for the dependant variable calving percentage.

Results and Discussion: The highest calving percentage of 89.6% was obtained when the discomfort index never rose above 89 before, during or after the breeding season. The lowest calving percentage of 60.0% was obtained with an average monthly discomfort index above 90 within the month just before breeding and during the first two months of the breeding season. This may be an indication that heat stress prior to and within the first portion of the breeding season had a negative impact on bull fertility. Maximum relative humidity one month prior to the start of the breeding season, had a high negative Pearson's correlation coefficient of -0.95 and minimum temperature within the last month of the 3 month breeding season had a low negative Pearson's correlation coefficient of - 0.35. The negative correlation between minimum temperature within the last month of the breeding season and calving percentage may indicate that cows were unable to cool down at night during the warmer summer months of the year, leading to lower conception rates and more resorptions.

Conclusion/recommendations: Results of the current study suggest that heat stress before and during the breeding season have a negative impact on calving percentage of extensively managed beef cattle in the sub-tropical summer rainfall area of the Central Bushveld Bioregion.

Farmers' attitude towards the use of earthworms as a protein feed source for village chickens

B. Gunya[1,2], E.M. Idamokoro[1,2], F.N. Fon[2] & M. Aliber[1]

[1]Agricultural and Rural Development Research Institute, University of Fort Hare, Private Bag X1314, Alice, 5700, South Africa, [2]Department of Agriculture, Faculty of Science and Agriculture, Private Bag X 1001, Kwa Dlangezwa, 3886, University of Zululand, South Africa.
GunyaB@unizulu.ac.za

Background: Village chicken production in South Africa is hampered by the cost of providing quality protein in their diets**.** The low-cost rearing of certain types of earthworms is a possible solution to this challenge; however, it is unclear whether farmers are amenable to such a solution.

Aim: This study was conducted to evaluate the attitudes of village chicken farmers to the use of earthworms as a protein feed source for their chickens.

Methodology: The data were gathered by administering a total of 150 questionnaires through face-to-face interviews with the chicken farmers in Eastern Cape Province of South Africa. Females participated in this study were 52% whereas males were 48%. The age distribution of the participants in this study was as follow; > 21 year (3%), 22-40 years (23%), 41-60 years (30%) and > 60 years (44%). The study questionnaire comprised of four sections. First, the questionnaire captured demographic information and socio-economic status of the households; their attitudes towards the use of earthworms as feed for chickens instead of crops; possible benefits associated with the use of earthworms in village chicken feed and lastly their perceptions of possible risks associated with the use of earthworms in village chickens feed. The data were analysed using IBM SPSS Statistic 24. Frequencies were used to analyse the demographic and socio-economic status of farmers. The ANOVA was used to test whether different chicken owners differ in identifying attitude and perception regarding the use of earthworms. Differences among means were determined by Tuckey's test.

Results and Discussion: The results of the study revealed that the idea of rearing earthworms for chickens was favoured by farmers, male farmers more strongly than females, while youth farmers rejected it. Moreover, the use of earthworms as a feed ingredient in chicken feed was accepted by farmers and no significant difference was observed among the type of owners of chickens. The consumption of chickens which were fed with earthworms was significantly influenced by chicken ownership. Farmers were willing to consume the end product produced from chickens fed with earthworms. Nevertheless, rearing of earthworms instead of growing crops for chicken feed was rejected by the farmers. The results show a positive attitude towards possible benefits that can be caused by the use of earthworms in chicken feed. The strongest benefit perceived was that earthworms improve production performance of chickens while the weakest was the use of earthworms for lowering feed price and production. Farmers' perception of health risks caused by earthworms was high.

Conclusion/recommendations: In conclusion, farmers accepted the idea of using earthworms as a source of protein for village chickens, except the idea of rearing earthworms instead of growing crops for chicken feed. Young farmers were reluctant about the possible opportunities to use earthworms as chicken feed. To persuade youth farmers will require the development of appropriate communication strategies where youth farmers can get more insight about the possible advantages of using earthworms as feed, as well as adequate monitoring of the diffusion of adoption of this innovation.

Relationship among body weight and hair production traits of Angora goat ewes over their lifetime in the flock

M.J. Herselman[1] & M.A. Snyman[1]
[1]Grootfontein Agricultural Development Institute, Private Bag X529, Middelburg EC, 5900, South Africa.
GrethaSn@daff.gov.za

Background: In Angora goats, income from the current flock is generated through hair production and reproduction. Angora goat ewes are mostly kept in the flock until the age of six to seven years. However, in some flocks nearly 10% of the ewes are older than seven years of age. It is therefore imperative that the ewes are able to maintain quantity and quality hair production until the end of their productive flock life.

Aim: The aim of this study was to determine the relationship among body weight and hair production traits of Angora goat ewes over their lifetime in the flock and assess the variation in hair production among ewes.

Methodology: The project protocol was approved by the Ethical Committee of the Grootfontein Agricultural Development Institute (GVE/AP2/18). Data collected on the flocks of three South African Angora goat producers from 2000 until 2015 were used for this study. Body weight, fleece weight, fibre diameter and staple length data recorded from 12 months until 11 years of age on the ewes were analysed. The number of fibres produced for each animal was calculated from the fleece weight, fibre diameter, staple length and specific gravity of mohair. For each animal, various ratios between the traits were also calculated. The GLM procedure of SAS was used to estimate the effect of age of the ewe on the various individual traits, as well as the trait ratios. The variation among all ewes, as well as 7-year old ewes, in terms of fleece weight produced per unit of body weight was also determined.

Results and Discussion: The relationships of age of ewe with body weight and fibre diameter followed similar trends; both increased up to five years of age, after which it tended to level off. Fleece weight, however, increased until three years of age, after which it decreased with age. No specific trend was discernable for staple length. The ratio of fleece weight produced per unit of body weight was the highest for kids and young ewes up until two years of age. Thereafter it declined with an increase in age. Fibre diameter and staple length followed the same trends as fleece weight relative to body weight. Expressing fibre diameter and staple length relative to unit of fleece weight produced, indicated that older ewes produce lighter fleeces with longer staples and higher fibre diameter than kids and young ewes (two years of age and younger). The number of fibres produced per animal declined from 2.194×10^6 per unit of body weight $^{0.67}$ in 12 month old kids, to 0.400×10^6 in 11-year old ewes. The number of fibres produced per unit of body weight $^{0.67}$ ranged from 0.178×10^6 to 7.878×10^6 for the 12-month old kids (average = 2.194×10^6) and from 0.142×10^6 to 2.287×10^6 for the 7-year old ewes (average = 0.807×10^6).

Conclusion/recommendations: Components of fleece weight include fibre diameter, staple length, number of fibres per area of skin (follicle density) and skin area (body size or body weight). From the trends of these traits with age, it is apparent that the decrease in fleece weight with age is due to a decrease in the number of follicles producing fibres. As ewes are not able to maintain high levels of hair production until older ages, it would thus not be advisable to select for increased fleece weight in young ewes.

Hair production, reproduction and income of Angora goat ewes that had six kidding opportunities

J.H. Hoon[1] & M.A. Snyman[1]
[1]Grootfontein Agricultural Development Institute, Private Bag X529, Middelburg EC, 5900, South Africa.
GrethaSn@daff.gov.za

Background: As with all biological traits, there are also differences among animals in their ability to maintain higher levels of production throughout their flock life. To maximise current flock income, it is important to keep ewes in the flock that are able to maintain a high level of mohair production and reproduction until the end of their flock life. Angora ewes are usually kept in the flock until the age of six or seven years.

Aim: The aim of this study was to determine the range in hair production, reproduction and income of Angora ewes that had six kidding opportunities in the flock. Furthermore, the relative contribution of hair production and reproduction to income of these ewes was also investigated.

Methodology: The project protocol was approved by the Ethical Committee of the Grootfontein Agricultural Development Institute (GVE/AP2/18). Data collected on the flocks of three South African Angora goat producers from 2000 until 2015 were included in this study. The following production data were recorded on the kids: Body weight at 12- and 16 months of age, as well as fleece weight, fibre diameter profile, style and character at the second and third shearings. Full reproduction data, body weight before mating as well as fleece weight, fibre diameter profile, style and character at the winter shearing were recorded on the ewe flocks. For all the analyses, only ewes in the dataset that had 6 (682 ewes) kidding opportunities (7 years of age) were included. Income per ewe was calculated as hair production income and reproduction income. Early and adult production and reproduction traits of the Top 100 and Bottom 100 ewes according to total lifetime income were compared. The relationships among the hair production and reproduction income and total yearly income were also determined. The ewes were also divided into four categories on the basis of their total yearly income and the relative sources of income for these ewes were compared.

Results and Discussion: Comparing the early and adult production and reproduction traits of the ewes in the Top 100 and Bottom 100 categories (lists according to yearly income) indicated significant differences in early fleece weight, fibre diameter, body weights and maiden ewe reproduction between the two groups. It is however, noteworthy that adult fleece weight and yearly fleece income did not differ between the Top 100 and Bottom 100 ewes. The main difference in total yearly income between ewes was due to differences in yearly reproduction income. Yearly hair production income was nearly the same for ewes in all categories. Reproduction income contributed more to total income in ewes in the top 25% income category compared to ewes in the bottom 25% category.

Conclusion/recommendations: Differences in total yearly income of ewes are largely due to differences in reproduction. These differences could be exploited by placing selection emphasis on those traits that contribute most to yearly income and for which high levels of production can be maintained until an older age. Selection of young ewes should be focussed on early body weight, number of kids produced and total weight of kids weaned at the first parity.

Influence of purified Black wattle (*Acacia mearnsii*) tannin on *in vitro* gas, methane and organic matter digestibility of *Eragrostis curvula* hay

S.L. Ibrahim[1] & A. Hassen[1]
[1]Department of Animal and Wildlife Sciences, University of Pretoria, Private Bag X20, Hatfield 0028, South Africa.
abubeker.hassen@up.ac.za

Background: Mitigation of enteric methane (CH_4) has gained the emphasis of recent researches in ruminant nutrition, because of its global warming effect and negative perception that attacks towards the livestock industry. *Acacia mearnsii* is categorized as an invasive plant in South Africa, and it is a rich source of tannin. Earlier research showed its potential to reduce CH_4 emissions but with some negative effects on rumen fermentation and digestibility due to the high proportion of hydrolysable tannin which many believed is toxic to animals. Purification of *A. mearnsii* tannin with ethyl acetate and pentanol could increase the proportion of condensed tannin thereby will reduce enteric CH_4 emissions without adverse effects on rumen fermentation.

Aim: To evaluate the effect of different dosages of *A. mearnsii* tannin purified with ethyl acetate and pentanol on *in vitro* gas, methane and organic matter digestibility (*IV*OMD) of *Eragrostis curvula* hay.

Methodology: This study was approved by the Animal Ethics Committee of the University of Pretoria (Ref No: EC075-17). The industrial extract of *A. mearnsii* tannin was purified with ethyl acetate and pentanol using Soxhlet extractor. For the *in vitro* study, the buffer solution was mixed with the rumen fluid (3:1) collected from three rumen fistulated Pinzyl steers fed *Medicago sativa* hay. The mixture (40 mL) was then poured into 150 ml serum bottles, which already contained 400 mg each of the substrate (*Eragrostis curvula* hay) and 4 mL extract of unpurified, ethyl acetate purified or pentanol purified tannins at four different dosages: 10, 20, 30 and 40 of dry matter (DM). The mixture was incubated at 39 °C while shaking at 120 rpm. Gas and CH_4 were evaluated at 3, 6, 12, 24 and 48 hours following four incubation runs with 3 blank bottles added for correction. For digestibility, 200 mg of the substrates were mixed together with 2 mL of unpurified, ethyl acetate and pentanol purified extracts at four dosages using the two–stage digestion processes. Data obtained were subjected to analysis of variance using randomized complete block design of SAS 9.4.

Results and Discussion: The findings revealed reduction ($P<0.05$) in *in vitro* gas, methane and *IV*OMD between the control (*Eragrostis curvula* hay) and all dosages (10, 20, 30 & 40 g/kg of DM) of unpurified and purified *A. mearnsii* tannins. Compared with the control a decrease ($P<0.05$) in terms of gas per unit *IV*OMD, CH_4 per unit gas and CH_4 per unit *IV*OMD were recorded at 10 g/kg of DM for pentanol purified, at 20 g/kg of DM for ethyl acetate purified and at 30 g/kg of DM for unpurified tannins levels. However, *IV*OMD decreased ($P<0.05$) at 30 and 40 g/kg of DM dosage of purified tannins. Generally, no significant difference statistically, but, up to 10% decrease in CH_4 was recorded with the addition of 10 g/kg of DM pentanol purified tannins and 13% decrease in CH_4 for 20 g/kg of DM ethyl acetate purified extract as compared with the unpurified tannin.

Conclusion/recommendations: Purification of *A. mearnsii* tannin with ethyl acetate and pentanol reduced *in vitro* gas and CH_4 emissions without much adverse effect on digestibility when used up 20 g/kg of DM feed. Lower dose levels (10-20 g/kg of DM feed) were sufficient to get similar effect when the unpurified tannin was used at a higher level (30-40 g/kg of DM feed).

Phenotypic characteristics and genetic diversity of Sudanese indigenous canines

A.M.E. Ibrahim[1]
[1]African Centre for Veterinary Consulting, Khartoum Sudan. P.O. Box 7346, Postal Code 11123 Alsitin Post Office, Khartoum, Sudan.
bagir@acvc.pro

Background: In addition to their modern uses as companion animals and in law enforcement institutions, dogs are widely used in Sudan for different purposes such as hunting and herding livestock.

Aim: This study was conducted to assess the physical and behavioural capabilities of two types of Sudanese dogs that herd sheep, cattle and camels.

Methodology: Twenty-eight dogs were collected from two regions of Sudan: Kababeesh dogs' type (KDT) from North Kordofan State (Western Sudan), and Umbararo Dogs' Type (UDT) from Blue Nile state (South East of Sudan). Dogs were raised in the Police Dogs School (Khartoum, Sudan), and subjected to a breeding program based on behavioural scores and body features. Records of the German Shepherd Dog (G.S.D) population from the Police Dog Schools were considered as control. The data collected was analysed by using SPSS (v 16.0) and experiment approved the ethical committee of University of Khartoum.

Results and Discussion: All dogs from both regions were smaller and weighed less than the G.S.D. In addition, results showed that males were larger and heavier than females in both Sudanese dog types, and KDT was significantly heavier and larger than UDT. The average body weight in KDT at 12 months old was 19.70 kg and 19.30 kg for males and females respectively, while it was 15.00 kg and 14.50 kg for males and females respectively in UDT. Mature body length was higher in KDT than UDT (45.00 cm and 42.90 cm) for males and females respectively in KDT and 36.60 cm and 35.40 cm in UDT. The highet at withers was 55.30 cm and 53.30 cm for males and females respectively in KDT while it was 47.20 cm and 32.50 cm for males and females respectively in UDT. Results also showed that the variations between KDT individuals were larger than in UDT, which indicates greater genetic uniformity within the UDT. Generally, the males grew faster than females, whereas the growth rate in KDT was higher than UDT. All Sudanese dogs from both sexes reached sexual maturity during the period between 12 to 14 months old. Behavioural traits, which included playfulness, social behaviour, the ability to solve problem showed that both KDT and UDT scored less than G.S.D, but KDT performed significantly better than UDT.

Conclusion/recommendations: Growth rate and behavioural scores seems to be negatively affected by the harsh local environment in North Kordofan and Blue Nile states. Furthermore, KDT is more suitable for disciplined training programs than UDT.

Analysis of productive and reproductive performance of existing indigenous poultry breeds in South Africa

P.A. Idowu[1], M. Mpayipheli[2], B. Mtileni[1] & V. Muchenje[2]

[1]Department of Animal Science, Faculty of Science, Tshwane University of Technology P/Bag X680, Pretoria, 0001, [2]Department of Livestock and Pasture Science, Faculty of Science and Agriculture, University of Fort Hare, PX1314, Alice.
ayodejiidowuolu@gmail.com

Background: Predominant indigenous South African poultry breeds are Ovambo, Venda, Potchefstroom Koekoek and Naked Neck. Such breeds are regarded as conservation priority breeds with unknown divergent reproductive and productive traits capacity. Previous study shows phenotypic characterization of indigenous poultry breeds in South Africa without assesing the reproductive performance of available indigenous poultry breeds in South Africa.

Aim: This study aims at analysing the reproductive and productive traits of four predominant indigenous poultry breeds in poultry production in South Africa.

Methodology: The study was approved by Ethics committee of University of Fort Hare (MPA031SIDO01). Mean comparison of traits was achieved using Tukey's Kramer Least Significant Difference. Least square means was computed using GLM procedure of SAS. The significance level selected on the mean differences was 5 and 1% respectively. Reproductive traits of indigenous poultry breeds were analysed using structured survey system, monitoring study, focal discussion and group discussion. There are basically four phenotypically distinquished breeds: Naked Neck, Ovambo, Potchefstroom Koekoek and Venda. Six different villages were used for this study from July 2017 to June 2018. Seven thousand, five hundred and thirty eight (7538) poultry were sampled from one hundred and sixty (160) poultry farmers. Data observed were, average age at production, clutch per year (CPY), duration of rearing (DR), egg laying length (EGL), egg per clutch (EGC), egg per year (EPY), hatchability (HATCH), mortality, natural brooding period (NBP), natural incubating period (NIP), recovery period (RP) and survivability at 10-12 weeks (SURV).

Result and Discussion: Four phenotypically distinguished breeds had the following respective frequency of occurence: Naked neck (864), Potchefstroom koekoek (2088), Ovambo (1838) and Venda breeds (2748) respectively. Potchefstroom Koekoek is observed to be a good egg producing breed with 15.11±0.25 eggs per clutch. Venda breed possess good hatchability and high survivability with 86.03±0.31days and 82.70±0.26 days, respectively. Naked Neck is known to be more prone to diseases with the lowest survivability (60.08±0.25 days). Village was positively correlated with EGC and HATCH, EGY and SURV at $P≤0.01$ and $P≤0.05$, respectively. Rearing system was positively correlated with EGC. Rearing system was positively correlated ($P≤0.05$) with EGC. Breed and village interactions were significant for RP, AA, DR, EGL, NBP and NIP.

Conclusion/recommendations: The current study shows variation in productive and reproductive traits of indigenous chicken across different rearing systems, breeds and villages. The responsible genes causing variation in productive traits across different breeds can be further studied.

Pelvimetry and other selected factors causing dystocia in young Dorper and Dohne Merino ewes – preliminary results

J. Jacobsz[1] & P.J. Fourie[1]

[1]Department of Agriculture, Central University of Technology, Free State, Private Bag X20539, Bloemfontein, 9300, Republic of South Africa.
pfourie@cut.ac.za

Background: Dystocia occurs when there is a failure in one or more of the main components of birth: expulsive force, birth canal adequacy and a disproportion between the offspring's birth weight and the dam's pelvic area. An incompatibility in size between the maternal pelvis and the lamb at birth is largely responsible for the need of assistance at birth. Measuring pelvic areas is a useful tool in a comprehensive replacement ewe selection program to reduce dystocia and perinatal instability in lambs and ewes. Mature pelvic area is reached at 12 to 13 months. Furthermore, gestation length (148 to 152 days in sheep) and length of parturition (the period from the first sign of impending birth up to deliverance) may also affect the ease of lambing.

Aim: The aim of the study was to investigate dystocia and quantify the correlations between the dam's pelvic area, the lamb's birth weight and the lam's body measurements in young Dorper and Dohne Merino ewes.

Methodology: The study was approved by the Animal Ethics Committee of the University of the Free State (UFS-AED2018/0051). The pelvic area of 369 young Dorper ewes 9.8 months old and 434 young Dohne Merino stud ewes 18.5 months old were measured at mating time. The young Dorper ewes were mated (laparoscopic) at an average age of 9.31 months and the Dohne Merino ewes at 18.5 months (natural group mating) as recommended by the breed standards. If the ewe could not expel the lamb after one hour, it was assisted. Recordings included gestation length (Dorper only), parturition period, pelvic area, birth weight of the lamb, birth status of the ewe and lamb, circumference of the lamb's head and pasterns, lamb's shoulder width and lambing ease score. Data were statistically analysed ($P<0.05$) using a one-way ANOVA.

Results and Discussion: The pelvic area of the young Dorper ewes (33.43 cm^2) differed ($P<0.05$) from those of the young Dohne Merino ewes (36.61 cm^2) at mating. The mean mating weight of the Dorper and Dohne Merino ewes were 55.05 kg and 57.42 kg respectively. In the Dorper ewes the pelvic area measured bigger ($P<0.05$) if she was born one of a twin or multiple lambs. The Dorper ewes took 62.77 minutes on average to expel the new-born lamb as measured from the start of stage 2 of parturition. The Dohne Merino lambs (4.85 kg) were heavier ($P<0.05$) than the Dorper lambs (3.7 kg) at birth, but the Dorper lambs' shoulder width (8.2cm) were bigger ($P<0.05$) than those of the Dohne Merino (7.04 cm) lambs. Sixty-seven percent of the Dorper ewes needed assistance as opposed to only 1% of the Dohne Merino ewes. The pelvic area to birth weight ratio of the Dorpers (9.69 cm^2/kg lamb born) were more favourable ($P<0.05$) than those of the Dohne Merino ewes (8.02 cm^2/kg lamb born). Gestation length varied between 143 to 154 days in the Dorpers and no significant correlations to dystocia was found.

Conclusion/recommendations: The preliminary results of the study suggest that despite the young Dorper ewes' more favourable pelvic to lamb birth weight ratio, they experienced severe levels of dystocia. It may be possible that the broader shoulders of the Dorper lambs contributed to difficult lambing. Furthermore, it should be considered to mate maiden Dorper ewes when they are slightly older. However, the results were variable, and no clear trend could be established.

A review of literature concerning the performance of small ruminants on relatively high tannin forages

K.B.T. Jali & F.N. Fon
Department of Agriculture, Private Bag X1001, University of Zululand, KwaDlangezwa, 3886, South Africa.
khanyiejali@gmail.com

Background: Domestic ruminants depend on forage diets as a source of energy and nutrients. However, more than half of those nutrients are unutilized and undigested, and are excreted in feces, urine and gases. This loss in goats consuming browse with relatively higher phenolic compounds, is due to poorer digestibility caused by the inhibition of rumen microbes (fungi, protozoa and bacteria) by tannins. However, small ruminants in the wild such as antelopes are thought to contain microbes and enzymes that might have evolved with their ability to ferment forages of high tannin concentrations.

Aim: This review will provide information on the performance of small ruminants on relatively high tannin forages especially domesticated ones and analyse their different inhibition mechanisms as well as the positive role it can play on forage digestibility or animal health as well as different inhibition mechanisms of tannins (high levels of tannins) to microbes, enzymes and feed.

Discussion: The high loss of nutrients within small ruminants is due to inhibition of anaerobic microbes responsible for forage or fibrous cell wall degradation. Forage's chemical complexity (amorphous cellulose, crystalline cellulose, hemicellulose and tannin) is very crucial in feed digestibility. It is further explained that this wastage is not entirely due to the crystalline nature of the forage but the presence of tannins at relatively higher percentages. Tannins inhibit the functionality of microbes and enzymes needed for feed fermentation through various mechanisms. They interfere with the attachment of microbes to plant cell walls, and such attachment is essential for degradation to occur. They form complexes with proteins and carbohydrates which renders these nutrients inaccessible to microorganisms, are chelating agents, and this could reduce the availability of certain metallic ions necessary for the metabolism of rumen microorganisms and can also react with microbial (both bacterial and fungal) enzymes, inhibiting their activity. In terms of feed, browse containing lower fibre are supposed to be highly digested or fermented but that is not the case since tannins bind to endogenous enzymes and gut microbes. Literature have demonstrated that microbial inhibition by tannins may reduce the potential of secreted enzymes to degrade fibrous components found in forages. In order for ruminants to continue exploiting plants as food resources, they must develop a relatively high resistance and tolerance to tannin-rich feeds. It was also reported that tolerance is only applied to a limited concentration of tannins. When that concentration is reached, enzymatic activity will be fully inhibited. Therefore, the alternative mechanism suggestions from this review might open new gaps for improved digestibility. Literature also demonstrates that small ruminants from the wild inhabit potential fibrolytic microbes with relatively higher tannin tolerance which can be manipulated for the improvement of rumen digestion in goats.

Conclusion/recommendations: For better utilization of forage in domesticated ruminants, more studies on the microbial mechanisms and diversity in wild antelopes should be further interrogated. Therefore, experimental studies of the relative activities of microbes from wild small ruminants will give a better understanding of microbes and enzymes responsible for plant cell wall degradation. Also the rumen microbial ecology of wild herbivores can be harvested and interrogated for diversity, evolution and fibrolytic potential.

Use of faecal nitrogen to indicate nutritional status and seasonal trends in wildlife species

B.B. Janecke
Department of Animal, Wildlife and Grassland Sciences, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa.
janeckbb@ufs.ac.za

Background: The study of nitrogen in faeces has many uses and applications in the field of animal science where livestock animals can be studied under controlled conditions. Dietary studies and direct assessment of nutritional characteristics of free roaming wildlife species are more difficult. These wild animals feed on natural vegetation and select their own food items based on their needs and on seasonal food availability. Faecal nitrogen concentrations are often used to assess feeding ecology of ruminant herbivores, namely to assess changes in body condition; as a comparison index between seasons and also between animal populations in similar habitats, among others.

Aim: The aims were to determine: i) if nutritional status can be indicated from faecal nitrogen (N_F) concentrations of wild animals; and ii) how seasonal dietary differences impact on N_F concentrations of different wild animal species in order to identify a seasonal trend.

Methodology: Faecal samples were collected monthly over a two year period for different species on game ranches in the central Free State. Nitrogen content was determined with the LECO Nitrogen Analyser from dried and milled faecal samples. A comprehensive literature search was done to include N_F concentrations of different wild animals in the comparison. Factorial ANOVA and Pearson's Correlation Coefficient were used.

Results and Discussion: Browse availability and quality are usually limited for wild browser animals during winter due to the deciduous nature of the more palatable woody plants. Presence of different phenophases of leaves on woody plants was determined for different seasons. Monthly leaf phenology of deciduous species (changes in leaf carriage percentages) correlated to N_F percentages of browsers (r = 0.64, $P < 0.001$) and both these values follow similar repetitive seasonal patterns. Critical N_F values, where animals lose body condition, were tested successfully. The range of N_F values, from minimum critical value to the maximum in summer months, for a specific area can be used to indicate the current nutritional status of specific wild herbivore species. It is known that higher N_F concentrations are generally present when diets contain phenolic compounds (tannins), resulting in possible overestimation of digestibility and available N, while problems with accurate prediction of N_F from diet N concentration also occurs. However, free-ranging herbivores are adapted to feed on browse containing tannins and some species are known to naturally avoid low-quality browse that could interfere with use of N_F as indicator of their nutritional status.

Conclusion/recommendations: In fenced areas, especially smaller wildlife ranches, it is important to monitor nutritional status of wild animals, since fences limit their access to natural food sources. Availability of nutritious food resources will ultimately determine presence or absence of animals in certain habitats. Wild animals must adapt to their environment to be able to utilize seasonally available, nutritious food that can sustain them throughout the year. Faecal nitrogen concentrations can be used to indicate nutritional status of specific animals during different seasons in order to make timely decisions on provision of supplementary feed when critical N_F levels are reached.

Price dynamics of red meat types and carcass classes in South Africa for the period 2013 to 2017

E. Janse van Rensburg[1], N.H. Casey[2], J.C. Jordaan[3] & E.C. Webb[2]

[1]Department of Agriculture and Animal Health, University of South Africa, Pretoria, South Africa, Cnr. of Christiaan de Wet Street & Pioneer Avenue, Florida Park, South Africa, [2]Department of Animal and Wildlife Sciences, University of Pretoria, Pretoria, South Africa, [3]Department of Statistics, University of Pretoria, Pretoria, South Africa.
dutoie@unisa.ac.za

Background: The agricultural product market is changing from a producer-orientated to a more consumer-orientated market. Consumers rely on the classification system within the red meat types. Different red meat types and carcass classifications influence the prices of red meat. This study was conducted to determine the effect of different red meat carcass types and carcass classes on the differentiation of meat prices, for the South African context. It was theorised that the different red meat classification classes and number of carcasses sold influence the price and demand of red meats. It was also theorised that specific meat classes have a greater influence on meat prices and supply than others.

Aim: The aim of this analysis was to identify the effects and interactions between type of meat (beef, mutton and lamb, and pig) and carcass classes on purchase price (R/kg cold carcass mass) over a selected period, in South Africa.

Methodology: Data comprising 259 sets were obtained via the Red Meat Abattoirs Association (RMAA) for the period 2013 to 2017. This data consists of weekly data from the abattoirs on the number of units sold, average mass, average purchase price, average selling price minimum and maximum selling price of each carcass class (pig, cattle and sheep). Data was analysed by means of SAS® (Version 9.4). Pearson's r correlations were determined between red meat carcass mass, number of units sold and average purchase price of red meat carcass classes. Correlations between red meat carcass classes and red meat carcass parameters (as explained above) were also calculated. Linear regressions were calculated using relevant correlations from the Pearson's correlation data (SAS 9.4) with a 95% confidence level. Ethical approval reference EC160519-31 was granted for the use of internal and external datasets in research with the RMAA and South African Pork Producer Organisation (SAPPO) as respondents.

Results and Discussion: Results of the study showed interactions between the different types of red meat (pork, beef, and mutton and lamb) and red meat carcass class factors on the price that the abattoir paid for red meat carcasses. Red meat carcass class factors are; tonnage of meat, number of carcasses sold, mass of carcasses sold (kg) and purchase price (R/kg). Surprisingly, the carcass factors did not contribute equally or in some cases did not contribute at all to the resulting price dynamics of meat supplied to the abattoirs. The results of this study showed that there are significant influences between the carcasses of the different red meat species on each other for price. This interaction is due to specific meat classes and not all the red meat carcass classes play a role in the effect. Different meat carcass classes therefore influence the prices of each other.

Conclusion/recommendations: The results of the present study indicate that there is a significant differentiation in price and supply between red meat types and carcass classes, while certain carcass classes play no role in the price dynamics. Further studies are required to determine the combined effect on price, supply as well as demand with regards to the internal factors and external factors affecting them.

The effectiveness of Cape aloe powder in controlling sheep roundworms in the Eastern Cape Province of South Africa

M.S. Jansen[1], J. Welgemoed[1] & M.A. Snyman[2]

[1]Döhne Agricultural Development Institute, Private Bag X 15, Stutterheim 4930, South Africa, [2]Grootfontein Agricultural Development Institute, Private Bag X529, Middelburg EC, 5900, South Africa.
Mlungisi.Jansen@drdar.gov.za

Background: Conventional drugs have become expensive and therefore unaffordable to resource-limited farmers, causing farmers to seek low cost alternatives, such as the use of medicinal plants. Cape aloe is one of the plants that is claimed to be effective in controlling roundworms in sheep.

Aim: The aim of the study was to investigate the effect of cape aloe powder in controlling roundworm species in sheep in the Eastern Cape Province in South Africa.

Methodology: Before the start of the project the ethical clearence ertificate was issued by the ethical committee**.** Dohne merino sheep of the Döhne Agricultural Development Institute (ADI) were used in a trial during 2018. The trial was done under the veld conditions at Döhne Agricultural Development Institute. Adult female animals (48) and female lambs (48) were randomly divided into 4 groups of 12 animals each. All animals were dosed with a broad-spectrum anthelmintic before the start of the trial in January 2018. The sheep were be dosed when the average faecal egg count (eggs per gram; epg) of a specific group reached 5000 epg for the adult sheep and 3000 epg for the lambs. Group A was the Control group (no treatment with Cape aloe powder mixture; treatment with anthelmintic). Group B were dosed with a solution of 75 g Cape aloe powder (Kowie Medicines) diluted in 1 liter of lukewarm distilled water. Group C would be dosed with solution of 50 g of Cape aloe powder (Kowie Medicines) diluted in 1 liter of lukewarm distilled water, and Group D would be dosed with a solution of 25 g of Cape aloe powder (Kowie Medicines) diluted in 1 liter of lukewarm distilled water. A dosage rate of 15 ml for adult sheep and 10 ml for lambs would be applied. Faecal specimens for parasitology were collected directly from the rectum of all animals twice a month and were dispatched to the Provincial Veterinary Laboratory for faecal egg count analysis. Faecal egg count data were analysed with the GLM procedure of SAS.

Results and Discussion: Faecal egg counts (FEC) reached 3000 epg in March 2018 in lambs, and 5000 epg in November 2018 in adult sheep. The above treaments were applied in the respective groups. In the lambs, treatment with 25 g of Cape aloe powder had no effect on FEC, in fact FEC increased with 1400 epg during the next two weeks, while FEC in the 50 g and 75 g groups also increased with 483 and 317 epg. Only the anthelmintic treatment was effective, with a decrease of 2867 epg over the next two weeks. The same occurred in adult sheep, where the FEC of the sheep in the Cape aloe groups still increased over the two weeks after treatment, while the FEC of the group that received an anthelmintic treatment, decreased with 3608 epg.

Conclusion/recommendations: It is evident that treatment with Cape aloe failed to reduce the mean faecal egg count of sheep in the present study. At this stage it is unknown whether other products of aloe would also not be effective in the control of roundworms. Alternative different products of aloe should be evaluated for the control of gastro-intestinal parasites.

The effects of different fibre levels on *in vitro* dry matter degradability of beef cattle feedlot diets

S.T. Jiyana[1,2], M.M. Ratsaka[4], K.R. Mbatha[2], P.M. Moshidi[1] & M.K. Mkhwanazi[3]

[1]Agricultural Research Council, Animal Production Institute, Animal Nutrition Section, Private Bag X 2, Irene, Pretoria, 0062, South Africa, [2]University of South Africa, Science Campus, Corner of Christian De Wet and Pioneer Avenue, Florida, Johannesburg, 1709, South Africa, [3]Gauteng Department of Agriculture and Rural Development, P.O Box 8769, 11 Diagonal Street, Newtown, Johannesburg, 2000, South Africa, [4]Department of Animal Science, Tshwane University of Technology, Private Bag X 680, Pretoria 0001.
JiyanaS@arc.agric.za

Background: High fibre feedstuffs are used to prevent metabolic disorders that may be encountered with high-energy diets in beef cattle feedlots. Appropriate dry matter degradability (DMD) results in the efficient absorption of nutrients into the blood stream of an animal.

Aim: This study was conducted to evaluate the effects of different fibre levels on the *in vitro* dry matter degradability of beef cattle feedlot diets.

Methodology: The study procedure was approved by the ARC – AP (Irene) Research Ethics Committee (Ref #: APIEC15/047). A stomach tube was used to collect rumen fluid from three Nguni steers (380 ± 25 kg live weight) fed a feedlot finisher diet. Rumen fluid was collected within two minutes per animal, which was then poured into a pre-warmed flask and sent to the laboratory within 20 minutes, where it was filtered through 2 layers of cheesecloth and kept at 39°C under constant flushing with CO_2. Treatment diets containing three neutral detergent fibre (NDF) levels (64.3 %, 40.4 % and 29.9 %, referred to as diet 1, 2 and 3, respectively) were used. Wheat bran was used as the primary source of fibre. Dried feed samples were weighed, heat-sealed and incubated in ruminal fluid mixed with a buffer solution for 0, 2, 4, 8, 12, 16, 24 and 48 hours according to the *in vitro* (IV Daisy[II]) procedure.

Results and Discussion: There was a significant difference (P<0.05) on the DMD of treatment diets for all incubation periods. A notable difference was observed in DMD (Mean±SD) at 48 hours of incubation with 54.9±0.71% for diet 1; 61.6±0.38% for diet 2 and 71.5±0.79% for diet 3. A high fibre level such as in diet 1 (41.5% CF) resulted in a marked decline in the DMD of the feedlot diets evaluated.

Conclusion/recommendations: Increasing dietary fibre level results in the significant decline of DMD. Dietary inclusion of fibre should be kept at moderate level to ensure efficient DMD. It is highly significant to ensure a balance between metabolic disorders prevention and appropriate DMD.

Effect of stocking density and *Cassia abbreviata* extract on growth performance and oxidative stress of Ovambo chickens

M.C. Jobe[1], C.N. Ncobela[1], N.W. Kunene[1] & A.R. Opoku[1]
[1]Faculty of Science and Agriculture, University of Zululand, KwaDlangezwa 3886, South Africa.
NcobelaC@unizulu.ac.za

Background: Healthy and organic meat from indigenous chickens suggests that these birds have the potential to contribute to national food security and human welfare. However, the optimum stocking density for indigenous chickens kept under intensive production systems is unknown. This makes it difficult to intensity their production performance without deterring their wellness. High stocking density induces metabolic disturbances that cause excessive production of oxygen-derived biological free radicals known as reactive oxygen species that leads to oxidative damage of biomolecules such as lipids. Stem bark from *Cassia abbreviata* has a potential to alleviate biochemical and metabolic adversities caused by higher stocking densities.

Aim: To determine the effect of stocking density and stem bark extract from *Cassia abbreviata* on growth performance, oxidative stress and liver enzymes of Ovambo chickens

Methodology: The ethical committee of the University of Zululand approved the use and care of chickens. A total of 420 female Ovambo chickens, aged 52 days old were used in the study. The chemical analysis of the basal diet was 880 g DM/kg, 160 g CP/kg DM, 25 g EE/kg DM, 50 g CF/kg DM, 6 g Ca/kg DM, 5 g P/kg DM and 9 g lysine$_{total}$/kg DM. Floor-housed birds were grouped into three stocking densities, which consist of low (5 birds/m^2), medium (10 birds/m^2) and high (20 birds/m^2). The stocking densities were repeated 3 times. A sample (200 g) of the ground stem bark from *Cassia abbreviata* was macerated with methanol on an orbital shaker machine at 157 rpm for 24 h, at room temperature. The ratio of the stem bark to solvent was 1:5. The extract was filtered using Whatman filter paper. Birds, in each stocking density, were orally administered with solution containing different dosages namely 0, 50, 200 and 500 mg/kg of stem bark extract from *C. abbreviata.* A total of 105 birds were used per dosage level. Birds were dosed in the morning, once a day. The experiment lasted for 45 days. A 3 × 4 factorial design was used in the study. Data were analysed using Statistical Package for the Social Sciences (2012). For measurements of oxidative stress, blood collected on the last day of the experiment.

Results and Discussion: Average feed intake was lower ($P <0.05$) in birds housed at 20 birds/m^2. There was a low ($P <0.05$) average daily gain in birds housed at 20 birds/ m^2. Malondialdehyde was higher ($P <0.05$) in 20 birds/m^2. Average daily gain was high ($P <0.05$) in birds administered with 0 and 50 mg/kg of *C. abbreviata* stem bark extract. Birds administered with 0 and 50 mg/kg of *C. abbreviata* stem bark extract had a higher ($P <0.05$) gain to feed ratio. Birds dosed with 500 and 200 mg/kg had high ($P <0.05$) superoxide dismutase activity. Birds administered with 500 mg/kg of *C. abbreviata* stem bark extract had the lowest ($P <0.05$) malondialdehyde. A 500 mg/kg of stem bark extract from *C. abbreviata* resulted to higher ($P <0.05$) activities of aspartate transaminase and alanine transaminase.

Conclusion/recommendations:
Increasing stocking density depressed growth performance and induced oxidative stress. Stocking density did not affect liver function. High dose (500 mg/kg) of *C. abbreviata* extract reduced growth performance. Dosage levels of *C. abbreviata* extract reduced oxidative stress. Dosage levels of *C. Abbreviata* induced hepatotoxicity in birds. This suggests the need to gauge dosage level of *C. abbreviata* extract that will improve growth rate, minimize oxidative stress and be hepatotoxic-free to indigenous chickens.

The effect of weather patterns on growth of beef calves in warmer parts of the country

F.J. Jordaan[1,2], M.M. Scholtz[1,2], F.W.C. Neser[2], M.C. Mokolobate[1,2] & A. Theunissen[3]
[1]ARC-Animal Production Institute, Private Bag X2, Irene 0062, [2]University of the Free State, P.O. Box 339, Bloemfontein 9300; [3]Vaalharts Research Station, Private Bag X9, Jan Kempdorp 8550, South Africa.
Fransj@arc.agric.za

Background: Several studies have investigated effects of beef production on greenhouse gas emissions and consequent climate change. But what is the impact of climate change on the production of beef and more specific on a cow-calf production system? Economic losses are incurred by livestock industries because farm animals are raised in locations and seasons where effective temperature conditions venture outside their zone of thermal comfort. Reproduction, production and maintenance requirements are essential components for cow efficiency and play an important part to mitigate the effect of global warming on beef production.

Aim: This study investigated the impact of weather patterns in the Northern Cape on the weaner calf production of the Vaalharts Bonsmara herd. A decline in weaning weights will have a negative influence on production of kg calf weaned per large stock unit and a negative effect on the production component of cow-calf efficiency.

Methodology: The 205-day weaning weights of the Vaalharts Bonsmara herd were obtained from the INTERGIS for calves born between 2001 and 2016. The data were used to evaluate average production per weaning season and to perform a within-herd BLUP analyses to determine the genetic status of the herd and the genetic trend for weaning weight over time. Vaalharts is in a dry-arid part of South Africa. Weather data recorded for these 16 years (2000-2016) at a weather station near Jan Kempdorp, were obtained from ARC Soil, Climate and Water. The length of each growing season was determined from the first to the last rainfall. In addition total rainfall and the average maximum temperature for each summer season were calculated.

Results and Discussion: The results indicated a stable genetic trend for the whole period and negative phenotypic averages for weaning weights in years 2009, 2012, 2015 and 2016. The preceding summer seasons had below average rainfall, short rainfall season length (below 200 days) and average maximum temperatures of above 31°C. These extreme weather patterns in the preceding season resulted in up to 10 kg weight loss per weaner calf, which has a huge monetary impact.

Conclusion/recommendations: Commercial farmers mainly produce weaners for feedlots. Breed and/or frame size of cows therefore need to be investigated to determine the ideal cow size per ecological region to ensure maintenance requirements are met. Humidity needs to be included in further research to determine a threshold temperature-humidity index per ecological region. In addition, heat stress compromises the fertility of the bulls, and is a common cause of reproductive inefficiency.Additional changes in the breeding strategy for commercial beef production might also include multi-sire mating and/or the use of bulls from tropical adapted genotypes, to mitigate the effect of heat stress on bull fertility.

Manipulation of relative growth in ostrich body components by varying nutrient densities

L. Jordaan[1], T.S. Brand[1,2], W.J. Kritzinger[1] & L.C. Hoffman[1]

[1]Department of Animal Sciences, University of Stellenbosch, Private Bag X1, Matieland, 7602, South Africa,
[2]Directorate for Animal Sciences, Western Cape Department of Agriculture, Private Bag X1, Elsenburg, 7607, South Africa.
tersb@elsenburg.com

Background: Knowledge on how the growth of body components are affected by varying energy and protein levels in diets of ostriches are needed to aid formulators with the optimisation of feed costs. These allometric coefficients will improve the accuracy of simulation modelling attempts for ostrich nutrition. Current standards are inappropriate as they are based on studies that do not separate the growth of the body components and body protein from that of feather protein. This separation is necessary to enable simulation modelling to play an important role in the future of ostrich production.

Aim: This study was conducted to describe the growth of carcass components as a proportion of the empty body protein weight (EBPW) and to determine if varying protein and energy levels could be used to manipulate component growth and the chemical composition of the body of the ostrich.

Methodology: Ethical clearance obtained through DECRA, Project R10/13. Hundred-and-twenty day old chicks (50:50 male to female) were placed in 15 pens (n = 8 birds/ pen). A 3 x 5 factorial design was used to allocate the formulated diets, with three varying energy regimes (high, medium and low) and five protein levels (1 - 5), which were supplied on *ad libitum* basis to each pen. An average intake per bird was determined. A randomly selected bird from each pen was slaughtered at respectively 1, 35, 63, 103, 159, 168, and 244 days of age. Each bird was weighed, stunned, exsanguinated, defeathered and eviscerated. Individual body components were dissected and weighed at every slaughter age. These components were then ground with the remainder of the carcass, excluding gut content, including blood and feathers for proximate analysis. Based on the analysis of ostrich feathers and the known mass of the feathers, the protein mass contribution of the feathers was deducted from the protein accretion of the bird. The data was transformed to natural logarithms and regressed against the featherless body protein growth, using SAS. Intercepts and slopes were compared to determine differences in growth rates ascribed to nutrient densities.

Results and Discussion: Neither dietary energy nor dietary protein level had a significant effect on the relative growth of the measured components except that fat deposition increased with the energy content of the diets (P <0.05). The increase in weight gain per day due to increased dietary energy levels can thus be partly ascribed to an increase in fat deposition in the whole body. However, protein deposition is the main factor that determines live weight gain, whilst the energy cost of protein deposition is greater than that required for fat deposition. Consequently, the effect of higher dietary energy intakes on the protein deposition rate in the body is not yet known as dietary protein and amino acid levels as used in this study had no effect on the weighed variables.

Conclusion/recommendations: Allometric coefficients were established that will be helpful to improve the accuracy of simulation modelling attempts for ostrich nutrition. More research on the exact combining effects of dietary energy and protein, the efficiency of nutrient utilisation and the possible manipulation of these factors are required.

Analysis of the population structure of the Elsenburg Percheron stud

P. Jorgensen[1], M. Burger[1] & B. Aucamp[1]

[1]Directorate: Animal Sciences, Research and Technology Development, Western Cape Department of Agriculture, Private Bag X1, Elsenburg, 7607, Cape Town, South Africa.
pavarnij@elsenburg.com

Background: The numbers of registered Percheron mares are limited in South Africa. Inbreeding can become a problem with only a few mares per stud and with only a few purebred mares in South Africa; the survival of the breed is at risk. The Elsenburg stud, with 12 purebred mares, is one of the largest of the Percheron studs with the best gene pool of purebred mares. The small population size of the Percheron stud requires careful monitoring of population structure and inbreeding. In order to mitigate inbreeding, genetic material from France has been introduced to the stud. While records have been kept for the stud, a deliberate breeding and selection strategy has not yet been implemented.

Aim: The purpose of this study was to assess the existing pedigree and determine the current population structure and inbreeding status of the stud in order to advise a breeding strategy to conserve the genetic resource.

Methodology: The project was approved by the Animal Ethics Committee at the Western Cape Department of Agriculture (Ethical approval No. R12/72). The pedigree data of 189 Percheron horses from 1937-2018 were analysed using POPREP software and hand drawn pedigrees.

Results and Discussion: The Elsenburg Percheron stud was established with the introduction of 4 purebred French Percheron from the Grootfontein Agricultural College Percheron stud. Histon Hallmark, a stallion from the UK, and further French bloodline imports Jongleur, Piston and Isidore were introduced over the years to mitigate the effects of inbreeding on the small population. However, this gene flow also prevents the divergence of the Elsenburg Percheron stud. The effective population size for the Elsenburg Percheron Stud was estimated to be 12 based on the pedigree. The average inbreeding was reduced from 11.8% in 2016/17 to 5.3% in 2017/18 due to the introduction of semen through artificial insemination from the stallions Tennessy Cauvellier and Vaillant Du Challis, originally imported from France.

Conclusion/recommendations: Due to the introduction of migrants to the small population of Elsenburg Percherons, much of the original genetic material has been lost. In order to conserve the current genetics of the Elsenburg Percheron line, an Elsenburg line should be established by at least 2 generations of deliberate inbreeding. A Tennessy Cauvellier line and a Vaillant Du Challis should be established and used for crosses and backcrosses. The aim of future selection should be to adhere to breed standards while implementing matings which will result in the lowest inbreeding.

Increasing production efficiency to mitigate climate change and improve livestock sector sustainability

C.T. Kadzere[1], N. Nyangiwe[1] & E. Chivandi[2]

[1]Döhne Agricultural Development Institute, Private Bag X15, Stutterheim, 4930, Province of the Eastern Cape, Republic of South Africa, [2]Facullty of Health Sciences, University of the Witwatersrand, 7 York Road, Parktown, 2193, Republic of South Africa.
kadzerect@gmail.com

Background: Globally, the livestock sector contributes up to two thirds of agricultural earnings. Climate change requires animal agriculture to innovate and provide technical solutions that increase production efficiency and minimize the emission of greenhouse gases (GHGs).This is vital to guaranteeing sector sustainability. Production efficiency decomposes into allocative efficiency and technical efficiency. Allocative efficiency is at farm level and deals with distribution of resources in production. Technical efficiency emanates from research to improve production and reduce inputs while increasing output due to innovations in genetics, nutrition, performance physiology, production systems and ancillary disciplines.

Aim: The study sought to gain deeper insights into how technical progress/improved efficiency in genetics, nutrition and performance physiology mitigates climate change when subjected to production function analysis and therefore, improve sustainability of the livestock sector.

Methodology: An analysis of literature relating to global warming, climate change, nutrition, performance physiology and production function was done to understand the link between improving technical efficiency and reducing GHGs. Hands-on work experience in livestock production, academia and research was drawn from, to arrive at conceptual and practical inferences to address the challenges of climate change on animal agriculture.

Results and Discussion: The production function in livestock is similar to that of any other agricultural enterprise. It depicts conversion of primary production factors of capital, labor, land and entrepreneurship, as well as the metabolism of ingested inputs into food and fiber. The relationship between inputs and output can be expressed as: $Y = f(x_1, x_2,.., x_n)$; wherein Y is the output (beef, milk..), and $x_1, \ldots x_n$ are the variables (feed,…). Improved efficiency uses fewer resources and therefore mitigates climate change. In addition to outputs/products, metabolic processes also yield by-products including GHGs that cumulatively affect the environment.

Conclusion/recommendations: Climate change requires the livestock industry to minimize production of by-products implicated in global warming. The livestock industry is culturally and economically important; it provides employment, essential nutrients to balance diets, is a source of animal fibers and livestock landscape the world's grasslands. Research must increase technical efficiency. Producers should effectively and efficiently allocate resources in support of various livestock production systems. Achieving the above will make animal agriculture competitive, environmentally sensitive, socially responsible, efficient and sustainable.

Breed and crossbreeding effects on birth and weaning weight, lamb survival and tick count in Dorper and South African Mutton Merino sheep

M.A. Kao[1], J.B. van Wyk[1] & S.W.P Cloete[2]

[1]Department of Animal, Wildlife and Grassland Sciences, PO Box 339, University of the Free State, Bloemfontein 9300, [2]Institute for Animal Production: Elsenburg, P/ Bag X1, Elsenburg, 7609, South Africa.
2015171545@ufs4life.ac.za

Background: Divergent sheep breeds differ in their ability to adapt to different environmental conditions as well as in performance pertaining to the quantity and quality of their products. Crossbreeding systems utilize the variation across the flocks to increase production of crossbred as compared to purebred flocks. In small scale farming operations, indigenous breeds are usually characterized by their low production performance. Therefore, in so many countries, the availability of exotic breeds with a higher performance, especially in reproduction, compared to indigenous breeds prompted an interest in breed evaluation and crossbreeding. However, crossbreeding studies on South African small stock breeds are scarce.

Aim: The purpose of the study was to compare the performance of purebred Dorper and South African Mutton Merino (SAMM) sheep with their reciprocal cross in an extensive environment.

Methodology: The data (700-1147 records) used were collected between 2009 and 2017 on Nortier research farm in the Strandveld region on the West Coast of South Africa. The animals used were the Dorper and SAMM resource flocks onsite. The animals were maintained as a single flock except during mating. The ewes of the respective breeds were mated randomly to 3-4 rams in single-sire groups during January-February to create four genetic groups; purebred lambs of commercial breed (Dorper and SAMM) and their reciprocal crosses (Dorper X SAMM and SAMM X Dorper). Lambing took place during June-July, when the natural pasture on the farm was expected to be actively growing after the expected autumn and winter rains. Ewes were side-branded with stock-marker spray to facilitate the identification of lambs with their dams from a distance. During lambing in a single group on natural pasture with shrub cover, lambs were tagged, weighed and identified with their dams within 24 hours of birth. They were also sprayed with the same number as the dam to facilitate the reunification of lambs with their dams. The lambs were grazed with their dams until weaning weight was recorded at an average (±SD) age of 116±16 days. Overall lamb survival from birth to weaning could be deducted from the birth and weaning records. Total full-body tick counts were also recorded for lambs within 14 days of weaning for the period from 2010-2017. All data were analysed with ASREML software.

Results and Discussion: Birth weight was affected by genotype ($P<0.05$). Dorper X SAMM lambs were between 6.7% and 8.5% heavier ($P<0.05$) at birth compared to the other three genetic groups, which did not differ ($P>0.05$). With reference to weaning weight, there was a clear advantage of crossbred progeny relative to purebred performance ($P<0.05$). It was notable that the contrast comparing the pure breeds was not significant for any of the traits. The direct heterosis estimate for weaning weight indicated that crossbred performance exceeded the mid parent value by 6.3%.

Conclusion/recommendations: No conclusive advantage for either pure breed was seen for any of the traits considered. Significant non-additive genetic variation was, however, demonstrated for weaning weight. These results indicate that commercial operations may benefit from crossbreeding using a combination of a meat and dual-purpose breed. Further studies involving the structured crossing of local ovine genetic resources should be conducted.

Analysis of environmental and genetic factors influencing reproductive traits and calf survival to weaning in Tswana cattle selected for early growth traits

M.I. Keoletile[1,2] & S.D. Mulugeta[2]

[1]Department of Agricultural Research, Private Bag 0033, Sebele, Gaborone, Botswana, [2]Department of Animal Science, Faculty of Agriculture, Science and Technology, North West University, Private Bag X2046, Mmabatho 2735, Mahikeng, South Africa.
mikeoletile@gmail.com

Background: Reproductive efficiency has been described as a fundamental goal in beef cattle production and its variation has been reported to be associated with variation in management and nutrition. Furthermore, it has been noted that genetic variation of reproductive efficiency is very low and its estimated heritability vary between 0 and 10%. Besides age at first calving and calving interval, calf survival also has a major impact on herd economic efficiency. Calf survival and longevity are eminent traits of interests to animal breeders due to their effects on herd economic performance and animal welfare. However, there is no previous study conducted on the reproductive as well as calf survival traits of Tswana cattle in Botswana.

Aim: The objective of this study was to determine the environmental and genetic factors affecting reproductive traits and calf survival from birth to weaning in Tswana breed of cattle.

Methodology: Analyses of environmental and genetic effects for calf survival traits were done using 7223 records of animals which were born between 1996 and 2013 from 1659 dams and 188 sires in 54 contemporaries. Analyses of environmental and genetic effects for age at first calving were done using 818 records of animals born between 1998 and 2013 from 611 dams and 136 sires in 49 contemporaries, while calving interval analyses were done using 1804 records of cows born between 1999 and 2013 from 496 dams and 121 sires in 45 contemporaries. Reproductive traits analysed were age at first calving (AFC) and calving interval (CI). AFC was analysed using univariate animal model while CI was analysed using repeatability model. Calf survival to weaning (CS) was analysed as a binomial trait using generalised mixed linear logistic model with logit as link function in the ASREML program.

Results and Discussion: Significant environmental effects for reproductive traits were selection line, calving year and season. CS was significantly influenced by calf sex, selection line, calf-birth weight and dam age. The estimated heritability values for reproductive traits were 0.07±0.02 for CI and 0.10±0.07 for AFC. Heritability estimate obtained for CS was 0.07±0.05. Low genetic variability obtained in reproductive traits and calf survival to weaning trait indicates that improvement of these traits through genetic selection may prove to be slow.

Conclusion/recommendations: Improvement of reproductive traits can therefore rapidly be achieved through modification of the management aspects than selection for these traits.

Parentage validation for small holder dairy herds in South Africa using SNP markers

C. Kgamehedi[1,2], Y.P. Sanarana[1], F.C. Muchadeyi[3], O. Tada[2] & C.B. Banga[1,4]

[1]ARC-Animal Production, Private Bag X2, Irene, 0062, South Africa, [2]Department of Agric Economics and Animal production,University of Limpopo, Private Bag X1106, Sovenga, 0727, South Africa, [3]ARC-Biotechnology Platform, Private Bag X5, Onderstepoort, 0110, South Africa, [4]Department of Animal Sciences, Faculty of Science, Tshwane University of Technology, Private Bag X680, Pretoria, 0001, South Africa.
kgahamedi@gmail.com

Background: Smallholder dairy farming in South Africa is mainly based on the use of crossbred animals, combining the adaptive traits of local indigenous breeds with the high milk producing exotic breeds. Pedigree records are barely kept, with parentage being mostly assumed on the basis of events before and after birth. It is, however, not known how reliable this pedigree information is. Lack of genetic improvement programmes is an issue of major concern for the smallholder farming system. Accurate pedigree records are required for the estimation of breeding values and to ensure high rates of genetic gain. High-density single nucleotide polymorphism (SNP) markers provide a reliable means for parentage assignment; hence they can be used to validate pedigree records.

Aim: The aim of the study was to validate pedigree records on smallholder dairy herds using SNP markers.

Methodology: Ninety-four hair samples were collected from cattle on smallholder dairy herds in four South African provinces. Deoxyribonucleic acid (DNA) was extracted at the ARC's Biotechnology Platform using Chemegen DNA extraction kit (Chemegen, 2016). DNA extracted from the samples was genotyped using the Illumina BovineSNP150K beadchip consisting of 141 716 SNPs. Genotyping was performed using the standard infinium assay protocol (Illumina, San Diego, CA, USA). Only autosomal SNPs mapped from chromosomes 1-29 were used in the analysis. Three animals with more than 90% missing genotypes were removed from the data. A pedigree file from smallholder dairy herds was used to select 58 genotyped parent-offspring pairs for parentage analysis. SNP quality control measures were calculated using the *R* package software described by Gondo *et al.* (2014). SNPs that had a median GenCall score lower than 0.6, GenTrain score <55%, displayed <95% call rate and less than 1% MAF as well as those that deviated ($P<0.001$) from the Hardy Weinberg Equilibrium were removed. After QC, 106 341 SNPs remained to validate the parentage records. Mendelian inconsistencies were determined by counting the number of opposing homozygous SNP genotypes between parent–progeny pairs. The pedigree of the population was reconstructed based on the absence of opposing homozygotes.

Results and Discussion: The means for animal call rates (0.99), minor allele frequency (0.33) and polymorphic information content of the markers (0.375) were observed. The sire-offspring pedigree was found to be 13.4% correct and 86.7% incorrect, meaning two offspring were assigned to the true sire. Meanwhile, the parentage of dam-offspring pairs were 97.6% incorrect, meaning only one offspring was assigned to the true dam. The separation value was negative to zero in many parent-offspring pairs (48%). These results demonstrate that the lack of structured recording in smallholder dairy herds results in highly inaccurate parentage assignment.

Conclusion/recommendations: Smallholder dairy herds in South Africa do not have structured pedigree recording in their herds, which leads to a high rate of misidentification of parents to offspring. These results highlight the need for parentage identification and pedigree reconstruction in South African smallholder dairy herds, as a prerequisite to genetic improvement.

Estimation of genetic parameters for female fertility traits derived from on-farm service records in South African Holstein cattle

R.D. Kgari[1,3], K. Dzama[3], C.J.C. Muller[3] & M.L. Makgahlela[1,2]

[1]Agricultural Research Council, Private bag X2, Irene 0062 South Africa, [2]Department of Animal, Wildlife and Grassland Sciences, University of Free State, P.O. Box 339, Bloemfontein 9301,South Africa, [3]Department of Animal Sciences, University of Stellenbosch, Stellenbosch 7600, South Africa.
kgarir@arc.agric.za

Background: Female fertility is a fundamental trait for a profitable dairy herd enterprise. Studies have shown a decline in fertility probably because of an intense selection for increased milk production. In South Africa, age at first calving (AFC) and calving interval (CI) are indicator traits to improve fertility, but these traits are greatly affected by the breeder's decisions. Service data present additional selection criteria with minimum bias. Service data are not recorded routinely into the national database but are kept on farm for management purposes.

Aim: To estimate genetic parameters for AI Service-based heifer and cow fertility traits in SA Holstein cattle.

Methodology: Service records were obtained from an on-farm management system, consisting of 64464 records from 18 South African Holstein herds. Pedigree data included animals born between 1992 and 2013. Data were edited to remove outliers and allow an acceptable threshold for each trait. The final data set used for analysis included 10017 heifer and 24909 cow traits. The traits analysed were age at first service (AFS) and number of services per conception (SPCh) for heifers, and calving to first service (CFS), number of days open (DO), and number of services per conception (SPC) for cows. Model effects for genetic evaluations were tested using the lme4 package (Bates et al., 2015) in R where the fixed effects of herd, year, season of birth or calving, age at insemination or calving and lactation number were fitted. The model for heifers included random animal effect and for cows it included the random effects of animal and permanent environment. Bivariate analyses were implemented to estimate genetic variances and heritabilities using airemlf90 of BLUPF90 family of programs (Misztal *et al.*, 2018).

Results and Discussion: The means±SD for the analyzed traits were CFS 89±36 days, DO 137±72 days, SPC 2.18±1.57, AFS 16±3.51 months and SPCh 1.52±0.91. Mean SPC was lower in heifers (1.52) and higher in cows (2.18), possibly because heifers haven't started lactating. Phenotypic correlations were -0.06 in heifers (AFS and SPCh) while they varied from -0.15 (CFS and SPC) to 0.71 (SPC and DO) in cows. Genetic correlations were 0.73 in heifers (SPCh and AFS) while in cows they varied from -0.62 (SPC and CFS) to 0.19 (CFS and DO). Negative phenotypic correlations were observed between AFS and SPCh, although they were weaker than genetic correlations. Thus, younger animals conceive from fewer inseminations. The observed negative phenotypic and genetic correlations between CFS and SPC indicates that lengthening CFS, a dam would have more time to recover from lactation, hence conceiving from fewer inseminations post-partum. Heritabilities ranged from low (0.02) to moderate (0.26), indicating that there is a genetic aspect for these traits, which is an opportunity for genetic improvement.

Conclusion/recommendations: The low to moderate heritability highlights the potential of these traits for use in selection programmes, in addition to AFC and ICP. Further research will investigate a multi-trait analysis of the defined traits and their associations with production traits.

Effects of xylanase on the fermentation and aerobic stability of mixed citrus (*Citrus sinensis*) and buffalo grass (*Cenchrus ciliaris*) silage

R.J.G. Kgopong[1], R.S. Thomas[2], F. Fushai[1], J.J. Baloyi[1] & A.T. Kanengoni[3]

[1]Department of Animal Science, School of Agriculture, University of Venda, Private Bag X5050, Thohoyandou, Limpopo Province, 0950, [2]ARC-Animal Production, Private Bag X2, Irene, 0062, South Africa, [3]Johannesburg Zoo, Private Bag X13, Parkview, 2122, South Africa.
felix.fushai@univen.ac.za

Background: Declining global grain production compounded by increasing demand for human food are increasing the cost of commercial feeds, which is a challenge for resource poor pig farmers. To reduce feed costs, research has increasingly focused on cheaper, readily available non-conventional feed resources. Fibrous feed resources are in abundance and ideal for resource poor farmers. Citrus pulp (*Citrus sinensis*) is a by-product from the industrial extraction of citrus juice. Wet citrus pulp spoils quickly, therefore ensilage in combination with water absorbing materials could be beneficial. Mixed ensilage with early-cut buffalo grass (*Cenchrus ciliaris*) hay may stimulate desirable fermentation and increase the protein content. Mixed ensilage of wet citrus pulp with high dry matter grass hay, and the application of xylanase enzymes to improve the silage quality are aspects which need needs further investigation.

Aim: To evaluate the effects of Ronozyme® WX (CT) on the fermentation characteristics and aerobic stability of Citrus (*Citrus sinensis*) pulp silage.

Methodologies: Fresh citrus pulp was mixed with chopped buffalo grass (*Cenchrus ciliaris*) at a ratio of 80:20. The mixture was ensiled in nine replicates of either no enzyme (Control) or 1 g/kg Ronozyme® WX (CT) (1000 FXU/g endo-1,4-beta-xylanase), within 1.5 L anaerobic glass jars that were kept at the ambient room temperature for 30 days. After the 30-day ensilage, three jars per treatment were opened and sampled to determine DM content, pH, water-soluble carbohydrate (WSC) and lactic acid. The remaining three silage samples per treatment were subjected to an aerobic stability test (CO_2 production) over 7 days. The PROC MIXED procedures of SAS software, version 9.3 (SAS, 2010) was used for the statistical analysis.

Results and Discussion: Xylanase rapidly and most increased ($P < 0.05$) lactic acid (2.2 g vs. 1.4 g LA/kg DM) in 30-day silage, suggesting enhanced fermentation. The enzyme did not affect aerobic stability of silage ($P > 0.05$). The results of the study suggested sufficient substrate for the xylanase in the orange pulp-buffalo grass silage to enhance fermentation and improve quality.

Conclusion/recommendations: Good quality citrus pulp silage can be produced when treated with xylanase. The evaluation of pig growth performance on xylanase-treated, mixed fresh orange pulp-buffalo grass silage diets is recommended.

Genetic diversity and population structure of Mozambican indigenous cattle breeds

F.J.M. King[1,2], C. Visser[2] & C. Banga[3]

[1]Instituto de Investigação Agrária de Moçambique, Av. das FPLM, 2698; Caixa Postal: 3658, Maputo, Moçambique, [2]Department of Animal and Wildlife Sciences, University of Pretoria, South Africa, [3]Agricultural Research Council, Private Bag X2, Irene 0062, South Africa.
fejomak@gmail.com

Background: Livestock production is a major feature of Mozambican's agriculture and contributes largely towards improving food security. Mozambican indigenous cattle have unique genetic attributes and can be classified into two main groups: the Sanga (Landim and Tete cattle breeds), and the Zebu (Angone cattle breed). Cattle production in Mozambique is mostly communal, resulting in indiscriminate crossbreeding. This poses a threat to indigenous populations as it results in erosion of unique genetic resources.

Aim: To investigate the genetic diversity and population structure within and between three indigenous Mozambican cattle breeds namely the Landim, Tete and Angone using the Illumina Bovine SNP50BeadChip.

Methodology: A total of 228 indigenous cattle from three breeds (Landim = 119; Tete = 61; Angone = 48) were included in this study. Hair samples were collected from 23 villages and 116 smallholder and commercial farms/herds across the country. Genotypes for all the animals were generated using the International Dairy and Beef chip (IDB) at Weatherbys (Ireland). Basic population parameters were estimated using PLINK v1.09. Population differentiation and admixture was investigated using principal component analysis (PCA) (GCTA version 1.24) and ADMIXTURE 1.21. The effective population size (Ne) was estimated using SNeP version 1.1.

Results and Discussion: Estimations of MAF ranged from 0.245±0.145 in the Tete to 0.228±0.154 in the Angone. Observed and expected heterozygosities ranged from 0.288±0.026 (Angone) to 0.303±0.045 (Tete). The levels of inbreeding observed in this study (FIS), ranged between 0.046±0.091 (Landim) to 0.078±0.138 (Tete), with an average of 0.065±0.109 across all populations. The three breeds were divided into two clusters based on PCA and cluster analyses, namely a distinct cluster comprising the Tete and Landim breeds and a combined breed cluster consisting of Landim, Angone and Tete breeds. All three breeds have declining effective population sizes, with the Tete showing the most drastic drop.

Conclusion/recommendations: The relatively high levels of genetic diversity indicate potential for genetic improvement. However, the results indicate an erosion of the three distinct breeds, with indiscriminate crossbreeding being common between the populations. This genomic analysis of indigenous Mozambican cattle could be used as a benchmark for further investigations.

Human-wildlife conflict and the importance of information in managing predation

Q. Kruger

The Predation Management Centre. Department of Animal, Wildlife and Grassland Sciences, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa.
PredationMC@ufs.ac.za

Background: With the increase in the human population, there is a growing demand for food. Increased food production, which includes increasing livestock populations, invariably requires expanding agricultural land and/or intensifying production. In addition, the growing human population results in increasing encroachment on natural habitats. This leads to increased human-wildlife conflicts, as humans and wild animals (particularly predators) compete for the same limited resources (food, water and living space). Predation on livestock puts additional pressure on livestock production enterprises. It is the most commonly reported aspect of human-wildlife conflict worldwide. Yet the greatest disparity exists in methods used to collect data and report results relating to predation and predation management. This hampers progress in terms of devising effective predation management strategies to reduce the impact of predation on livestock production.

The role of modern technology in accruing information to aid predation management: Despite various forms of predation management having been implemented for centuries, some seemingly effective at a local level, predation over large areas has been reported to increase. Due to the myriad factors that may influence predation on livestock as well as predation management, however, it is difficult to assess the extent of the problem and the effectiveness of predation management efforts. Although research has made valuable contributions to our knowledge of predation management, the lack of a reliable or consistent framework for assessment and management of predation has hampered meaningful progress in terms of reducing the levels of predation on a large scale in South Africa.

In light of this need, a method was developed for collecting detailed, standardised data on predation management to facilitate coordinated research efforts. The use of the latest available technology allows for the collection of large sets of longitudinal (long-term), data in real time by those knowledgeable in the field and close to the industries being served.

In the short term, information collected in this manner will aid in identifying predation hotspots. The extent and distribution of predation is important to gauge the impact of predation and for allocating relevant resources to areas where predation impacts are most intense. In the long term, predation risk models can be created to advise authorities and managers on where and when livestock are most at risk, so that preventative action may be taken. Information on the long- and short-term efficiency of different predation management methods under different circumstances is important in formulating management strategies that effectively reduce predation impacts. Ultimately, best management practices may be formulated, which take into account the benefits, costs and possible environmental or production-related trade-offs of management strategies under particular sets of circumstances.

Conclusion/recommendations: The negative impact of predation on livestock production and, therefore, food security and the economy is considered a major challenge in South Africa. However, predation management is a highly controversial issue and the lack of scientific information is a major concern and impediment for initiatives to devise effective and acceptable management strategies. The success of the technology developed for gathering information to address predation management issues, will depend on involvement and cooperation of all stakeholders and coordinated action on local, regional, as well as national level.

Evaluation of smallholder goat production system in Limpopo Province, South Africa

P.E. Kubjana[1], T.C. Rasekgoalo[1], M.L. Mashiloane[1], K.F.M. Madia[1], T.C. Matelele[2] & H.K. Magabe[1]

[1]Limpopo Department of Agriculture and Rural Development, Mara Research Station, Private Bag X2467, Louis Trichardt, 0920, [2]Harvest House, Department of Agriculture, Forestry and Fisheries, Directorate: Genetic Resources, Private Bag X973, Pretoria, 0001.
kubiepe@gmail.com

Background: Limpopo Province consists of a dichotomy in the farming system, namely communal and commercial. The management practices in communal areas are generally not known but classified as low input management practices. Description of such system is particularly relevant in developing regions where farm animals are kept under diverse production systems and for multiple uses. This baseline information is essential in identifying successes and failures of different extension advices to smallholder goat farmers and as basis for goat guidelines and training to be provided.

Aim: To evaluate management practices under smallholder production systems of indigenous goat flocks.

Methodology: A total of 694 farmers were interviewed in Mopani, Sekhukhune, Capricorn, Waterberg and Vhembe districts of Limpopo Province. A structured questionnaire was administered to deduce essential information on health care, feeding practices and other livestock ownership information. Frequency analysis for various categories of responses from the questionnaire was done.

Results and Discussion: The study has found that although 86% of farmers indicated having problems with goat diseases, the majority (87%) do not vaccinate their goats. However, the study revealed that 87% of farmers control external parasites using mainly spray (43%), dipping (15%) and handdressing (12%) but only few (37%) do routine internal parasites control by drenching (81%). Communal extensive production system (96%) is predominant, followed by farm extensive system. The results also revealed that goats kept under free grazing (60%), herded (34%), free grazing and herded (5%), free grazing and tethering (0.58%) are supplemented (60%) with different feedstuffs. A major characteristic of smallholder goat farmers is that they keep other livestock species such as cattle, chickens, sheep and pigs.

Conclusion/recommendations: Previous efforts to improve smallholder goat production failed due to poor understanding of their production system. The results of this study suggest some form of training of smallholder goat farmers on basic management practices that would aid in improving productivity of their goat flocks.

The potential of diterpenes to preserve sheep sperm viability and morphological integrity during heat stress conditions

H. Lambrechts[1] & G.L. Gulyas[1]
[1]Department of Animal Sciences, Stellenbosch University, P/Bag X1, Matieland, 7602, South Africa.
helet@sun.ac.za

Background: An inability of rams to thermoregulate testis temperature can ultimately result in sperm DNA damage and thus a declined fertilizing ability. Although the production of reactive oxygen species (ROS) is beneficial and necessary for hyperactivation, capacitation and the acrosome reaction, higher than normal levels of ROS (as produced during heat stress (HS)) can be deleterious to sperm. Endogenous antioxidant (AO) proteins such as superoxide dismutase and glutathione peroxidase can act as free radical scavengers in the testes. Low levels or improper functioning of such endogenous AO proteins can severely affect testicular function and sperm quality. The diterpenes rosmarinic acid, carnosic acid, and carnosol occur in the aqueous extract of plant species such as common rosemary *(Rosmarinus officinalis* L., CR*)* and wild rosemary *(Eriocephalus africanus* L., WR*)*, and demonstrate AO activity. The potential of the three diterpenes obtain from CR and WR to minimize the deleterious effect of HS on ram sperm during liquid storage, has not been investigated.

Aim: To assess the potential of the abovementioned diterpenes in the aqueous extract of CR and WR, respectively, to preserve the viability and morphological integrity of sheep sperm during HS.

Methodology: Ethical clearance was obtained from the Animal Ethics Committee of the University of Stellenbosch (SU-ACUD16-00069). Semen samples were collected using electroejaculation from 30 Dohne Merino (*Ovis aries*) rams, aged 15 months, and diluted with a milk-yolk extender supplemented with 50mM trehalose. The 3X5 factorial design (replicates=5) entailed inclusion of CR and WR aqueous extracts, respectively, at 0g/100mL (control), 2.5g/100mL, 5g/100mL, 7.5g/100mL, and 10g/100mL, and storage temperatures of 38.5°C, 39°C and 41°C. Data on viability, motility, and morphology were recorded at 0h, 1h, 1.5h, 2.0h, and 2.5h. Means were adjusted for multiple comparisons using the Bonferroni t-test. A two-way analysis of variance (ANOVA) was used for the comparative analysis.

Results and Discussion: Rosmarinic acid, carnosic acid and carnosol minimized the morphological damage to sperm during HS. Percentage viability was significantly higher for the CR at 38.5°C and 41°C, while the viability at 39°C was similar for both the CR and WR extracts over time. Viability declined significantly between 0h and 1h post-collection for both the CR and WR species at 38.5°C, and then remained relatively stable until the end of the study. The CR- and WR-supplemented samples maintained at 39°C and 41°C also experienced an initial decline in viability after 0h before stabilising and remaining constant. The percentage of morphological abnormalities was significantly higher for the WR species when compared to the CR species over the entire 2.5h period, as well as at all temperatures and time intervals, and at all temperatures and AO inclusion levels. Rosmarinic acid extracted from the WR, at all inclusion levels, was the only diterpene that did not maintain sperm viability at 41°C.

Conclusion/Recommendations: Diterpenes extracted from the WR conferred a higher degree of protection to sperm that the diterpenes extracted from the CR. An extended observation period should be considered to assess the ability of the AO's to buffer changes caused by ROS, as well as different extraction methods investigated to optimise the extraction of the diterpenes.

Monitoring nutrition of ruminants by faecal NIRS

S.Y. Landau[1], T.A. Glasser[2], H. Muklada[1], T. Deutch[1], A. Perevolotsky[1] & E.D. Ungar[1]

[1]Department of Natural Resources, Institute of Plant Sciences, Agricultural Research Organization, the Volcani Center, 68 HaMaccabim Road, Rishon LeTsiyon, P.O. Box 15159, Israel, [2]The Ramat Hanadiv Nature Park, P.O. Box 325, Zikhron Ya'akov, 3095202, Israel.
vclandau@volcani.agri.gov.il

Background: Elucidating the botanical composition of grazing animals helps in understanding the expected impact of grazing on rangelands. Determining the nutritional value of diets selected by free-ranging livestock allows feed supplementation according to true needs. Also, elucidating the dietary choices of individual animals kept as a group allows nutritional studies under farm conditions.

Aim: Here we show how faecal-NIRS (FNIRS) calibrations for botanical and nutritional composition, that were established for goats kept in confinement or grazing in a woodland environment, and for beef cattle grazing herbaceous rangelands, can be instrumental in improving management decisions in rangeland-based or confined production systems.

Methodology: FNIRS calibrations are based on statistical associations between the spectral attributes of faeces in the NIR (1100-2500 nm) and the composition of diets consumed, i.e., pairs of faecal spectra and nutritional attributes ("FNIRS pairs"). We established calibrations for the concentrations of ash, CP, IVDMD, NDF and ADF in beef cattle and goat diets and for dietary tannins in goat diets. For confined goats, we collected FNIRS pairs *post hoc* from digestibility trials carried out in three research centres in France, Italy and Israel. In order to determine dietary browse percentages, we first established equations for five major browse species, hay and concentrates, under confinement with goats given combinations of the browse species. We then established calibrations of the same botanical and nutritional attributes selected by goats grazing in woodland. This was based on bite count observations carried out on the same goats throughout whole grazing days in the dry and green seasons. For cattle, calibrations were established with FNIRS pairs collected in confined cows fed combinations of green fodders (cereals, legumes, forbs) at different phenological stages and supplements (gain and poultry litter) and validated with pasture monocultures in commercial operations. All calibrations encompassed two years of FNIRS-pair collections.

Results and Discussion: All FNIRS calibrations obtained for dairy goats in confinement had very high linearity (R^2cal > 0.95) and good accuracy (estimated as SEcv, standard error of cross-validation). They enabled monitoring of individual dietary percentages of hay, concentrates or green fodder. When concentrate was fed individually, knowledge of dietary percentage of concentrate enabled total intake to be calculated, hence, to derive components intake (g/d). Linearity of calibrations was ≥0.9 for all nutritional attributes and >0.8 for calibrations of botanical composition. Calibrations established in confined goats were not robust to grazing situations. As to applications of FNIRS, in goats, FNIRS was instrumental in establishing between-breed differences in feeding behaviour at pasture, showing the efficacy of goats at combatting tree and brush encroachment, and demonstrating the effects of botanical dietary components on milk attributes. In beef cattle, FNIRS was instrumental in showing the impact of seasonality and yearly patterns of rainfall distribution on dietary quality, and demonstrating that very high animal density is associated with soil ingestion in spring and excess intake of poultry litter, given as supplement, in the dry season.

Conclusion/recommendations: FNIRS is a valuable tool for elucidating individual animal diets under confined or grazing conditions. It is the only procedure that is practical under farm conditions and unaffected by animal welfare regulations. However, establishing FNIRS calibrations is time-consuming, in particular if based on bite counts. Overall, FNIRS is a method of choice to provide information to decision-makers (rangeland and forests managers and government agricultural extension), but using it routinely to facilitate farmer decisions is hampered by economic constraints.

Behavioural adaptations of goats to brush-grazing: emergence of goat cultures

S.Y. Landau[1], H. Muklada[1], A. Perevolotsky[1], E.D. Ungar[1] & T.A. Glasser[2]
[1]Department of Natural Resources, Institute of Plant Sciences, Agricultural Research Organization, The Volcani Center, 68 HaMaccabim Road, Rishon LeTsiyon, P.O. Box 15159, Israel, [2]The Ramat Hanadiv Nature Park, P.O. Box 325, Zikhron Ya'akov, 3095202, Israel.
vclandau@volcani.agri.gov.il

Background: Texas A&M experts state that **"**Culture in its broadest sense is cultivated behaviour; that is the totality of a person's learned, accumulated experience which is socially transmitted, or more briefly, behaviour through social learning". Modern goats thrive in inhospitable environments, featuring extreme botanical and chemical variation in space and in time. However, archaeological evidence, which sources from goat faecal pellets dating 6,000 years B.C., i.e., soon after domestication in the Ancient Fertile Crescent, suggests that diets selected were rich in protein but low in lignin, hence sourced in young herbaceous vegetation, using a strategy of "take the best and leave the rest" characteristic of low animal densities. Later, approximately 2000 years ago, written legislature stated that crops had to be protected against grazing incursions and goats were kept off limits: goats were reared exclusively in woodlands. Such restrictive legislation strongly contributed to the evolution of foraging preferences: indeed, in Spain, where wild goats (*Capra pyrenaica*) and domestic goats (*Capra hircus*) share the same territory, the latter consume half as much browse and three-fold more herbaceous species than the former. A major difference between evergreen browse and herbaceous plants is their contents of plant secondary compounds (PSC). Translocated adult goats show impaired performance and succumb to poisoning.

Aim: Here we summarize the behavioural mechanisms that possibly allowed the survival of goats stocked at high animal density in environments rich in toxic PSCs and parasites and examine if their way of transfer for generations is compatible with the hypothesis of local goat cultures.

Methodology: We reviewed observations and faecal-NIRS aided studies of selective feeding behaviour in Mamber and Damascus goats conducted over a period of 17-years. Goats of the two breeds do not differ in salivary response to tannins but the Damascus goat consume two- to three-fold more of the tannin-rich ubiquitous *Pistacia lentiscus*. By cross-fostering of kids, we evaluated the role of genetics vs. maternal education on the establishment of feeding behaviour. We also infected young goats of the two breeds with strongyles and determined if they self-medicate by increasing their preference for *P. lentiscus*. Finally, we questioned if globally, goat behaviour, encompassing a wide array of apparently well-organized bite sequences, which protect animals against plant toxicity and parasitism, but allow them to ingest enough nutrients to survive and be productive, can be considered as a culture.

Results and Discussion: At least 10 species of plants are sampled by local goats for every 30 min of grazing and sequences of bites in the right order increase intake. Independent of genotype, kids accompanying their biological or fostering mother at pasture acquire the maternal level of propensity for tannin-rich *P. lentiscus* browse and the botanical dietary composition of mother and accompanying kids is identical. As tannin-rich species feature anti-parasitic and, in particular, anthelmintic properties, Damascus goats, which consume more tannins, adopt a preventive strategy while Mamber goats, who increase their preference for *P. lentiscus* only when challenged by strongyles, adopt a therapeutic strategy. We consider that globally, these two breeds have created different cultures transferred to generations by mothers.

Conclusion/recommendations: Forest fire prevention, increased plant species-richness and milk quality all derive from behaviours conserved in local goat cultures for millenia. While introducing managerial novelty one must prevent the disruption of these cultures.

Oestrus cycling of different beef genotypes entering their first breeding season at age 14 months

M. le Roux[1], A. Theunissen[1] & M.M. Scholtz[2]

[1]Department of Agriculture, Land Reform and Rural Development, Private Bag X 9, Vaalharts Research station, Jan Kempdorp, 8550, South Africa, [2]ARC-Animal Production Institute, Private Bag X2, Irene, 0062, South Africa.
marize.leroux@gmail.com

Background: It has been indicated that early breeding leads to a more reproductive and efficient lifespan of beef animals, so much so, that in temperate climates heifers are bred at approximately one year of age (14 months). In South Africa, however, the normal breeding age of heifers for most breeds is still approximately two years of age. Seeing that South African bull fertility is constantly improved through genetic selection, the overall fertility from their female offspring is anticipated. It is therefore probable that heifers are ready for breeding earlier than what is currently practiced.

Aim: This study investigated if crossbred heifers at 14 months were in estrus cycle or not through vaginal cytology.

Methodology: Thirteen crossbred genotypes produced from Afrikaner, Nguni, Bonsmara, Angus and Simmentaler were evaluated. Five heifers per genotype were selected. A vaginal smear was taken from each heifer on a two week + 2 days basis from the last sampling day. Vaginal smears were fixed in methanol and stained with Giemsa. The parabasal, intermediate and superficial cells were quantified with an Olympus BX43 microscope and Microptic SCA software and expressed in percentage; 50 cells per smear were counted. Heifers were scored a "Yes" if they showed signs of estrus cycling and a "No" if not. Smears were taken from 15 November until 11 February which correlates with the normal breeding season of the herd. The experimental procedures were approved by the Animal Ethics Committee of the Department of Agriculture, Land Reform and Rural development (NC/AREC/18/11/004).

Results and Discussion: All heifers had a composition of cells that indicate estrus cycling at the first sampling date, except for heifers from the exotic sires. The non-cycling heifers showed signs of cycling by the second sampling date, two weeks later. Though unclear, it seems that exotic breeds may reach puberty later as opposed to indigenous breeds. The age of puberty (first signs of estrus) should be investigated for individual breeds in a follow up study.

Conclusion/recommendations: Heifers are reaching puberty long before 14 months of age. The exact age of puberty can be determined in a similar manner as this study although much earlier, perhaps soon after weaning. The study is proving that heifers can be included in the breeding season as soon as 14 months. Feed management, however, will play a major role in the success of early breeding for one year old heifers and should be managed diligently.

Evaluating the use of dietary supplemental ascorbic acid on broiler performance and litter quality under South African summer conditions

J.D. Lemmer[1], A. Hugo[2], M.D. Fair[1] & F.H. de Witt[1]

[1]Department of Animal, Wildlife and Grassland Sciences, [2]Department of Microbial, Biochemical and Food Biotechnology, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa.
jarred843@gmail.com

Background: Supplementary ascorbic acid (AA) has been recommended to alleviate stress, based on the assumption that its requirements may exceed the synthesizing and absorption ability of birds during periods of heat stress. However, the use of untreated supplementary AA in pelleted diets remains debatable due to its heat sensitivity and needs further investigation to determine its eficicy.

Aim: To evaluate the efficacy of coated AA at incremental levels within pelleted diets on production performance and litter quality of broilers housed under summer conditions in central South Africa.

Methodology: Experimental procedures were approved by the Animal Ethics Committee (AEC) of the University of the Free State – UFS-AED2018/0008. A total of nine hundred and sixty (n=960) day old as-hatched broiler chicks of the Arbor Acres genotype were obtained from a hatchery and randomly allocated (n=192/treatment) to each of the five dietary treatments. Each treatment was sub-divided into six replicate pens (n=32 birds/pen) at a stocking density of 16 birds/m^2. The five experimental diets consisted of a negative control (0 mg ascorbic acid/kg), while coated AA (Halor C^{TM}) was incrementally included at 100 mg, 200 mg, 300 mg and 400 mg ascorbic acid/kg in the other four treatments. The specific inclusion levels of AA were kept constant during the (i) starter (D0-7; crumbs), (ii) grower (D7-21; pelleted) and (iii) finisher (D21-35; pelleted) phases. The trial was conducted during January-February 2018 and supplemental heating was provided by means of infrared shortwave heaters and lights. Daily minimum and maximum temperature and relative humidity (RH) was recorded within individual pens, while litter moisture content of each pen (n=6 pens/treatment) was determined once weekly. The total body weight and feed intake of all live birds within each replicate pen was recorded on days 7, 14, 21, 28 and 35 of age. Data were analysed using a fully randomized analysis of variance for one continuous dependable variable (ANOVA) and for multivariate responses (MANOVA).

Results and Discussion: Increased dietary inclusion levels of AA had no effect (P >0.05) on production parameters such as feed intake (108.45 ± 12.52 g/b/d), ADG (60.46 ± 11.73 g/b/d), FCR (1.82 ± 0.19) and PEF (290 ± 30) of broilers during the entire experimental period (D0-35). Data analysed on a weekly basis illustrated no effect (P >0.05) on production parameters during the different feeding phases with incremental levels of AA up to 400 mg/kg. The mean mortality rate (4.18%) was relatively low given the mean maximum environmental temperature (36.6 ± 2.1 °C) during the experimental period. Dietary AA levels had no effect (P >0.05) on litter quality such as moisture content (34.9 ± 6.1%) and temperature (32.4 ± 1.2 °C) during the 35-day trial period. Litter moisture content increased (P <0.05) over time, irrespective of dietary AA inclusion level. Results indicate that an increase in environmental temperature resulted in more variation among birds performance, regardless of treatment – possibly contributing to the lack of statistical significant differences between AA treatments.

Conclusion/recommendations: Results of the present study show that increased levels of dietary supplemental AA have no significant influence on production performance of broilers or litter quality. The potential loss of AA efficacy during feed pelleting as well as optimum inclusion levels needs further investigation before AA could be recommended for use in pelleted diets for broilers.

Assessment of inbreeding in SA dairy breeds on genomic parameters

J. Limper[1], C. Visser[1] & E. van Marle-Köster[1]
[1]Department of Animal and Wildlife Sciences, University of Pretoria, Private Bag x 20, Hatfield, 0028, South Africa.
carina.visser@up.ac.za

Background: Small effective population sizes and inbreeding are major challenges faced by dairy cattle populations worldwide. Estimates of pedigree-based inbreeding (Fped) are unreliable due to a lack of pedigree data and pedigree errors and that may lead to an underestimation of inbreeding rates. Inbreeding based on runs of homozygosity (FROH) has become the preferred method of estimating inbreeding as it is able to accurately predict the amount of autozygosity within the genome. No genomic estimates for inbreeding in South African (SA) dairy breeds are currently available.

Aim: The aim of the study was to estimate genomic inbreeding and effective population sizes for these breeds.

Methodology: In this study 1002 dairy cattle, representing four South African dairy breeds (Ayrshire, Holstein, Jersey and SA Dairy Swiss) were genotyped at the ARC-Biotechnology Platform (Onderstepoort, 0110) with the bovine 50K Ilumina SNP bead chip. Genotypes for these animals originated from the Dairy genomics program (DGP). PLINK v1.90 (Purcell et al., 2007) was used to perform animal and marker-based quality control, as well as to investigate levels of inbreeding based on runs of homozygosity (ROH). FROH was calculated according to the following parameters: no more than one possible heterozygous genotype was allowed and no more than two missing genotypes were allowed per window. The minimum SNP density was set to 1 SNP every 120 kb with no restriction placed on the minimum number of SNPs in a ROH. The maximum gap length allowed between two consecutive SNPs was no more 1000 kb. Pedigree-based inbreeding (FPED) estimates were received from SA Stud Book for the Ayrshire, Holstein and Jersey and compared with the genomic inbreeding estimates.

Results and Discussion: FROH were estimated at different lengths (ROH1 = 1000 kb, ROH2 = 2000 kb, ROH4 = 4000 kb, ROH8 = 8000 kb, ROH16 = 16 000 kb). FROH > 16 Mb ranged from 0.227 to 0.255 (Ayrshire and Holstein). FROH estimates for the four South African dairy populations indicated an increase in inbreeding across the last ten generations. The inbreeding coefficients estimated from FPED were lower than inbreeding estimated calculated for FROH. This difference may be due to FPED only capturing inbreeding based on recorded pedigree that may only extend to a few generations back, whereas FROH is able to capture both ancient and recent inbreeding. The effective population size (Ne) can be used to assess inbreeding rates and thus genetic diversity within populations. The Ne for the four populations included in the study has decreased to 117, 133, 120 and 112 for the Ayrshire, Holstein, Jersey and SA Dairy Swiss, respectively as estimated approximately 13 generations ago. Strong selection pressure practiced on dairy breeds over the past few decades has resulted in high rates of genetic gain along with increases in inbreeding and thus decreases in the effective population size.

Conclusion/recommendations: Results indicate that inbreeding has been increasing in South African dairy populations, possibly due to the increased use of artificial insemination. The monitoring and control of inbreeding using effective population size as a parameter, is essential for implementation of genetic improvement programs based on genomic information.

The genetic diversity of Nguni cattle populations from South Africa and Swaziland

D.A. Linde[1,2], J. de Vos[1], M. Okpeku[3] & E. van Marle-Köster[1]

[1]Department of Animal and Wildlife science, University of Pretoria, Pretoria, 0002, South Africa, [2]ARC – Animal Production, Private bag X2, Irene, 0062, South Africa, [3]School of Life Sciences, University of KwaZulu Natal, Durban, 4000.

LindeD@arc.agric.za

Background: The sustainability of livestock practices is a focal point in modern day farming. As global warming takes effect by increasing temperatures, the utilization of adapted genotypes for meat production is becoming important. The Nguni is an adapted small frame breed that is used for beef production in communal, smallholder or commercial capacity. It is known for its adaptive traits and therefore well-suited for breeding systems in sub-tropical and climatic challenging regions. Selection for increased production may have a negative impact on genetic diversity and monitoring thereof holds potential for more effective designs of breeding programs. Genotypes generated with high density single nucleotide polymorphism (SNP) arrays have made genomic analyses possible and genomic information on the genetic relatedness among Nguni populations in South Africa and neighbouring countries could be utilized within the breed and in crossbreeding systems.

Aim: The aim of this study was to investigate the genomic diversity of Nguni cattle populations from South Africa and Swaziland, representing stud, commercial and experimental herds.

Methodology: Genotypic data of Nguni cattle generated within the Beef Genomic Project funded by Technology Innovation Agency as part of a feedlot project (n=59) (De Vos, 2018), a diversity project (Makina *et al.*, 2014) (n=56) and Swaziland (n=69) were included. All three projects received ethical clearance. Quality control was performed in PLINK with an individual and SNP call rate of 98%, minor allele frequency (maf) of 0.05 and Hardy-Weinberg Equilibrium (HWE) of 0.1. After quality control 182 animals remained with 41 964 SNPs. The genetic relatedness (heterozygosity and inbreeding) between animals were investigated through PLINK and with a principal component analysis (PCA) using GCTA software (v1.24). The results from the genomic relationship matrix was visualized in Microsoft Excel. Population structure was thereafter investigated with the Admixture function in GENESIS software.

Results & Discussion: Heterozygosity (H_e) of the populations varied from 0.30, 0.29 and 0.31 for the SA populations and Swaziland populations respectively. The PCA and population structure indicated that the Nguni populations from South Africa (SA) formed a tight cluster, while those from Swaziland are widely dispersed and formed a separate cluster compared to the SA populations. Admixture was clear with closer relationships among the SA animals compared to the Swaziland population. This was confirmed by the inbreeding coefficient as the SA populations were higher with 0.01 and 0.03, compared to the Swaziland population with 0.005. The Admixture graph indicates the common ancestry among the three populations, but the Swaziland population is clearly separated. The differences observed can be attributed to the SA population being subjected to well-structured selection programs for a number of decades.

Conclusion/recommendations: It was observed that the Swaziland population showed lower genetic relatedness compared to the SA populations. The Swaziland Nguni's is a valuable resource with regard to the genetic relatedness and inbreeding observed, but further studies will be required.

Implications of bromide toxicity in livestock production

H.L. Lucht[1] & N.H. Casey[1]
[1]Department of Animal and Wildlife Sciences, University of Pretoria, Private Bag X20, Hatfield, 0028, South Africa.
h.lucht@gmail.com

Background: Groundwater is an essential resource for livestock production in South Africa. Bromide (Br^-) concentrations (mg/L) in groundwater range from no observed adverse effect levels (NOAEL) which are considered safe, increasing to constituent of concern (COC) when the concentrations approach the recommended maximum levels for safety, to potentially hazardous chemical constituent (PHCC) when the concentrations exceed the recommended safe levels.

Aim: To illustrate the implications of bromide toxicity in livestock production.

Methodology: Data of Water Research Commission (WRC) reports and scientific papers were collated and analysed.

Results and Discussion: The WRC reports showed the extent and vast range of 0 - 132.68 mg/L of Br^- present in groundwater across South Africa. Risk is a factor of exposure per livestock type and their physiological state. Exposure is calculated as concentration (mg/L) X intake (L/period). Analysed scientific papers brought into perspective that acute and chronic exposure in addition to interactions with environmental factors, can induce negative consequences including hypothyroidism and reduced production, Br^- accumulation in organs and secretion in milk. Bromide competes with Cl^- and infiltrates the Cl^- space in the body; has a relatively long half-life proportional to the ingestion rate and low renal clearance rate of approximately 5% of ingestion, leading to an accumulation in the body. The default recommended NOAEL of ≤0.01 mg/L was validated using the highly sensitive chicken embryo model. The most vulnerable livestock are foetal, neonatal and suckling animals, those with a high water intake such as during lactation or in an adverse environment. However, the default NOAEL of 0.01 mg/L may not be equally applicable to these groups due to the physiological differences between species.

Conclusion/recommendations: Considering this scenario against the validated NOAEL of ≤0.01 mg/L, it emerged that many livestock production systems in South Africa could be exposed to the negative effects of Br^- toxicity. Identifying vulnerable populations and monitoring site-specific water quality enable adequate risk assessment and implementing mitigating strategies to manage exposure risk. It is recommended that research be extended to validate NOAEL for the livestock species according to their physiological status.

Knowledge and perception of small holding farmers on supplementation and feeding of sweet potato vines to goats

C.F. Luthuli[1,2], F.N. Fon[1] & B. Gunya[1]

[1]Department of Agriculture, Faculty of Science and Agriculture, Private Bag X 1001, Kwa Dlangezwa, 3886, University of Zululand, South Africa. [2]Department of Agriculture and Rural Development, Private Bag X20013, Empangeni, 3880, South Africa.
GunyaB@unizulu.ac.za

Background: Goats in rural communities are often raised in conditions which do not allow them to achieve their maximum performance nor express their genetic growth potential. They are raised on poorer quality feeds, with low energy and protein content. For goats to perform to their full potential, they require highly nutritious feed especially in winter with shortages or during high producing periods where nutrient demand is high. However, supplementation can be done using fresh green feeds, protein blocks or vitamins which are often expensive hence the need for indigenous crop residues.

Aim: This study assessed the knowledge and perception of goat farmers on indigenous forage supplementation especially sweet potato vines to goats.

Methodology: This study was conducted at KwaMthethwa community area, under Umfolozi local Municipality, KwaZulu-Natal in South Africa. The data was gathered by administering a total of 105 structured questionnaires using face-to-face interviews. The questionnaire investigated the following about the rural farmers: biodata and some background, livestock inventory, supplementary feeding and perception towards sweet potato vines and cause of any losses incurred. This study was approved by the Research Ethics Committee from University of Zululand with ethical clearance number UZREC171110-030 PGM 2016/292.

Results and Discussion: The results revealed that majority (56.2%) of the farmers were males and 43.8% were female. The majority (71.4%) of households reared goats for socio-cultural purposes whereas few (15% and 9%) reared for income generation and consumption, respectively. Majority of farmers (71.4%) were aware and practice some sort of supplementary feeding but it was mainly to lure animals to the kraal. Some farmers bought feed (34.3%) while others used crop residues (26.7%) or indigenous trees branches (9%). It was confirmed that most farmers (72.4 %) cultivated sweet potatoes for different purposes such as income generation (53.3%), consumption (27.5%) or both (8%). Sweet potato vines were being discarded as waste or burnt (32.4%), left on the field as manure (25.7%), conserved as propagation material (8.6%) or randomly fed to livestock (7.6%). Nevertheless, most of the farmers (78.1%) rejected the use of sweet potato vines as feed for livestock. Most farmers seemed to know about or do some sort of supplementary feeding but lack basic knowledge of the importance and application of supplementary feeding. Sweet potato vines seem to be available to all farmers as the number of rural farmers cultivating it is increasing. However, farmers were not willing to feed vines to goats since they believe vines cause fatal diarrhoea to goats.

Conclusion/recommendations: This study indicates farmers have knowledge of suppletory feeding, however, more interventions are required to develop farmers' knowledge on vines feeding, which is possible through training and workshops for them to enable them to supplement in a profitable manner and eradicate the myth of vines being fatal to goats or making them diarrhoea prone.

The effects of cutting frequency on chemical composition and *in vitro* digestibility of vines from four sweet potato cultivars and yield of tubers

C.F. Luthuli[1,2], F.N. Fon[1] & B. Gunya[1]

[1]Department of Agriculture, Faculty of Science and Agriculture, Private Bag X 1001, Kwa Dlangezwa, 3886, University of Zululand, South Africa, [2]Department of Agriculture and Rural Development, Private Bag X20013, Empangeni, 3880, South Africa.
cynfix@webmail.co.za

Background: Livestock feed is still a challenge in small scale farmers found in developing countries. Exploitation of traditional crops which are often grown with low inputs, and adapted climatically, can be encouraged. It was found that sweet potatoes vines are available hence Sweet potato is one of the five most important food crops in developing countries. Therefore, it will be right to investigate the nutritional quality of vines as feed for livestock.

Aim: This study was conducted to evaluate the effect of defoliation on the chemical composition of sweet potato vines (and its frictions leaf, petiole and stem) from four cultivars at different harvesting periods, and sweet potato tuber yields.

Methodology: Sweet potato vines (and its proportions) from four different cultivars were harvested at different periods (60, 75 and 120 days after planting (DAP)) and the treatments were replicated into three in a complete randomised design. The vines harvested were dried and milled for chemical (neutral detergent fibre, acid detergent fibre and acid detergent lignin, crude protein, condensed tannins) and *in vitro* digestibility analysis. Data collected, was subjected to analysis of variance (ANOVA) using SPSS (2015) and the means were significance difference at $p < 0.05$. This study was approved by the Research Ethics Committee from University of Zululand with ethical clearance number UZREC171110-030 PGM 2016/292.

Results and Discussion: The results indicated that vines and its fractions harvested at 120 DAP had the highest ($P < 0.05$) DM 17.11, 18.15, 19.26 and 21.11%, received from 1990, A40, A45 and Beauregard cultivars, respectively when compared to 60 and 75 DAP. The CP concentration decreased ($P < 0.05$) as the plants matured and condensed tannins (CT) seemed to increase ($P < 0.05$) with plant maturity, except A45 cultivar that had lower tannin concentration even at 120 DAP. The fresh vine yields (75DAP) of 68.08, 25.08, 22.04 and 14.85 t/ha were observed for 1990, A40, A45 and Beauregard cultivars, respectively. Fresh tuber yields of 56.91, 7.22, 6.84 and 15.92 t/ha for 1990, A40, A45 and Beauregard cultivars, respectively, were observed after 75DAP. The vines harvested 60 and 75 days after planting had higher crude protein content compared to those harvested after 120 days. This may be attributed to the high content of fibre since its formation increased more as the plant was maturing.

Conclusion/recommendations: In conclusion the 1990 cultivar had the highest vine and tuber yields at 75 DAP. The vine chemical components did not differ between cultivars when harvested at the same time, apart from the fact that fibre was increasing with maturity and CP decreased. The vines had a comparable nutrient value that is essential for ruminant production with the relatively suitable CP of more than 8% which meets the basic nutrient requirements of ruminant diets.

Population genetic structure and admixture analysis of small holder dairy cattle herds in South Africa using SNP markers

M.E. Maake[1,2], F.C. Muchadeyi[3], O. Tada[2], M.A. Madilindi[1] & C.B. Banga[1]
[1]ARC-Animal Production, Private Bag X2, Irene, 0062, South Africa, [2]Department of Agric Economics and Animal production,University of Limpopo, Private Bag X1106, Sovenga, 0727, South Africa, [3]ARC-Biotechnology Platform, Private Bag X5, Onderstepoort, 0110, South Africa.
maakeeldred@gmail.com

Background: Smallholder dairy production in South Africa is characterised by a low input production system and poor animal productivity. Non-existence of genetic improvement programs and a lack of systems for supporting sound breeding decisions are major factors contributing to impaired animal productivity in this sector. Research has been carried out to benchmark cow productivity on smallholder dairy herds; however, there is limited information on the current status of breeding practices and genetic makeup of cattle used in this production system. Such information is a prerequisite to the design of an appropriate breeding programme for the production system.

Aim: To determine the genetic structure and animal admixture levels for the smallholder dairy (SHD) cattle population in South Africa, through the use of SNP markers.

Methodology: Hair samples of 96 unrelated cattle (Holstein n=80, Jersey n=9 and Nguni n=7) from smallholder dairy herds participating in ARC's National Dairy Animal Recording and Improvement Scheme, in four provinces of South Africa were used. Although the animals were assigned breed-types, they were predominantly crossbred. Deoxyribonucleic acid (DNA) was extracted using the Chemegen extraction kit (Chemegen, 2016). Extracted DNA samples were genotyped using the Illumina BovineSNP150K beadchip. Genotyping was performed using the standard infinium assay protocol (Illumina, San Diego, CA, USA), which features 141 722 SNP probes distributed across the whole bovine genome with an average spacing of 89 kb. Quality criteria, Principal Component Analysis (PCA) and Linkage Disequilibrium (LD) were statistically analysed using SNP and Variation Suite (SVS) V8.1. Estimation of individual breed composition was computed using the Admixture v 1.3.0 software. The PCA results were visualised using the GENESIS package.

Results and Discussion: Estimated means for level of inbreeding, observed and expected heterozygosity were -0.046±0.042, 0.38±0.17 and 0.37±0.13, respectively. All the breeds showed a positive gene diversity, ranging from 0.36 for Holstein and Nguni to 0.38 for Jersey. Holstein had a low positive inbreeding level (F_{IS} values = 0.008±0.080), while the Jersey and Nguni had a slightly higher and negative inbreeding level (F_{IS} values = -0.073±-0.054 and -0.073±0.107). Based on the inspection of admixture plot and PCA, K=2 represented the most appropriate population number for the data set. Admixture analysis showed that most of the animals were Holstein-Jersey crosses. The PCA analysis revealed only two sub-populations, comprising of an admixture of Jersey and Holstein.

Conclusion/recommendations: Smallholder dairy farmers in South Africa are mostly farming with crosses of Holstein and Jersey breeds, and there is a high level of genetic diversity and low level of inbreeding levels in this production system. These results provide a useful insight into the genetic structure and prevailing breeding practices on South African smallholder dairy herds.

The effect of fibre source on the digestibility and production performance of finishing lambs

J.F. Macdonald[1], O.B. Einkamerer[1], A. Lepori[1], A. Hugo[2], G.C. Josling[1] & M.D. Fair[1]

[1]Department of Animal, Wildlife, and Grassland Science, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa, [2]Department of Microbial, Biochemical and Food Biotechnology, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa.

jf.macdonald2@gmail.com

Background: Lucerne hay (LH) is one of the most popular fibre sources used to formulate diets for ruminants in South Africa, but variation in cost and availability often forces producers to consider alternatives. However, research that compares the effect of substituting LH with alternative fibre sources on digestibility and performance of finishing animals are limited.

Aim: The objective of this study was to evaluate the effect of different dietary fibre sources on the nutrient digestibility and performance traits of finishing lambs.

Methodology: All experimental procedures received ethical clearance (UFS-AED2018/0004). Four diets with a comparable nutrient composition were formulated using lucerne hay (LH), soybean hulls (SH), maize stover (MS) and Eragrostis teff (ET) as fibre source. A digestibility study was conducted to determine the nutrient availability of the experimental diets. Thirty six (36) Merino ram lambs (28±1.78 kg) were randomly allocated to the four dietary treatments (n=9 lambs/treatment) and kept individually for the duration of the digestibility study. In addition, a production study was conducted (n=15 lambs/treatment) to determine the dry matter (DM) intake, metabolizable energy (ME) intake, average daily gain (ADG) and feed conversion ratio (FCR). Feed and water were provided *ad lib.* Data were statistically analysed (*P*<0.05) using a fully randomised one-way ANOVA procedure of SAS (2012) and Tukey's studentized range (HSD) test was used to identify significant differences.

Results and Discussion: No differences were recorded between the treatments for neutral-detergent fibre (NDF), acid-detergent fibre (ADF) and ether extract (EE) digestibility, except for MS that had a lower (*P*<0.05) NDF digestibility. LH and SH treatments had comparable DM, organic matter (OM) and non-structural carbohydrates (NSC) digestibility coefficients, while the LH treatment had a significantly higher crude protein (CP) digestibility, ME and available minerals. SH and ET had similar ME content, but SH had a higher (*P*<0.05) DM digestibility. The lowest (*P*<0.05) dietary ME content was recorded for MS. During the production study DMI of LH (1604 g) was significantly higher compared to SH (1472 g) and MS (1477), while the MEI was overall the highest (*P*<0.05) for the LH diet (14.43 MJ/day). Lambs fed LH (315 g) achieved the highest (*P*<0.05) ADG, followed by SH (280 g). FCR of ET (6.3) did not differ from MS (6.4), but both performed significantly poorer than LH (5.1) and SH (5.3). No differences were noticed between LH and SH for FCR. Results indicate that LH achieved the highest ADG due to the higher feed and ME intake. SH were comparable to LH but had an overall lower DM intake which contributed to its lower ME intake and ADG. Overall, MS and ET were outperformed by LH and SH.

Conclusion/recommendations: The present study suggest that lambs fed a finishing diet containing SH as a fibre source performed equally well compared to LH. However, differences in feed intake of LH and SH should be further investigated. Overall the alternative fibre sources can achieve acceptable and possibly profitable performance levels in finishing lambs especially when fibre sources are scarce.

The versatility of an animal scientist

M.D. MacNeil[1,2]

[1]Delta G, Miles City, Montana USA; Agricultural Research Council - Animal Production Institute, Irene, South Africa, [2]University of the Free State, Bloemfontein, South Africa.
macneil.deltag@gmail.com

Background: A successful career as an animal scientist is characterized by a degree of ability to adapt. This versatility should exist at every point in time and evolve over the course of a career.

Discussion: The successful animal scientist will multitask throughout their career and implement updated methods over time. Examples, drawn from addressing problems in animal breeding, will be shown for illustration. Personality traits (e.g., integrity, high standards, collaborative, willingness to share, passionate, and committed) are seen as an important foundation on which to build. Training that focuses on durable disciplines (e.g., critical thinking, mathematics, chemistry, biology, communications) is viewed as the mortar the holds the personality together over the course of a career. The animal scientist is encouraged to continuously study both their science and the applicable livestock industries.

Conclusion: Finally, the thriving animal scientist will stay busy, partner appropriately, do good work, solve problems, and learn continuously.

Evaluation of the use of Assisted Reproductive Technologies for improvement of communal beef cattle project in Limpopo province: Preliminary results

K.F.M. Madia[1], M.L. Mashiloane[1], P.E. Kubjana[1], T.C. Rasekgoalo[1] & P.J. Sebei[1]
[1]Limpopo Department of Agriculture and Rural Development, Mara Research Station, Private Bag X2467, Makhado, 0920, South Africa.
madiak@agric.limpopo.gov.za

Background: Evaluation of any project is done with the aim of determining the extent to which the set objectives of the project were achieved. The information acquired may help to make informed decisions within the project or similar projects to be implemented in future. With a project that is currently ongoing, performance might be improved upon identifying areas that are lagging behind or where progress is not achieved in an efficient manner.

Aim: This study was aimed at evaluating the Assisted Reproductive Technologies (ART) project in Limpopo province

Methodology: Historical data was used for testing of achievements against objectives and a survey used to determine the impact the Beef Profit Partnership (BPP) training had on the farmers and also to gather information on their perceptions on reproductive technologies. Data used included secondary and primary data. Project records and progress reports constituted the main data sources for secondary data. For primary data, structured questionnaire was administered and divided into 4 sections; Section A covered the farmer profile; Section B covered farming operations used by the farmer; Section C strived to determine if the farmer has learned anything from the BPP training and Section D was on determining how the farmer generally views reproductive technologies. Graphical presentation of the contrast between targeted performance and actual performance was made and frequency analysis for various categories of responses from the questionnaire was done.

Results and Discussion: A total number of 280 farmers participated in the ART project for the whole Limpopo province and 756 animals were selected, 631 animals synchronized and 594 animals artificially inseminated. Fourty three percent of the animals were diagnosed pregnant. Fourty six percent of farmers received the BPP training, 85% believed that the recommended methods could improve their production if only they were compatible with their production environment. Fourty three percent seemed to have prior knowledge of these technologies. This was evident as the majority of the farmers only obtained knowledge of these technologies, especially artificial insemination (88%), during the BPP training (38%) and the actual running of the ART project (37%). For all those farmers who received the training, 87% rated the training as effective in improving their current production. A general perception of farmers on the concept of ARTs was that these technologies were effective (86%) in improving the current quality of their livestock.

Conclusion/recommendations: The ART project has met most of its objectives, mainly, to introduce genetically superior cattle to the communal areas of Limpopo province and also to introduce and train farmers on BPP model. The general perception of ART beneficiaries is that, ARTs are effective technologies in improving the production and reproduction of communal livestock herds in Limpopo province.

Conservation and sustainable utilization of indigenous goat genetic resources at Mara ADC

K.F.M. Madia[1], M.L. Mashiloane[1], M.G. Makgobatlou[1] & P.E. Kubjana[1]

[1]Limpopo Department of Agriculture and Rural Development, Mara Research Station, Private Bag X2467, Makhado, 0920, South Africa.
madiak@agric.limpopo.gov.za

Background: The risk of extinction and dilution of the genetic make-up of indigenous goats is a prevailing threat world-wide. This is partly due to on-going crossbreeding with or replacement by exotic germplasm in commercial farming systems and uncontrolled breeding management in communal farming systems. Conservation of indigenous goats will ensure that adapted and reproductively viable goats are available for utilization in possible breeding programs that may be needed in future. In a long run, conservation of indigenous goats will also provide an undiluted genetic pool to the communal/small-holder and as well as the commercial farming system who may need to exploit the epistatic and gene interaction effects in terminal cross breed programs. The continuous improvement through performance selection of the on-station herd will enable Mara to give emergent farmers high performance but adapted animals that will have a positive impact on Livestock Improvement Program (LIP).

Aim: This study was aimed at conserving and promoting sustainable utilization of the indigenous goat genetic resource and also evaluating growth and reproductive performance of the herd.

Methodology: The conservation herd was kept at Mara Research Station, Limpopo Province. The animals composed of 52 breeding does,11 bucks and 25 kids. They were kept in a kraal and allowed to go out in the morning to the browsing camps and then kraaled again in the afternoon. The animals were weighed every 28 days, dosed against internal parasites every season particularly during rainy or wet season. The breeding season of these indigenous goats commenced in June/ July of every year and followed by kidding during November/December. Data analyzed included 64 records on performance data from 2017 to 2018. Productive traits of birth weight (BW), weaning weight (WW) and average daily gain (ADG) were considered for analysis while reproductive traits included were multiple birth percentage(MBP), kidding percentage (KP), weaning percentage (WP) and pre-weaning mortality (PWM).

Results and Discussion: Male kids averaged a BW and WW of 2.22 kg and 12.83 kg respectively while the female kids averaged a BW and WW of 1.90 kg and 11.67 kg respectively. The results also indicated that male kids had an average pre-weaning growth rate of 69.55 g/day, while female kids averaged pre-weaning growth rate of 67.58 g/day. Does showed a high KP (108.82), a moderate WP (67.57) and a moderate MBP (43.24). The current flock had a high PWM of 32.4%.

Conclusion/recommendations: The results suggested that, under good management, the indigenous goat can produce sustainably for resource poor farmers, however more data needs to be gathered to investigate and evaluate the perfomance of the current flock.

Genetic differentiation and population structure of four Mozambican indigenous cattle populations using microsatellite markers

M.A. Madilindi[1,2], N.O. Mapholi[3], E. Bhebhe[2], Y.P. Sanarana[1], K.S. Nxumalo[1], M.G. Taela[4] & C.B. Banga[1,5]

[1]ARC-Animal Production, Private Bag X2, Irene, 0062, South Africa, [2]Department of Animal Science, University of Venda, Private Bag X5050, Thohoyandou, 0950, South Africa, [3]Department of Life and Consumer Sciences, University of South Africa, Private Bag X6, Florida, 1710, South Africa, [4]Directorate of Animal Science, Agrarian Research Institute of Mozambique, Av. Namaacha Km 11.5 P.O. Box 1410, Maputo, Mozambique, [5]Department of Animal Sciences, Faculty of Science, Tshwane University of Technology, Private Bag X680, Pretoria, 0001, South Africa.
matomemadilindi@gmail.com

Background: Knowledge of genetic diversity and population structure among livestock populations plays an important role in the design of genetic improvement programmes, as well as sustainable utilization and conservation of genetic resources. Previous studies on the genetic diversity of Mozambican indigenous cattle have been limited to only three populations (Angone, Bovine de Tete and Landim). The Namaacha Nguni has, however, not been studied at the genetic level; hence the need to assess the genetic diversity of all existing Mozambican indigenous cattle.

Aim: To investigate genetic differentiation and population structure among four Mozambican indigenous cattle populations using 25 bovine-specific microsatellite markers.

Methodology: Animal ethical clearance to conduct the study was granted by the Animal Ethics Committee of the University of Venda, South Africa (SARDF/16/ANS/03/1404). Hair samples were collected from 120 unrelated animals from government research stations and stud herds in Mozambique. These comprised of Angone n=30, Bovine de Tete n=30, Landim n=30 and Namaacha Nguni n=30. Deoxyribonucleic acid (DNA) was isolated by using phenol-chloroform extraction and the DNA extracts were genotyped using a panel of 25 bovine-specific microsatellite markers. Allele sizes of each microsatellite marker were analysed using GeneMapper version (ver.) 4.0, followed by computational statistics using software such as Microsatellite toolkit, GenAlex ver. 6.4.1, Arlequin ver. 3.1, DARwin ver. 6 and STRUCTURE ver. 2.3.4.

Results and Discussion: Estimates of mean number of alleles as well as observed and expected heterozygosity were 6.92 ± 0.20, 0.68 ± 0.02 and 0.71 ± 0.01, respectively, for the populations. These indicated sufficient genetic diversity across all studied populations. Genetic differentiation among the populations accounted for 8.02 % of total genetic variability. Negative (-0.025 ± 0.029) to low positive (0.073 ± 0.050) levels of inbreeding were observed within the four populations (Angone, Bovine de Tete, Landim and Namaacha Nguni). Genetic distances indicated by Factorial Correspondence Analysis revealed a close relationship between the Bovine de Tete and Landim as opposed to the Angone and Namaacha Nguni. STRUCTURE analysis assigned the four Mozambican populations independently. However, Bovine de Tete and Landim showed relatively higher levels of admixture with each other than Angone and Namaacha Nguni.

Conclusion/recommendations: It can be concluded that Mozambican indigenous cattle populations have a high level of genetic diversity. Moreover, Bovine de Tete and Landim are genetically closer than the Angone and Namaacha Nguni. These results may be useful for determining current and future breeding programmes, management and conservation strategies for Mozambican indigenous animal genetic resources.

Effect of lambing season, sex, and birth type on pre-post growth performance and wool characteristics of Merino lambs

M. Magawana[1], T.J. Dugmore[2] & J.F. de Villiers[2]

[1]KwaZulu-Natal Department of Agriculture & Rural Development, Kokstad Research Station, Livestock Science Research Services, Private Bag X 501, Kokstad, 4700, [2]KwaZulu-Natal Department of Agriculture & Rural Development, Cedara Research Station, Livestock Science Research Services, Private Bag X 9059, Pietermaritzburg, 3200.
mpumelelo.magawana@kzndard.gov.za

Background: In the East Griqualand of KwaZulu-Natal, there are three lambing seasons for sheep namely: March and April (Autumn) normal lambing season, September and October (Spring) and year round (breeding sheep out of season). The respective breeding seasons are well adopted by the commercial sector with unlimited resources in terms of availability of feed throughout the year. Spring is the most common breeding season used by commercial farmers, while year round breeding is generally practiced by the resource poor sheep farmers within a radius of 100 km around Kokstad Town. However, the effect of year round breeding on growth performance and wool characteristics has not been investigated previously.

Aim: The aim of this trial was to evaluate the effects of lambing seasons (autumn, spring and year round) on growth performance and wool characteristics of Merino lambs.

Methodology: The departmental research committee and sub-committee on animal welfare approved the trial with project number: AS-B08/03K. A two- year study was conducted at Kokstad Research Station to investigate the effect of three lambing seasons, sex and birth status on growth performance and wool characteristics of Merino lambs. Data was collected using 156 lambs born from autumn (52), spring (60) and year round lambing (44) seasons respectively and was subjected to statistical analysis ($P<0.05$) using GenStat 18.1.

Results and Discussion: Lambs born in spring were (1.5 kg) heavier ($P<0.001$) than those born in autumn and year round (1.1 kg) lambing at birth (0 days). Lambs born in spring (4.3 kg) and autumn (4 kg) were heavier ($P<0.001$) than those born in year round at weaning (90 days). Moreover, lambs born in autumn (5.6 kg) and year round (3 kg) were heavier ($P<0.001$) than those born in spring post-weaning (180 days). Male lambs were (0.4 kg) heavier ($P<0.05$) than female lambs at birth (0 days). Lambs born in autumn (286.9 g/day) had a higher ($P<0.001$) pre-weaning ADG than the lambs born spring (223.1 g/day) and year round (203.2 g/day), respectively. The effect of sex and birth status of lambs was not significant ($P>0.05$) on pre-weaning ADG. Moreover, lambs born in year round (106.8 g/day) had a higher post-weaning ADG than those born in autumn (28.7 g/day) and spring (29.4 g/day). The effect of sex and birth status of lambs was not significant ($P>0.05$) on post-weaning ADG. The year of lambing had a significant effect on birth, pre- and post- weaning live weights. Similarly, the year of lambing also had a significant effect on pre and post ADG. Lambing seasons had a significant effect on fleece weight and fibre diameter whilst there was no effect on clean yield. The fleece weight and fibre diameter were affected by shearing year. There was a significant interaction between year and 90-180 days ADG.

Conclusion/recommendations: The results suggest that spring born lambs tend to perform better from birth to 90 days than those lambs born in autumn and year round. However, spring born lambs perform poorly at 180 days compared with autumn and year round, respectively. Spring born lambs performed better in terms of wool characteristics than those born in autumn and year round.

The genomic evaluation of farm animals in Southern Africa

A. Maiwashe[1, 2]
[1]ARC-Animal Production, Private Bag X2, Irene, 0062, South Africa, [2]University of the Free State, Department of Animal, Wildlife and Grassland Sciences, PO Box 339 Bloemfontein 9301, South Africa.
norman@arc.agric.za

Background: The Southern African Development Community (SADC) is home to a number of farm animal species owing to its abundance of natural resources. Apart from their role as food-producing animals, they also play important socio-cultural roles. Recent regional and global trends such as global warming and climate change, rapid urbanisation and veld degradation, amongst others, pose a threat to food security in the region. Accordingly, genetic improvement offers a sustainable approach towards maintenance of genetic diversity of the farm animal genetic resources in the region.

Aim: This study presents a review of the current breeding programmes in South Africa as a case study and provides perspectives on how to enhance national genetic evaluation systems by incorporating state-of-the-art genomic technology.

Methodology: South Africa has well established performance recording and improvement schemes for major food-producing species. This tradition dates back to the early 20th century. These Schemes have evolved over time from simple and rudimentary pedigree-based selection to performance-driven and currently more advanced and accurate genomic-based selection. In keeping with the tradition of continuous innovation and improvement, South Africa is currently involved in various national initiatives to implement genomic selection in livestock breeding and improvement programmes. Key lessons have been learnt through the first phase of the national beef and dairy cattle genomics programmes. Lessons learnt are discussed and future perspectives on genomic selection are discussed.

Results and Discussion: After almost 10 years of discussions and planning, South Africa has made tremendous progress in genotyping and sequencing of livestock through the Beef and Dairy Genomics Programmes (BGP and DGP, respectively). To date, these national initiatives have yielded modest quantities of data leading to implementation of genomic selection. Given different levels of performance recording in different beef breeds, the process followed to implement genomic selection considered two different approaches. One group of breed associations focused on genotyping while the other group placed more emphasis on collection of difficult and costly phenotypes e.g. feed efficiency and meat quality. This differences in approach suggest that there is no one-size-fit all with regard to implementation of genomic selection. Through this initial efforts, it is evident that cooperation among different stakeholders is of critical importance in ensuring success of these national initiatives. One of the major achievements is that the volume of genotyping has increased leading to drop in the price of the SNP chip. It is anticipated that the rate of implementation and adoption of genomic selection will be exponential in the few coming years. While the country has demonstrated that genomic selection can be implemented in the region, despite all the logistical challenges, the need for phenotypic data cannot be emphasised enough.

Conclusion/recommendations: Given the general low level of performance recording in Southern Africa, it is recommended that improvement of the accuracy of pedigree / relationship is used as a leverage to fast track implementation of genomics technology. Other uses of genomic data such as parentage testing provides an incentive for easy adoption of the genomics technology.

Effects of different inclusion levels of Marula (*Sclerocarya Birrea*) pulp at ensiling on the rumen degradability of Napier grass (*Pennisetum purpureum*) silage

U. Makharamedzha[1], M.S. Mikasi[1] & J.J. Baloyi[1]

Department of Animal science, School of Agriculture, University of Venda, Private Bag X5050, Thohoyandou, 0950, Republic of South Africa.
joseph.baloyi@univen.ac.za

Background: Drought, rainfall patterns, and temperature variations, especially in the tropical regions of southern Africa, limit forage supply for livestock production. Hence there is need to conserve forages in the form of either hay or silage as an alternative to maintain animal productivity especially during dry periods. Tropical forages are low in water soluble carbohydrates (WSC), which are important for ensiling. Addition of sources of WSC like Marula pulp would result in increased lactic acid production.

Aim: The study aimed to determine the effect of Marula (*Sclerocarya birrea*) pulp inclusion on the chemical composition and rumen degradability of Napier grass (*Pennisetum purpureum*) silage.

Methodology: Napier grass was planted in 4 x 5 meter plots replicated three times and irrigated using spray irrigation for 12 weeks. Fresh Napier grass was manually harvested, chopped and ensiled with Marula pulp included at four different levels of 0% (control), 10%, 30% and 50% of the grass. After 8 weeks of ensiling, the Napier grass-Marula silage samples were analyzed for chemical composition and rumen degradability profiles were determined at 0, 6, 12, 24, 48, 72, 96 and 120 hours (h) in three Bonsmara steers fitted with rumen cannula. Analysis of variance (ANOVA) on silage quality was performed using General Linear Model (GLM) procedures of MINITAB Statistical package version 17 (Minitab, 2014). Significant differences between the treatments were detected, means were separated using the Tukey's test (Tukey, 1953). The University of Venda's Ethics Committee was sought and granted ethical clearance before the research trials with animals begun (**Project no: SARDF/16/ANS/07/2208)**. The animals were cared according to the guidelines of the Animal's Ethics committee of the University of Venda.

Results and Discussion: Fermentation characteristics did not differ ($P>0.05$) with the level of inclusion of Marula pulp. However, the 10% inclusion had highest crude protein (CP) (97.0 g/kgDM) and lowest pH of 3.5. DM, CP and NDF disappearance of all treatments increased linearly with the duration of ruminal incubation. Fifty percent Marula pulp inclusion increased CP disappearance ($P<0.05$). The soluble fractions "*a*" ranged from 10.9 – 15.7% among the evaluated treatments. Potential degradability "*a+b*" of DM showed 30 and 50% inclusion levels with the highest effective DM degradability ($P<0.01$) as compared to the 0 and 10%.

Conclusion/recommendations: In conclusion, fresh Marula pulp additive inclusion improved the nutritive value of Napier grass-Marula silage with 10 and 50% inclusion dominating in terms of quality, chemical composition and rumen DM and CP degradability as compared to the other treatments.

Identification of single nucleotide polymorphisms in epigenetic related genes associated with carcass traits in South African indigenous cattle

K.T.E. Makua[1,2], A.A. Zwane[1], M.L. Makgahlela[1], K.A. Nephawe[2] & B.J. Mtileni[2]
[1]Animal Production Institute, Agricultural Research Council, Private Bag X2, Irene, Pretoria, 0062, South Africa, [2]Department of Animal Science, Tshwane University of Technology, Private BagX680, Pretoria, 0001, South Africa.
makuaet@outlook.com

Background: South African (SA) indigenous beef cattle such as Nguni, Afrikaner and Bonsmara play an important role in the country's livestock industry, especially in beef sector. The meat characterisation of indigenous cattle plays a key role in economic market of the country. The application of effective molecular markers in selection for beef quality traits is important approach that can bring improvement in beef quality. There is lack of information regarding SNPs in epigenetic related genes associated with carcass quality traits in indigenous cattle such as Nguni, Afrikaner and Bonsmara cattle.

Aim: The aim of the study was to identify single nucleotide polymorphisms in epigenetic related genes associated with carcass traits in South African beef cattle using Illumina BovineSNP50 BeadChip.

Methodology: Genotype data generated from preceding projects were available for this study (Makina *et al.*, 2014; Zwane *et al.*, 2016). Data from BovineSNP50 generated for Nguni (n=60), Afrikaner (n=41) and Bonsmara (n=46) were analysed. Holsteins (n= 41) included as reference population. Genetic variability between breeds, allele frequency distributions and proportion of SNPs estimated within breed using PLINK version 1.09. Breed specific SNPs identified using Reynolds Fst and extended Lewontin and Krakauer's (FLK) statistics. Breeds differentiated using principal component analysis (PCA). SNPs association analysis done to determine SNPs associated with beef quality traits.

Results and Discussion: No significant differences observed between indigenous breeds for proportion of SNP with minor allelic frequency (MAF) ≥ 0.01. Minor difference observed between Afrikaner and Nguni populations for proportion of SNP with MAF ≥ 0 and MAF ≥ 0.05. Holstein had highest MAF (0.31) compare to indigenous cattle for proportion of SNP with MAF ≥ 0.05. This may be due to ascertainment bias in the design of the BovineSNP50 assay because were designed specifically for bos Taurus breed. Lowest percentage of polymorphic SNPs observed in in Afrikaner (50%) compared to Nguni (66%) and Bonsmara (69%). Closed genetic distances observed between Nguni, Afrikaner and Bonsmara respectively. Four epigenetic related genes (DNMT1, DNMT3a, DNMT3b and HDAC5) significantly associated with carcass quality traits across three indigenous cattle. The CAPN1 SNP significantly associated with meat color score (p<0.05) in Nguni. These findings suggest that epigenetic related genes could be potential candidate genes for genetic improvement in beef quality traits.

Conclusion/recommendations: The SNPs found in this study can be used in further studies to investigate and validate their functional effects on meat quality traits in cattle. These SNPs could guide investment in better cattle offspring as complementary indicators of meat quality. However, further studies are needed to validate the extent of DNA methylation on the identified genes, on indigenous cattle.

The *in vitro* activity of *Brevibacillus laterosporus* and *Bacillus coagulans* on sheep nematodes control

M.I. Malatji[1], D. Luseba[1], M.A. Tsotetsi-Khambule[2]

[1]Department of Animal science, Private Bag X680, Tshwane University of Technology, Pretoria, 0001, South Africa, [2]Department of Helminthology, Private Bag X04, Agricultural Research Council – Onderstepoort Veterinary Institute, Onderstepoort, 0110, South Africa.
innociousmoyahabo@gmail.com

Background: Gastrointestinal nematodes infections in small ruminants endanger animal welfare and causes economic losses. Recent studies have shown the probiotic effect on intestinal parasite and few non-gut infections. These varieties of probiotics (either used individually or in combination) possess antiparasitic effects against gastrointestinal parasites both in egg and larval stage of the parasites. However, more studies needs to be done on *in vitro* culture systems to evidence the cellular interactions between probiotics and pathogens, and the probiotic multiple molecular mechanisms that might provide a strain-specific protection against parasites. Therefore, their application in therapeutics remains controversial.

Aim: To analyse *in vitro* probiotic efficacy of *B. laterosporus* and *B. coagulans* towards nematodes control when supplemented separately and in combination of the two.

Methodology: The experimental procedures involved were approved by TUT and ARC-OVI Ethics committee (Experiment No. 21/017). Faecal samples from 40 adult Pedi sheep were collected using McMaster technique to evaluate, identify and characterize nematode eggs. Larval cultures were prepared according to Reinecke (1983) and incubated at 27℃ for 7 days. At day 7 the larvae were harvested from the *in vitro* cultures and poured into a single petri dish. The L3 larvae were pipetted into 96-well assay plates. Probiotics were also pipetted in same wells at 3 different concentrations levels (0,001, 0,002, and 0,003 CFU/g). Thiabendazole® (positive control) and distilled water (negative control) were also added at same concentration levels. All the tests were replicated 3 times. Larval counts were done firstly at 2, 24, 48 and 72 hour intervals. All live and motile L3 stage larvae were counted. Repeated measured techniques of SAS in modelling the covariance of the structured data were used. Fishers LSD test were used to separate the means ($P<0.05$).

Results and Discussion: In larval mortality assays, *B. laterosporus* + *B. coagulans* (BL+BC) had the highest mortality rate at 89, 63%, followed by *B. coagulans* (BC) at 86, 82%, and *B. laterosporus* (BL) being the lowest at 83, 16% in overall. It was evident that these probiotics performs better when used in combination than when used separately. The BL + BC mortality percentage was significantly ($P <0.05$) higher by 2, 81% from BC, and 6, 47% higher from BL. Therefore, BL + BC obtained the highest mortality rate followed by BC, with BL being the lowest. On this study, only ten nematode eggs were documented. The results showed that *Coccidia* was the leading parasite at 3 300 EPG (Egg Per Gram) followed by *Haemonchus contortus* at 1 700 EPG.

Conclusion/recommendations: Integrated parasite and proper management techniques should be aligned together with biological controls. The results from this study verified the probiotic potency on gastrointestinal parasites. However, their efficacy is not completely documented and therefore; more studies needs to be done to elucidate their therapeutic use.

Non-genetic effects on milk traits in the South African Saanen goat herd

M.J. Malemela, O. Tada & K.R. Nemutandani

Department of Agricultural Economics and Animal Production, Private Bag X1106, University of Limpopo, Sovenga, 0727, South Africa.
Mahlatsemalemela93@gmail.com

Background: The primary objective of dairy goat production is to improve traits that are associated with milk production. However, the production of milk is not only dependent on the genetic merit of animals; non-genetic factors determine to what extent the genetic merit is expressed. Effects of various non-genetic factors on certain milk traits in the South African Saanen herd have previously been reported to be non-significant. However, due to changes in the environment, management practices and an improvement in record keeping over time their effects on milk traits should be investigated. Adjusting records for non-genetic effects is essential for defining models that are appropriate for the improvement of selection procedures and variance components estimations.

Aim: This study was conducted to investigate the effects of dam kidding age, birth season, kidding season, parity and litter size on lactation yield of SCC (somatic cell count), urea concentration, yields for milk, fat, protein and lactose in the South African Saanen herds.

Methodology: 31, 294 lactation records from 1959 to 2018 were obtained through South African Studbook and MILCH breeders' society. The dataset comprised of all grade and registered goats participating in the official Milk Recording and Performance Testing Scheme of the Animal Improvement Institute of the Agricultural Research Council of South Africa. The fixed factor levels were 4, 4, 8 and 3 for birth season, kidding season, parity and litter size respectively. The dataset was statistically analysed using a fully randomized ANOVA to determine significant non-genetic factors affecting SCC, urea concentration, yields for milk, fat, protein and lactose. Fisher's least significant difference (LSD) method at 95% confidence was used for mean separation. Pearson correlation co-efficients were calculated for the kidding age and milk quality traits.

Results and Discussion: Dam kidding age was positively correlated to SCC (r=0.193) while negatively correlated to fat, protein, lactose and urea concentration (*P<0.05*). Parity had significant effects on all the traits investigated with 3rd parity dams yielding the highest milk, fat, protein and lactose per lactation (1059.5±40.1, 39.75±1.61, 22.85±1.24 and 24.82±1.86 kg respectively) and the least yields were from 8th parity dams (723.7±75.4, 25.35±3.03, 11.3±2.34 and 9.89±3.50 kg for milk, fat, protein and lactose respectively). The highest (2.42±1.04) and least (0.970±0.906) SCC index were from dams in the 8th and 1st parity respectively while 3rd parity dams had the least urea concentration (27.000±0.679mmol/L) with 7th parity dams having the highest (30.22±1.10mmol/L). Dams born during post-rainy season had the highest yields for lactose (20.29±383g/L) and milk (961.7±82.4kg) while those born during cold-dry season yielded the least (16.39±1.84g/L and 884.2±39.5kg for lactose and milk respectively). The post-rainy kidding season gave the least yield of 30.46±5.24g/L, 6.62±6.07g/L and 1.55±1.03 on fat, lactose and SCC index respectively. Hot-wet kidding season yielded significantly high fat and SCC index while the highest yield for lactose was from hot-dry kidding season (23.08±1.23g/L). Dams with triplets yielded the highest milk (957.7±43.3kg) and lactose (18.92±2.01g/L) per lactation while the least yields were from animals with single kids (898.8±42.7kg and 17.71±1.99g/L respectively).

Conclusion/recommendations: Results on the study suggest that yields for milk traits investigated decrease as the kidding age of the dam increases except for SCC. All the traits investigated were affected by dam parity. Depending on the objective, planned breeding should be used to obtain high yields. It is recommended to use dams in their 3rd parity to obtain high yields for milk, fat and protein and least urea concentration per lactation. Hot-dry season is the ideal breeding season for obtaining desirable attributes of milk traits such as milk yield, fat yield, lactose yield and SCC index.

Performance, carcass and bone characteristics of Ross 308 broiler chickens fed varying levels of low tannin Macia sorghum-based diets

T.G. Manyelo[1], J.W. Ng'ambi[1], D. Norris[1] & M. Mabelebele[2]

[1]University of Limpopo, Department of Agricultural Economics and Animal Production, School of Agricultural and Environmental Sciences, South Africa, [2]University of South Africa, Department of Agriculture and Animal Health, College of Agriculture and Environmental Sciences, South Africa.
manyelo.t.g@gmail.com

Background: Maize constitutes about 50 to 60% of the diets for broiler chickens. However, its use in the poultry industry is becoming scarce and expensive because of the decline in its production due to unfavourable climatic conditions. Moreover, there is high demand for maize by humans which puts pressure on prices. Therefore, there is need to replace maize with other energy feeds such as sorghum meal.

Aim: This study was conducted to determine the effect of replacing maize with low tannin white sorghum on the production performance, carcass and bone morphometrics of Ross 308 broiler chickens.

Methodology: A total of 250 day-old male Ross 308 broiler chickens weighing 42.05±3 g were randomly assigned to a complete randomised design with five treatments, each replicated five times (n=10 birds/replicate) during a 42-day trial. Chickens between D0-21 and D22-42 of age were offered varying sorghum levels as maize replacement at 0%, 25%, 50%, 75% and 100% formulated to be isonutritive and isoenergetic. Chickens were raised on 25 floor pens. The Animal Ethics Committee of the University of Limpopo approved the experiment with the number AREC/01/2017: PG. Feed intake and body weight of each replicate treatment were determined on a weekly basis to calculate feed conversion ratio. Diet digestibility was done between D15-21 and D35-42 of age. Four birds were randomly selected from each replicate and transferred to metabolic cages to measure apparent digestibility. At D42, two birds per pen (n=10/treatment) were sacrificed for carcass and bone characteristics measurements. Breast meat samples were analysed for shear force and sensory attributes. A total of 25 participants were used for consumer sensory attributes. A total of 80 right tibia bones were obtained to determine the weight, length diameter and mineral contents. General Linear Model (GLM) procedure of SAS (2008) was used to analyse data.

Results and Discussion: Feed intake, growth rate, FCR and N-retention, were not affected (P >0.05) by replacing maize with low tannin white sorghum. Body weight was higher (P <0.05) for birds fed a level of 50% of maize replaced by sorghum than those that fed 100% maize. Replacing maize with sorghum improved metabolisable energy of broiler chickens aged 42 days. Body weights and FCR of birds in the 50, 75 and 100% of maize replaced by sorghum were higher and better (P <0.05) than those on the diets containing 25 and 0% sorghum between D22 and 42. The breast meat yield of broiler chickens offered 75 and 100% sorghum levels were heavier (P <0.05) than those on diets having 0, 25 and 50% of maize replaced by sorghum. The sorghum replacement level did not influence (P <0.05) the ultimate pH of meat parts. The shear force was higher (P <0.05) for breast meat of chickens offered sorghum replacement of 75 and 100%. Sensory attributes and bone morphometries of chickens aged 1-42 days were not affected (P >0.05) by replacing maize with sorghum.

Conclusion/recommendations: It can be concluded that low tannin white sorghum could replace maize as energy source in broiler diets without having any adverse effect on performance, carcass and bone characteristics.

Effects of feeding canola meal-containing diets on tibia inorganic contents and biomechanics of Potchefstroom Koekoek chickens

F. Manyeula[1], V. Mlambo[2], U. Marume[3] & N.A. Sebola[3]

[1]Department of Animal Science, Botswana University of Agriculture and Natural Resources, P/Bag 0027, Sebele, Gaborone, Botswana, [2]Faculty of Agriculture and Natural Sciences, University of Mpumalanga, Private Bag X11283, Mbombela 1200, South Africa, [3]Department of Animal Science, North-West University, P /Bag X2046, Mmabatho 2735, South Africa.
manyeulafreddy@yahoo.com

Background: Indigenous chickens are a major source of animal protein in resource-poor communities and thus play a critical role in ensuring food and nutrition security. Canola meal is a potential alternative protein source for these chickens; however, mineral bioavailability from canola meal tends to be lower when compared to soybean meal. Feeding canola meal-containing diets may negatively affect bone development and mineralisation in indigenous chickens due to the mineral composition thereof.

Aim: To evaluate the effects of partial replacement of soybean products (SBM) with canola meal (CM) in Potchefstroom Koekoek (PK) cockerel diets on tibia biomechanics and inorganic contents.

Methodology: All experimental procedures were approved by the animal ethical committee at the North-West University (NWU 00517-16-A9). Dietary treatments were formulated with the inclusion of canola at 0, 3.75, 6.25, 8.75 and 17.5% in place of soybean meal in grower diets. A hundred and seventy-five, 36-day old PK cockerel chicks were randomly allocated to the dietary treatments (n=35 birds/treatment). Each treatment was sub-divided into five replicate pens with 7 birds/pen. The birds were weighed at the beginning of the experiment (342.6±16.52 g) and on a weekly basis thereafter. All birds were humanely slaughtered at the end of the experimental period (13 weeks). Five right and left tibiae were randomly removed for each treatment for inorganic contents and tibia biomechanics. Data on inorganic contents and tibia biomechanics parameters were obtained and analysed using the general linear models (GLM) procedure of SAS (2010).

Results and Discussion: There were no dietary effects ($P>0.05$) on tibia length, weight, width, density, diameter proximal end, diameter distal end, breaking strength and ash percentage. Dietary inclusion of canola meal had an effect ($P<0.05$) on both macro and trace mineral concentrations of the tibia. Tibia from cockerels fed 17.5% CM had the lowest ($P<0.05$) Ca and P content. Lower ($P<0.05$) tibia Mg and Na concentration were observed in the cockerels fed 8.75 and 17.5% CM compared to tibia of those fed on the other diets. The tibia inorganic contents had a significant effect on macro and trace mineral concentrations of the chickens indicating that inclusion of canola in diets did not negatively affect bone and general health of the chickens.

Conclusion/recommendations: Replacing SBM with CM had no negative effect on tibia biomechanics but 17.5% levels CM negatively affected tibia inorganic contents suggesting a problem with mineral bioavailability.

Comparison of the quality of embryos produced *in vivo versus in vitro* in African Bonsmara, Boran and Nguni cattle

M.H. Mapeka[1, 2], R. Treadwell[3], C.M. Pilane[1], N. Moyo[2], J.W. Ng'ambi[2] & <u>C. Banga</u>[1,4]

[1]Agricultural Research Council, Animal Production Institute, Germplasm Conservation & Reproduction Technology, Private Bag X2, Irene 0062, South Africa, [2]Embryo Plus, P.O Box 2644, Brits 0250, South Africa, [3]University of Limpopo, Faculty of Science & Agriculture, Department of Animal Production & Agricultural Economics, Private Bag X1106, Sovenga 0727, South Africa, [4]Tshwane University of Technology, Department of Animal Sciences, Private Bag X 680, Pretoria, 0001, South Africa.
Cuthbert@arc.agric.za

Background: The widespread utilization of bovine embryo technologies has emphasized a big need for embryo production, for scientific as well as commercial purposes. Embryos with normal morphology are classified as high quality embryos, which translates to high conception rates. The quality of embryos is determined and can be affected by inadequate culture environment after fertilization. Factors such as breed of the animal and nutrition may also influence embryo quality.

Aim: The Aim of this study was to evaluate the effectiveness of embryo production systems (*in vivo* & *in vitro*) on embryo quality in African Bonsmara, Nguni and Boran cows.

Methodology: Ethics approval for this study was granted by the Agricultural Research Council-Animal Production ethics committee. Two embryo production methods (*in vivo* & *in vitro*) were compared on the quality of embryos. For the *in vivo* method, cows were superovulated then inseminated with frozen/thawed bull semen. Seven days post insemination, the cows were flushed using an embryo flushing medium for retrieval of embryos, which were then transferred to the laboratory for quality assessment. For the *in vitro* method, two oocyte retrieval techniques were used: Ovum pickup from live cows and ovary aspiration from slaughtered cows. Oocytes retrieved from both methods were matured separately for 24 h in TCM-199 containing 10% foetal calf serum, 10 µg/ml LH, 1 µg/ml E2 and 1 µg/ml FSH under humidified air of 5% CO_2 at 38.5°C. Following maturation, oocytes were fertilized with semen from Bonsmara, Nguni and Boran breeds then co-incubated in Bracket and Oliphant's fertilization medium at 38.5°C for 18 hrs. After 18 hrs, zygotes were again incubated at 38.5°C and cultured in synthetic oviductal fluid based medium containing 8 mg/ml fatty acid-free BSA for 7 days. Following culture, embryos that developed to blastocyst stage were selected and their morphology was graded according to the standards developed by the "International embryo transfer society". Data were statistically (*P<0.05*) analysed by one-way ANOVA.

Results and Discussion: Breed had no effect (*P>0.05*) on the total number of blastocysts produced *in vivo*. However, day 8 blastocyst was significantly higher (*P<0.05*) in Bonsmara (7.50 ± 1.91) and Nguni (7.50 ± 1.73) compared to Boran (4.5 ± 1.00). Moreover, there was no significant (*P>0.05*) difference in the number of grade 1, grade 2 and grade 3 blastocysts produced *in vitro*. Flushing and Ovum pickup/*IVF* resulted in a significantly (*P<0.05*) higher (9.33±7.39; 10.50±7.09) blastocyst rate compared to ovary aspiration (1.33±1.21).

Conclusion/recommendations: This study demonstrated that the *in vivo* method produced morphologically better quality embryos compared to the *in vitro* method. Furthermore, the studied breeds did not show any significant effect on the quality of embryos produced.

Reproduction performance of Bapedi ewes following oestrous synchronisation and natural mating in different conservation farms

A. Maqhashu[1,2], M.L. Mphaphathi[2,3], P.J. Sebei[5], F.V. Ramukhithi[3], T. Raphulu[5], N. Bovula[3], N.O. Mapholi[6], K.A. Nephawe[3], H.A. O' Neill[2] & T.L. Nedambale[2,3,4]

[1]Department of Animal and Wildlife Sciences, University of Pretoria, Pretoria 0002, RSA, [2]University of the Free State, Department of Animal, Wildlife and Grassland Sciences, P.O. Box 339, Bloemfontein, 9300, RSA, [3]Agricultural Research Council, Private Bag X2, Irene, 0062, Pretoria, RSA, [4]Tshwane University of Technology, Faculty of Science, Department of Animal Science, Private Bag X680, Pretoria, 0001, RSA, [5]Mara Research Station, Limpopo Department of Agriculture, Private Bag x 2467, Makhado, 0920 Limpopo, RSA, [6]Department of Life and Consumer Sciences, University of South Africa, Private Bag X6, Florida 1710, RSA.
nedambaletl@tut.ac.za

Background: Good reproductive performance is a prerequisite for any efficacious livestock production and conservation programme. Indisputably, there is no milk if birth does not occur, no meat and fibre if survival cannot be ensured. Bapedi sheep are indigenous to South Africa, classified under the Nguni sheep breeds, they are fat-tailed, fine wool and a multi-coloured breed. Indigenous sheep of South Africa have not been characterized fully and little is known about their reproductive performance.

Aim: The objective of this study was to measure reproductive performances of Bapedi ewes conserved *in situ* and *ex situ* following oestrous synchronisation.

Methodology: This experiment procedures and management of animals were evaluated and approved by the Agricultural Research Council ethics committee under the Germplasm Conservation and Reproductive Biotechnologies department (APIEC 17/13). A total of 89 Bapedi ewes conserved *ex situ* (ARC; n = 34) and *in situ* (Towoomba n=15; Tompi Seleka n= 20 and Mara farm; n= 20) were synchronized for oestrus and ovulation using a 9 days protocol where a controlled internal drug release device (CIDR) was inserted in the vagina of each ewe on day 0 and were injected with 300 IU of eCG on the day of progestogen withdrawal (day 9) and heat was observed using a vasectomised ram. All ewes observed to be on heat (tail wagging, restlessness, frequent bleating and stand to be mounted) were exposed to fertile rams for mating. The data (oestrus response, pregnancy rates, prolificacy and fecundity) was recorded and analysed using analysis of variance (ANOVA) and general linear model of (SAS, 2009).

Results and Discussion: The Bapedi ewes were synchronized successfully and the response rates ranged from 83-100% in both conservation methods. The pregnancy rates were (*ex situ in vivo* ARC) 65 %*,(in situ* Towoomba, Tompi Seleka and Mara farms) 67, 53, and 70% respectively. Towoomba farm had only single births, this can be due to nutrition, genetics and or population differences. There were no significant differences (P<0.05) between the two conservation methods on the gestation length of Bapedi ewes. Prolificacy of Bapedi sheep was 1.30±0.6 1.28±1.3; 1.29±0.8 and 1.31±0.5 for ARC, Towoomba, Tompi Seleka and Mara farms respectively. Most of the lambs born were males (88%) than females (12%). Lambs were all weaned successfully with no mortalities.

Conclusion/recommendations: It was concluded that conservation methods did not affect the oestrus synchronization and the pregnancy rates of Bapedi sheep. Towoomba farm had only single births. It is recommended that ewes be flush fed before breeding to improve the prolificacy and fecundity of the breed. It is recommended that further studies on reproductive performance of South African indigenous sheep be done for their conservation and improve their production.

Managing the water footprint of beef through efficient production

F.A. Maré[1] & H. Jordaan[1]
[1]Department of Agricultural Economics, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa.
MareFA@ufs.ac.za

Background: Beef production is well documented to have a very high water footprint (WF), leading to recommendations that consumers should eat less beef in order to decrease the pressure on the scarce freshwater resource. Given the importance of beef production to the South African economy, in the context of severe freshwater scarcity, it is important to understand the water footprint of beef production in order to ensure the ecological stewardship of the sector.

Aim: The study was conducted to analyse the WF of beef from different breeds of beef cattle, following the same production method, with the aim of identifying the factors influencing the WF.

Methodology: The green, blue, and grey WF of each breed for every step in the value chain (cow calf production, feedlot finishing and abattoir processing) was estimated through a bottom-up approach in order to quantify the freshwater consumption. The WF for a kilogram (kg) of beef for different beef cuts was then estimated according to the value factor (VF) of each cut in relation to the total value (TV) of the slaughtered animal. In order to treat all the breeds the same, a simulation model was used for the extensive cow-calf enterprise that simulated the feed intake and reproduction data of each breed according to the breed's national average performance data. The feedlot data were gathered through an experiment where 35 bull calves from each breed (245 in total) were fed, while the processing (slaughter and deboning) data were collected when the fattened calves from the feedlot were slaughtered and processed.

Results and Discussion: There were notable differences between the different breeds in terms of their WF. It was interesting to note that while the Bonsmara had the lowest overall WF per kilogram of beef, it did not revealed the lowest WF for all the links in the value chain. The Bonsmara had the lowest WF per kilogram of live calf produced in terms of the extensive cow-calf enterprise, while the Brahman and Simbra exhibited the lowest WF per kilogram of live weight added in terms of feedlot finishing for the profit maximizing and normal pre-determined feeding periods respectively. The Simmentaler, had the lowest WF per kilogram of carcass weight in terms of abattoir processing. The results further showed that there is a large difference in the WF of different cuts of beef, with the high-value cuts having a much larger WF than the lower-value cuts.
Diving deeper into the results revealed that, in the case of the cow-calf enterprise, the WF and weaning percentage was closely correlated. In the event where the weaning percentage of all the breeds were set equal to one another, the differences in the WFs of the various breeds were much smaller. In the event of the feedlot it was found that the feed conversion ration and the WF was closely corelated with the breed with lowest feed conversion revealing the lowest WF. In terms of processing it is the size of the carcass that matters as larger carcasses revealed lower WFs.

Conclusion/recommendations: It can be concluded that there are notable differences in the WFs of beef produced from different breeds of beef cattle. It must however be kept in mind that some of the factors contributing to the differences between the breeds can be managed to reduce the WF. It is recommended that more in depth research should be done in terms of animal breeding and production to find ways to reduce the WF of beef. This is especially important in the case of countries like South Africa where large parts of our natural resources (grazing) can only be utilised by livestock.

Evaluation of the sustainability of a Livestock Production Improvement Scheme

P.J. Malan[1], I.D.M. Mashinini[2] & A. Geyer[1]
[1]Department of Animal, Wildlife and Grassland Sciences, P.O. Box 339, University of the Free State, Bloemfontein, 9300, [2]Grootfontein Agricultural Development Institute, Private Bag X529, Middelburg (EC), 5900, South Africa.
malanpj@ufs.ac.za

Background: The Eastern Cape Livestock Production Improvement Scheme (EC Scheme) was established in 2005 with the objectives to promote sustainable and profitable livestock production (part of the natural conservation programme), and to supply superior animal genetic breeding material and to encourage the use of adapted animals by the Eastern Cape communal farmers. Government programmes that are aimed at rural communities for genetic improvement and the use of locally adapted breeds form the basis for sustainable genetic improvement, economic prosperity and food security. However, many research studies in the Eastern Cape indicate that there are many challenges facing government programmes. There is a need to evaluate the programme to confirm if it is meeting the intended objectives and to also propose strategies for improvements where necessary.

Aim: This study was conducted to provide credible and evidence-based information to ascertain whether the objectives of the programme are being met and to identify ways for improvements based on objective evidence.

Methodology: Twenty six extension personnel, which are key players in the execution of the scheme, from 6 districts were interviewed via questionnaires. Secondary data collection was done through documentary sources (e.g. legislation, policies, reports, research, etc.). The SPSS programme was used to analyse the data. The analysis used descriptive statistics with frequency counts and percentages.

Results and Discussion: The findings indicate that most of the respondents are of the view that the Scheme is not only sustainable (76.9%), but also profitable (69.2%) and that 85% of the projects according to the respondents are practicing natural resource strategies, such as managed grazing (57.7%), crop rotation (19.2%), better water management and integrated pest management, each at 11.5%. Of concern was that 15.4% indicated that they are not practicing any natural resources strategies, which should be addressed to ensure adherence to objectives and sustainability of the natural resources. Other findings, which were in support of other studies conducted in the Eastern Cape, indicated that the major challenges facing the scheme are lack of the following: infrastructure/facilities, participation and conflicts among beneficiaries, coordination and support between stakeholders (linkages), farmer training and animal health issues. All these challenges can be addressed by a collective effort from all involved.

Conclusion/recommendations: The Scheme has both economic and non-economic benefits for rural communities and should be emphasised equally because 'value' should not be restricted to economics. The non-economic benefits are realised through the utilisation of the genetic resources that can protect against diversity decline, which threatens natural resources and development.

Phenotypic characterization of indigenous goats in the districts of Limpopo province, South Africa

T.C. Matelele[1], T.D. Mphahlele[1], T.C. Chokoe[1,7], M.L. Mashiloane[2], P.J. Sebei[2], T.T. Mnisi[3], F.T. Sambo[3], O.F. Muzielwane[4], M. Sitholimela[4], D.J. Ngobeni[5], M.M. Maja[6] & M.A. Ntsoane[6]

[1]Department of Agriculture, Forestry and Fisheries, Genetic Resources, Private bag X 973, Pretoria, 0001, [2]Mara Research Station, LDARD, Private bag X 2467, Makhado, 0920, [3]Mopani District, LDARD, Private bag X 577, Giyani, 0826, [4]Vhembe District, LDARD, Private bag X 2247, Sibasa, 0970, [5]Waterberg District, LDARD, Private bag X 2455, Mokopane, 0600, [6]Sekhukhune District, LDARD, Private bag X 1201, Sekhukhune, 1124,[7] University of Limpopo, Private Bag x 1106, Sovenga 0727.
TlouMa@daff.gov.za

Background: Understanding of characteristics of animal genetic resources is vital for their development, breeding programmes, conservation and their sustainable use. Limpopo province has a large number of goats kept in small holder production systems however, there is lack of information on phenotypic characteristics of indigenous goats particularly in the hands of communal farmers. Therefore, characterization should be conducted in order to make informed decisions on appropriate management, breeding and conservation programmes.

Aim: To phenotypically characterize and compare the phenotypic variables of indigenous goats by districts.

Methodology: The study was carried out in Mopani, Waterberg, Sekhukhune and Vhembe districts of Limpopo province. One municipality in each district was selected on the basis of having the largest number of indigenous goats. Community-based conservation group for indigenous goat farmers was then formed in each selected municipality. Measurements of different body traits (shoulder height (SH), hip height (HH), ear length (EL), head length (HL), body length (BL), cannon circumference (CC), heart girth (HG) and neck circumference (NC)) were collected from 588 mature female indigenous goats from farmers belonging to the community-based conservation groups. General Linear Model, Stepwise Discriminant Analysis, Canonical Discriminant Analysis and Discriminant Analysis procedures of SAS were used to analyse data.

Results and Discussion: Mean HG differed ($P<0.05$) between the districts. The average HH, SH, BL, EL, HL, NC and CC of indigenous goats in Waterberg district differed significantly to values recorded in Sekhukhune, Mopani and Vhembe districts. Phenotypic measurements HG, EL, HL, CC, BL and NC have discriminating power for classifying the indigenous goats into the districts. The results revealed that all the Pairwise distances for indigenous goats between the districts were significant with the longest distance (8.67) between Vhembe and Waterberg and the shortest distance (0.32) between Mopani and Vhembe. Goats in Waterberg district had highest percentage (75.17%) of correct clasification into their original district.

Conclusion/recommendations: Results revealed that phenotypic variables of indigenous goats in the districts of Limpopo province differ. There is also some homogeneity in terms of phenotypes for some variables. The phenotypic variation and homogeneity revealed in this study could be of assistance in future in making informed decisions on management, breeding and conservation programmes.

Effects of dietary *Sclerocarya birrea caffra* (marula) nut meal on the growth performance and liver and kidney function of Japanese quail

B.E. Mazizi[1], D. Moyo[1], K.H. Erlwanger[1] & E. Chivandi[1]

[1]School of Physiology, University of the Witwatersrand, Medical School 7 York Road Parktown, 2193.
Johannesburg South Africa.
elvismazizi@gmail.com

Background: In sub-Saharan Africa, soybean production fails to meet soyabean meal (SBM) requirements for the poultry feed industry hence the need to explore and develop alternatives exist. Marula nut meal (MNM) has the potential to substitute SBM as a dietary protein source in broiler chicken feeds. However, quail differ from broiler chicken in terms of the gut microbiota population and composition and gastrointestinal organ sizes. This impacts digestion and absorption of nutrients. The kidneys and liver are prone to toxicity from dietary constituents such as phytochemicals that may have anti-nutritional effects.

Aim: To evaluate the potential of MNM as substitute to SBM as a dietary protein in quail feeds by determining its effect on the growth performance, feed utilisation efficiency and health of broiler Japanese quail

Methodology: The study was approved by the Animal Ethics Screening Committee (ARESC) of the University of the Witwatersrand, South Africa (AESC number: 2017/08/54B). The grower and finisher diets were formulated such that MNM replaced the SBM on a crude protein (CP) basis at 0%, 25%, 50%, 75% and 100%. Two hundred 7-day old unsexed quail chicks were randomly allocated to the five experimental treatments (n=40/treatment) which were sub-divided into 10 birds per pen and fed grower diets for 4 weeks before transferred onto the corresponding finisher diets for another two weeks. The birds were weighed once weekly. Feed intake (FI) was measured daily for all the birds in each pen. Terminal body mass (TBM), body mass gain (BMG), average daily gain (ADG) and feed conversion ratio (FCR) was calculated. At the end of the trial, twenty-four birds (12 males and 12 females) per dietary treatment were randomly selected and humanely slaughtered. Blood was collected and centrifuged to harvest serum for the determination of surrogate markers of liver and kidney function. Data were analysed using GraphPad Prism 5. Data on weekly body weight and daily feed intake were analysed using repeated measures ANOVA while the rest of the multiple-group data were analysed ($P \leq 0.05$) using a one-way ANOVA.

Results and Discussion: Dietary MNM did not affect ($P > 0.05$) the BMG, ADG, FI and FCR of birds during either (grower or finisher) dietary phases. Similarly, overall the substitution of SBM with MNM did not affect ($P > 0.05$) the growth performance and feed utilisation efficiency. Also the substitution of SBM with MNM had no effect ($P > 0.05$) on the serum aspartate aminotransferase and gamma-glutamyl transferase as well as blood urea nitrogen, uric acid and total bilirubin, surrogate markers of liver and kidney function, respectively.

Conclusion/recommendations: The results from this study indicate that MNM can be used as substitute for SBM as a dietary protein source in the grower and finisher diets of quail without compromising growth performance.

Growth performance, blood metabolites and carcass characteristics of Dohne Merino lambs supplemented with various inclusion levels of Canola meal

L. Mbambalala[1], M. Mpayipheli[1], K.J. Leeuw[2] & V. Muchenje[1]

[1]Department of Livestock and Pasture Science, University of Fort Hare, P. Bag X1314, Alice, 5700, South Africa, [2]Agricultural Research Council-Animal Production Institute, Private Bag X2, Irene, 0062, South Africa.
dr.mbambalala@gmail.com

Background: In the livestock production sector, feed accounts for about 50% up to 75% of total production costs, thus making it to be one of the largest expenses for farm producers. Resolution for this challenge is to use cheaper alternative feed source with high nutritive values. Canola meal (CM) is gaining popularity due to its low cost and favourable balanced amino acids content. Protein from CM is ranging from 35% up to 40% and can be a potential substitute to the expensive Soybean meal (SBM) in developing countries, including South Africa. There is little or no information regarding the use of CM on production performance of Dohne Merino sheep, which is the predominant sheep breed near the areas in the Eastern Cape Province.

Aim: The objective of this study was to determine the effect of supplementing diets with various inclusion levels of CM on growth performance, blood metabolites and carcass characteristics of Dohne Merino lambs.

Methodology: All experimental procedures were permitted by the University Ethics Committee, University of Fort Hare, South Africa (Ethical clearance No: MBA011SMBA01). The effect of supplementing diets containing various inclusion levels of CM was evaluated using a total of 40 Dohne Merino lambs with average body weight of 24±2.63 kg. The animals were randomly asigned to four iso-nitrogenous diets namely: control, 10%CM, 50%CM and 100%CM for a 70 day trial. The lambs were individually housed in pens measuring 1.6 m^2 with feeding and water troughts in a completely randomized design (CRD). Data on growth performance, blood metabolites and carcass characteristics was collected to each diet. Data were statistically analysed using JMP (statistical software) of SAS (2018). Means showing significant difference were separated by Least Significant Deference (LSD). The level of statistical significance was set at P <0.05.

Results and Discussion: Dietary treatment had no effect on average daily feed intake. Differences were recorded for feed conversion ratio (P <0.05), average daily weight gain (P <0.05), slaughter weight (P <0.05), total protein (P <0.05), total cholesterol (P <0.01), blood urea nitrogen (BUN) (P <0.001) and albumin showed higher values (P <0.001) at the end of the trial. Diet x Time (D x T) only influenced BUN (P <0.001). Warm carcass weight and cold carcass weight were higher (P <0.05) in the CM100 and CM0 respectively.

Conclusion/recommendations: The inclusion of CM in lamb'sdiets improves growth performance and carcass characteristic without any negative impact on blood metabolites.

Variability in sunflower meal quality and its effect on the growth performance, gut viscosity and carcass traits of broiler chickens

M.J. Mbukwane[1] & T. Nkukwana[1]
[1]Department of Animal and Wildlife Sciences, University of Pretoria, Private Bag X20, Hatfield, Pretoria, 0028, South Africa.
mbusombukwane@yahoo.com

Background: Soybean meal (SBM) is the most used source of dietary protein in broiler diets. In South Africa, sunflower meal (SFM) is also widely used as a protein source in broiler diets, and its use may potentially increase because when compared to SBM, it is cheaper and accessible. However, locally produced SFM vary considerably in terms of its quality, which has a bearing on the performance and quality traits of the end-product. There are limited studies conducted in South Africa on the influence of SFM-based diets on growth performance, gut viscosity and carcass yield and even the few that are there are often inconsistent.

Aim: This study was conducted to determine variability in sunflower meal quality and its effects on broiler performance, ileal gut viscosity and carcass traits in broiler chickens fed different qualities of SFM.

Methodology: All experimental procedures were approved by the Animal Ethics Committee at the University of Pretoria. Five isoenergetic (12.2 MJ AME/kg DM) and isonitrogenous (220 g CP/kg DM) diets were formulated using different SFM sources at a constant 50 g/kg inclusion level. These followed a 3-phase feeding program of starter (0-10d), grower (11-28) and finisher feed (29-35d). Maize-soybean meal with no sunflower oil cake inclusion was used as a control. Treatment 2 used 38% CP. The rest of the treatments were achieved by dilution of this SFM with SFM hulls at 25%, 50% and 100% (5% hulls with no SFM). Unsexed day-old broilers were randomly allocated to 40 pens (n=1000), to the 5 treatments (n=8 replicates/treatment) from day 1 to 35 of age. Weekly, birds were weighed for FI and for calculation of FCR. Two birds per pen, within the pen average were selected on the sampling day (day 35) and these were sacrificed for carcass parameters and ileal gut viscosity measurements. Carcass yield included portions such as breast, leg, thigh and wings. Gut viscosity measurements were done using a viscosity meter (Brookfield digital DV -11[+] Brookfield Engineering labs). Data were statistically analysed (P <0.05) using a fully randomized one-way ANOVA.

Results and Discussion: Dietary treatment had no effect (P >0.05) on carcass yield such as breast size (0.509 kg), thigh (0.225 kg), leg (0.203 kg) and wing (0.165kg), respectively. In terms of the ileal gut viscosity, treatment 4 had the highest, whereas, treatment 5, resulted in the least gut viscosity. Most parameters regarding the chemical composition of the rations were not significantly different from each other. However, rations differed significantly in terms of the crude protein (CP), gross energy (GE) and ether extracts (EE) values. CP values ranged from 18.5 to 20.5 %, EE ranged from 4.6% to 7.8% and GE ranged from 16.9 to 17.7 MJ ME/kg. Despite the diets being isoenergetic and isonitrogenic, variations possibly resulted from interactions amongst other ingredients used in the diet. There were no significant differences in terms of the growth performance.

Conclusion/recommendations: Results of the current study suggest that SFM can be used on broiler diets with less variability in terms of the growth performance parameters, carcass traits and nutritional composition of the feed. There is increased gut viscosity as you increase SFM in the diet and this may likely be overcome by the inclusion of exogenous enzymes to the diet.

Dietary effects of *Mimusops zeyheri* seed meal on growth performance, feed utilisation and meat quality of quail

B. Mdoda[1], B.W. Lembede[1] & E. Chivandi[1]

[1]School of Physiology, Faculty of Health Sciences, University of the Witwatersrand, 7 York Road, Parktown Johannesburg, RSA.
Eliton.Chivandi@wits.ac.za

Background: Maize meal (MM) is the major dietary energy source in poultry feeds. This results in competition between humans and poultry for maize since it is a staple crop for human consumption. This competition-driven shortage of dietary energy sources for poultry feeds contributes to high feed costs. There is need to search and develop alternatives. *Mimusops zeyheri* seed meal (MZSM) has a greater energy content than MM and its potential as an energy source in poultry feeds must be evaluated.

Aim: To determine the potential of MZSM to substitute MM as an energy source in quail finisher diets by evaluating its effects on the growth performance, feed utilisation efficiency and meat quality of broiler quail.

Methodology: The study was approved by Wits University's Animal Ethics Screening Committee (AESC No: 2017/08/56/B). Experimental procedures complied with the internationally accepted guidelines on the care and use of laboratory animals. Thirty-two 5-week old male broiler quail were randomly allocated to 4 diets (n=8/diet) wherein MZSM replaced MM on an energy basis at 0%, 12.5%, 25% and 37.5% (diet 1 to 4, respectively) and fed for 4 weeks. Each bird was individually housed in a cage measuring 60cm L × 55cm W × 73cm H and served as a replicate. Body weight (twice weekly) and feed intake (FI; daily) was measured. Average daily gain (ADG) and feed conversion ratio (FCR) were calculated. At slaughter, carcasses were eviscerated and carcass weight (CW) and dressing percentage (DP) determined. pH, colour, water holding capacity (WHC), tenderness, proximate and fatty acid profile of the breast meat were determined. Data were analysed using GraphPad Prism 6. The effects of dietary MZSM on weekly growth performance and daily FI were analysed using repeated measures ANOVA. Multiple-group data on terminal body weight, ADG, FCR, and meat quality properties were analysed using a one-way ANOVA. Tukey's *post hoc* test was used to compare means. Significance was set at *P<0.05*.

Results and Discussion: During the 2nd week of the trial, birds fed diet 4 had lower (*P*<0.0001) FI compared to birds fed diets 1 and 2. Birds fed diets 3 and 4 had lower (*P*<0.01) total FI compared to that of birds fed diet 1 throughout the trial. MZSM had no effect (*P*>0.05) on the final body weight, ADG, FCR, CM and DP. It did not affect (*P*>0.05) the colour (L*, a*, b*, C*, H*) and pH of the meat 30-min post-slaughter; but 24-hours post-slaughter redness (a*) of breast muscle from birds fed diet 4 was lower (*P*<0.05) compared to that from birds fed diet 1, 2 and 3. Dietary MZSM increased (*P*<0.05) the meat's WHC but decreased (*P*<0.001) cooking and drip loss. It also increased (*P*<0.05) tenderness of the meat. With increasing dietary MZSM, protein content of meat increased (*P<0.05*) but fat content decreased (*P*<0.0001). While dietary MZSM had no effect (P>0.05) on the total concentration of SFAs, MUFAs and PUFAs of the meat, a decrease in trans- and cis- fatty acid content was recorded at 37.5% inclusion level of MZSM.

Conclusion/recommendations: *M. zeyheri* seed meal can replace MM in quail finisher diets without compromising growth and feed utilisation efficiency. Dietary MZSM produced leaner meat with higher protein content. Importantly, it improved the WHC, tenderness and juiciness of the meat.

Linkage disequilibrium and characterization of haplotype blocks in South African Brahman and Afrikaner breeds using medium and high-density genotypes

S. Mdyogolo[1,2], F.W.C. Neser[2], M.D. MacNeil[2,3], M.M. Scholtz[1,2] & M.L. Makgahlela[1,2]

[1]ARC-Animal Production, Private Bag X2, Irene, 0062, South Africa, [2]University of the Free State, Department of Animal, Wildlife and Grassland Sciences, PO Box 339 Bloemfontein 9301, South Africa, [3]Delta G, Miles City, MT, USA.

mdyogolos@arc.agric.za

Background: Statistical power of genome wide association studies (GWAS) and genomic selection (GS) relies on the extent of linkage disequilibrium (LD) between markers and quantitative trait loci (QTL). Haplotype block structure provides insight on effects of genetic selection. Brahman (Indicus) and Afrikaner (Sanga) are tropically adapted beef breeds and widely used across harsh environments in South Africa. Thus, they are important breeds for the South African beef industry.

Aim: This study characterised the extent of LD and haplotype block structure in South African Brahman and Afrikaner breeds.

Methodology: The Agricultural Research Council Ethical Committee (APIEC18/03) approved hair and semen sample collection as well as genotyping. The GeneSeek Genomic Profiler 150K and Illumina 777K SNP chips were used to genotype 309 and 155 Brahman cattle, respectively while 373 Afrikaner cattle were genotyped on the GeneSeek Genomic Profiler 150K chip. Markers with minor allele frequency <0.02, call rate <0.95 and individuals with call rate <0.90 were excluded. After quality control 288 and 150 Brahman cattle, characterized by 92 291 and 625 004 markers, and 360 Afrikaner cattle characterized by 99 086 markers were retained. Linkage disequilibrium was determined as an average pairwise squared correlation (r^2) over a window of 10000kb and a distance ranging from 1kb to 2000kb. Beagle 4 and Plink 1.9 were used to phase and partition data to haplotype blocks. Markers were by default included into the blocks if the pairs were within 200kb of each other. An in-house awk script was used to determine the number of blocks per chromosome, the length of each haplotype block and the number of SNPs within each haplotype block.

Results and Discussion: For Brahman, LD decreased by 0.143 and 0.081 at a distance of 1-10kb and 10-20kb on the 150K and 777K panels, respectively. The decrease in LD reached equilibrium at a distance of 60-100kb for the Brahman 777K panel. For the Afrikaner, LD decreased by 0.154 at a distance of 1-10kb reaching an equilibrium at a distance of 500-1000kb. An increase of inter-marker distance and recombination events may explain the equilibrium phase reached by Brahman and Afrikaner. Furthermore, evidence of strong LD in the Afrikaner may be the reason for equilibrium only reached at a great marker distance (500-1000kb) in comparison to the Brahman 777K (60-100kb). A total of 13 226 and 82 353 haplotype blocks were found on the 150K and 777K panels for the Brahman with the greatest number of haplotype blocks found on BTA 6 (854) and BTA 1 (5319), respectively. The Afrikaner had 18 346 haplotype blocks with the greatest number of blocks found on BTA 1 (1169).

Conclusion/recommendations: Variation in both LD and haplotype block structure across breeds and genotype panel's gives insight into possible effects of selection and environmental changes on the breed genome. This warrants further analysis as it can reveal genes within these haplotype blocks that may be associated with important production and functional traits**.**

Silage in South Africa: What can improve?

R. Meeske[1], R. Venter[2] & O.B. Einkamerer[3]

[1]Western Cape Department of Agriculture, Outeniqua Research Farm, P.O.Box 249, George, 6530, [2]AGSCI Silage consultant, Postnet suite no 16, Ps X132 Centurion,South Africa, 0046, [3]Department of Animal, Wildlife and Grassland Sciences, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa.
robinm@elsenburg.com

Background: Maize silage is extensively used in dairy and beef cattle diets in South Africa. Whole crop maize is easy to ensile as it contains high levels of water soluble carbohydrates, a relatively low protein content and is easy to compact. A system to evaluate silage on farms has been developed which includes nutritional value, fermentation parameters, compaction, top layer losses and aerobic stability of silages.

Aim: To report on the composition, compaction, and aerobic stability of maize silage in South Africa.

Methodology: A total of 227 maize silage bunkers were sampled from 2014 to 2018 during the Santam/Plaas Publishing silage competition. Each bunker was sampled by taking three core samples with a 110 mm polyvinyl chloride (PVC) silage corer in the middle of the bunker, spaced 1 m apart. Each core sample was taken at three depths: 0-10 cm, 10-20 cm and 20-40 cm. Compaction of the different layers was determined using the weight and volume of each core sample. The three core samples were pooled for each depth and a representative sample was taken, sealed in a plastic bag, kept at 4°C and frozen pending analysis. The dry matter (DM), pH and ash content of all silage samples were determined. A representative sample of 800 g from the 20-40 cm pooled sample was loosely placed in a 5 litre plastic container with several holes on its sides to determine aerobic stability. Silage was exposed to air for 5 days and then frozen. The DM, ash content and pH was determined to calculate organic matter (OM) losses and monitor aerobic stability. The DM, pH, ash, total digestible nutrient (TDN), crude protein (CP), starch, neutral-detergent fibre (NDF), lactic acid, acetic acid, propionic acid and butyric acid of silage samples taken at 20-40 cm in the bunker were determined at Cumberland Valley Analytical Services (CVAS). The chop length of silage was determined by measuring 10 maize stalks of the composite 20-40cm sample.

Results and Discussion: The composition (DM basis) of the 227 maize silage bunkers was: DM 34.0±5.3%, pH 3.82±0.22, TDN 71.6±2.82%, CP 8.44±1.09%, starch 29.5±6.8%, NDF 41.6±4.91%, lactic acid 4.41±1.56%, acetic acid 3.19±1.47% and propionic acid 0.24±0.18%. The average compaction in the 0-10cm, 10-20cm and 20-40cm layer was 516±112, 682±122 and 713±108 kg silage/m^3 respectively. The compaction of the 20-40cm core sample was 241±40 kg DM/m^3. The organic matter (OM) loss in the top 10 cm layer, 10-20cm layer and silage exposed to air was 19.3±25.3%, 9.8±13.3% and 7.2±9.6% respectively. The highest OM loss in the top 10 cm was 90.4% while no OM losses were found in the best sealed bunkers. The most stable maize silages had no OM losses after 5 days of aerobic exposure, while 45.9% of OM was lost in the least stable silage. The average pH of silage increased from 3.82 before aerobic exposure to 5.11 after 5 days of exposure to air. The pH of the most stable silage did not increase while pH of the least stable silage increased to pH 8.48. The average chop length of maize silage was 12.8±3.4 mm, with the shortest chop length at 5.3 mm and the longest chop length 25.2 mm. The maize silages were well preserved as indicated by the low average pH of 3.82 at a DM content of 34.0%. Whole crop maize harvested at DM content below 30% resulted in silage with a low TDN and low starch content. This clearly showed the negative impact of ensiling whole crop maize too early. Bunkers with poor top layer compaction also had higher pH and higher OM losses in the top layer.

Conclusion/recommendations: Aerobic stability of maize silage is still a challenge and top layer compaction and sealing of the bunker can be improved on many farms.

The milk production potential and temperament of Nguni x Holstein cows

L. Metaxas[1] & M. Motsoahae[1]
[1]Department of Agriculture and Rural Development, Glen Agriculture Institute, Glen, 9360.
lelanie@fs.agric.za

Background: The most popular dairy breeds used in South Africa are the Holstein and Jersey. These breeds are of European origin and are not well adapted to South African veld conditions. Consequently, the milk production of these breeds on veld is very low, and the animals cannot subsist and produce without some form of supplementary feed. The Nguni breed is an African breed, and is used by communal farmers in KwaZulu-Natal to supply milk for the household. Though these animals are well adapted to the African veld, and can produce calves yearly with little or no supplemental feed, the milk production potential of these cows is quite low.

Aim: The goal of the trial was to utilise a cross between the Nguni breed and Holstein cattle to obtain a cow that is hardy and more adaptable to the prevailing veld conditions in South Africa, yet with a higher milk production potential than pure Nguni cows at very low input costs.

Methodology: The trial was started in 2004, utilising Holstein cows at Glen Agricultural farm. Cows were inseminated with a Nguni bull and the resultant heifers were raised on veld with no additional supplementation other than a salt-phosphate lick. Upon sexual maturity the heifers were divided into two groups, synchronised for insemination and half the heifers inseminated with Nguni semen and the other half with Holstein semen. After calving, the cows were milked once a day on site with a mobile milking machine, with the calves only being separated from the cows during milking. Due to the calves having unrestricted access to the cows during the night and separated from the calves during the milking process to facilitate handling of the cows, partial suckling was not used to initiate the milk let-down reflex. In literature there are some articles advocating partial suckling to facilitate milk let-down, and articles advocating separating the calves from the mothers in a "kindergarten" system. The cows were milked for 2 consecutive years and their milk production recorded. If the cow's milk production declined to less than 0.3 l/day, milking was ceased. The temperament of the cows was visually observed during milking.

Results and Discussion: The resultant milk production was very variable, with approximately 20% of the cows having a high milk production and able to sustain the production for about 5 months. The cows with the highest production were visibly relaxed, while the majority of the cows with lower production appeared tense and very quickly learned to limit their milk let-down reflex, keeping most of the milk for their calves. These cows were also more protective of their calves, and were more prone to kicking the workers during the milking process. Total production over the period of the trial varied from a high of 2002.5 litres produced by one cow over 2 lactations, to a low of 221 litres produced by a different cow, during the same period.

Conclusion/recommendations: The results of this trial seem to indicate that temperament, and especially the mothering ability (defined for the purposes of this trial to be milk let-down reflex and the resultant milk production, as well as the ease of milking the cows), of the Nguni x Holstein cows, could play a large role in their behaviour and milk production potential.

Evaluation of claw health of dairy cattle housed in dirt lot vs free stall in TMR systems in the central regions of South Africa

N.L. Mhlongo[1], J. Tucker[2] & E. van Marle-Koster[1]

[1]Department of Animal and Wildlife Sciences, University of Pretoria, Private Bag X20, Hatfield, 0028, Republic of South Africa, [2]Chemuniqué, 330 Surrey Ave Unit 6 Ferndale, Johannesburg, 2194, Republic of South Africa.
nokuthula1175@gmail.com

Background: Claw health is arguably an important factor in animal welfare and its evaluation is an early indicator of lameness in dairy cattle. In South Africa, information on claw disorders is not routinely collected and not included in genetic evaluations, that can lead to losses in productivity.

Aim: The aim of the study was to evaluate claw health of dairy cattle housed in dirt lot vs free stall under the TMR systems in the central regions of South Africa.

Methodology: Approval was granted by the University of Pretoria Research and Ethics Committee and the study involved 9 commercial dairy farms having a dirt lot or, free stall systems. Data was collected during trimming, by professional claw trimmers (DairySmid) from January 2011 to May 2018 and recorded on lesion recording sheets. The initial lesion data contained a total number of 24 887 claw disorders from 48 993 cows. The scored claw disorders were heel erosion (**E**), digital dermatitis (**DD**), foot rot (**F**), hairy attack (**HA**), axial fissure (**AX**), sole ulcer (**U**), toe ulcer (**TU**), white line (**WL**), sole fracture (**SF**) and corkscrew (**C**). Data from 34 526 cows and 12 309 claw disorders was statistically analysed using chi-square (SPSS 20) and descriptive statistics for year, season and dirt lot vs free stall variables. Mean separation test after chi-square was also performed.

Results and Discussion: No significant differences ($P > 0.05$) were observed for DD, HA, SF and across the years and farms. Significant differences ($P < 0.05$) were present for C in 2014 and 2015 across all farms. Significant differences were also observed in 2014 for F, U, AX, TU and WL, and the highest frequencies were observed in 2014 and 2018 for WL (6.5%) and E (11%) respectively. Seasons had no effects ($P > 0.05$) on the prevalence of DD, SF and AX, but a higher frequency of C (8.4%), WL (3.3%) and HA (1,2%) lesions was observed in winter, autumn and summer. Significant differences ($P > 0.05$) in F between autumn and spring were recorded, with F (3.8%) being more prevalent in autumn. Autumn had an effect ($P < 0.05$) on U and TU. For E a significant effect ($P < 0.05$) was observed across all seasons. Free stall and dirt lot farms had no significant effect ($P > 0.05$) on DD. The frequency of E (10.0%) and U (3,5%) was high in free stall system. WL, AX, HA and F were significantly ($P < 0.05$) affected by both systems, with dirt lot having the highest incidence. No significant differences ($P > 0.05$) were observed for TU, SF and C in both systems.

Conclusion/recommendations: The current study suggests that variation in seasons and type of housing system have marked effects on the prevalence of claw lesions. The finding is thus suggestive of the influence of these factors in the incidence of lameness, with different lesion type having significantly different risk factors. Thus, improved management and housing systems may result in significantly decrease incidences of lameness in dairy cows.

The effect of non-genetic factors on the inter-calving period of Nguni cows in South Africa

F.N. Mkhize[1], E.C. Webb[1] & M.M. Scholtz[2,3]

[1]Department of Animal and Wildlife Sciences, University of Pretoria, Private Bag X20, Hatfield, 0028, South Africa, [2]Agricultural Research Council, Private Bag X2, Irene, 0062, South Africa, [3]University of the Free State, Bloemfontein, 9300, South Africa.
Nomfuzo.mkhize@kzndard.gov.za

Background: Reproductive efficiency of cows is a key factor to improve profits in a beef herd. One of the factors that is related to cow productivity is inter-calving period (ICP), which is defined as the time period from one calving to the next. ICP is a major factor in the determination of the reproductive efficiency of a cow and it is affected among others by the level of available nutrition and management. The postpartum period which is one of the three phases that constitute ICP is instrumental in the re-establishment of the ovarian activity and preparation of the cow for re-conception. Good nutrition can shorten postpartum period thereby shortening the ICP of cows.

Aim: The purpose of this study was to address the question of whether non-genetic factors such as vegetation type and availability of feed sources have any effect on the inter-calving period of Nguni cattle.

Methodology: Data of Nguni cows (n=26681) from 427 Nguni breeders in the Savanna and the Grassland Biomes of South Africa were analyzed to establish the impact of non-genetic effects on inter-calving period (ICP) of the cows. In the Savannah Biome the Central Bushveld, Eastern Kalahari Bushveld, Lowveld and Sub-Escarpment Savannah bioregions were identified. While, in the Grassland Biome, the four bioregions were Drakensberg, Dry Highveld bioregion, Mesic Highveld and the Sub-Escarpment grassland. Data collected over a period of 20 years (1990-2010) were categorized into 5-year groupings and divided into calving seasons (summer, autumn, winter and spring). Cows with an ICP of less than 315 and above 730 days were removed from the dataset before analysis to comply with the Nguni breed standards, while the breed average ICP of 409 days was used to compare the efficiency of Nguni cows in the study. Data were analyzed statistically using GLM of SAS. The main factors considered in the analysis were biomes, bioregions, seasons and year categories. Dam age in months was included as a covariant.

Results and Discussion: The inter-calving period (ICP) increased slightly up to 48 months of age, after which a decline was noticed up to 108 months of age. A similar decrease in number of productive cows after the age of 108 months was observed. The different biomes had a significant effect ($P<0.0001$) on the mean ICP of cows. Cows in the Savannah Biome had significantly shorter mean ICP than those in the Grassland Biome. In the Savannah Biome, the mean ICP was significantly shorter for cows bred in the Eastern Kalahari Bushveld bioregion than for cows bred in the other bioregions in the same biome. In the Grassland Biome, cows bred in the Drakensberg bioregion had significantly shorter mean ICP than cows bred in the other bioregions of the Grassland Biome. Cows that calved in year group 2 (1996-2000) and year group 4 (2005 - 2010) had significantly shorter mean ICP than cows categorized in the other groups of years.

Conclusion/recommendations: The results of this study indicate that non-genetic factors significantly influenced the ICP of Nguni cows probably due to environmental factors such as the availability and quality of feed and to some extent the management of breeders. It follows that in both the Savannah and the Grassland Biomes, the Nguni cows are able to perform as well as is expected of an adapted animal.

Influence of Agro-Ecological Zone and Sex on the Intensity of Gastro-Intestinal Nematodes in Pedi Sheep in Limpopo Province, South Africa

K. Modiba[1], K.A. Nephawe[1], T.J. Mpofu[1] & B.J. Mtileni[1]

[1]Department of Animal Sciences, Tshwane university of Technology, Private Bag X680, Pretoria, 0001, South Africa.
k.modiba@yahoo.com

Background: Sheep form an important part of livestock industry in South Africa. Gastro-intestinal nematodes parasite are of economic importance, highly prolific and responsible for high mortalities in sheep production industry. Worms are likely to be a problem in the case of ineffective deworming programme, intensive systems, wet weather and planted pastures. Climatic conditions such as mild winter and long summer including rainy seasons create a favorable environmental condition for the survival of various parasites and high infections of GIT parasites.

Aim: To determine the influence of agro-ecological zone and sex on intensity of gastrointestinal nematodes in Pedi sheep population in the Limpopo Province of South Africa.

Methodology: The study was approved by the Animal Research Ethic Committee of the Faculty of Science, Tshwane University of Technology (AREC REF No.: 2017/08/001). Fecal (80) and blood (80) samples from Pedi sheep in different agro-ecological zones (arid, semi-arid, humid and dry sub-humid) were collected directly from the rectum and jugular vein, respectively. The egg per gram (EPG) count and Pack Cell Volume (PCV) were determined through the McMaster egg counting technique and capillary microhematocrit counter centrifuge method. The EPG or worm count was normalized by log10 (EPG count + 1) before statistical analysis in order to stabilize the variance. The GLM procedures of SAS were used and the least square means were used to compare the treatment means ($P<0.005$).

Results and Discussion: The AEZ influenced the EPG ($P<0.01$) and PCV ($P<0.001$). The EPG of Pedi sheep in humid zones (1.63) did not differ ($P>0.05$) to those in arid zones (1.01), whilst differing significantly with those in semi-arid (0.88) and dry sub-humid (0.72) AEZ. Sheep in humid (1.63) zones had higher ($P<0.05$) EPG than those in semiarid (0.88) and dry-sub humid (0.72) AEZ. Sheep in dry sub-humid (32.20) zones had higher ($P<0.05$) PCV compared to those in other AEZ. The PCV of sheep in arid (35.06) and semi-arid (34.93) zones did not differ significantly. Sex of sheep did not influence EPG (0.9) and PCV (0.7). The intensity of GIT nematodes of sheep in dry sub humid and semi-arid zones was marginally lower due to low rainfall and temperature which lowers the productivity of the nematodes. Highest sheep's EPG in humid and arid zones depicts a favorable environment that allows excellent incubation of the GIT nematodes; hence it promotes their prolific nature. The highest GIT nematodes prevalence in the humid zone led to the low PCV value showing their ability to suck blood whilst the highest PCV in dry sub-humid was a result of low GIT infestation.

Conclusion/recommendations: The agro-ecological zone influenced the prevalence of nematodes in the GIT of Pedi sheep in the Limpopo Province. Humid areas need to be taken heed of, because intensive management of internal parasites is required in this AEZ. The higher the EPG, the lower the PCV. Further studies are recommended on comparing the influence of AEZ on prevalence of gastro intestinal nematodes on Pedi sheep in all seasons in Limpopo Province.

The presence of genetic markers associated with reproduction in Dohne Merino and Dorper cross sheep breeds

A.H. Molotsi[1], A.N. van Der Walt[1] & G. Venter[1]
[1]Department of Animal Sciences, Stellenbosch University, Private Bag X1, Matieland, Stellenbosch, 7602, South Africa.
annelind@sun.ac.za

Background: Reproductive success in sheep farming is the key driver of profitability for farmers. Factors such as the number of lambs born per ewe per reproductive cycle will determine success of the farmer irrespective whether the farmer is farming for meat or wool or both. Genes that play a role in reproduction include the: Booroola gene (FecB), growth differentiation factor 9 (GDF9), fibroblast growth factor 2 (FGF2) and fibroblast growth receptor 3 (FRS3). The Booroola gene is known to increase the ovulation rate when present in sheep. GDF9 is another known fecundity gene that along with FecB increases ovulation rates in sheep. Both GDF9 and FecB lead to increased ovulation rate resulting in increased litter size. FGF2 is involved in the regulation of embryonic and early placenta development. FRS3 has been identified to be present in lactating sheep and downstream signalling from fibroblast growth substrates.

Aim: The aim of this study was to identify the presence of FecB, GDF9, FGF2 and FRS3 in the Dohne merino and Dorper crosses.

Methodology: Ethical clearance was granted prior to the commencement of the trial from the Stellenbosch University Animal Care and Use Committee (SUACUC #6511). Blood samples were collected from 3 Dohne merino ewes and 3 Dorper cross ewes. DNA was extracted from the blood samples using a Sbeadex livestock DNA extraction kit. Polymerase chain reaction was performed using the MiniAmp™ Thermal Cycler with gene-specific primers for FecB, GDF9, FGF2 and FRS3. PCR products were run on a 1.2% Agarose gel (Lonza FlashGel® System) to verify successful amplification. PCR products that amplified successful were sent for capillary gel analysis using the 3500X ABI analyser. Allele scoring was done using genemapper software.

Results and Discussion: Results indicate that the Booroola gene is present in all six of the sheep tested. The Booroola gene is proven to increase the ovulation rate in sheep. The FecB mutation is heterozygous (FecBB/FecB+) in four of the sheep and present as homozygous (FecBB/FecBB) in two. Ewes homozygous for FecB (FecBB/FecBB) have been shown to have reduced conception rates due to failure of normal proliferation of granulosa cells as well as abnormal type 3 follicle. Ewes that are heterozygous for FecB (FecBB/FecB+) show no abnormal type 3 follicles and continue to have increased litter size. GDF9 are heterozygous for all three of the Dohne Merino and only one of the Dorper crosses are heterozygous for GDF9. The remaining two Dorper crosses are homozygous for GDF9. Five of the sheep are homozygous for FGF2 and one of the Dohne Merino sheep is heterozygous for the FGF2 gene. FRS3 are homozygous for all six of the sheep tested.

Conclusion/recommendations: Both breeds have been found to have two of three major fecundity genes, Booroola gene and GDF9, as well as two additional genes FGF2 and FRS3 that are involved in embryonic development and downstream signalling from FGF respectively. The presence of these four genes in both sheep breeds is indicative of their genetic potential for high ovulation rates, litter sizes and increased lambing rates. The present study includes a small number of sheep for each breed; therefore, more extensive research with larger sample sizes should be conducted to confirm these results.

Genetic parameters for growth, morphometric and carcass traits in Tswana goats

P.I. Monau[1] & S.J. Nsoso[1]

[1]Department of Animal science and production, Faculty of Animal and Veterinary sciences, Botswana University of Agriculture and Natural Resources, Private bag 0027, Gaborone, Botswana.
phetogomonau@gmail.com

Background: Tswana goat is the predominant breed in Botswana contributing significantly to the economy and food supply of the poor resource farmers. This breed has demonstrated adaptation and survivability to low input management systems. Sustainable utilization of this breed requires development of genetic improvement programs which includes information on genetic traits of economic importance.

Aim: The aim of this study was to estimate genetic parameters for live weight, body measurements and carcass traits of indigenous Tswana goats.

Methodology: Data was simulated based on actual measurements of body weight, body length, heart girth, height at withers, rump height and ultrasound muscle depth at 1st rib, 12/13 rib and 5th lumbar on Tswana goats kept under a semi-intensive system. Live weight was measured using a weighing scale, body measurements were measured using tailors tape and real time ultrasound scanner was used for carcass traits. The data was simulated to 10 000 records for each trait for over 10 years. Age at measurements were 4 months, 8 months and 12 months for live weight, body measurements and ultrasound measurements. Variance components were estimated from Individual Animal Multivariate ASREML analysis.

Results and Discussion: Heritability estimates for both body weight and body measurements at different age groups ranged from 0.10 to 0.13 whilst for ultrasound muscle depth ranged from 0.09 to 0.30. Phenotypic correlations between body weights at different ages were positively low (0.20) to moderate (0.48). The phenotypic correlations between body weight and body measurements varied from 0.23-0.75 and 0.35-0.92 at 4 months and 12 months, respectively. The genetic correlations between body weight and body measurements at 12 months were quite high ranging from 0.70±1.49 to 0.97±1.49. Genetic correlation between carcass traits and body weight at 4 months was also high ranging from 0.83±1.34 to 0.98±1.72. The low heritability estimates of body weights observed in this study indicates that it would be very slow to improve live weight in Tswana goats through selection. However, the positive and high phenotypic correlations imply that either of these variables or their combination could provide a good estimate for predicting live weight and other body measurements in Tswana goats. The high genetic correlations between body weight and body measurements indicates that either one of the traits could be included in a selection program designed to improve growth on Tswana goats.

Conclusion/recommendations: The study gave an insight on genetic parameters of Tswana goats and possibilities for genetic improvement of Tswana goats via sound selection methods. However, more research is needed to evaluate phenotypic and genotypic parameters of Tswana goats based on actual data and maternal effects should be included in the model to increase accuracy.

Growth performance, blood lipid profile, bone morphometrics and mineral content of chickens fed graded levels of *Imbrasia belina* worm meal

S. Moyo[1], V. Muchenje[1] & P.J. Masika[2]

[1]Department of Livestock and Pasture Sciences, Faculty of Science and Agriculture
University of Fort Hare, P/Bag X1314, Alice 5700. South Africa, [2]Fort Cox Institute of Agriculture and Forestry, P.O Box 2187, King Williams Town 5600, South Africa.
pmasika@fortcox.ac.za

Background: The use of *Imbrasia belina* meal in broiler diets is limited; while the ideal inclusion level for optimum broiler performance is inconsistent. More so, there is paucity of information on its use on blood lipid profile, bone morphometric and mineral content.

Aim: This study was conducted to determine the effect of increasing dietary levels of *Imbrasia belina* meal on growth performance, blood lipid profile, bone morphometric and mineral content in Arbor Acres broiler chicks.

Methodology: The protocol of the experiment was approved by the Animal Research Committee (AREC) of the University of Fort Hare (Animal Ethics No MUC531SMOY01). A total of 360 day-old chicks were randomly allocated to 4 dietary treatments, with each treatment group replicated 6 times (n=15/replicate). The inclusion levels of the *Imbrasia belina* meal in the diets were 0%, 4%, 8% and 12%. A three phase feeding program consisting of a starter (0-14d), grower (15-28d), and finisher (29-35d) phase was employed for the study. Body weight (BW), average daily gain (ADG), feed intake (FI) and feed conversion ratio (FCR) were recorded weekly to determine growth performance. At termination of the study, blood samples were collected from 12 birds per treatment (n=12) from the wing vein to determine total cholesterol (TC), triglycerides (TGL), high density lipoprotein (HDL), low density lipoprotein (LDL) content. Also 10 birds per treatment (n=10) were randomly selected and slaughtered for bone morphometric and mineral content determination. Data for growth performance indices was analysed using a repeated measures design Proc Mix of SAS and for blood lipid profile and bone morphometric and mineral content was subjected to ANOVA of GLM proc of SAS.

Results and Discussion: Treatment 4 (12%) resulted in a higher (P <0.05) BW than T2 (4%) and T3 (8%), but did not differ (P >0.05) from T1. Results showed that chicks on T1 had the highest (P<0.05) feed intake, while those on T4 being the lowest. Lowest feed intake recorded in T4, could be due to dull appearance portrayed with increase of *I. belina* dietary inclusion levels. Feed conversion ratio was improved proportional to the inclusion levels of *I. belina* meal in birds; this depicts good nutritive profile leading to reduced feed intake and increased BWG, ultimately improved FCR. Dietary treatment had no effect (P>0.05) on the blood lipid profiles such as TC, HDL and LDL, while differences (P<0.05) were recorded for TGL. Dietary inclusion levels of *I. belina* had no effect (P>0.05) on femur weight, width, relative bone density, and bone breaking strength, while the macro and micro mineral content increased (P<0.05) with higher dietary inclusion levels of *I. belina*. The broiler chickens fed T1 (6.62 g/100g, 15.24 g/100g) had the highest femur Ca and P content, meanwhile T3 (6.37 g/100g, 14.82 g/100g) recorded the lowest. Femur Zn content of broilers fed T4 (24 mg/100g) was highest and T1 (13.86 mg/100g) lowest. The higher contents of micro minerals of broilers fed T4 diet may stimulate bone growth and increase bone strength, as trace minerals are linked to the use of the macro minerals in bone development.

Conclusion/recommendations: Results suggest that *I. belina* meal up to 12% can be effectively utilised in broiler diets without any adverse effect on growth performance and bone mineral properties.

The relationship between the fluke burden and pathological damage of livers of dairy cattle slaughtered at a commercial Eastern Cape abattoir

Z. Mpisana[1], I.F. Jaja[2], M.C. Marufu[3] & V. Muchenje[4]

[1]Department of Livestock and Pasture Science, University of Fort Hare, Alice 5700, South Africa, [2]Faculty of Veterinary Science, University of Pretoria, 100 Old Soutpan Road, Onderstepoort, 0110.
Ijaja@ufh.ac.za

Background: Fasciolosis is a global parasitic disease caused by *Fasciola* species that has a huge impact on animal welfare, productivity and leading to economic losses through liver condemnation and carcass degradation. Furthermore the disease significantly affects food security as well as public health.

Methodology: The research protocol was approved by the university of Fort Hare research ethics committee and an approval certificate was issued with the reference number MUS 071SJaj01. The study was conducted at the East London abattoir. The abattoir is located 120 km South East of the University of Fort Hare, Alice campus at latitudes and longitudes of 32.97^0S and 27.87^0E and 542 m above sea level. The climate of the area is mild with an average rainfall of 850 mm. The temperatures during the study period ranged from 14^0C-18^0C. The condemned livers were immediately weighed after slaughter. The livers were thoroughly and visually inspected for the presence of fluke species and gross pathological damage. Liver infection was classified according to the number of flukes observed in each liver. Fluke burden was classified into three categories: 1-lightly, 2-moderately and 3-severely affected.

Results and Discussion: The fluke burden (number of flukes) significantly affects the weights of condemned livers ($P < 0.001$). Severely affected liver were observed to be heavier (55.5%) than moderately (42.8%) and mildly (1.8%) affected livers. According to the intensity of pathological lesions, 55.3% constituted severely affected livers, 30.3% were moderately affected livers and 14.4% were lightly affected livers. The findings of the current study reveal that most affected cows had poor body condition scores 57.4%, moderately affected 40.2% and lightly affected 2.4%. Additionally, fluke burden significantly ($P < 0.001$) affects carcass weights of severely affected cows.

Conclusion/recommendations: In conclusion, this study demonstrated severity of infection of fluke burden cause reduction of body condition scores and carcass class of the slaughtered dairy cattle. Therefore, necessary measures should be done to control fasciolosis as it can also affect human health.

Effect of gastro-intestinal nematodes co-infection on haematological parameters of South African communal goats

T.J. Mpofu[1], K.A. Nephawe[1] & B.J. Mtileni[1]
[1]Department of Animal Sciences, Tshwane university of Technology, Private Bag X680, Pretoria, 0001, South Africa.
MpofuTJ@tut.ac.za

Background: Gastro-intestinal nematode (GIN) infection is a major constraint in livestock industry, especially in small stock. Losses include lowered production rates, mortalities, decreased reproduction rates and costs of treatment and control measures. Animals reared under natural conditions are more likely to suffer from multi-parasite infection than single infection. Parasites that concomitantly infect a host would directly interact with each other, particularly those occupying the same niche in the host. Literature indicates that haematological studies are of ecological and physiological interest to understand the relationship of blood characteristics to the environment especially to certain infections such as GIN parasitism. However, there is paucity of information on the GIN co-infection and their interactions in goats in relation to the haematological parameters.

Aim: The study was conducted to determine the effect of the GIN co-infections between parasite pairs on the haematological response of South African communal goat populations.

Methodology: The study was approved by the Animal Research Ethic Committee of the Faculty of Science, Tshwane University of Technology [FCRE 2017/10/01 (02) (SCI)]. A stratified clustered random sample of South African communal goats in a longitudinal study design was used and monitored seasonally (summer and winter). In each season, 288 faecal and blood samples were collected and analysed to determine the infection status of each goat as well as their haematological response. The haematological parameters investigated included packed cell volume (PCV), haemoglobin and mean corpuscular haemoglobin (MCH). For co-infection, very few animals were co-infected with *Coccidian occyst* and *Moniezia* spp., *Strongloides* and *Moniezia* spp., M*oniezia* and *Trichuris spp.*, therefore not all comparisons were possible, only five dual infections were possible in addition to five single infections and no infection. Generalized mixed-effect models were used to model the infectious status of pathogens against each haematological parameter, including significant interactions between pathogens and means were separated using Fisher's Protected LSD test ($P<0.05$).

Results and Discussion: There was a significant effect of the infection status on the haemoglobin and PCV, however, the MCHC was not influenced ($P>0.05$). Goats co-infected with *Strongyle* and *Moniezia* spp., *Strongyle* and *Trichuris spp.* resulted in lower ($P<0.05$) haemoglobin (*Strongyle* and *Moniezia* spp.: 8.71 g/dL, and *Strongyle* and *Trichuris spp.*: 8.64 g/dL), PCV (*Strongyle* and *Moniezia* spp.: 28.71 %, and *Strongyle* and *Trichuris spp.*: 22.89 %) and MCHC (*Strongyle* and *Moniezia* spp.:31.24 pg, and *Strongyle* and *Trichuris spp.*: 31.19 pg) compared to those co-infected with *Strongyle* and *Strongloides spp.* and the single infections. Goats with no infection of any of the GIP yielded higher ($P<0.05$) haemoglobin (11.17 g/dL), PCV (28.71 %) and MCHC (33.15 pg). The cumulative impact of *Strongyle* and *Moniezia* spp., *Strongyle* and *Trichuris spp.* co-infections can potentially result in anaemia. *Coccidia* infection caused a slight decrease of PCV and haemoglobin of goat population which was not clinically significant from those free of any GIP and may be due to the level of dehydration due to diarrhoea.

Conclusion/recommendations: The results suggest that interactions between concomitant GIP complicate the clinical outcome of the infected goats and should be taken into consideration in any study that investigates disease under field conditions and disease management programme. It would be interesting to investigate the association between coccidia and other clinical parameters such as presence or absence of diarrhoea in this population.

Gastro-intestinal nematodes co-infection and their interactions as drivers of host heterogeneity in South African communal goat population

T.J. Mpofu[1], K.A. Nephawe[1], & B.J. Mtileni[1]

[1]Department of Animal Sciences, Tshwane university of Technology, Private Bag X680, Pretoria, 0001, South Africa.

MpofuTJ@tut.ac.za

Background: Infection patterns of parasites can be highly heterogenous due to complex interactions between parasites, hosts and their environment. Species interactions are essential processes in determining community structure and generating biodiversity. In the parasite communities, direct interactions occur when parasites compete for the same resource, while indirect interactions occur when the host's immune response to one parasite affects the host's ability to control a second parasite species. However, there is paucity of information on the gastro-intestinal nematode (GIN) co-infection and their interactions in goats.

Aim: The study was conducted to determine how the concomitant infecting GIN parasites modifies host susceptibility, parasite intensity and the pattern of distribution within the South African communal goat population.

Methodology: A total of 288 goats were randomly sampled in communal areas of Limpopo, Mpumalanga and KwaZulu Natal provinces of South Africa. For each goat, the intensity measured in faecal egg count of the three nematodes, *Strongyle, Strongloides* and *Trichuris* spp., were determined using modified McMaster technique. Four subsets of data were used: the first included goats infected with single nematode species, either *Strongyle, Strongloides* or *Trichuris* spp, the second, third and fourth considered goats co-infected with any two possible combinations of the three nematodes. The GLM procedures of MiniTab 17 was used to analyse data.

Results and Discussion: Three nematodes exhibited different age–intensity profiles: *Strongloides* spp. intensity remained constant ($P>0.05$) with increasing host age, while the *Strongyle* and *Trichuris* spp. exhibited a type III convex age-intensity relationship ($P<0.05$). For single infections, *Strongyle* and *Trichuris* spp. infection intensities were higher ($P<0.05$) in young goats compared to suckling and adult goats. Co-infection by *Strongloides* and *Trichuris* spp., and *Strongyle* and *Trichuris* spp. increased the age–intensity profile of these nematodes but their pattern didn't change significantly. Young goats exhibited higher ($P<0.05$) *Strongyle* spp. intensity in dual infection with *Strongloides* (500.97) and *Trichuris* spp. (853.72) than suckling (dual infection with *Strongloides*: 310.81) and adult goats (dual infection with *Strongloides*: 355.33, dual infection with *Trichuris* spp: 461.53). The intensity patterns of *Strongloides* and *Trichuris* spp. were similar ($P>0.05$) for suckling, young and adult goats when co-infected with *Strongyle* spp. (*Strongloides,* suckling: 245.18, young: 231.89 and adult: 280.04) and *Trichuris* spp. (*Trichuris,* young: 255.85 and adult: 340.02). Sex–intensity profile of nematodes in single infections did not differ ($P>0.05$), for *Strongyle* (males:199.54, females: 257.25), *Strongloides* (males:125.63, females: 126.97) and *Trichuris* spp. (males: 130.58; females: 124.12). Co-infection by *Strongloides* and *Trichuris* spp. did not influence ($P>0.05$) the sex-intensity pattern of these nematodes (*Strongloides*, males: 221.58 and females: 190.76; *Trichuris,* male: 282.59 *vs* female: 190.76). Sex-intensity profile for *Strongyle, Strongloides* and *Trichuris* spp. was higher in female goats co-infected by *Strongyle* with either *Strongloides* (*Strongyle*, females: 599.50 *vs* males: 313.87; *Strongloides*, females: 432.90 *vs* males: 271.59) or *Trichuris* (*Strongyle*, females: 867.91 *vs* males: 453.14; *Trichuris*, females: 369.61 *vs* males: 229.90).

Conclusion/recommendations: The co-infection contributed to aggregation of GIN in the host population, but also enhanced differences in parasitism between goat ages and sexes. This was apparent for *Strongloides* and *Trichuris* spp., depicting a strong acquired immune response but not for *Strongyle* spp. It can be concluded that concomitant infections mediated by host immunity are important in modifying host susceptibility and influencing heterogeneity amongst individual hosts.

An overview of the role of tannin on microbial fibrolytic activity from wild and domestic herbivores

N.N.P. Msimango[1] & F.N. Fon[1]
[1]Department of Agriculture, Faculty of Science and Agriculture. University of Zululand, KwaDlangezwa 3886, South Africa.
khaliphathabizolo@gmail.com

Background: The world's livestock sector is substantial and driven by high demand for meat and milk as protein source. The most important force behind this increasing demand for livestock products is the ever increasing human population especially in developing countries. Therefore, the challenge is to enhance animal productivity to reach this demand. The main limitation to ruminant production is poor nutrition especially in dry seasons when both quality and quantity of pasture is limited. However, leguminous forages have been reported to be a valuable source of protein supplement where pasture is scarce but often limited by their high content of polyphenolic compounds (tannins). The negative impact of these compounds often exceeds its advantages when looking at browse digestibility as more than 40% of digestible nutrient is found in feces.

Aim: This review will be looking at different tannins based on their chemical structures and properties, major classification groups, inhibition mechanism of digestibility in the rumen environment and possible strategies to increase tannin tolerance without losing fibrolytic potential in both domestic and wild animals.

Discussion: The present review article gives a detailed discussion on six mechanisms on tannase activities and strategies (chemicals and synthetic molecules) that have been used to negate or reduce the effect of tannin on feed intake, protein utilization and dietary carbohydrates digestibility. It also discusses possible mechanisms that can be incorporated in the future and the necessity to use molecular biology techniques for identification of rumen microbes with potential to tolerate tannins is also emphasized in this review. The tannin chemistry diversity and its occurrence in ruminant diets as well as its beneficial and adverse effects on ruminants, is also briefly reviewed.

Conclusion/recommendations: The adaptation mechanisms showed that tannin tolerance seems to be slightly higher in rumen microbes in wild animals that are continuously being exposed to tannins, hence the need to further investigate microbes with such potential and possibility of how long does it take before tolerance can be observed. Future research to improve on rumen microbes functioning and relatively higher tannin tolerance potential is encouraged. Future research should focus on the potential of evolved microbes in the wild under stringent conditions compared to domesticated animals as a potential reservoir for un-manipulated microbes.

Investigation into the current communal wool production enterprise in the Nquthu District of KwaZulu-Natal

P.P. Msuntsha[1] & E.A. van Zyl[1]

[1]KZN Department of Agriculture and Rural Development, Dundee Research Station, P.O. Box 626, Dundee, 3000, South Africa.
Phumzile.Msuntsha@kzndard.gov.za

Background: Communal farmers in some areas of Northern KZN (N-KZN) own wool sheep, from small to relative large flocks. Wool income in these areas is largely unexploited. Therefore, wool is a potential new source of income, especially when current high wool prices are taken into account. If the production constraints of the current enterprise are identified, suitable interventions to enhance the enterprise can be investigated. This study was conducted to gain baseline information regarding the wool sheep enterprise in the Haladu area in the Nquthu Municipal district, as run currently by communal farmers.

Methodology: Investigation 1: A rural participatory questionnaire was completed with 15 rural wool sheep respondents, all farmers belonging to the Thandabantu Wool Growers Association in Haladu Area, Nquthu Municipality. Haladu is situated in the sandy sourveld area (BRG 14) of KwaZulu-Natal. The survey was done between Spring 2015 to midsummer 2016. Data was analysed through GENSTAT – tally. Investigation 2: A pilot investigation on wool sheep production norms was conducted with the same farmers mentioned above. Five farmers, selected by the Association, dedicated 10 ewes each for the investigation. The ewes were identified with tags, the owner's name and breed type recorded. Monthly data from the selected animals were recorded by weighing and establishing approximate age (by examining teeth). Farmers were visited on a monthly basis and the following recorded: live weight, mortality, lambs born, single or twins and lamb mortality. Dung samples were also taken from each ewe, combined per farmers and submitted to the Vryheid veterinary laboratory for detection of internal parasites. Results were communicated with the farmers.

Results and Discussion: Investigation 1: 40% of the respondents identified their sheep as Dohne merino sheep, 27% as having Merino, 13% having crossbred Merino and Nguni sheep, 13% having Nguni sheep and 7% reported having Dorper sheep. The majority of farmers (53%) own 10 or less ewes and 27% of the farmers owns 48 or more ewes. Some farmers own even up to 300 ewes. The majority of respondents have one ram, while other respondents have up to seven rams depending on the number of ewes. The majority of lambs are born in the winter period, which co-incidence with feed constraints being on a sourveld area. The majority of respondents (70%) have reported that they do not practice weaning and are keeping all their sheep in one flock, irrespective of age, due to a shortage of camps. The remaining 30% of farmers, who reported that they practice weaning, have camps available to separate the sheep at weaning. Investigation 2: From the data collected, the following were calculated: ewe mortality, lambing percentage, lamb survival, growth performance of lambs and lastly incidence and level of internal parasite infestation. Low fleece weight was recorded.

Conclusion/recommendations: The collected baseline data contributed to understanding the current wool enterprise practised, and identification of production constraints.

Cattle production and breeding practices in a communal farming system in the Eastern Cape, South Africa

S. Mthi[1], N. Nyangiwe[1], T. Thubela[1], N. Nyalambisa[1], Z. Madyibi[1] & M. Yawa[2]

[1]Döhne Agricultural Development Institute, Private Bag X15, Stutterheim 4930, South Africa, [2]Department of Livestock and Pasture Science, University of Fort Hare, Private Bag X1314, Alice 5700, South Africa.
sizamthie@gmail.com

Background: Communal cattle farming reflects a high level of mortality, low reproduction rate, and low weaning percentages. This results in a low off-take of less than 12% which is much lower than 25% found in the commercial sector. The lack of breeding plans, feed shortage, poor infrastructure, diseases and poor management practices are the major constraints contributing to low productivity in communal farming system.

Aim: The objective of the study was to assess cattle breeding management and production constraints in a communal farming system as an essential step for designing an optimal livestock improvement program.

Methodology: Ethical clearance (approval number: 01/2016) was obtained from Dohne Research Ethics Committee. A total of 100 households heads (cattle owners), from Nxaxo community near Centane, were randomly sampled using a pre-tested structured questionnaire. All interviews were conducted with households heads referred to as farmers in this manuscript. The interviews were conducted in isiXhosa. The questionnaire included questions related to demographics and farm characteristics such as total land size, ownership, livestock management practices such as feeding, selection traits, purpose of keeping cattle and constraints.

Results and Discussion: The majority of the respondents (74%) were male, while 52.4% of the cattle owners were older than 35 years of age. The mean herd size of 7 was obtained. Farming experience was significantly ($p < 0.01$) affected by gender and marital status, while means of acquiring foundation stock and purpose of keeping cattle were significantly ($p < 0.05$) affected by the sources of income. All of the respondents (100%) practice uncontrolled breeding and they attributed that to lack of infrastructure. Breeding parameters such as body size (37.8%) and growth (29.1%) were ranked high for beef production, whereas milk production (18.6%) was the most used parameter for selecting breeding cows. Mothering ability (11.6%) and coat colour (2.9%) were other traits used for selecting breeding animals. Lack of infrastructure, tick-borne diseases, feed shortage, stock theft as well as market accessibility were the major constraints of cattle production in this study area.

Conclusion/recommendations: Poor breeding management contributes to low reproduction in the communal areas and more training on animal related aspects are required for farmers to enhance their knowledge. Traits preferred by communal farmers need to be incorporated in livestock genetic improvement programs in order to improve production in communal farming system.

Proposing the use of percentile graphs to set minimum breed standards for scrotal circumference in Drakensberger bulls in performance testing

T. Mudzungwane[1], H.A. O'Neill[1] & M.D. Fair[1]
[1]Department of Animal, Wildlife and Grassland Sciences, University of the Free State, Bloemfontein, South Africa, 9300.
tmudzungwane@gmail.com

Background: Current breed standards for Drakensberger bulls include fixed, minimum scrotal circumference (SC) in cm for different liveweight (LW) classes. Animals are scored on a pass / fail basis. Bulls that score less than the minimum cut-off point "fails" this method of assessment. Many young bulls are being discriminated against during phase C and phase D performance testing without taking development relative to physiological age into consideration. It is recommended that the minimum acceptable SC is the bottom 5% value at any live weight. This minimum recommendation should be a "lower threshold". Bulls with a SC that is not within "normal limits" should then be viewed with doubt unless it can be shown by other means that this does not pose a risk.

Aim: This study was conducted to establish minimum SC by using percentile graphs to set minimum breed standards of Drakensberger bulls in phase C and phase D.

Methodology: Data from Drakensberger bulls was used to determine variance between groups during phase C and D performance testing. Data was sourced from Phase C and D pedigree Drakensberger bulls of the National beef recording and improvement scheme of the agricultural research council of South Africa. Data was grouped according to test phase and include bull identification, site, birth date, measurement date, LW, and SC. Scrotal circumferences (SC) were plotted on a nonlinear regression graph against LW and age for each phase in order to indicate possible differences between these phases. Scrotal circumference (SC) was analysed as a function of LW and age (P<0.5). A mathematical equation was developed to fit SC on a percentile curved graph using LW and age as a function. The type of models used were either of the following: **Exponential decay model; SC = a*(1-exp (b* ew)) or Gompertz model; SC = a* exp (- exp (b* ew)).** The models were ranked on residual variance. The selected model explained maximum variance and achieved even distribution of bulls below the predicted fifth percentile.

Results and Discussion: Factors that predict SC were analysed. It was found that the significant parameters differed (P< 0.05) between the factors. Regardless of whether an exponential decay or Gompertz model was used, prediction curves for SC were almost identical. Though the highest percentage of variation occurred when using exponential decay model, the proportion of bulls with SC below the fifth percentile (recommended minimum) was very similar with each model. Using these mathematical equations still shows that LW is a better predictor for SC than age, but the variation between phase C and phase D indicates that different breed standards should be used for each phase. Live weight (LW) appears to be a better reference point in comparison to age as measure for assessing acceptable SC in young bulls. Variation at any age is higher because of nutritional effects on weight per day of age, so age may also be of use.

Conclusion/recommendations: To ensure that reproductive development and performance of bulls are maximized, proper nutrition is needed. Since reproductive traits are not highly heritable greater selection intensity is required to achieve genetic improvement. Structurally sound bulls with large SC and high semen quality of an individual bull changes over time and for bulls to be fertile, libido and mating ability should be evaluated periodically.

The determination of normal testicular development in tropically adapted beef bulls in South African seed stock herds

T.J. Mugwabana[1,2], M.R. McGowan[1], G. Boe-Hansen[1] & T. Barnes[1]

[1]School of Veterinary Science, University of Queensland, Queensland, Gatton Campus, 4343, [2]Department of Agricultural Economics and Animal Production, University of Limpopo, Polokwane, Mankweng, 0727.
Mugwabanatj@gmail.com

Background: The measurement of scrotal circumference (SC) has long been regarded as a simple indicator of the inherent fertility status in bulls and as such is a major component of bull breeding soundness examination (BBSE's). SC can be used as an indicator of daily sperm production, especially in young bulls and can be a highly repeatable measure if the appropriate technique is used. The current recommendations (Entwistle and Fordyce, 2003) are broad and concerns have been raised about their applications in *Bos indicus* and *Bos indicus* derived bulls subject to different nutritional conditions.

Aim: The study was conducted to determine the typical relationship between scrotal circumference and age and live weight in South African beef bulls.

Methodology: The study used previously recorded Phase C (on-station) and Phase D (on-farm) data sourced from the Integrated Registration and Genetic Information System (INTERGIS) database. Bulls from different tropically adapted beef breeds were either enrolled for Phase C or Phase D, and not both. Bulls were admitted into Phase C between 151 and 250 days of age at the beginning of adaptation. Adaptation period lasted for 28 days and the test length was 84 days. The maximum age of the bulls at the end of Phase C was 362 days. Phase D started when the bulls were between 151 and 425 days of age. The bulls were adapted for between 21 and 90 days and the test length varied from between 84 to 270 days. The maximum age of the bulls at the end of Phase D was 785 days. Data collected was on breed, age, live weight and SC. The age was measured as the number of days from birth to the date of SC measurement (days). Live weight was measured through subjecting the animal to a cattle weighing scale (kg) on the date of SC measurement. The SC was measured using testes circumference meter (cm) developed in South Africa. The testes circumference meter was scaled in millimetres and centimetres and was attached to a rod in its manufactured state. During measurement, animals were moved into a crush pen, restrained and the measuring tape was used to measure the scrotum. The tape could only measure SC from 200 mm upwards. The data was modelled using linear log, negative exponential and gompertz model for SC against live weight.

Results and Discussion: Preliminary results from this study shows that live weight and scrotal circumference was breed related. Breeds differs in testicular development and it might be important perhaps to determine the minimum acceptable scrotal circumference that is breed specific.

Conclusion/recommendations: The preliminary conclusion drawn from this study is that live weight and breed are important determinants of whether scrotal circumference is within normal range for South African beef bulls that experience a wide range of nutritional conditions. It is also important to determine the age effect on scrotal development.

Mapping a production progress landscape of emerging and communal beef cattle sector in Mpumalanga province, South Africa

N.J. Mulaudzi[1], M.D. Motiang[1] & A.E. Muntswu[2]

[1]Agricultural Research Council, Animal Production, Beef Recording and Improvement Scheme, [2]Agricultural Research Council, Animal Production, Dairy Recording and Improvement Scheme, Private Bag X 2, IRENE, 0062, South Africa.

nyadzani@arc.agric.za

Background: Developing (EM) and communal (COM) beef cattle farmers went through a period of hardship during the recent drought spell. A routine survey conducted in several local municipalities of Gert Sibande (GS) and Nkangala (NK) Districts in Mpumalanga high veld regions, assisted to unpack situations as unfolding since 2016 to date.

Aim: To analyse production and adaptability in terms of calving rate, mortality and off-take given 2016 good rainfall and contingent intervention to highlight strategic adaptive practices as well as drought relief roll-out.

Methodology: Data of reference was collected from 129 emerging and 289 communal farmers of Gert Sibande district, Mpumalanga province, who respectively owned 7 614 and 2 709 cattle. Similarly, data from Nkangala district farmers comprised 112 emerging and 186 communal of 5 864 and 572 cattle, respectively. Substantial data were obtained through use of a questionnaire survey, farmer recordkeeping templates and to some extend from INTERGIS database. Information was captured separately and organised according to particular sector and types. Data were used to determine reproduction performance, mortality rate and off-take. Both mortality rates and off-take were determined from the overall herd, including culls and mortalities of all ages and sex demography. Data were analyse on excel to compute descriptive statistics such as frequencies, means and standard deviation.

Results and Discussion: In 2016, EM sector at GS achieved 52%, 3% and 19% for calving, mortality and sales, respectively. In the same order, this category of farmers in NK achieved 53%, 1% and 11%. COM in GS achieved 61%, 14% and 10% for the respective parameters. In NK, 45%, 33% and 0 in the same order was recorded (insufficient data for conclusive analysis). In 2017, EM in GS achieved 66%, 1% and 17% in calving, mortality and sales respectively. In the same order, this category in NK achieved 61%, 2% and 8%. Performance rates of COM in GS were 41%, 5% and 6% on similar criteria, while supporting information in NK could not be obtained. In 2018, EM sector at GS achieved 61%, 1% and 11% in calving, mortality and sales respectively. In the same order, this category in NK achieved 71%, 3% and 19%. For COM in GS, 38%, 8% and 11% was recorded on similar criteria while in NK performance was 47%, 35% and 17% in the same order. Contingents such as drought relief rollout and other support mechanisms seem less influential to some COM communities who made little progress despite those provisions and recent rainfall.

Conclusion/recommendations: Although EM sector shows some considerable and consistent trends on mortality and off-take improvement, there is still an opportunity to focus attention on improving reproduction. The plight of both reproduction and mortality need serious attention in COM sector in these areas.

Effect of *Moringa oleifera-*containing diets on the physiological and meat quality traits of Japanese quails

A. Mulaudzi[1], C.M. Mnisi[1] & V. Mlambo[2]
[1]Department of Animal Science, Faculty of Natural and Agricultural Science, North-West University, Mafikeng, South Africa, [2]School of Agricultural Sciences, Faculty of Agriculture and Natural Sciences, University of Mpumalanga, Mbombela, South Africa.
anzaimatshavhange@gmail.com

Background: Quail farming is a new enterprise in the South African poultry industry. If it is allowed to develop sufficiently and sustainably, it can contribute immensely to animal protein supply, enabling the poultry industry to guarantee food and nutrition security as well as economic growth. Non-conventional feed sources such as *Moringa oleifera*, with no value as direct food resources for humans, need to be evaluated for use in poultry diets in an attempt to reduce production cost.

Aim: To investigate the effect of *Moringa oleifera* leaf meal (MOLM) on growth performance, haemato-biochemical parameters, carcass and meat quality traits of Japanese quails.

Methodology: The feeding trial was approved by the Animal Research Ethics Committee of the North-West University (approval no. NWU-00243-18-S5). The female quails (n = 224) at five weeks of age were randomly allocated to 28 pens (experimental units) with each pen holding eight birds. A commercial grower diet was treated with MOLM at a rate of 0, 25, 50 and 75 g/kg, producing four (CON, MOLM25, MOLM50 and MOLM75, respectively) isonitrogenous and isoenergetic dietary treatments. The four diets were randomly allocated to the 28 pens resulting in seven replicates per dietary treatment (n=56 birds/treatment). Average weekly feed intake and average weekly weight gain were determined and used to calculate feed conversion efficiency (FCE). At 10 weeks of age, all quails were slaughtered at a local abattoir. Blood was collected during slaughter for analyses of haematological and serum biochemical indices. The carcasses were then weighed at the abattoir to obtain the hot carcass weight (HCW). After 24 h of chilling, they were weighed to obtain cold carcass weight (CCW) and the meat quality measurements were recorded after slaughter. Data were statistically analyzed (P <0.05) using the GLM procedure of SAS (2010) in completely randomized design.

Results and Discussion: Dietary treatments had an effect (P <0.05) on overall body weight gain (P < 0.05). Japanese quails fed MOLM25 had higher (P <0.05) overall body weight gain (30.72 g/bird) compared to those fed on MOLM50 (18.60 g/bird), however, all treatment groups were comparable to the control diet (P>0.05). Quails offered MOLM25 had higher haemoglobin (14.85 g/dL) than those fed diets MOLM75 (12.69 g/dL), however, MOLM-containing diets promoted similar (P>0.05) haemoglobin content as the control diet. Japanese quails offered MOLM75 (14.13 cm) had longer large intestines than those offered MOLM50 (11.24 cm). CON diet promoted similar large intestine length as MOLM25 and MOLM75. Similarly, the highest (P <0.05) gizzard weight (3.87 g) was observed in quails fed MOLM75. Diets had no effect (P >0.05) on meat quality parameters measured 24 h post mortem.

Conclusion/recommendations: Results indicate that the inclusion of *M. oleifera* leaf meal at 2.5% promoted higher weight gain of female Japanese quails. Research on the growth performance of Japanese quails fed on graded levels of *M. oleifera* meal with multi-enzyme supplementation should be conducted.

In vitro evaluation of *Megasphaera elsdenii* and *Saccharomyces cerevisiae* on the fermentation of ruminant diets

T. Mulaudzi[1], K.R. Mbatha[1] & C.M. Muya[2]

[1]Department of Agriculture and Animal Health, Private Bag X6, University of South Africa, Florida, 1710, South Africa, [2]Dairy nutrition, Agricultural Research Council-API, Private Bag X2, Irene, 0062, South Africa.
mulaut@unisa.ac.za

Background: Supplementation of *Megasphaera elsdenii* NCIMB 41125 during transition from roughage to high levels of concentrate has proved to be effective in decreasing lactic acid and maintaining ruminal pH above sub-acute ruminal acidosis (SARA) thresholds in fresh high producing dairy cows receiving high energy diets. Live yeast (*S. cerevisiae* NCYC 1026) has also shown to play an important role in stabilizing rumen pH. The potential associative and/or complementary effects of these strains have not been described.

Aim: This study was conducted to evaluate the effects of *M. elsdenii* NCIMB 41125 and *S. cerevisiae* 1026 individually and a combination thereof on rumen pH, lactate and ammonia nitrogen concentration, and concentration of volatile fatty acids (VFA) in high concentrate ruminant diet.

Methodology: This research was approved by the CAES Animal Research Ethics Review, University of South Africa (2016/CAES/009). In this *in vitro* fermentation studies, 3 blanks were included simultaneously in each incubation run to provide a baseline for all results. Ruminal contents were collected from a 605-kg ruminal cannulated (14 days in milk) lactating Holstein fed a total mixed ration (TMR) with 70:30 concentrate to roughage ratio. The ruminal contents were obtained two hours after morning feeding and squeezed through four layers of cheesecloth into a flask with an O_2-free CO_2 headspace. Particle-free fluid was anaerobically transferred (20% vol/vol) to a buffer (pH 6.5) prepared according to Russel and Storbel (1988). The treatments were: (i) control (basal diet only); (ii)) basal diet with Me (0.5 mL of *M. elsdenii* NCIMB 41125 (9×10^6 cfu added into each bottle); (iii) basal diet with LY (live yeast (10^8 CFU/g) was added to achieve final concentrations of 0.35 and 0.73 g/L of buffered rumen fluid) and (iv) basal diet with both Me+LY. Buffered rumen fluid (100 ml) was transferred anaerobically to 250-ml serum bottles that contained 0.5 g of ground TMR. Treatment bottles were prepared in triplicate and sealed with butyl rubber stoppers and aluminium seals to contain the gas pressure and placed in a 39°C shaking water bath for 12, 24 and 48 h incubations. Data were analysed ($P<0.05$) by analysis of variance using the GLM procedures of SAS (2014).

Results and Discussion: The pH was not affected by additives and averaged 5.76. Addition of Me+LY significantly reduced the concentration of lactate ($P<0.0001$). All additives reduced acetate ($P<0.001$) and LY increased ($P<0.01$) butyrate concentration (13.06 µmol/L). When evaluated per incubation period, no additive affected lactate concentration after 12 h incubation, but after 24 h and 48 h lactate was decreased by LY and Me+LY and was not affected by Me. After 48 h, lactate concentration decreased in all samples, but in control diet it remained above 5.0 mM, whereas it was below 4.5, 4.1 and 3.6 mM in Me- and LY-diets. The acetate: propionate (A: P) ratio was decreased by all additives ($P<0.01$) and the acetate: propionate + butyrate (A: P+B) ratio was decreased by LY (P=0.002) and Me+LY (P=0.03) only.

Conclusion/recommendations: Findings suggest that the overall impact of Me or LY on mean rumen fermentation parameters as applied here are minor, and that there is no synergy between LY and Me. However, evaluation of means among individual samples suggested that there may have been responses to the imposed treatments relative to the absolute level. Further studies challenging pH and lactate production is warranted.

The effect of including stature in sire selection on the live weight, milk yield, fertility and feed efficiency of Holstein cows

C.J.C. Muller[1], S.W.P. Cloete[1,2] & M. Burger[2]

[1]Department of Animal Sciences, University of Stellenbosch, Stellenbosch 7602, South Africa; [2]Directorate Animal Sciences, Western Cape Department of Agriculture, Elsenburg 7607, South Africa.
careljcmuller@gmail.com

Background: Service sires determine the genetic merit and production performance of a dairy herd. Breeding and selection of dairy cows focus mainly on improving milk yield and conformation. This has resulted in an increase in live weight (cow size) over time. The efficiency of milk production is increasingly scrutinised to improve dairy profit margins. Little information is available on the effect of including cow size (stature) in sire selection on the production performance and production efficiency of dairy cows.

Aim: The study was conducted to determine the effect of sire selection based on fat and protein yield and on the stature of progeny on the live weight, body size, milk yield, feed efficiency and fertility of Holstein cows.

Methodology: Two groups of bulls were selected once a year for artificial insemination of cows. Bulls were ranked from high to low for combined fat and protein yield. The top five bulls for yield were selected for the production group and five sires with negative values for stature within the top 25 bulls were selected for the stature group. Sires were matched to cows in two groups based on their estimated breeding value for milk and for stature using a commercial mating programme. Progeny were reared similarly. Live weight, body size, milk yield and reproduction were recorded on an ongoing basis. Simple linear regressions were fitted to determine the relations of milk yield and live weight on production and efficiency measures. Production and reproduction records were compared by one-way ANOVA.

Results and Discussion: As the study is ongoing, only preliminary results are being presented. Cows from stature bulls were smaller with a reduced first lactation milk yield ($P<0.05$). Milk yield had a positive ($P<0.05$) relationship with live weight, estimated dry matter intake, an alternative Kleiber ratio, Gaines ratio (4% fat corrected milk yield/live weight) and milk yield divided by live weight (Jones ratio). Live weight had an expected, positive ($P<0.05$) effect on dry matter intake, while the alternative Kleiber, Gaines and Jones ratios were not affected ($P>0.05$). For this population of cows it seems that small cows (450 kg) had similar efficiencies as large cows (700 kg). Days open and proportion of cows pregnant by 100 days in milk did not differ ($P>0.05$) between sire groups. Efficiency was higher ($P<0.05$) in progeny of sires selected for production.

Conclusion/recommendations: Aiming to reduce the live weight of dairy cows by selection for lower values for stature may compromise milk yield and production efficiency. Access to feed intake data of cows would enable the estimation of the residual feed intake. There is clearly a need for further studies on the genetics of feed efficiency in dairy cows to reduce the maintenance cost associated with dairy production.

Estimation of genetic parameters and trends of growth traits and lamb mortality in the Elsenburg Dormer resource flock

A. Muller[1], A.C.M Kruger[2] & S.W.P. Cloete[1,2]

[1]Department of Animal Sciences, University of Stellenbosch, Private Bag X1, Matieland, 7602, South Africa
[2]Directorate: Animal Sciences: Elsenburg, Department of Agriculture, Western Cape Government, Private Bag X1, Elsenburg, 7607, South Africa.
schalkc@elsenburg.com

Background: The Dormer breed was developed at the Elsenburg Agricultural College in the 1940's, when Dorset Horn rams were crossed with German Merino ewes to establish the Elsenburg Dormer stud. The Dormer plays an important role as a terminal sire breed on woolled breeds in the local ovine genetic resource population. It is therefore important to assess the breed in terms of economically important traits, such as live weight and lamb survival.

Aim: To estimate genetic parameters and trends for growth traits and lamb mortality of the Elsenburg Dormer flock using records obtained from 1941 to 2018.

Methodology: The Elsenburg Dormer flock is an important local resource flock and are described thoroughly in the available literature. The flock was maintained at first on Mariendahl research farm and from the 1970's at Elsenburg. Initially the flock was closed to outside genetics, but migrant sires were regularly introduced from the 1990's and since. Traits analysed were birth weight (BW), lamb mortality from birth to weaning (LM), weaning weight (WW) and yearling weight (YW). The total number of records used amounted to 14368 for BW, 14400 for LM, 11900 for WW and 2083 for YW. The stud consisted of between approximately 120 and 150 breeding ewes over time. All statistical analyses were conducted in ASREML. Ethical clearance was obtained from the Departmental ethical committee for research on animals (DECRA), reference number R12/55.

Results and Discussion: Singles and rams were heavier than respectively multiples and ewes at all ages. Progeny of maidens and the oldest age group of ewes were generally lighter than the intermediate age groups. Survival of multiples and the progeny of young and old dams were compromised relative to singles and the progeny of intermediate dam age groups. Single-trait heritability estimates were 0.18 for BW, 0.02 for LM, 0.12 for WW and 0.15 for YW. Maternal genetic variance ratios were 0.22 for BW, 0.10 for WW and 0.08 for YW. Dam permanent environmental variance ratios were 0.12 for BW, 0.05 for LM and 0.09 for WW. Direct-maternal genetic correlations (r_{am}) were -0.31 for BW and -0.41 for WW. Direct and maternal genetic correlations among weight traits were positive and high. LM was not genetically related to BW, but all other correlations of LM with BW were negative. This finding suggested that heavier lambs would be less likely to succumb than their lighter contemporaries. Derived genetic trends from 1941 to 2018 amounted to 0.0056 kg/year for BW, 0.0543 kg/year for WW, 0.0462 kg/year for YW and -0.0005 for LM. Expressed relative to the respective overall means, the genetic merit of lambs increased by 0.14% p.a. for BW, 0.19% p.a. for WW and 0.09% p.a. for YW. Maternal genetic trends were appreciably less pronounced.

Conclusion/recommendations: All traits were heritable and variable and should respond to selection. Genetic change in the flock was favourable, albeit relatively slow compared to the gains that could be achieved in theory. This could be related to the emphasis placed on subjective conformation traits in the flock throughout the period of assessment. Further studies should also include other traits of economic importance, such as reproduction.

Key performance indicators for a dairy herd towards economic sustainability

C.J.C. Muller
Department of Animal Sciences, University of Stellenbosch, Stellenbosch 7600, South Africa.
careljcmuller@gmail.com

Background: For dairy farms to be economically sustainable, herd managers should, on a continual basis, monitor specific factors (or key performance indicators, KPIs) affecting animal productivity. Indicators must be based on quantitative or performance goals which are specific, measurable, attainable, relevant and easily tractable. These may include the average daily milk yield of cows, daily feeding costs and specific reproduction parameters. Each farm has its own natural resources, infrastructure and management style affecting milk yield, production cost while milk price affects the breakeven milk yield level.

Aim: The aim of this paper is to develop KPIs indicating production performance and trend lines showing changes over time for a Jersey herd on a total mixed ration (TMR) feeding system.

Methodology: No ethical clearance is required as data from a commercial Jersey dairy herd were used. Milk production records were collected once a week from a herd comprising of about 710 cows in milk. Cows are fed TMRs in seven feeding groups twice a day in fence-line feeding troughs. Data consisted of individual daily milk yield records, number of days in milk (DIM), and daily feeding cost per feeding group. Feeding groups were based on milk yield and stage of lactation while first parity cows were in a separate group. Based on the herd milk price and daily feeding cost, the breakeven milk yield levels were estimated for all cows within each feeding group. Gross margins per cow in the herd, margin over feed cost within feeding groups and margin above breakeven milk yield were further estimated. Furthermore, following monthly cow pregnancy testing by rectal palpation, reproduction parameters were estimated and monitored. Trend lines for specific parameters were fitted using simple linear or polynomial regression equations using Excel.

Results and Discussion: The mean±standard deviation daily milk yield of cows was 20.0±0.8 kg/day ranging weekly between 18.4-20.9 kg/day. The feeding cost of cows in the different feeding groups varied between R41 to R81 per cow per day. Increasing the average daily milk yield resulted in an increase ($P<0.01$; R^2 =0.86) in profit margin per cow. An 11% decline in herd milk yield resulted in a 30% decline in margin above feed cost. Reproduction parameters indicate that 87% of all cows were in milk. The interval from calving to first service was 63 days with 72% of cows serviced before 80 days in milk. Days open for all cows was 95 days with 70% of cows conceiving within 100 days after calving. The number of service per conception ranged from 1.9-2.3 for a conception rate of 0.43-0.52. Overall, 72% and 85% of cows more than 100 and 200 days in milk, respectively, were confirmed pregnant. The mean DIM is maintained at 160±5 days ranging between 151-168 days. Herd size increased linearly ($P<0.05$) by *ca* 5% per annum.

Conclusion/recommendations: A number of KPIs was developed and trend lines fitted. The difference between milk income and variable feed cost is a simple, easy to estimate KPI. Dairy farmers should develop their own indicators which may include daily milk output, gross profit margins and specific reproduction management indicators. Other factors that require regular monitoring may include the cost of heifer rearing, heifer survival from birth to first calving, age at first calving, animal health and diseases, genetics sales and marketing.

An analysis of longevity and lifetime performance of cattle on smallholder and emerging dairy herds in South Africa

A.E. Muntswu[1] & C.B. Banga[1,2]

[1]ARC-Animal Production, Private Bag X2 Irene, 0062, South Africa, [2]Department of Animal Sciences, Faculty of Science, Tshwane University of Technology, Private Bag X680, Pretoria, 0001, South Africa.
muntswue@arc.agric.za

Background: Despite its high socio-economic importance, the emerging and smallholder dairy sector in South Africa remains highly underdeveloped and contributes insignificantly to the mainstream dairy industry. Recent research benchmarked the productive and reproductive performance, as well as udder health status, of dairy cows on smallholder herds against their counterparts in the high-input commercial production system. It is, however, important to carry out such benchmarking for all economically important traits. Hence, the current study was carried out to determine cow longevity for these herds. Longevity is an economically important trait for dairy cattle, and is among the most important traits in the breeding objectives of South African dairy cattle.

Aim: The aim of the study was to determine longevity and lifetime performance of dairy cattle on smallholder and emerging dairy herds in South Africa.

Methodology: Cow performance data were obtained from the Integrated Registration and Genetic Information System of South Africa (INTERGIS). It comprised of data on animals participating in the National Dairy Animal Recording and Improvement Scheme between 2004 and 2019. There were 6 048 lactation records of 181 cows from 19 emerging dairy herds and 275 lactation records of 19 cows from 11 smallholder dairy herds. All cows were known to have been culled. Measures of longevity analysed were number of lactations initiated, total lifetime milk yield (kg), total lifetime lactation length (days) and herd life (days). Analyses were performed using the PROC Means procedure of the Statistical Analysis System (SAS, 2008).

Results and Discussion: Means for number of lactations, lifetime milk production, lifetime lactation length and herd life were 2.5 lactations, 7 337 kg, 824 days and 2 293 days, respectively, for emerging herds. Corresponding means for smallholder herds were of 2 lactations, 2 719 kg, 289 days and 1 398 days, respectively. These results indicate poor cow survival and productive performance on these herds, which may be attributed to low levels of nutrition and management. This supports previous research, which looked at other indicators of cow performance.

Conclusion/recommendations: Performance of cows in the emerging and smallholder sector, as indicated by longevity and lifetime performance, is poor. There is a need to develop a strategy to improve the various aspects of cow performance, in order to develop this sector.

Establishment of a minimum sperm dose to optimize fertility after artificial insemination of ostrich females

P.T. Muvhali[1], M. Bonato[1], I.A. Malecki[1,2] & S.W.P. Cloete[1,3]

[1]Department of Animal Sciences, University of Stellenbosch, Private Bag X1, Matieland 7602, South Africa, [2]School of Agriculture and Environment, Faculty of Science, The University of Western Australia, 35 Stirling Highway, Crawley, WA 6009, Australia, [3]Directorate Animal Sciences, Western Cape Department of Agriculture: Elsenburg, Private Bag X1, Elsenburg 7607, South Africa.
20501609@sun.ac.za

Background: Artificial insemination (AI) has been proposed as a viable method to counter infertility and mate incompatibility in farmed ostriches. AI also has a potential to reduce excess males currently used for breeding since semen from one male can be used to service multiple females. A viable semen collection protocol, improved AI methods and a diluent specifically for ostrich semen have been developed but the optimal sperm dose for maximal fertility of females after AI has not yet been investigated.

Aim: To optimize fertility in ostriches by determining the minimum sperm dose required for AI.

Methodology: A total of 22 South African black ostriches (7 males and 15 females) aged between 2-10 years old were used in this study. Semen was collected using a dummy female and diluted 1:4 (semen: diluent) with the ostrich specific semen diluent. Females were inseminated with various sperm doses of fresh semen from the same male three times a week every second day resulting in a total sperm dose of A=<2.5×10^9, B=2.5-5×10^9, C=5-7.5×10^9 and D=>7.5×10^9 sperm/week. Eggs laid after the last inseminations were opened to determine the fertilization status of the germinal disc (GD) with an unaided eye. The fertile period was calculated as the number of days fertilized eggs were laid after the last AI. Generalized linear mixed models of SAS, version 9.3 were performed on the data and was considered statistically significant at $P<0.05$. Ethical clearance was granted by the Western Cape Department of Agriculture's Departmental Ethical Committee for Research on Animals (Ref No.: R9/24).

Results and Discussion: A blastoderm was present on fertilised eggs, while unfertilised eggs contained a blastodisc. Overall, 50% of the eggs produced after the last inseminations were fertilized. Fertility rates differed between doses ($F_{3,\ 170}=3.31$, $P=0.0216$) with lower fertility rates achieved with dose A (6.25%) as compared to dose B (54.40%), dose C (57.40%) and dose D (48.10%). However, no difference in fertility rates was found between dose B, C and D ($P>0.05$), suggesting that the maximum capacity of the sperm storage tubules was reached. The overall mean (±se) fertile period was 8.08±0.63 days. No significant differences in the fertile period between dose A (3.00±5.85 days), dose B (8.79±1.09 days), dose C (7.21±1.06 days) and dose D (7.34±1.17 days) were found ($P>0.05$), possibly due to the high standard error associated with dose A.

Conclusion/recommendations: The fertility in ostrich females after AI was optimized with a sperm dose of 2.5-5×10^9 sperm/week, as higher doses did not result in higher fertility rates. Data on the number of sperm trapped on the outer periviteline membrane of eggs and the subsequent rate of sperm loss are currently being analyzed. In addition, further studies are required to establish minimum sperm doses that optimize fertility after AI when using chilled and frozen-thawed semen.

Effect of feeding milk once a day to Jersey calves on growth and rumen development

A.P. Myburgh[1] & R. Meeske[1]

Western Cape Department of Agriculture, Directorate: Animal Sciences, Outeniqua Research Farm, P.O. Box 249, George, 6530, South Africa.
bertusm@elsenburg.com

Background: In conventional calf rearing systems milk is fed twice a day to dairy calves. At Outeniqua Research Farm calves have been reared successfully by feeding milk once a day. Feeding milk once a day reduces labour requirements and may affect growth, health and rumen development of calves. This might result in more rapid development of the digestive system. More effective calf rearing will reduce calf mortalities and calf rearing costs for commercial and small holder farmers.

Aim: This study was conducted to determine the effect of feeding milk once or twice a day to calves on intake, growth and rumen development.

Methodology: Forty eight heifer and 24 bull calves were randomly allocated to 2 treatments resulting in 24 heifer and 12 bull calves per treatment. Treatment 1: Milk fed once a day (3L in morning); Treatment 2: Milk fed twice a day (1.5L in morning and 1.5L in afternoon). Calves stayed with their mothers for 3 days after birth to ensure colostrum intake. From day 4 calves were randomly allocated to the 2 treatments and placed into hutches on pasture. Calves were weaned at 2 months. Daily intake of starter pellets was recorded. Live weights were recorded at birth, weaning and monthly thereafter. Head circumference, shoulder height and body length were measured at birth, weaning, 6 months, 12 months and 15 months of age. Six bull calves from each group were slaughtered at 2 months and at 6 months of age. Weight of the heart and liver of each bull calf were determined as well as rumen pH and rumen volume.

Results and Discussion: Feeding milk once or twice a day did not affect (P>0.05) weight at weaning, 90 days, 120 days or 150 days of age. No significant differences were found in head circumference, body length and shoulder height of heifers between treatments. The average daily intake of calf starter pellets from birth to weaning was higher (P=0.04) when milk was fed once a day compared to the twice a day milk feeding treatment. Pellet intake was 546 and 474g/calf/day respectively. From week 8 till weaning, pellet intake differed (P<0.05) and was 1160g/calf/day for the once a day and 993g/calf/day for the twice a day milk feeding treatment. No significant difference in bodyweight for bull calves at weaning or at 6 months was found. Rumen pH of bull calves did not differ between treatments and varied from 6.57 to 6.74. Treatments did not affect the weight of hearts and livers of bull calves. Rumen volume differed (P=0.03) and was 12.2 and 9.83 litre at weaning and 41.4 and 35.7 litre (P=0.02) at six months of age for the once or twice a day milk feeding treatment respectively. Calves fed milk once a day had increased rumen capacity. Calf health and mortality was not compromised by feeding milk once a day.

Conclusion/recommendations: Feeding milk once a day resulted in higher intake of calf starter pellets and increased rumen capacity. This system is less labour intensive and does not compromise calf growth or calf health.

Performance of Indigenous goats grazing *Dactylis glomerata* with strategic supplementation of concentrates

D.Z. Ndlovu, D.I. Nash & D.L. Berjak

Grass and Forage Scientific Research Services, KZN Department of Agriculture and Rural Development, Private Bag X 9059, Pietermaritzburg, 3201.
Doreen.ndlovu@kzndard.gov.za

Background: Different forage production systems for indigenous goats have been studied with the aim of improving their growth performance and average daily gain. Cocksfoot has been evaluated with and without concentrate supplementation in a goat forage production system, because it is a perennial pasture that can persist in drier environments. This current study will be more practical for farmers without access to irrigation water.

Aim: The aim of the study was to evaluate weight gain of indigenous goat castrates grazing cocksfoot supplemented with concentrates at different levels.

Methodology : The study was approved by the Departmental Research Committee, Project number AS 2017 03C. The study site was Cedara Research Station located at $-29^o31'59.99'$S latitude and $30^o16'60.00"$E longitude. Indigenous goats were born and raised at Cedara until weaning. Forty-eight of the castrates were randomly selected from Cedara pool of goats. They were weighed, sorted and allocated to four treatments. The treatments were 0 g, 100 g, 200 g and 300 g of a 14% CP finisher pellets and supplemented for 154 days, including 14 days adaptation. The trial was started on the 1st November 2017 to 17th April 2018. At the beginning of the study, castrates were 5 months old weighing an average of 19.65±0.02 kg. All 48 castrates grazed together the cocksfoot pastures from 8H00 to 15H00. In the afternoon, castrates were sorted per supplementation treatment. Each castrate was allocated to a feeding pen where each castrate would receive its portion based on treatment. After feeding, castrates were let out of the pen so that they have access to water and lick *ad libitum*. The cocksfoot pasture, cv. Cristobal, was established in the first contour in 2016 planting, and the second contour planted in 2017 using an Aitchison© planter to the area of 1.5 ha at 15kgseed/ha. For the study, the pasture was divided into five camps. Each camp was grazed for seven days. After each grazing period, the camp was fertilized with 30 kg N/ha and irrigated immediately. Grab samples were taken from each camp prior to grazing to do chemical analysis of pasture. Castrates were weighed every second week; FAMACHA scores were also done, and every castrate scoring 3 and above on the FAMACHA chart were dosed with an anthelmintic. Data were analyzed using ANOVA on GENSTAT 18th Edition. Significant differences were tested using Tukey's LSD ($P<0.05$).

Results and Discussion: Supplementation with finisher pellets increased mean weights in all treatments ($P<0.05$) and over time (154 days).Mean final weights of castrates were 25.07kg, 28.25kg, 29.81kg and 30.92kg per 0g, 100g, 200g and 300g supplementation treatment respectively. Effect of supplementation on treatment*time was significant ($P<0.05$). Mean weight gain of 300g concentrates was significantly higher ($P<0.05$) than those castrates fed 100g per day and control ($P<0.05$) thus resulting in higher final body weight. There were no differences in castrates fed 200 g and 100 g feed per day.

Conclusion/recommendation: Final body weights of the castrates showed that supplementation could improve their performance. However, it is important to determine if the increased supplementation will be economically viable.

Tick species distribution and prevalence in wet and dry season: A case study in the Mangwe District, Matabeleland South, Zimbabwe

S. Ndlovu[1], O. Sibanda[1] & B. Moyo[2]

[1]Department of Animal Science and Rangeland management, Faculty of Agricultural Sciences LupaneState University, P. O Box 170 Lupane, Zimbabwe, [2]Department of Animal Science Faculty of Life Science, Gwanda State University P. O. Box 30, Filabusi, Zimbabwe.
busamoyo@gmail.com

Background: Ticks are ecto-parasites sucking blood and a vector of tick borne diseases to a wide range of animals, both domestic and wild. The prevalence of the ticks is influenced by weather patternsin the area and the host's resistance.

Aim: The main objectives of the study were to determine the most prevalent tick species, tick prevalence between wet and dry season, tick species distribution in wet and dry season and how infestation varies with the age of the animal.

Methodology: The protocol of the experiment was approved by the Institutional Animal Care and Use Committee of Lupane State University (IACUC 2016-01). The study was carried out at Sedgemoor farm during the wet and dry season. Wet season being December, January, February and March while dry was April, May, June and July. Sixty animals were randomly selected from a herd of 125 South Devon x Nguni cross cattle. Adult ticks were collected from one side of the body of the animal using forceps to avoid decapitulation. Ticks were then preserved in 70% alcohol until identification was done. Sample collection was repeated four times a month within the period of the study. Tick counts of different species were performed after each collection and ticks were identified by visual analysis using morphological characteristics. The data analysis was done using the Minitab Version 14. A Shapiro Wilk test was used to assess the normality of the data. A paired t test was used to determine the effect of season in tick species load and prevalence of ticks in cattle.

Results and Discussion: A total of 734 adult ticks were collected in this study, with 397 (54.1%) collected during the wet season and 337 (45.9%) collected in the dry season. Nine tick species were identified, belonging to the genera *Amblyomma*, *Hyalomma* and *Rhipicephalus.* Specific tick species recovered were*: Rhipicephalus evertsi evertsi* (19.9%), *Rhipicephalus. zambesis* (16.1), *Hyalomma truncatum (*13.9%), *Amblyomma variegatum* (12.3%), *Rhipicephalus appendiculatus (*11.1%), *Amblyomma hebraeum* (9.2 %) *Rhipicephalus simus* with (8%) *Hyalomma marginatum* (7.9%). The lowest number of ticks were *Rhipicephalus Boophilus decolaratus* (1.5%). A high tick prevalence was recorded in the wet season and prevalence decreased in the dry season attributed to unconducive environment. Six tick species had high densities during the wet season than on the dry season namely *R. appendiculatus, R. evertsi evertsi, A. variegatum, R. simus, H. trancutum and H. rufipes. Amblyoma hebraeum, R. B. decoloratus and R. zambensis* had high population densities in the dry season. Young cattle were most preferred as hosts than adults, which could be attributed to the toughness and thickness of the skin. Only 2 tick species showed significant difference in response to season, namely *R. appendiculatus* and *A. hebraeum.* A more potent acaricide may be necessary during the wet season and vaccination against tick borne diseases. The t test showed that there is a significant difference in tick species prevalence between wet and dry season.

Conclusion/recommendations: The prevalence of ticks varied between seasons and were also affected by the age of the cattle.

Intestinal pH, morphology and microbial counts of broiler chickens fed *Moringa oleifera* leaf meal

X.P. Nduku[1,2], V. Muchenje[2] & T.T. Nkukwana[3]

[1]Agricultural Research Council, Private Bag X2, Irene 0062, South Africa, [2]Department of Livestock and Pasture Science, University of Fort Hare, Private Bag X1314, Alice 5700, South Africa, [3]Department of Wildlife and Animal Science, University of Pretoria, Private Bag X20, Pretoria 0028, South Africa.
ndukux@arc.agric.za

Background: Research efforts have been made to find sustainable feed additives to enhance the natural defence mechanisms of broiler, in an attempt to reduce the use of antibiotic growth promoters (AGPs). The use of natural feed additives such as probiotics and organic acids; could improve the quality and utilisation of feed, while reducing pathogenic bacterial populations. *Moringa oleifera* meal might also be an interesting alternative feed additive that could be used as substitute of dietary AGPs, since Moringa leaves are reported to have an impressive range of growth promotion and antimicrobial effects. Thus, the use of Moringa, which have limited use in poultry diets, needs to be investigated.

Aim: This study was conducted to compare the effects of *Moringa oleifera* leaf meal (MOLM) in combination with probiotic and organic acid feed additives on intestinal pH, morphology and microbial counts of 14-day-old broiler chickens.

Methodology: All experimental procedures were approved by the Animal Ethics Committee at the Agricultural Research Council Animal Production (MUC221SNDU01). Three hundred, day-old Cobb500 unsexed broiler chicks were randomly allocated to the five experimental treatments, each group consisting of six replicates with 10 birds per replicate in a completely randomized design. Experimental diets were as follows: T1, positive control, antibiotic growth promoters (AGP) (300 g Zinc bacitracin/ton and 500 g Salinomycin/ton); T2, 1000 g MOLM/ton; T3, probiotic (500 g Enviva Pro/ton); T4, organic acid (1000 g Novyrate C/ton); and T5, 0% additives (negative control). Body weights (BW), average body weight gain (BWG), feed intake (FI) were determined weekly and used for the calculation of feed conversion ratio (FCR) during the starter phase (D0-14). At D14 of age, 12 birds/treatment were randomly selected and weighed individually before they were sacrificed by cervical dislocation. The digestive organs were then weighed individually and digesta samples were collected for respective analyses. Data were analysed using a one-way ANOVA, using the GLM procedure of SAS/STAT® software 9.4.

Results and Discussion: Dietary treatments had no effect ($P > 0.05$) on BW, ADG and AFI during the 14 d period. A higher ($P < 0.05$) FCR was recorded for the T4 and T5 treatments, with the T1 birds having the lowest ($P < 0.05$) FCR during the first week. No treatment effects ($P > 0.05$) were noted on intestinal pH. An increase ($P < 0.05$) in small intestines size was observed in T2 birds, while that of the T5 birds were the smallest. The birds in T2 and T5 had a shorter jejunum villi length compared with the birds in T1, T3 and T4. Effects on villi width were only observed in the duodenum, where T2 birds (fed MOLM) had shorter width compared with the birds in T1. The jejunum villi surface area was higher ($P < 0.05$) in T5 birds compared with the birds in T1.

Conclusion/recommendations: Results of the current study indicate that MOLM had no prominent negative effect on gut integrity and that MOLM could be used in broiler diets during the starter phase, having comparable effects to probiotics and organic acid feed additives on growth performance, gut morphology and microbial loads. Further studies are recommended over a full production cycle to obtain more complete data on the usage of MOLM in broiler diets.

Chemical analysis and shear force of *Kigelia africana* fruit for ruminants

K.C. Ndwandwe[1] & F.N. Fon[1]

Department of Agriculture, Faculty of Science and Agriculture, Private Bag X 1001, Kwa Dlangezwa, 3886, University of Zululand, South Africa.
FonF@unizulu.ac.za

Background: *Kigelia africana* persist through the winter and can withstand water scarce environments where there is inadequate forage availability for ruminants, thereby providing a nutrient source during dry periods, which form the greatest constrain in livestock production in the country. There is no reported literature on the chemical analysis and shear force of *Kigelia africana* fruit.

Aim: This study was conducted to investigate the nutritional value and shear force of the *Kigelia africana* fruit.

Methodology: Fresh *Kigelia Africana* fruits were harvested at the University of Zululand premises, separated into five portions (parts) called Exocarp (Ex), Endocarp plus Seeds (En+SS), Endocarp (En), Seeds (SS) and Whole fruit (Wf). The different chemical components determined for each feed were dry matter (DM), moisture content (MC), crude protein (CP), condensed tannins (CT), neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL), cellulose and hemi-cellulose. Fibre components were analysed using the ANKOM filter bag method while proteins were analysed using the Kjeldhal method. Acid butanol Assay and Warner-Blatzer shear device were used to analyse condensed tannins and shear force, respectively. Analysis of variance from SPSS was used to compare means of dependent variables measured where Duncan test under PostHoc was used and differences were established at $P \leq 0.05$. Ethical clearance number UZREC 171110-030 PGM 2016/262.

Results and Discussion: The results revealed that SS and Ex had the highest cellulose content (32% and 42%, respectively). Ex had the highest ($P<0.05$) NDF, ADF and ADL content (70.67%, 59.18% and 17.69%, respectively) compared to other extracts. High fibre components (cellulose and lignin) were observed on the exocarp as they play a role in preventing herbivory. The highest ($P<0.05$) protein content was observed in SS (12.37%) while the lowest was seen in Ex. This is because seeds contain endosperm which supplies nutrients to the growing embryo. Ex had the highest ($P<0.05$) FMax (1060.1N) while En had the lowest shearing force of 540N. Removal of the hard exocarp reduced *Kigelia africana* fruit shear force requirements and possible ease of chewing. Ex had higher CT concentration ($P<0.05$) compared to other potions. The highest CT content (4.6%) was in the Exocarp, which was understood as a mechanism to deter browsers from utilising the fruit.

Conclusion/recommendations: *Kigelia africana* fruit can be suggested as a potential feed supplement for ruminants due to its chemical constituents and high moisture especially in winter when water sources are scarce. High jaw shear force illustrate that fruit shear force is not the major limitation towards fruit utilisation by domesticated ruminants, specifically cattle. However, there is a need to further investigate the digestibility of this plant both *in vitro* and *in vivo* to confirm its application as well as its anthelminthic potential.

Genetic trends, principal components and signatures of selection for a Merino resource flock divergently selected for reproduction

C.L. Nel[1], S.W.P Cloete[1,2] & K. Dzama[1]

[1]Department of Animal Sciences, Stellenbosch University, Stellenbosch, South Africa.
[2]Directorate: Animal Sciences, Western Cape Department of Agriculture, Elsenburg, South Africa.
neliusn@elsenburg.com

Background: Reproductive performance is a key facet of livestock production systems. However, the genetic improvement of reproductive traits is known to face restrictive challenges. The Elsenburg Merino flock has been important in studies on the genetic improvement of reproduction in *ovines*. Previous studies on the flock have shown sustainable gains for reproductive traits that supported the inclusion of these traits in breeding programs. Genomic approaches to the evaluation of genetic merit are considered a promising incentive for the improvement of hard-to-measure reproduction traits. However, the Elsenburg flock remains largely uncharacterised on available genotyping platforms.

Aim: To evaluate the long term breeding values of traits of the Elsenburg Merino flock and to elaborate on quantitative observations through genomic inquiries into population divergence.

Methodology: The Elsenburg Merino flock consists of two selection lines (High Line and Low Line) separated by divergent selection for reproduction from 1986 to 2016. ASREML was used for the estimation of breeding values for respective traits in single-trait analyses. Subsequent breeding values were used to predict means for each selection line for each year and used to plot genetic trends. A total of 381 influential animals from the Elsenburg flock were genotyped with the Illumina OvineSNP50 bead chip. Following standard quality control, principle components and signatures of selection were performed on 50095 SNPs using base functions of the "R" statistical software, as well as the accompanying packages *ggplot2*, *dplyr*, *irlba* and *lokern*. Ethical clearance was obtained from the Departmental Ethical Committee for Research on Animals (DECRA) for the running of the research population (R12/57) and genotyping (R14/100).

Results and Discussion: Regression coefficients of average yearly breeding values of the respective lines were significant ($P <0.05$) for weaning weight, yearling weight, total fold score as well as the reproduction traits number of lambs born per ewe mated, number of lambs weaned per ewe mated and total weight of lamb weaned per ewe mated. Trends were divergent ($P <0.05$) in all instances. Selection lines displayed clear clustering across the first principle component (PC1), which accounted for 7.18% of the total observed genotypic variance. PC2 through to PC10 showed no clear separation of animals according to selection line. A total of 1089 SNPs situated throughout the genome displayed a fixation index (F_{st}) value outside 3 x standard deviations (SD) from the mean. A kernel regression smoothing algorithm identified at least 4 positions along the genome with regional F_{st} values outside 3 x SD from the mean, suggestive of possible selection signatures in the upwardly selected High Line.

Conclusion/recommendations: Results observed in the current study aids in understanding the effects related to selection for reproductive performance. It provided evidence of relatively few detrimental effects in production traits under such selection, promoting the inclusion of reproductive traits in selection indices. It also provides promising insights on a genomic level that supports the quantitative observations of divergence on a genotypic level. The continued generation of genomic data to allow for more fundamental analyses on this and other resource flocks should be prioritised.

Assessment of growth rate and feedlot performance of F_2 progeny developed from Angus bulls × Nguni cows

N. Nemukondeni[1,3], N. Maiwashe[3], C.A. Mbajiorgu[1], M.M. Ratsaka[4] & N.O. Mapholi[2]
[1]Department of Agriculture and Animal Health, University of South Africa, Florida, South Africa, [2]Department of Life and Consumer Sciences, University of South Africa, Florida, South Africa, [3]Agricultural Research Council-Animal Production Institute, Irene, South Africa, [4]Department of Animal Science, Tshwane University of Technology, South Africa, Pretoria, South Africa
nemukn@unisa.ac.za

Background: There is a rising demand for beef meat products due to its rich protein for human consumption. Crossbreeding between the Nguni and Angus breeds could be an alternative way to increase beef production and meet this demand. This is so because Nguni cows have the ability to adapt to harsh conditions, are resistant to ticks and disease whereas, Angus bulls have high growth performance, fertility and good carcass quality.

Aim: The purpose of this study was to estimate genetic parameters for feed intake, growth and feed conversion ratio of the F_2 Nguni × Angus population based on their genotypes and to determine their population structure, including their parental breeds.

Methodology: This study was done at the Agricultural Research Council-Animal Production Campus (ARC-API) Irene, South Africa. Ethical clearance was approved by ARC (Ref APIEC17/02 and University of South Africa (Ref: 2016_CAES_094). A total of 125 animals (composed of 44 = genotype 1; 27 = genotype 2; 31 = genotype 3; 12 = Nguni; 11 = Angus) were used in this study. All animals were placed in single pens at the age of 12 to 15 months for 10 weeks with *ad libitum* feed and water. Feed intake was measured daily and live weight weekly in order to calculate the average daily feed intake (ADFI), average daily gain (ADG), residual feed intake (RFI) and feed conversion ratio (FCR). Animals were genotyped using Illumina Bovine SNP150 assay for the estimation of genetic parameters and population structure. Data were analysed with general linear model procedure using SAS (2008). Duncan's multiple test range was used to separate means and Pearson's correlation coefficient to determine relationship within measured variables. Heritability was estimated using the kinship matrix, built using the SNP genotypes in GenABEL and population structure using the ADMIXTURE 1.2.3 software.

Results and Discussion: The F_2 Nguni × Angus genotype 2 had a higher ($P<0.05$) ADG which was similar to that of the Angus cattle breed. No differences were observed for FCR between all breeds. The Nguni cattle breed had a better ($P<0.05$) RFI when compared to three F_2 genotypes and the Angus cattle. There was a strong positive correlation ($r^2 = 1.00$) between ADFI and RFI. While, ADG and FCR had a strong negative ($r^2 = -0.83$) correlation. Heritability estimates of the F_2 Nguni × Angus genotypes were 0.17 for yearling weight (YW) and 0.53 for FCR. Nevertheless, birth weight (BW) failed to converge. Population structure of the F_2 Nguni × Angus genotypes showed variation within the genotypes, Nguni and Angus cattle breed. Angus had a higher ADG as expected. Surprisingly, F_2 Nguni × Angus genotype 2 had a similar ADG while consumed less feed. RFI of Nguni cattle was higher when compared to other breeds.

Conclusion/recommendations: Overall, the F_2 Nguni × Angus genotype 2 had a better feedlot performance when compared to other genotypes, Nguni and Angus. Variations within the genotypes, with certain individuals clustering close to Nguni and others towards Angus might be due to unequal share of genetic materials. When selecting for RFI Nguni cattle would be suitable.

Determination of variance components for ostrich skin traits

K.R. Nemutandani[1,3], A. Engelbrecht[2], S.W.P. Cloete[1,2], K. Dzama[1] & O. Tada[3]
[1]Department of Animal Sciences, Stellenbosch University, Private Bag X1, Matieland 7602, South Africa,
[2]Directorate Animal Sciences, Western Cape Department of Agriculture, Private Bag X1, Elsenburg 7607,
South Africa, [3]Department of Agricultural Economics and Animal Production, University of Limpopo, Private
Bag X1106, Sovenga 0727, South Africa.
khetho.nemutandani@ul.ac.za

Background: Breeding is widely considered as a sustainable and ethical means to improve production and product quality in harmony with the available resources. Determining the genetic basis of leather quality is therefore important to determine genetic (co)variation that could potentially be utilized in a breeding plan for the ostrich industry. Previous analysis of skin traits were done with limited records and estimates consequently need to be updated.

Aim: To analyse records of ostriches to derive genetic and environmental parameters for skin traits for developing a selection index for the ostrich industry in South Africa.

Methodology: Pedigree and performance records from 1998 to 2018 from the ostrich resource flock on the Oudtshoorn Research Farm were included in the analysis. The traits included were live weight, crust skin size, nodule size, hair follicle score, skin weight, skin thickness, crown size (width and length), neckline size (length within the crown and width measured at the top of the crown). The number of records for live weight amounted to 3955, while skin trait records ranged from 2000 to 2300. The fixed effects tested included slaughter group, sex, dam age and their interactions with slaughter age as a covariate. The ASReml program was used to estimate fixed effects and subsequently to derive variance components and ratios for the respective traits. Bivariate analysis were done to obtain genetic, environmental and phenotypic correlations.

Results and Discussion: Slaughter group were significant for all the traits. All traits were dependent of the age, except for neckline traits. Sex did not have an influence on live weight and crust skin size; however, it significantly influenced skin weight, skin thickness, nodule size and hair follicle score. Generally, males had thicker skins (0.89 vs. 0.83 mm). Crown width was not significantly influenced by sex, but crown length was longer for males (841 vs. 828 mm). The direct single-trait heritability (h^2) for live weight, crust skin size, nodule size, hair follicle score and skin thickness were 0.36, 0.37, 0.33, 0.37 and 0.21, respectively. The heritability for crown width was 0.22 and 0.19 for crown length. Heritability for neckline length and width were 0.41 and 0.24, respectively. High genetic correlations were obtained for live weight with crust skin size (0.93), skin weight (0.54), crown width (0.51) and crown length (0.81). The genetic correlation between live weight and hair follicle score was negative but not significant (-0.08±0.12). Nodule size was positively correlated with crust skin size and skin weight.

Conclusion/recommendations: This study showed that skin and crown traits were influenced by age. It also validates the significant genetic variation found previously in most quantitative skin traits (crust skin size, crust skin weight, leather thickness and neckline traits). Hence, sustainable genetic progress in these traits appears feasible. This information can be used in future for the development of a selection index in the ostrich industry.

Factors affecting productive herd life in Nguni cows

M. Ngayo[1,2], M.D. Fair[1], F.W.C. Neser[1], M.M. Scholtz[1,2] & M. van Niekerk[1]
[1]Department of Animal, Wildlife and Grassland Sciences, University of Free State, P.O. Box 339, Bloemfontein, 9300, South Africa, [2]ARC-Animal Production Institute, Private Bag X2, Irene 0062, South Africa.
2013204611@ufs4life.ac.za

Background: Each year beef cow managers are faced with the question of which animals to cull and replace in their herd. A cow is removed from the herd due to her inability to continue as a productive breeding cow or dam. The ability of an animal to remain in the herd and avoid involuntary culling is regarded as the measure of length of productive herd life. Several studies indicate a cow's productive herd life (HL) to be neither greater, nor significantly different, when heifers first calve at 2 compared to 3 years of age. However heifers calving at 2 years of age produce 0.7 more calves in their lifetime than those calving at 3 years of age for the first time.

Aim: To investigate possible traits that could affect Nguni beef cow productive herd life.

Methodology: Nguni beef cow records (28 138) with pedigree information were edited and analyzed using ASREML software to test different animal models to assess effects and traits to be included to predict productive herd life (HL). The final model was:

$$y = X\beta + Za + e$$

Where y= a vector of phenotypic observations for the cow's productive herd life (HL)

> X= an incidence matrix relating records to the fixed effects β.
> β= a vector of fixed effects: number of parities (NP= 1 to 15) and year (Y= 1968 to 2015). Cow's age at first calving in days (AFC) and average inter-calving period in days (ICP) as co-variables.
> Z= an incidence matrix relating records to the additive genetic effect
> a= a vector of the additive genetic effects
> e= a vector of residual effects.

Results and Discussion: Age at first calving (AFC) minimum and maximu was 512 and 1 099 days, respectively with a mean±std of 893.9±136.4 days. The minimum and maximum inter-calving period (ICP) was 313 and 800 days, respectively with a mean±std of 408.4±59.54. The number of parities (NP) was expressed in categories ranging from the 1st to the 15th parity, mean±std was 7.2±3.59. All the fixed effects fitted in the model had a significant effect ($P<0.05$) on productive herd life. The year was also significant ($P<0.05$). The model with direct animal effects as random yielded a low heritability when year was excluded from the analysis. However, when year was included in the model the direct animal variance was zero. This indicates that all variance measured in the model was due to environmental effects indicating that productive herd life was not heritable for this population.

Conclusion/recommendations: Further investigations are needed to confirm the initial results of no direct genetic effect on productive herd life and the included factors affecting the productive herd life in Nguni cows.

Effect of storage temperature on sperm motility from Zulu ram semen assessed using Computer-Aided Sperm Analysis

J.N. Ngcobo[1,2], K.A. Nephawe[1], A. Maqhashu[2], N. Bovula[2], F.V. Ramukhithi[2] & T.L. Nedambale[1]

[1]Tshwane University of Technology, Department of Animal Sciences, Private Bag X 680, Pretoria, 0001, South Africa, [2]Agricultural Research Council, Germplasm Conservation and Reproductive Biotechnologies, Private Bag X 2, Irene, 0062, South Africa.
NedambaleTL@tut.ac.za

Background: Male fertility is an important aspect in the reproduction of mammalian species especially after the introduction of artificial insemination (AI) technology. Nevertheless, AI requires good post-thawed semen quality. There are several parameters used to assess spermatozoa quality following freezing or liquid storage. These include sperm motility, morphology, viability and acrosome integrity. Among these parameters, sperm motility remains an important parameter that is highly correlated with fertility. However, sperm motility has been evaluated subjectively in mammals including rams. For this reason, several research stations have adopted the use of Computer-Aided Sperm Analysis for sperm motility evaluation accuracy.

Aim: The aim of the current study is to evaluate the effect of storage temperature on sperm motility of Zulu ram semen during the breeding season and non-breeding season.

Methodology: Experiment procedures were approved by the ethics committee from Agricultural Research Council, Irene (APIEC16/034) and Tshwane university of Technology (AREC2018/03/004). Section 20 of Animal Disease Act (Act no. 35 of 1984) was granted by the Department of Agriculture, Forestry and Fisheries (DAFF). Six pure-breed Zulu rams were used in the study. Semen was collected with the aid of artificial vagina filled with warm water (40-42^0 C), twice a week over four consecutive weeks in each season (breeding season and non-breeding season). After semen collection, semen was transferred to the lab within 30 minutes for analysis. Autumn (February to April) was taken as a breeding season while winter to spring (July to September) taken as a non-breeding season. Semen was diluted with the tris-based (without egg yolk) swim up (1:100µL) and analysed using Computer-Aided Sperm Analysis (CASA). Furthermore, tris-based extender (with egg yolk) was used to dilute semen before storage to 5ºC, 10ºC and 15ºC. Statistical analysis was done using General Linear Model (GLM) in Minitab 17®. Means were compared using Tukey's procedure and considered significantly different when alpha was less than 0.05.

Results and Discussion: Storing semen at 15ºC resulted in higher sperm motility than 10ºC and 5ºC ($P<0.05$) before 24 hours but quality declined drastically thereafter. Noteworthy, semen collected and stored during non-breeding season recorded significantly higher ($P<0.05$) progressive motility despite the temperature (5ºC, 10ºC and 15ºC). Furthermore, when sperm motility was scrutinized within seasons, all storage temperatures of non-breeding season was better than 5ºC, 10ºC and 15ºC of breeding season in terms of progressive motility.

Conclusion/recommendations: Zulu ram's semen can be stored and hold quality at 15ºC until 24 hours but thereafter decline drastically. Therefore, 15ºC can only be used within the first 24 hours of storage. Hence, 10ºC is a good alternative when semen is intended to be used after 24 to 48 hours. On other hand, 5ºC is useful when semen will be used after 48 hours. It is recommended that, the future studies involve the fertility data in these different storage temperatures.

The effects of garlic leaves and paw-paw seeds on *in vitro* digestibility of *Eragrostis spp.* and *Medicago sativa* hay

M.J. Ngele[1], D. Luseba[2] & M.C. Muya[1]

[1]Department of Animal Science, Tshwane University of Technology, Private Bag X680, Pretoria 0001, South Africa; [2] Agricultural Research Council - Animal Institute, Private Bag X2, Irene, 0062, South Africa.
tebogongele7@gmail.com

Background: It is commonly known that forage crop serve as a valuable energy source in ruminants due to its cellulose content. However, it is of a lower quality as a result of poor digestibility and limited availability of energy when compared with maize and cereal grains. With the effect of temperature and shortage of precipitation, most available natural C4 forage pastures and crop residues are of poor nutritive value as they consist of highly lignified stem during the dry season. In part, this prevents crop forages to be used as the sole feed for high-producing ruminants. Fibrolytic enzymes have shown ability to improve forage digestibility due to their action on forage cell wall. However, it is a costly option and the results on ruminants were inconsistent. Additives that increase energy availability and maximise forage utilisation are essential. Garlic and paw-paw are known to possess a range of properties and digestive enzymes and can be tested as cost-effective options.

Aim: To evaluate the potential of garlic leaves and paw-paw seed powder in improving fiber digestibility in ruminants.

Methodology: The experiment was approved by the Animal Ethics Committee at the Agricultural research council - Irene (APIEC 18/08). The experiment was performed as a complete randomized design with 4 treatments (Control (C), Garlic (G), paw-paw (P) and their combination (G+P)). *In vitro* digestibility was performed as described by the manufacturers (ANKOM® Technology Corp., Fairport, NY, USA) with a large incubator of four digestion jars of 2 L each, using nylon bags. Lucerne *(Medicago sativa)* and *Eragrostis curvula* hay samples (0.5±0.01 g) were respectively filled into bags and heat sealed. Twenty one bags filled with substrates and three blank bags were placed into a jar. A pre-warmed (39 ºC) and reduced buffer solution (4000 ml) was poured into each jar containing 21 filter bags which were pre-treated 12 hours prior to incubation, sealed and placed in the water bath at 39 ºC to equilibrate the milieu. Rumen liquor (2000 ml) collected from a cannulated Holstein cow was then added to each flask. At defined periods of time (0, 3, 6, 9, 12, 24 or 48 h) three bags were removed per jar. The retrieved bags were gently washed under running cold water and placed in the drying oven at 60 ºC for 48 hours to determine the dry matter (DM). The neutral detergent fiber (NDF) was determined according to standard method. The effective degradability was calculated at 3 passage rate: ED1 (0.02 h−1); ED2 (0.05 h−1) and ED3 (0.08 h−1).

Results and Discussion: The soluble DM fraction of Lucerne hay was higher for G and G+P than C. The Insoluble degradable DM fraction and ED2 were higher for P and G+P than C. The ED3 of DM was higher for G+P than the rest of treatments. The soluble NDF fraction and ED1 of Lucerne hay were higher (P<0.05) for P than the rest of treatments. The insoluble degradable DM fraction of *Eragrostics curvula* hay was higher (P<0.05) for P and G+P than C. All additives had higher degradation rate of degradable DM fraction of *Eragrostics curvula* than control. The ED1 and ED2 of DM were all higher (P<0.05) for P and G+P compared to C and G. The degradability of NDF of *Eragrostis curvula* was not affected by treatments.

Conclusion/recommendations: Addition G increased the soluble DM and NDF fraction in Lucerne and not *Eragrostis curvula* hay. Addition of paw-paw increased the insoluble degradable DM in both Lucerne and *Eragrostis curvula* hay. More improvement on both DM and NDF degradability was observed with the combination G+P, suggesting associative effects between the two additives.

Effect of dietary threonine level on productivity and carcass characteristics of Ross 308 broiler chickens

D. Ngomani, J.W. Ngambi & D. Brown

Department of Agricultural Economics and Animal Production, University of Limpopo, P.O. Box X1106, Sovenga, 0727, South Africa.
delisilengomani@gmail.com

Background: Threonine is a major component of body protein and plays an important role as a precursor of lysine and serine. Results of the effect of dietary threonine level on productivity of chickens have been variable and inconclusive. Threonine requirement levels for optimal productivity of Ross 308 broiler chickens are also changing due to breed improvements. It is, therefore, important to provide sufficient levels of threonine for improved Ross 308 chicken breeds to support the needs of tissue maintenance and accretion while minimising any excesses.

Aim: This study was conducted to determine the dietary threonine levels for optimal production performance and carcass characteristics of Ross 308 broiler chickens.

Methodology: All experimental procedures were approved by the Animal Ethics Committee at the University of Limpopo (Experiment No. 12/17). Two experiments were conducted to determine the effect of dietary threonine level on production performance and carcass characteristics of Ross 308 broiler chickens. In each experiment the diets were isocaloric and isonitrogenous but with different dietary threonine levels. A total of 150 unsexed day-old chicks were used in a CRD having 5 treatments (6.4, 7.5, 8, 8.5 and 9g of threonine/kg DM feed), replicated 3 times and having 10 chickens per replicate for Ross 308 broiler chickens aged between D1-21. Seventy-five male chickens were used in a CRD having 5 treatments (6.4, 7.5, 8, 8.5 and 9g of threonine/kg DM feed), replicated 3 times and having 5 chickens per replicate for male Ross 308 broiler chickens aged between D22-42. Diet digestibility was done between D15-21 and D35-42 of age. A quadratic regression model was used to determine the optimal productivity of the chickens while a General Linear Model procedures for the statistical analysis of variance was used to detect dietary treatment effects. At the age of D21 and D42 two chickens per replicate were slaughtered for the determination of carcass characteristics.

Results & Discussion: Dietary threonine levels used in this experiment affected ($P<0.05$) feed intake, growth rate, live weights, ME intake, nitrogen retention, FCR and gut organ weights and lengths of unsexed Ross 308 broiler chickens aged 21 days. Dietary threonine level did not affect ($P>0.05$) diet digestibility. FCR, proventriculus digesta pH, gut intestine length and caecum length of unsexed broiler chickens were optimized at different dietary threonine levels of 9.6, 8.5, 6.6 and 8.4 g/kg DM, respectively. Dietary threonine levels used had effect ($P<0.05$) on feed intake, diet digestibility, ME intake, live weight, proventriculus pH values, GIT length, gut organ and carcass organ weights of male Ross 308 broiler chickens aged 22 to 42 days. Proventriculus and large intestine weights were optimized at different dietary threonine levels of 7.5 and 9.1 g/kg DM feed, respectively. Dietary threonine level did not affect ($P>0.05$) growth rate and FCR of male Ross 308 broiler chickens aged D22-42.

Conclusion/recommendations: It is concluded that dietary threonine levels used in this study affected production performance of younger broilers (D1-21) more than that of older birds (D22-42). However, production variables were optimized at different dietary threonine levels. This has implication on diet formulation for the chickens.

Socio economic status of the feedlots and custom feeding centres in the Eastern Cape Province, South Africa

T. Ngqwebo[1], A. Fadana[1], N. Nyalambisa[1] & A.Y. Chulayo[1]
[1]Department of Rural Development and Agrarian Reform, Dohne Agricultural Development Institute, Private Bag X15, Stutterheim, 4930, Republic of South Africa.
tngqwebo4@gmail.com

Background: In agricultural economy, livestock production is one of fastest growing sectors, driven by income growth and supported by technological and structural change. The Livestock sector contributes about 40% to the global value and agricultural output, while it supports the livelihoods and food security of almost one billion people. Worldwide, livestock contributes 15% of total food energy and 25% of dietary protein. The feedlot industry in South Africa dates back to 1965 when a few entrepreneur cattle farmers started producing - grain to supply feed during periods of shortage, especially during the winter season. Feedlotting is a system that is less affected by season and uses a small piece of land to finish large numbers of animals to produce high quality beef.

Aim: This study was conducted to establish the challenges associated with animals, feeding and market linkages on feedlots and custom feeding sites in the Eastern Cape Province.

Methodology: A total number of nine custom feeding centers (CFC) and one feedlot (Ikephu based in Elliot) in all the six (6) Districts of the Eastern Cape were visited. The CFC were Lower Hukuwa, Komani, Lahlangubo, Ngangegqili, Fort Malan, Njiveni, Ncora, Mt Frere, and Gxwalibomvu. These CFC differed in terms of structure and intake. A descriptive questionnaire was developed as a standard tool for data collection. Questions focused on farmers and members participating in the feedlot in 2016 and 2017, respectively. Interviews were then conducted by Department of Rural Development and Agrarian Reform (DRDAR) officials (Socio economic researchers, District scientists and Extension officers). The data was later analyzed using Microsoft Excel.

Results and Discussion: Several challenges and differences were observed in all the CFC and feedlot. The Ikephu was the only feedlot among the CFC in the province. It is well structured with a total number of 500 cattle full capacity. The daily average weight gain at Ikephu was 1.83 kg and their target weight was 400 kg after 120 days. The other CFC had similar infrastructure with several challenges encountered such as stock theft, diseases, water scarcity and marketing. The latter CFC do not have any selection criteria for animal intake and animals were sold to the informal market. The breeds that they use are mostly inferior breeds. These challenges potentially prohibit farmers from full participation in the formal marketing of livestock. This appears to indicate that increase in body condition of the livestock could possibly increase formal market participation by the farmer, when other factors are kept constant. Although, these CFC planned to establish fodder flow programs to curb feed challenges, it was found that they require support. They further planned to establish market linkages with existing industry partners such as the National Agricultural Marketing Council (NAMC).

Conclusion/recommendations: The Custom Feeding Centers depend on the participation of farmers who are willing to bring their animals for fattening. The keys to successful feeding are to start with a pen of cattle which is uniform in weight, body type, age, breeding and previous nutritional management.

The water footprint of South African beef production: a review

A.M. Ngxumeshe, M.M. Ratsaka, T.J. Mpofu & K.A. Nephawe & B.J. Mtileni
Tshwane University of Technology, Staatsatillerie road, Private Bag X680, Pretoria, 0001.
NgxumesheAM@tut.ac.za

Background: There is an increase in competition and water requirement while water resources are decreasing at an accelerating rate. Agriculture is the biggest consumer of water and therefore has the largest water footprint and yet not known. The largest proportion is acknowledged to be for producing animal products. The water footprint concept takes into account the volume of fresh water used to produce a product, measured along the entire value chain from the production of inputs to the final stage where the final product reaches the consumer

Aim: This study is aimed at quantifying the volumetric water footprint of beef production from weaning to slaughter.

Methodology: To enable to determine the water footprint both the water withdrawn from surface and groundwater and the use of soil should be accounted for. This water footprint is categorized into green (water used by plants), blue (water consumed from mixed feed, drinking and irrigation) and grey (water required to dilute pollutants to an acceptable level such that the quality of the ambient water is maintained). The largest water footprint of animal products such as beef meat relates to animal feeding. There are three identified major determining factors of water footprint of meat; these include feed conversion efficiency (FCE), feed composition and feed origin. The FCE and feed composition are influenced greatly by the animal production system. In South Africa, there are two distinct production systems; which are the intensive and extensive production systems. Intensifying beef animals improve their FCE due to faster growth rates per kg feed consumed and reduced activity, and therefore reduce water footprint. Beef cattle feed on a large component of roughage feed, particularly in the extensive system, while the intensive production system has a high concentrate to roughage ratio. This theoretically increases the water footprint in the intensive system due to the larger water footprint of concentrate feeds.

Results and Discussion: Literature indicates that the volumetric water footprint indicator of boneless beef in South Africa is 17 387 l/kg, compared with the global average of 15 414l/kg. The water requirement is claimed that approximately 15 500 L is needed to produce 1 kg beef, it is assumed that it takes three years to produce 200 kg of boneless beef.

Conclusion/recommendations: Water foot print assessment is critical to enable consumers to make well informed and sound decisions when considering changing their behaviour due to effect this have on both the social, economic and environmental impacts.

In-vitro efficacy evaluation and toxicity assessment of selected medicinal plant extracts used to control internal parasites in goats in the province of Eastern Cape

W. Nikelo[1], M. Mpayipheli[1], F. Makhubu[2] & L. McGaw[2]

[1]Department of Livestock and Pasture, University of Fort Hare, Private bag X1314, Alice, 5700, South Africa;
[2]Department of Paraclinical sciences, University of Pretoria, Private bag X04, Onderstepoort, 0110, South Africa.
MMpayipheli@ufh.ac.za

Background: Throughout the world, internal parasites seem to play a significant role in hindering goat production, especially those found under smallholder production systems. The control of these parasites is usually through expensive pharmaceutical remedies, which are unaffordable for resource-limited farmers. This situation somehow forces these farmers to seek for alternative cost effective controls such as the use of indigenous medicinal plants. However, scientific evidence on the anti-parasitic efficacy of most plant products is limited, regardless of their wide ethnoveterinary usage. Scientific validation of the anti-parasitic effects and possible side-effects of plant products in ruminants is necessary prior to their adoption as a novel method for parasite control. In this study, three plants from different family were selected based on the results obtained from literature survey.

Aim: The current was to evaluate efficacy and toxicity of selected medicinal plants extracts used to control internal parasites in goats using *in-vitro* conditions

Methodology: Fresh roots and barks were collected from Nyandeni Local Municipality (Hluleka village) in Eastern Cape under the guidance of one of the community leaders and later authenticated by Magda Nel at Schweickerdt Herbariumfrom, University of Pretoria . The *in vitro* efficacy of extracts of *F.natalensis*, *S,eriopus* and *S.henningsii* was determined against *Haemonchus contortus*. Eggs and larvae of *H.contortus* were incubated at 23 °C in the extracts of the bark and root of *F.natalensis*, *S,eriopus* and *S.henningsii* at concentrations of 0.078–2.5 mg ml−1 for 2 and 5 days, respectively. Albendazole and phosphate buffer saline (PBS) were used as positive and negative controls, respectively. Cytotoxicity was determined using MTT (3-5-dimethyl thiazol-2-yl-2, 5-diphenyl tetrazolium bromide) method on Vero Monkey kidney cells.

Results and Discussion: Extracts inhibited egg hatchability and larval development (from L_1 to infective stage L_3) at concentration of 2.5 to 0.078 mg/mL. Inhibition of egg hatching increased significantly ($P<0.05$) with increasing concentration of the extracts. However, in larval development almost all plant extracts inhibited development of larvae by 100% (no larvae could be observed) even at the lowest concentration of 0.078 mg/mL. Extracts of *S.eriopus* were not toxic in both solvents. The current study revealed that *F.natalensis* extracts have anthelmintic activity and water extracts are non-toxic, thus providing support for their use in traditional veterinary practices.

Conclusion: All plants evaluated for anthelmintic activity have some degree of anthelmintic activity against egg and larvae of *H.contortus*. *F. natalensis* and *S.eriopus* were found to be the most promising plants which may be further studied to identify the active constituents responsible for anthelmintic activity and confirm these findings *in-vivo*.

Intrinsic factors contributing to variation in the AMEn value of maize for broiler chickens

S.S.M. Nkabinde[1,3], C. Jansen van Rensburg[1], K.M. Venter[1,3], W. Louw[2] & P.W. Plumstead[3]

[1]Department Wildlife and Animal Sciences, University of Pretoria, Pretoria, 0002, South Africa, [2]Southern African Grain Laboratory, The Willows, Pretoria, 0041, South Africa, [3]Chemunique International (PTY) Ltd, Randburg, 2194, South Africa.
sibong@chemunique.co.za

Background: Maize is the primary cereal grain in South African (SA) broiler diets, contributing up to 70% of the apparent metabolisable energy (AMEn) consumed by broilers. Therefore, the ability to rapidly and accurately estimate AMEn of maize used in feed formulation is of economic and nutritional importance. Previous research showed AMEn of maize varied due to differences in chemical composition, as well as intrinsic kernel factors such as kernel hardness, vitreousness, kernel density, and kernel size. However, current prediction equations to calculate the AMEn of maize do not consider differences in digestibility arising from differences in kernel hardness or physiochemical structures.

Aim: This study determined which intrinsic kernel factors contributed significantly to the observed variance in AMEn of white and yellow maize samples and if these factors improved the accuracy of a model to predict the AMEn of maize.

Methodology: White (n=471) and yellow (n=639) maize samples from the 2015/2016 (n=338) and 2016/2017 (n=772) harvest seasons were collected from different regions in South Africa and analysed for moisture, protein, crude fat, milling index, grit yield all and AMEn using Near-Infrared Transmittance (Infratec^{TM} 1241 Grain Analyser, Foss, Denmark). The hectolitre mass of physical maize was measured per litre. The Pearson Product moment correlation coefficient of all variables was determined using the multivariate analysis test (JMP Pro 13.1). The relationship between AMEn and all parameters was analysed using Multiple Regression Model Fit test (JMP Pro 13.1). Factors were included in the final model using step-wise regression to minimise the Bayesian Information Criterion (BIC).

Results and Discussion: Significant positive correlations were observed between AMEn and fat (r=0.63), protein (r=0.58), and moisture (r=0.32). A significant negative correlation between AMEn and maize starch (r=-0.60) can be explained by starch in-turn being negatively correlated with fat (r=-0.34) and protein (r=-0.85) of maize. Physical kernel properties of maize that were influential in explaining variance in AMEn included hectolitre mass (r=-0.47); milling index (r=0.55); and grit yield all (r=0.52). Model selection using stepwise forward selection that minimised the BIC resulted in a final model: AMEn=3589.8 + 37.59*crude fat + 9.76*crude protein - 30.32*moisture + 0.3*Milling Index. The R^2 of this model was 0.89 with a root mean square error (RMSE) of 8.95 kcal/kg. Maize starch did not significantly affect AMEn (P=0.07) after other independent variables were included.

Conclusion/recommendations: Results showed that variance in the AMEn of maize arose from differences in intuitive parameters such as fat, protein, and moisture, as well as physical characteristics of the kernel such as Milling Index. The resultant model was able to predict AMEn of maize with a RMSE of 8.95 kcal/kg. The significance of milling index in the model suggested that, in addition to chemical composition, physical properties of the kernel contributed to observed variation in AMEn and should be included in prediction equations of AMEn.

Preliminary results on the evaluation of cow reproductive performance of market-oriented smallholder and communal farmers in South Africa

M. Nkadimeng[1,2], E. van Marle-Koster[2], M.L. Mphaphathi[1], F.V. Ramukhithi[1], A. Maqhashu[1], M. Tshabalala[1] & M.L. Makgahlela[1]

[1]Agricultural Research Council, Animal Production Institute, Germplasm Conservation, and Reproductive Biotechnologies, Private Bag X2, Irene 0062, South Africa; [2]Department of Animal and Wildlife Sciences, University of Pretoria Hatfield 0002, South Africa.
nkadimengm1@arc.agric.za

Background: Reproductive performance is the single most important economic trait in beef cattle. Due to poor efficiency in reproductive traits, it results in major economic losses in livestock production. Poor reproduction management, including low calving and weaning rate is one of the primary challenges in the smallholder sector in most developing countries.

Aim: The aim of the study was to evaluate pregnancy status on cow reproductive performance of market-oriented smallholder and communal farmers of Mpumalanga, Gauteng, Northwest and Limpopo province.

Methodology: Data was collected within the Australian Centre for international agricultural research (ACIAR) free-range beef market to the communal and market-oriented smallholder farmers project. Pregnancy status was recorded using a portable ultrasound scanner (IbexTM). The study recorded body condition score(BCS) and body weight(BW) as performance traits that contribute to the pregnancy rates in market-oriented smallholder and communal farmers. All measures were recorded on a total number of 1961 cows in 23 farms of market-oriented smallholder and communal farmers of Mpumalanga, Gauteng, Northwest and Limpopo province during the breeding season, over a one-year period. Body condition score was recorded using the 1 to 5 scale system: poor (1), ordinary (2), average (3), good (4) and very good (5), and body weights were measured using a weighing scale. Data was electronically captured and analyzed using SAS 9.2 statistical software. Data on BCS and BW was expressed as means and standard deviation (MEAN ± SD) and PD data was recorded in percentages.

Results and Discussion: BCS showed no significant difference between Gauteng (2.74 ±0.89) and Limpopo province (2.77±0.40). Northwest recorded BSC of 3.07±0.29 and a significantly higher BSC (3.23±0.66) was observed in Mpumalanga compared to all other provinces. However, measures on BW in Northwest showed significantly higher (461.80±98.70) records compared to Mpumalanga (427.78±99.47), Limpopo (381.26±91.13) and Gauteng (433.19±91.32). The significantly lower (P>0.05) observation on BSC and BW in Limpopo was comparable to the 22 % pregnancy status as compared to (37%) in Northwest and (38%) in Gauteng. Mpumalanga had significantly high (68%) pregnant cows compared to other provinces. The results of pregnancy diagnosis in Limpopo, Northwest, and Gauteng emphasize the impact of low reproductive efficiency of 48% calving rate recorded in the smallholder sector over the past decade. Furthermore, low reproduction rates are known to influence improvement in production growth and efficiency in this sector.

Conclusion/recommendations: It is concluded that reproductive performance on pregnancy status of market-oriented smallholder and communal farmers in the Northwest, Limpopo and Gauteng province is below average, however, cows in Mpumalanga have high reproductive performance. The study is ongoing and more fertility traits that include calving rate, foetal loss and inter-calving period are being studied in market-oriented smallholder and communal farmers.

Effective population size, inbreeding rate and risk status classification of Kalahari Red goats in stud flocks of South Africa

K.P. Nkgapele, O. Tada & K. Nemutandani

Department of Agricultural Economics and Animal Production, School of Agriculture and Environmental Sciences, Private Bag 1106, University of Limpopo, Sovenga,0727, South Africa.
preciouskatlego011@gmail.com

Background: Inbreeding is one of the major threats that affect production in the goat industry. Inbreeding rates have been estimated for other breeds except the Kalahari Red goats. Studies have shown that chevon is one of the valuable meats for healthy human consumption. However, the effective population size and the risk status classes of goats have not been estimated on this breed due to unavailability of reliable data to derive the parameters.

Aim: To asses small population genetic parameters in Kalahari red goats under the stud flocks of South Africa.

Methodology: A sample of 26 205 animal records from 1977 to 2018 of Kalahari Red goats registered with the South African studbook were used in this study. Information on the breeding males and females, and flock size will be required. The relationship between the two parents and common ancestors were evaluated to observe the inbreeding rates (F). The effective population size (N_e) per generation was calculated through a formula $N_e = ((4*N_m*N_f)/(N_m+N_f))$ using Minitab 18.1 and MS Excel, and for the risk status classification, a template was utilized to classify the number of breeding females in several categories (i.e., normal, insecure, vulnerable, endangered, critical and extinct).

Results and Discussion: The results of this study are presented in categories of generations to fully detail the pattern in which these parameters fluctuated per generation. The effective population size from 1st to 16th generation classified as endangered, the 18th to 22nd generation the breed was observed to be vulnerable, and from generation 23rd to 34th generation the breed was considered rare. However, findings further indicated that in the 35th generation the breed was vulnerable. Therefore when the Effective population size is >10000 (mature animals) the population reduction rate will decline with 30-50%. The risk status class of the goats from generations 1-15, 16 -24 and 25 -33 were critical, endangered and vulnerable respectively. Thus, there was an increase in the risk class of Kalahari Red goats. However, in the last two generations (34th and 35th) there was a decrease in the number of breeding female and the risk class was back to being endangered. The rate of inbreeding has been inclining rapidly up to 7% in the 16th generation which falls extremely above the advisable limit of the rate of inbreeding which is between 0.5% -1%. Furthermore, from the 17th generation the inbreeding rate has been ranging within the advised range, meaning this population will still survive inbreeding in the long run.

Conclusion/recommendations: The stud goat numbers is currently endangered and is at risk of extinction should the stud breeding trends continue in the same pattern. The rate of inbreeding is within the advised ranges to protect the population in the long run. Inbreeding coefficients and its effect on kidding intervals, birth weight and litter size should be investigated.

Effects of microbial silage additives on ruminal dry matter degradability of avocado (*Persea americana*) pulp silage

B.D. Nkosi[1], R. Meeske[2], M.C. Muya[1], R.S. Thomas[1], I.M. Malebana[1], T. Langa[1], M.D. Motiang[1] & J.A. van Niekerk[3]

[1]Agricultural Research Council-Animal Production, Private Bag X2, Irene, 0062, South Africa, [2]Directorate: Animal Sciences, Western Cape Department of Agriculture, Outeniqua Research Farm, George, 6530, South Africa, [3]Centre for Sustainable Agric. Rural Development, University of the Free State, Bloemfontein, 9300, South Africa.
dnkosi@arc.agric.za

Background: Avocado (*Persea americana*) pulp (AP) is a non-conventional by-product that contains appreciable nutrients for ruminant nutrition. The making of silage from AP is seen as a good method for preserving this resource. The making of silage involves the use of microbial additives, which improve the nutritive value, fermentation, aerobic stability and animal performance. Literature that evaluates the effects of microbial additives on silage ruminal dry matter (DM) degradation is limited.

Aim: This study was conducted to evaluate the microbial inoculation effects on ruminal dry matter (DM) degradation of silage produced from Avocado pulp.

Methodology: This research was approved by the Animal Ethics Committee of the Animal Production with reference number :APIECIS/027. The PA (800 g PA/kg) fresh matter (FM) was mixed with 150 g grape pomace/kg of FM and 50 g sugarcane molasses/kg of FM. The mixture was treated with: 1) no additive (control), 2) Emsilage (denoted as EMS) that contained *Bacillus subtilis, Bifidobacterium animalis, Bifidobacterium bifidum, Bifidobacterium longum, Lactobacillus acidophilus, Lactobacillus casei, Lactobacillus bulgaricus, Lactobacillus fermentum, Lactobacillus plantarum, Lactococcus lactis subsp. Lactis, Rhodopseudomonas palustris, Saccharomyces cerevisiae, Streptococcus salivarius subsp. Thermophiles)*, and 3) Sil-All 4x4 W.S (denoted as Sil) that contained > 1.2 x 10^{10} CFU/g *Lactobacillus plantarum CNCM I-3235*, > 1.5 x 10^9 CFU/g *Enterococcus faecium CNCM I-3236* , > 1 x 10^8 CFU/g *Lactobacillus salivarius CNCM I-3238*, > 6 x 10^9 CFU/g *Pediococcus acidilactici CNCM I-3237*, > 30 CMC/g cellulase from *Trichoderma longibrachiatum ATCC 74252*, > 500 IU/g *Beta glucanase from Aspergillus niger* MUCL 39199, and > 750 IU/g xylanase from *Trichoderma longibrachiatum MUCL 39203*. The materials were thoroughly mixed, compacted into 1.5 L anaerobic jars (J. Weck, GmBHu. Co., Wehr-Oflingen, Germany) and kept at room temperature for 90 days. For determination of silage dry matter (DM) degradability, three rumen cannulated mid-lactating (days in milk: 180 ± 5 d) Holstein cows with an average bodyweight of 667 ± 43 kg were used. Cows were offered a 40:60 forage to concentrate ratio TMR formulated to meet their nutrient requirements. Triplicate samples of AP, grape pomace and the mixture PA, grape pomace and sugarcane molasses, with and without inoculants, were sub-sampled (6.5 g) and placed in polyester bags (10 x 20 cm; 50 μm pore size) (Ankom, Fairport NY, USA) to achieve 15 mg/cm² (ratio of sample size to surface area bag). The bags were incubated simultaneously in the ventral rumen of each cow for 2, 4, 8, 16, 24, or 48 h.

Results and discussion: Potential degradable fraction and the extent of degradation were similar (*P*>0.05) amongst the treatments. The EMS treatment had higher (*P*<0.05) soluble fractions and lower degradation rate than other treatments. The Sil inoculation improved (*P*<0.05) the effective degradation of the silage compared with the other treatments. The microbial inoculation was effective in improving the fermentation characteristics and reducing the fibre fractions of AP silage.

Conclusion/recommendations: Microbial inoculation improved the AP silage as a potential feed in animal production. The degradability of protein and fibre should be evaluated.

Effect of dietary inclusion levels of diatomaceous earth on production, carcass characteristics and faecal egg count of lambs

A.T. Nkwana[1,2], P.J. Fourie[1] & J.H. Hoon[2]

[1]Department of Agriculture, Central University of Technology, Free State, Private Bag X20539, Bloemfontein, 9300, South Africa, [2]Grootfontein Agricultural Development Institute, Private Bag X529, Middelburg (EC), 5900, South Africa.
pfourie@cut.ac.za

Background: Diatomaceous earth (DE), also known as diatomite, has been recognized as an organic product for animal health and nutrition and is claimed to be an effective growth promoter and alternative natural anthelmintic for sheep, goats and other livestock. Numerous reports by scientists, veterinarians, farmers and others are available on results and observations made in their operations with diatomite. These reported results and observations are, however, inconsistent and often contradictory.

Aim: The aim of this study was to determine the effect of different levels of DE on the growth rate, carcass characteristics and faecal egg count (FEC) of lambs receiving feedlot diets.

Methodology: Fifty Ronderib Afrikaner x Merino lambs (37.2 kg ± 4.4) were used in the study. The animals were divided on a stratified body weight and FEC basis into five groups of ten lambs each. The animals in all the groups were provided with the same feedlot diet. DE was included at different levels as part of the diet. The groups consisted of one control and four treatment groups and the following DE levels were included on an as-fed basis: Treatment 0 (Control) = 0%, Treatment 1 = 0.5%, Treatment 2 = 1.0%, Treatment 3 = 1.5% and Treatment 4 = 2.0%. Body weights were recorded on a weekly basis and FEC (roundworms and coccidia) on a two-weekly basis for the duration of the project. The eye muscle area and fat depth over the eye muscle area of the lambs were measured with an ultrasound scanner at the start and again at the end of the project just before slaughtering. All the lambs were slaughtered after a 46-day feeding period. After slaughtering, warm and cold carcass weights, fat measurements, hind leg length, hind leg circumference, carcass length and abdominal fat weight were recorded. The General Linear Model procedure of SAS was used to determine the effect of different DE inclusion levels in feedlot diets on the growth rate, FEC, eye muscle area, fat depth and carcass characteristics of the lambs.

Results and Discussion: There were no differences (P >0.05) among the different groups in terms of weekly body weights, body weight change and average daily gain. For eye muscle area change from the start to the end of the project, no differences (P >0.05) were observed among the groups. However, fat depth change of Treatment 4 was higher (P <0.05) than Treatment 2, but did not differ from the other groups. The warm and cold carcass weight, carcass yield, carcass length, hind leg length, hind leg circumference and abdominal fat weight also did not differ (P >0.05) among the different groups. The FEC results of this study showed that DE at different inclusion levels did not affect (P >0.05) the roundworm and coccidia counts of the lambs.

Conclusion/recommendations: Despite the widespread interest in and use of DE as a growth promoter and natural anthelmintic for livestock, the inclusion of different levels (0.5% to 2.0%) of DE in feedlot diets in general did not have a significant effect on the growth rate, carcass characteristics and FEC of the lambs in this study.

Prevalence of indigestible foreign bodies in the stomach of cattle and their effect on body condition score at abattoirs of the Eastern Cape, South Africa

V.V. Nongcula[1], L. Zhou[2], K. Nhundu[2,3] & I.F. Jaja[1,2]

[1]Department of Livestock and Pasture Science, University of Fort Hare, Alice 5700, South Africa, [2]Risk and Vulnerability Science Centre, University of Fort Hare, Alice 5700, South Africa, [3]Agricultural Research Council, 1134 Park St, Hatfield, Pretoria 0001, South Africa.
200901532@ufh.ac.za

Background: It is estimated that South Africa's population will be above 65 million in 2050. Thus, food production needs to increase in order to alleviate poverty. However, infectious and non-infectious diseases affect livestock productivity, thereby hampering food supply. Non-infectious disease/conditions caused by the consumption of solid waste material are rarely reported.

Aim: This study aimed at investigating the occurrence and type of indigestible foreign objects (IFOs) in the stomach of slaughtered cattle in relation to body condition score in two high-throughput abattoirs ($n = 4424$) in the Eastern Cape Province of South Africa.

Methodology: The study design and methods was approved by the University of Fort Hare ethics committee with reference number JAJ011SNON01. The two abattoirs considered were Queenstown abattoir (QTA) and East London abattoir (ELA) with average daily/yearly slaughter rate of cattle at 80/2400 and 200/6000, respectively. All animal handling (where applicable) was facilitated by the abattoir's veterinarian and trained eviscerators. The study was carried out on cattle because they are poor selective grazers and are more likely to ingest IFOs compared to sheep or goats. After slaughter, the contents of the forestomach and intestines were removed and carefully examined for the presence of IFOs. Data on animal body condition scoring (BSC) was obtained antemortem using a scoring system of 1 (emaciated) to 5 (obese). An inventory of the types of materials and their location on cattle stomach was determined and subsequently analysed using linear regression analysis in SPSS version 23 to determine the relationship between the BSC of the cattle upon occurance of IFOs.

Results and Discussion: The study revealed that metallic and non-metallic indigestible objects had an overall prevalence of 63% in cattle slaughtered in Queenstown abattoir (QTA, (n=1906) and 64.8% at the East London abattoir (ELA, (n=2518). Most of the IFOs were found in the rumen (64.2% and 70.8%) and reticulum (28.5% and 20.6%) at QTA and ELA, respectively. The leading IFOs in the stomach of cattle at QTA were plastics (27.7%), polybezoars (10.7%) and ropes (10.7%), while polybezoars (19.8%), ropes (17.6%) and stones (10.7%) were the main IFOs seen in cattle at ELA. The study showed a statistical significance ($P<0.05$) between body condition score and the prevalence of indigestible foreign objects in cattle. This implied that meat production is affected by ingestion of solid waste materials.

Conclusion/recommendations: The study concluded that waste containing IFOs could pose a threat to livestock health and productivity. The practice of good animal husbandry and efficient solid waste management will mitigate the problem of animals consuming IFOs.

The effects of dietary quercetin supplementation and sex on the fatty acid profile of rabbit muscle, dissectible fat and caecotrophes

M.K. North[1], A. Dalle Zotte[2] & L.C. Hoffman[1,3]

[1]Department of Animal Sciences, Stellenbosch University, Private Bag X1, Matieland, Stellenbosch 7602, South Africa, [2]Department of Animal Medicine, Production and Health, University of Padova, Agripolis, Viale dell'Università, 16, 35020 Legnaro, Padova, Italy, [3]Centre for Nutrition and Food Sciences, Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland, Health and Food Sciences Precinct, 39 Kessels Road, Coopers Plains 4108, Australia.
louwrens.hoffman@up.edu.au

Background: Studies linking the fatty acid (FA) composition of the human diet to health have led to recommendations that the polyunsaturated (PUFA):saturated fatty acid (SFA) ratio be ≥0.4, and the n-6:n-3 PUFA ratio 1:1–4:1. This has resulted in efforts to modify the FA composition of meat products. Evidence suggests that supplementing flavonoids to the diet may beneficially alter the FA composition of the meat. Unfortunately, research investigating this is limited, especially for rabbit meat.

Aim: To investigate the effects of dietary quercetin supplementation on the FA profile of the dissectible fat and meat of rabbits, and possible mechanisms responsible for this effect.

Methodology: Ethical clearance was obtained from the Stellenbosch University Animal Care and Use Committee (protocol SU-ACUD16-00094). Sixteen male (M) and sixteen female (F) individually-caged New Zealand White rabbits were fed a control (C) or quercetin-supplemented (2 g/kg quercetin dihydrate, Q) diet from 5 to 12 weeks old, then slaughtered. At slaughter, caecotrophes were collected from the gut, and the dissectible fat, loins (LTL), and deboned hindlegs (HL) were sampled. Lipids were extracted from the samples and transmethylated, and FA were identified and quantified using GC-FID. The PUFA:SFA, n-6:n-3 and hypocholesterolemic to hypercholesterolemic FA (h/H) ratios, and the atherogenic (AI) and thrombogenic (TI) indexes, were calculated. Statistical comparisons (P ≤0.05) of the sample types, and the sexes, diets and their interactions, were performed using the R lm software package of Statistica version 13, and principle component analysis (PCA) was performed using XLStat.

Results and Discussion: All the FA differed (P ≤0.05) between the sample types, with the feed having the highest ΣPUFA (55%), and the caecotrophes the highest ΣSFA (68±0.8%), indicative of biohydrogenation. The FAME profiles of the meat and fat were more similar to the feed than the caecotrophes, and the meat PUFA:SFA (0.7±0.02) and n-6:n-3 (HL: 3.3±0.08; LTL: 4.2±0.16) ratios aligned to nutritional recommendations. Quercetin-supplementation had no effect on the caecotrophes or HL, but increased (P =0.05) C18:0 in the fat (C: 7.0±0.23; Q: 7.8±0.32), and C20:4n-6 in the LTL (C: 3.6±0.41; Q: 4.8±0.34), possibly by modifying endogenous lipid metabolism. Sex significantly affected the caecotrophe FAs, with females having higher (P =0.03) ΣSFA and lower (P =0.03) ΣPUFA. Females also had lower C18:1 in the fat (P =0.04), HL (P =0.01) and LTL (P =0.01). However, although other FA were also affected, this did not affect the measures of nutritional impact.

Conclusion/recommendations: This study confirmed that rabbit meat has a favourable FA profile, despite caecal biohydrogenation, and suggested that biohydrogenation could vary between the sexes. The significant impact of dietary quercetin on the fat and loin FA suggest that more research should be done on the effects of flavonoids on endogenous lipid metabolism.

Growth performance and faecal egg count reduction in naturally parasitized pigs fed graded levels of dry chicory (*Cichorium intybus*) roots

I.C. Nwafor[1], H.A. Roberts[2] & P.J. Fourie[1]

[1]Department of Agriculture, [2]Department of Life Sciences, Central University of Technology, Free State, Private Bag X20539, Bloemfontein 9300, South Africa.
nwaforifeomac@gmail.com

Background: Helminthiasis have been reported to be a major setback to profitable pig production in Africa. Its zoonotic potential can also cause significant health threats in humans. Helminth control is usually based on the mass treatment of farm animals with anthelmintics which are not sustainable due to the development of anthelmintic resistance, affordability and the presence of drug residues in some animal products. The desire for a more sustainable farming practice has resulted in an intensified effort to find alternative helminth control options which are less reliant on chemotherapy and improves animal welfare.

Aim: This study was done to investigate the *in vivo* anthelmintic efficacy of dry chicory (*Cichorium intybus*) (DCR) roots on faecal egg count reduction (FECR) and as a growth promoter in pigs.

Methodology: This protocol was approved by the Animal Ethics Committee at the UFS (Experiment No. 24/2016). Twenty (n=20) semi-intensively managed grower pigs (Large White x Landrace) of an average age of 11 weeks and initial live weights of 21±0.8 kg, naturally parasitized, were selected based on their initial high faecal egg counts (FEC) and used for a 28-day feed trial. The pigs were assigned to four groups (A, B, C and D) in a completely randomized design with five pigs in each group. Group A pigs were used as control and fed with the conventional pig grower feed, while groups B, C and D were the experimental groups fed with 5%, 10% and 15% of DCR inclusion levels in their diets respectively. No anthelmintic was given to the pigs. Faecal samples were collected from pigs at the beginning, midway and at the end of the trial for parasitological analysis. The helminth eggs were identified and the FEC expressed as EPG (egg per gram) were quantified. A scoring system of EPG ≤100 = low infection, EPG >100 <500 = moderate infection and EPG ≥500 = high infection was used. Growth parameters like feed intake (FI), average daily gain (ADG), total weight gain (TWG) and feed conversion ratio (FCR) were recorded. Data were statistically analysed ($P<0.05$) using one-way ANOVA.

Results and Discussion: There were differences ($P<0.05$) in the FEC between the treatment groups on Day 1 and 28. These groups recorded a much lower FEC on Day 28 compared with the control group. The mean FECR recorded for the three experimental groups over 28 days was 76.2%. This rate was lower than the 90% reduction threshold regarded as "highly effective" and the 80% reduction threshold regarded as "adequate" for plant secondary metabolites. The lower reduction rate recorded in this study may be due to false negative parasitology results, seasonal variations, sample size or the quality of DCR used. Differences ($P<0.05$) were recorded for FI across all groups for week 1, while no differences ($P>0.05$) were recorded between treatments for TWG and ADG. However, group C had a slightly higher TWG and ADG all through the trial period, and the overall best FCR (1.8:1).

Conclusion/recommendations: Results of this study indicate that DCR is effective in reducing FEC and improving growth in grower pigs. It is therefore recommended that DCR be included at 10% in the diets of grower pigs parasitized by gastro-intestinal helminths.

Population dynamics of ticks on and off bovine hosts in the Eastern Cape Province of South Africa

N. Nyangiwe[1], M. Yawa[2], V. Muchenje[2], C.T. Kadzere[1], T.C. Mpendulo[2], M.C. Marufu[3]
[1]Döhne Agricultural Development Institute, Private Bag X15, Stutterheim 4930, South Africa, [2]Department of Livestock and Pasture Science, Faculty of Science and Agriculture, University of Fort Hare, [3]Faculty of Veterinary Sciences, University of Pretoria, Onderstepoort 0110, South Africa.
nyangiwe1@gmail.com; nkululeko.nyangiwe@drdar.gov.za

Background: Studies on seasonal occurrences of different developmental stages of ticks are of great significance in the epidemiology of tick-borne diseases and planning of appropriate tick control measures. High incidence of tick infestation leads to poor animal performance, decreased milk production, low conception rates, and in extreme cases death. Tick abundance varies with time and species to species due to interactions of numerous factors, such as host diversity, type of vegetation and climate. Knowledge of tick numbers on cattle provides useful information on tick population dynamics, dynamics of disease transmission and estimations of resistance of different hosts.

Aim: The aim was to determine the ecological preferences and seasonal dynamics of free-living and parasitic ticks from cattle and on vegetation in the Eastern Cape Province.

Methodology: The study was conducted at three agro-ecological zones (Bedford Dry Grassland (BDG); Kowie Thicket (KT); Bhisho Thornveld (BT). Ticks were collected from 10 cattle and also from six drag samples during the 12-month study period. Tick collection on cattle was done before dipping and were removed from the right hand side of each animal. Ticks questing for host on vegetation were collected using drag-sampling technique and all instars of ticks were placed in containers filled with 70% ethanol. Ticks were identified at genus and species level using a standard stereomicroscope.

Results and Discussion: A total of 31,425 ticks were collected from 10 cattle and also from six drag-samples during the study period. Based on morphological traits, 10 tick species were identified: *Rhipicephalus (Boophilus) decoloratus* (32.5%), *R. evertsi evertsi* (18.8%), *R. appendiculatus* (17.3%), *Amblyomma hebraeum (16.3%), R. simus (7.7%), Ixodes pilosus (3.8%), Hyalomma rufipes (3.5%), R. follis (0.08%), Haemaphysalis elliptica (0.04%), H. silacea (0.02%).* The southern African yellow dog tick, *H. elliptica*, was only found on vegetation. The agro-ecological zones differ significantly in tick species and their distribution. The *A. hebraeum* and *R. evertsi evertsi* counts were higher in KT during summer season (2.05 ± 0.01 and 1.00 ± 0.09, respectively) compared to BDG and BT veld types. In all vegetation types, *R. appendiculatus* had higher counts in KT in spring (0.91 ± 0.08), summer (0.78 ± 0.08) and winter (0.78 ± 0.08). *Rhipicephalus (Boophilus) decoloratus* was more frequent in the BT (1.78 ± 0.11) during the summer season.

Conclusion/recommendations: Seasonal variation and agro-ecological differences had influence on the abundance of free-living and engorged tick species on cattle and off host. It is of epidemiological interest that *R. (B.) microplus* was absent from the study area and this warrants a further investigation.

Catecholamines and the definition of animal behaviour and stress responsiveness

H.A. O'Neill
University of the Free State, Department of Animal, Wildlife and Grassland Sciences, P.O. Box 339, Bloemfontein, 9300, RSA.
oneillha@ufs.ac.za

Background: Selection of animals relied heavily on certain production traits in the past. More recently, temperament has been considered to a greater extent in calculating breeding indexes. A stress response is a result of a combination of many factors controlled by cognitive function as well as hormonal regulators. The exact mechanism of how these factors interact to influence an observable or measurable stress response is still unknown. The way in which an animal expresses fear and individual animal personalities are not clearly defined yet. Understanding the term 'stress response' in animals is complicated further by individual differences in behaviour in many species.

Aim: This is an overview of the involvement of catecholamines in the expression of stress in animals and the heritability of catecholamine synthesis, and how it relates to domestication. Terms of animal behaviour that are currently used in animal personality research are discussed.

Results and Discussion: Catecholamines are implicated in the behaviour of animals. Catecholamines activate homeostatic mechanisms to enable an animal to deal with acute stress, hunger, transport, increased activity and pain. Catecholamine synthesis is inherited genetically as polymorphisms occur in the dopamine-β-hydroxylase gene. Dopamine-β-hydroxylase is responsible for the conversion of dopamine to norepinephrine and dopamine to epinephrine of which the rate of conversion differs between cattle breeds. A quick release of catecholamines leads to changes in the carbohydrate metabolism to provide glucose for important functions. In some cases an 'active' response is characterized by fight-or-flight and a 'passive' coping style shows a conservation withdrawal response in adverse situations. This is often recognized behaviourally by immobility and low levels of aggression. Animal personality influences behaviour and physiology directly and therefore individual welfare. One should keep in mind that welfare, via a feedback loop, can influence behaviour and physiology directly.

Conclusion/recommendations: The conversion of dopamine to norepinephrine and epinephrine is dependent on dopamine-β-hydroxylase, which is inherited genetically and is implicated in humans and the expression of attention deficit hyperactivity disorder. The terms 'coping style' and 'temperament', should not be examined as independent concepts. Farm animal personality should be increasingly considered to improve animal housing, management, breeding and welfare.

Quantification of the relationship among body weight measured at various ages in a dual purpose sheep breed

W.J. Olivier[1] & M. van Heerden[1]
[1]Grootfontein Agricultural Development Institute, Private Bag X529, Middelburg EC, 5900, South Africa.
WillemO@daff.gov.za

Background: In most of the sheep flocks in South Africa body weight is considered to be one of the most important traits during selection of both replacement rams and ewes. The selection for increased body weight will result in the improvement of early growth rate of the progeny, which will have a positive effect on profitability. However, due to the high genetic relationships among body weight at various ages, selection for body weight can also have a detrimental effect on the profitability. This is because the adult body weight of the ewes will also increase, which means that fewer ewes could be kept on the same area available for production. Alternatively, additional feeding could be supplied at increased cost to support the heavier ewes.

Aim: The aim of this study was to quantify the genetic relationships among body weights measured at various age in a dual purpose sheep breed to determine the most efficient method to incorporate body weight in selection strategies.

Methodology: Body weight recorded from birth until 82 months of age from 2001 to 2017 on the Grootfontein Dohne Merino stud were included in this study. The project protocol was approved by the Ethical Committee of the Grootfontein Agricultural Development Institute (GVE/ AP10/1/6). Mixed model bivariate models were used to analyse body weight traits. The fixed effects included for testing were year of birth, sex, dam age and rearing status, as well as age of the animal as a covariate (included only for weights recorded from 42 days of age until performance testing). Only effects that had a significant effect on a trait were included in the final model for the respective trait. Significance were tested with Proc GLM of SAS. Genetic parameters and (co)variance components were estimated using ASReml. Log Likelihood were used to determine the most suitable model for each trait. Maternal and additive genetic effects were included for body weights until performance testing age, while for adult body weights only the additive genetic effects were included in the bivariate models.

Results and Discussion: The additive heritabilities of the body weights ranged from 0.12 ± 0.03 (Birth weight) to 0.51 ± 0.03 (12-month body weight after shearing), the corresponding maternal heritabilities ranged from 0.02 ± 0.01 to 0.10 ± 0.02. The genetic correlations among early body weights were moderate to high (0.24 ± 0.12 to 0.95 ± 0.09) and increased with an increase in age. The same tendency was observed among the adult body weights from 22 months of age until 82 months of age. These correlations ranged from high (0.85) to unity. The genetic correlations among the early and adult body weights were moderate to high, with the body weights at birth and 42 days of age having the lowest correlations. The two traits currently included in the selection index of the Dohne Merino breed, namely weaning weight and body weight at approximately 12 to 14 months of age, were highly correlated with adult body weights (0.80 ± 0.06 to 0.99 ± 0.12).

Conclusion/recommendations: The results of this study support the findings in the literature that body weight at different ages are positively correlated. This means that selection for body weight at any age would result in an increase in growth rate and subsequently adult body weight.

The correlated response in staple strength to selection for fibre diameter in a dual purpose sheep breed

W.J. Olivier[1], A.C. van Graan[2] & M. van Heerden[1]
[1]Grootfontein Agricultural Development Institute, Private Bag X529, Middelburg EC, 5900, South Africa,
[2]Agricultural Research Council, Private Bag X529, Middelburg (EC), 5900, South Africa.
WillemO@daff.gov.za

Background: Wool has several quality and quantity characteristics, such as fibre diameter, staple strength and staple length that are very important to wool producers, manufacturers and consumers. The second most important factor after fibre diameter that influences the processing of wool and consequently the price for wool is staple strength. It is a well-established fact that the strength of wool is largely a function of fibre diameter and that the coefficient of variation of fibre diameter can explain 70 to 80 % of variation in staple strength. Tender wool with a staple strength of below 30 N/Ktex will obtain a much lower price due to its effect on the processing of wool. The fact that finer wool types tend to have a lower staple strength compared to stronger wool types is of major concern to the wool producer.

Aim: The aim of this study was to determine the correlated response in staple strength to selection for fibre diameter in a dual purpose sheep breed.

Methodology: Data collected on the Grootfontein Dohne Merino stud from 2001 to 2017 were used for this study. The project protocol was approved by the Ethical Committee of the Grootfontein Agricultural Development Institute (GVE/ AP10/1/6). The traits included in the analysis were tensile strength, fibre diameter and coefficient of variation of fibre diameter at performance testing age. Selection in the stud from 2001 to 2009 was mainly focussed on fibre diameter, while from 2010 onwards selection was mainly focussed on body weight and reproduction, with no pressure on fibre diameter. The variance components and estimated breeding values were obtained through multivariate analysis with ASReml software.

Results and Discussion: The heritability estimates for fibre diameter, staple strength and coefficient of variation were 0.64 ± 0.03, 0.25 ± 0.03 and 0.50 ± 0.03 respectively. The genetic correlation between fibre diameter and staple strength and coefficient of variation were 0.47 ± 0.05 and -0.20 ± 0.05 respectively and -0.69 ± 0.05 between staple strength and coefficient of variation. It is evident from these correlations that fibre diameter and staple strength are unfavourably correlated. This means that selection for decreased fibre diameter would result in an unwanted decrease in staple strength and this is illustrated through the genetic trends for the two selection phases. The genetic trends for fibre diameter and staple strength were $y = -0.108X - 0.1295$ ($R^2 = 0.65$) and $y = -0.3187X + 0.2532$ ($R^2 = 0.60$) respectively from 2001 to 2009, while the respective trends from 2010 onwards were $y = 0.0888X - 1.6409$ ($R^2 = 0.68$) and $y = 0.2473X - 3.5733$ ($R^2 = 0.76$).

Conclusion/recommendations: From the results of this study it is evident that selection pressure for decreased fibre diameter can have a detrimental effect on staple strength when staple strength is not monitored. The fact that these two traits are the main factors influencing wool price, further complicates selection strategies. It can therefore be concluded that staple strength should be included in the selection objectives when selection for decreased fibre diameter is practised.

Quantification of the relationship among reproduction traits and body weight measured at various ages in a dual purpose sheep breed

W.J. Olivier[1] & M. van Heerden[1]

[1]Grootfontein Agricultural Development Institute, Private Bag X529, Middelburg EC, 5900, South Africa.
WillemO@daff.gov.za

Background: The most important trait in any sheep enterprise is reproduction because of its direct contribution to profitability. Reproduction also has an indirect contribution though the number of animals available for selection, as more animals available means stricter selection and subsequent improved production and profitability. The reproduction efficiency of ewes is a combination of the number of lambs, mothering ability of the ewe and growth rate of the lamb. The biggest constraint with regard to selection for reproductive traits is the low heritability and the fact that it could only be measured late in life. Due to this, breeders still opt to select for reproduction indirectly through body weight, which is positively correlated with reproduction.

Aim: The aim of this study was to quantify the genetic relationship among reproduction and body weight measured at various ages in a dual purpose sheep breed to determine the most efficient method to incorporate reproduction in selection strategies.

Methodology: Body weight from birth until 82 months of age, as well as number of lambs born, number of lambs weaned and total weight of lamb weaned recorded from 2001 to 2017 on the Grootfontein Dohne Merino stud was included in this study. The project protocol was approved by the Ethical Committee of the Grootfontein Agricultural Development Institute (GVE/ AP10/1/6). The fixed effects included were year of birth, sex, dam age, number of lambing opportunities (only for reproduction traits) and rearing status, as well as age of the animal as a covariate (included only for weights recorded from 42 days of age until performance testing). Only effects that had a significant effect on a trait were included in the final model for each trait. Significance was tested with Proc GLM of SAS. Genetic parameters and (co)variance components were estimated with ASReml. Maternal and additive genetic effects were included for body weights until performance testing age, while for adult body weights and reproduction traits only the additive genetic effects were included in the bivariate models.

Results and Discussion: The respective heritabilities for number of lambs born, number of lambs weaned and total weight of lamb weaned was 0.11, 0.10 and 0.08. The genetic correlation between number of lambs born and weaned was 0.99, while the correlations between total weight of lambs weaned and the number of lambs born and weaned were 0.80 and 0.93 respectively. The relationship among the different body weights and the number of lambs born or weaned were low negative. However, these correlations were not significant due to their high standard errors. The genetic correlation among the different body weights and total weight of lamb weaned ranged from 0.26 (birth weight) to 0.70 (post shearing weight at 12 months of age). The genetic correlations between the adult weights and total weight of lamb weaned were at the higher end of the range.

Conclusion/recommendations: The results for the reproduction traits in this study concur with estimates for these traits found in the literature. However, despite the low heritabilities, selection for reproduction would be possible due to the large variation within these traits. Indirect selection to increase reproduction efficiency through body weight would be possible. It is however, recommended that breeders should refrain from using the indirect route because of the negative effect that selection for body weight can have on the overall profitability of a flock. It is therefore concluded that, despite the low heritability breeders should select for reproduction by including total weight of lamb weaned as the main selection objective.

Carry-over effect of nutritional stress on post weaned lambs in the Sandy Sourveld of KwaZulu-Natal

P.A. Oosthuizen & E.A. van Zyl

KZN Department of Agriculture and Rural Development, Dundee Agricultural Research Station, P.O. Box 626, Dundee, 3000, Republic of South Africa.
peter.oosthuizen@kzndard.gov.za

Background: Overwintering of sheep, especially on the sandy sourveld of KwaZulu-Natal, presents specific challenges because of veld grass quality. This nutritional stress is evident in lambs born in autumn. The chances of survival for the lamb and its growth performance, depends largely on the level of nutrition of the ewe during lactation.

Aim: To assess the performance of weaned lambs under different nutritional conditions in summer considering pre-weaned performances (dams overwintered on different feeding regimes).

Methodology: Two breeds of sheep were used in the experiment on Dundee Research station. Lamb growth (Merino n=24 and Nguni n=20) post-weaning, was assessed during summer taking into account the carry-over effect of the nutritional regimes the lambs were exposed to during winter. Live weight change comparisons were calculated by determining the percentage loss or gain against the starting weight of the animal to compensate for different breeds. Feed analyses were done to determine the quality of forages throughout the duration of the trials. Lambs were blocked according live weight and were assigned to either a kikuyu or veld treatment for the summer, resulting in four possible treatment groups: The lambs came from ewes fed on either veld (L) or grazing maize (H) over winter and were then assigned to either veld (L) or kikuyu (H) summer grazing, resulting in four combination treatments: LL, LH, HL or HH. Data were statistically analysed by one-way ANOVA and assessing least significant differences (LSD) at a 5% level of significance using Genstat software.

Results and Discussion: Highly significant (P <0.001) differences were recorded between breeds as expected. Merino from the HH treatment had a mass change of 30.31% from starting mass whilst they recorded only 16.99% mass increase on the HL treatment. The Nguni lambs showed a mass increase of 27.24% on the HH treatment and an increase of 13.74% on the HL treatment. The Nguni lambs, at termination of the experiment, recorded a change in mass (% of summer start mass) of 63.74% in the LH and 64.43% in the LL treatment, compared to the Merino lambs, which had an increase in mass of respectively 84.46% in the LH treatment and 88.41% in the LL treatment. Clearly, compensatory growth occurred over summer in the lambs that were exposed to nutritional stress during winter.

Conclusion/recommendations: Sheep weaned off veld (L treatment for the winter) showed compensatory growth compared to the sheep weaned from grazing maize (H treatment for the winter). The Merino lambs had the highest percentage growth. Even though compensatory growth was noticed, sheep that were weaned off veld did not manage to achieve the same final weight than ones weaned off grazing maize (winter). This emphasizes the importance of better nutrition pre weaning. Nguni sheep lost less live weight than Merino sheep when grown on veld forage, and are therefore considered to be better adapted to poor nutritional circumstances.

Correlation of semen parameters and seminal plasma constituents in relation to Bonsmara bull fertility

A.M. Peta[1], T.L. Nedambale[1], F.V. Ramukhithi[2] & T.J. Mpofu[1]

[1]Tshwane University of Technology, [2]Agricultural Research Council, Private bag x680, Tshwane University of Technology, Pretoria, 0001, South Africa.
ashleymarumo@gmail.com

Background: Fertility traits in Bonsmara bulls, especially semen parameters, are important during their selection for breeding purposes. Evaluation of seminal plasma constituents (LDH, Na^+, K^+, Mg^{2+}, Ca^{2+}, glucose, cholesterol, triglycerides) in bulls are useful in relation to fertility and play a role during metabolic processes**.** The relationship between seminal plasma constituents and fertility of Bonsmara bulls is unknown.

Aim: The aim of the study was to correlate semen parameters and seminal plasma constituents in relation to fertility in Bonsmara bulls.

Methodology: All experimental procedures were approved by the Animal Ethics Committee at Tshwane University of Technology and Agricultural Research council. Semen was collected from 45 Bonsmara bulls by aid of electro ejaculator in 15 mL graduated tubes. Semen volume was measured by reading the measurements on the tube. Semen pH was determined using a pH meter inserting into the tube containing the semen sample. Sperm cell concentration was determined with a spectrophotometer. Semen was analyzed for total, progressive and non-progressive motility; rapid, medium, static velocities by the use of phase contrast microscope. Semen was further analyzed for normal and abnormal morphologies by use of fluorescent microscope. Seminal plasma was then collected from all the semen samples by means of centrifugation at 1500 rpm for 5 minutes. Following centrifugation, seminal plasma was removed using 1 mL disposable plastic pipettes. The seminal plasma was then transferred into 5 mL centrifuge tubes and stored at -20 ºC until analysis. Eight seminal plasma constituents were analyzed due to higher costs. Further analyses were done using commercial *kits* at University of Pretoria, Veterinary laboratory. Semen parameters and seminal plasma constituents' data were statistically analysed ($P<0.05$) using a fully randomized one-way ANOVA.

Results and Discussion: According to the results, it was found that Bonsmara's lactate dehydrogenase had positive significant ($P<0.01$) to volume (0.177) and rapid velocity parameters (0.181). This shows that an increase in lactate dehydrogenase, results in high rapid velocity semen, which leads to good quality sperm membrane, acrosome, viability and fertilization. The lactate dehydrogenase had negative significant relationship ($P<0.05$) to non-progressive motility (-0.102). This shows that an increase in lactate dehydrogenase results in low non progressive motility, which results in less non-intact sperm membrane and acrosome which leads to high fertilization. Triglycerides had negative significant relationship where $p<0.05$ to non-progressive motility (-0.102) and medium velocity (-0.103). An increase in level of triglycerides results in low non progressive motility and medium velocity, which results in high energy supply, membrane fluid and high fertility capacity.

Conclusion/recommendations: Semen parameters as measures of bull fertility had relationship with and seminal plasma constituents. The results also show positive effect on the breeding potential of Bonsmara bulls. Further studies however need to be conducted on the major seminal plasma constituents.

Feeding management practices of lactating cows adapted by smallholder dairy farmers under Agricultural Research Council records in South Africa

P.S.K. Phakwago[1], M. Malatje[2] & C. Banga[2]

[1]Department of Agriculture and Game Management, Nelson Mandela University, PO Box 77000, South Africa, [2]Agricultural Research Council-Animal Production Institute, Dairy Science, Private Bag X2, Irene, 0062, South Africa.
ppotego@yahoo.com

Background: The farmers fed lactating animals aiming to maximize production. They had indigenous knowledge on feeding practices of lactating animals but could not apply it due to limited resources like capital to purchase feeds during dry sessions, equipment and latest technologies to plant and store feed for dry seasons, only very large animal holding farmers had knowledge of silage making, however landless, small and marginal farmers with small animal holding do not make silage and silage making is done with maize fodder.

Aim: The aim of the study was to understand the existing feeding management practises of lactating cows.

Methodology: The structured interview schedule and observation were employed to gather information from 84 purposively selected farmers under Agricultural Research Council records between mid-2017 and mid-2018. The farmers had only grazing and stall feeding, were feeding ration in the form of green fodder (graze and browse in bushes, kikuyu and K11), dry fodder (lurcene hay and paddy straw) and concentrates (readymade). Grazing and browsing on the farm or bush was the major way of accessing green fodder throughout the year, because the farmers did not have right equipment and knowledge to plant on the land. Paddy straw in summer and paddy straw along with lucerne hay in winter was common dry fodder used. Data was statistically analysed using Chi-Square (*P<0.05*) and Principal Component Analysis.

Results and Discussion: 90% of respondents used readymade concentrates at 1kg for every 2.5 litres of milk produced in cow and it is generally given to cows to improve their production after they went to graze and brows. Only 2% practiced homemade (not measured) together with concentrate, which was fed separately Ingredients for making concentrates mixture were maize and/or sorghum, de-oiled soya bean cake, cotton seed or cotton seed cake. Ten per cent of the respondents did not use any concentrate mixture because of high prices and lower yields of their animals. It was only 27% of respondents consulted nutritionist. Only milking animals received 50 g of mineral supplements per day depending on the availability of the mineral supplements. Animals were not monitored during feeding and farmers experienced shortage of feed almost throughout the year. Some farmers use Calcium supplement in lactating animals normally in early lactation after calving. Farmers do use common salt or block of rock salt. Water was ad lib in 90 % of farms visited and 10% relied on river water.

Conclusion/recommendations: Due to low selling price of milk dairy farmers are having constraints in adopting new feeding related practices and other recommendations made by the development agencies.

Investigation on the prevalence of Bovine brucellosis in the Eastern Cape, South Africa

W. Phingilili[1], L. Zhou[2] & I.F. Jaja[1]

[1]Department of Livestock and Pasture Science, University of Fort Hare Private Bag X 1314 Alice, 5700, [2]Risk and Vulnerability Science Centre - University of Fort Hare.

ijaja@ufh.ac.za

Background: Brucellosis poses a food security and public health threat in developing countries, including South Africa. Bovine brucellosis outbreak lead to significant losses of animal productivity in the form of abortions, stillbirth, low fertility and loss of milk production. Meat and milk condemnation due to bovine brucellosis outbreaks compromise food security especial vulnerable livestock-keeping populations in resource-limited settings that rely on livestock and livestock products for food security.

Aim: This study aims to determine to the prevalence of bovine brucellosis in the Eastern Cape.

Methodology: A retrospective study which involves retrieving and analysing provincial veterinary records of diagnosed cases of bovine brucellosis in the local municipalities of the Eastern Cape Province was conducted. The retrospective study covered a period from January 2013 to December 2018 and was conducted on records for cattle, collected from provincial veterinary database in the Department of Rural and Agrarian Reform (DrDAR) Bhisho in the Eastern Cape, South Africa.

Results and Discussion: The results showed a yearly prevalence of (6.1%) 2013, (0.8%) 2014, (25.3%) 2015, (48.3%) 2016, (9.2%) 2017 and (10.2%) 2018. Seasonal prevalence were (13.3%) summer (17.6%) autumn (19.2%) winter and (49.9%) spring. The prevalence per district were (12.1%) Alfred Ndzo, (9.5 %) Amatole (13.8%), Chris Hani (3.3%), Joe Gqabi (4.6%), OR Tambo and (56.8%) Sarah Baartman. The prevalence of bovine brucellosis shows a fluctuating trend in all the three parameters measured in the study which is an indication that, although bovine brucellosis prevalence is rife in some districts, seasons and years. Its occurrence is moderate in the province. Information on the prevalence of bovine brucellosis aid in the identification of areas and time that need to be prioritised for intensive control and intervention to strengthen its controlled status in the province. Brucellosis is a zoonotic disease and poses a public health threat. It can lead to trade ban if surveillance and control and eradication programmes fail.

Conclusion/recommendations: the prevalence is very high in few areas of the province and with such prevalence more animals are at risk of contracting the disease and possibly people who are consuming animal products of infected animals. Intensive control for bovine brucellosis is needed in the province.

Translating findings on goat meat research into industry practices

P. Pophiwa[1], E.C. Webb[1] & L. Frylinck[2]

[1]Department of Animal & Wildlife Sciences, University of Pretoria, Private bag X20, Hatfield 0028, South Africa, [2]Animal Production Institute, Agricultural Research Council of South Africa, Private bag X2, Irene 0062, South Africa.

ppophiwa@gmail.com

Background: Goat meat (chevon) is gaining popularity due to a growing demand for lean and nutritious products, particularly in Africa's resource constrained environments. However, there are some concerns with the visual and eating quality of chevon. It is important to understand the underlying factors that affect chevon quality in order to ensure the best possible quality.

Aim: This paper translates knowledge from goat meat research into practices that guarantee chevon quality.

Methodology: The paper reviews scientific literature on chevon quality. It discusses key factors that affect chevon quality and provides practical mitigating strategies. Examples of studies that have resulted in enhancement of chevon quality are presented.

Results and Discussion: Among animal factors, the genetics and age at slaughter are key to chevon quality. Conditioning of goats destined for slaughter can improve the eating quality of chevon through more desirable carcass fat content. It has been established that goat carcasses have a low glycolytic potential and consequently yield higher pH meat. Minimising *ante-mortem* stress is important for chevon quality. Chilling conditions should be carefully monitored in order to minimise the deleterious effects associated with rapid chilling of goat carcasses. Electrical stimulation has been reported to improve tenderness, even in goat carcasses with a low glycolytic potential. Pelvic suspension may result in improved chevon tenderness compared to Achilles-hung carcasses. Post-slaughter ageing has been shown to further improve the tenderness of goat meat.

Conclusion/recommendations: Most concerns pertaining to chevon quality have been addressed, but the challenge now is to promote the consumption of chevon among diverse consumers and establish it as a dietetically acceptable red meat source.

Cow-calf efficiency of a three-breed diallel of Afrikaner, Bonsmara and Nguni and top-crosses by Angus and Simmental sires

G.M. Pyoos[1,2], M.M. Scholtz[1,2], M.D. MacNeil[1,2,4], A. Theunissen[3] & F.W.C. Neser[2]

[1]Agricultural Research Council, Animal Production Institute, Private Bag X 02, Irene, 0062, South Africa, [2]University of the Free state, Department of Animal, Wildlife and Grassland Sciences, PO Box 339, Bloemfontein, South Africa, [3]Northern Cape Department of Agricultural, Land Reform and Rural Development, Private Bag X9, Jan Kempdorp 8550, South Africa, [4]Delta G, 145 Ice Cave Road, Miles City, MT 59301, USA.
pyoosg@arc.agric.za

Background: Pasture-based calf production and feedlot-based finishing are separate segments of the beef production system. Hence, partitioning traits into pre- and post-weaning performance is important in understanding production system efficiency.

Aim: To estimate breed additive and heterosis effects on efficiency using four alternative measures.

Methodology: Breeds of Afrikaner (AF), Bonsmara (BN), Nguni (NG), Angus (AN) and Simmental (SM) bulls mated to AF, BN, and NG cows were used. Four different analyses for efficiency were carried out using SAS. In model 1: 205-day weight / cow weight, and breed-specific genetic effects are estimated with simultaneous adjustment for effects of year, sex of calf, and dam age at weaning. In model 3: 205-day wt. as a ratio of Large Stock Unit (LSU) were estimated. In models 2 and 4, a slightly different approach was taken relative to models 1 and 3. Rather than analyzing a ratio, 205-day wt. was analyzed using cow weight (model 2) or LSU (model 4) as a covariate.

Results and Discussion: The trade-off in variation between herd of origin and residual was affected by how cow weight was accounted for in the expression of efficiency. For all measures of efficiency the residual variation among cow-calf pairs explained between 80% and 90% of the phenotypic variation. Use of ratios to quantify efficiency favoured calves from the smaller Nguni dams. At weaning, BN and AN sired calves attained 53% of the weight of their Nguni dams, and their weaning weight per LSU was 169±9kg. However, AN sired calves from BN dams were most efficient when efficiency was determined by analysis of covariance (162±17 kg and 133±22 kg for models that incorporated cow weight and LSU, respectively). These results illustrate the difficulty in determining differences in efficiency in the absence of a standard definition for this index. Inconsistencies in results arose depending on whether efficiency was defined by a ratio or through analysis of covariance.

Conclusion/recommendations: Improving efficiency is rather challenging to the relative current situation. One potential alternative would be to maximize the difference between output and input when the traits are reported in consistent units such as calories, kg protein, or Rand.

Farmers' perceptions and knowledge on the loads and control of gastrointestinal nematodes infestation in goats under different vegetation types

L. Qokweni[1] & M. Chimonyo[2]
[1]Bizana Department of Rural Development and Agrarian Reform, Private Bag x 525 Bizana 4800, Republic of South Africa, [2]Department of Animal and Poultry Science, University of KwaZulu-Natal, P bag   X01 Scottsville 3209, Pietermaritzburg, South Africa.
qokweni.luxolo@gmail.com

Background: Gastrointestinal nematodes are responsible for huge economic losses in goat production in most developing countries, where large numbers of goats are kept by limited-resource farmers. These goats contribute essential role to improve livelihoods of goat farmers. However, goat production is highly impacted many factors which include parasitic diseases, feed availability, forage quality and low reproduction efficiency. For effective control of gastrointestinal nematode infestations there is need to determining farmer's perceptions and knowledge on the loads and control of gastrointestinal nematodes infestation.

Aim: The objective of the study was to determine perceptions and knowledge of goat farmers on loads and control of gastrointestinal nematodes infestation on goats foraging in different vegetation types.

Methodology: A personal interview survey on goat farmers was conducted using a structured questionnaire. A total of 282 farmers in two villages of Mbizana local municipality in Alfred Nzo district were interviewed. Administered questionnaire was designed to obtain information about the heads of household demographics, goat health and parasites and goat feeding and management. Logistic regression (SAS 2009) was used to analyse the data.

Results and Discussion: Higher prevalence of diseases, parasites and feed availability were among the constraints highlighted to be limiting goat productivity. Young farmers were more likely ($P<0.05$) to be aware of the effect of vegetation types on gastrointestinal nematodes infestation in goats than older farmers. More goats ($P<0.05$) were recorded in the forestland compared to grassland type. Farmers perceived a higher ($P<0.05$) loads of gastrointestinal nematodes in goats foraging in grassland relative to forestland type. Tethered goats were perceived to have higher ($P<0.05$) gastrointestinal nematodes infestation compared to free browsing goats.
Most goat farmers on both vegetation types indicated to use conventional medicine to control gastrointestinal nematodes infestation.

Conclusion/recommendations: Results from this study indicated that farmers across vegetation types perceived higher prevalence of gastrointestinal nematodes infestation on goats foraging in grassland relative to forestland. The majority of farmers chief rely on conventional medicines to control gastrointestinal nematodes in goats.

Evaluation of non-genetic factors affecting birth weight of Kalahari red goats in South Africa

M.P. Ramoroka[1], C.B. Banga[2] & O. Tada[1]

[1]Department of Agricultural Economics and Animal Production, Faculty of Science and Agriculture, University of Limpopo, South Africa, [2]ARC-Animal Production Institute, Private Bag X2, Irene, 0062, South Africa.
mamidprince@gmail.com

Background: Birth weight is a measure of prenatal growth which partially affects postnatal development. It determines the future performance of the individual engaged in the prevailing environment. Previous studies proved that body weight at all ages is positively genetically correlated, selection for an increased birth weight will lead to an increase in mature body weight, which could have a desirable impact on overall profitability. Weight at birth is influenced by genetic and non-genetic factors.

Aim: The aim of this study was to evaluate non-genetic factors affecting birth weight of Kalahari Red goat kids in three regions of South Africa. Knowledge of such factors will help to achieve improved flock performance through more accurate selective breeding and better-informed management decisions.

Methodology: Records from SA Studbook with performance data on the South African Kalahari Red goat Breeders Society's database for the period of 10 years (from 2008 to 2017) were used. After editing, the dataset consisted of 1902 animal's records. All animals without birth weight were excluded from the analyses. The information contained in the data set included pedigree information, birth date, season of birth, birth weight, breeder, sex, age of sire/dam at kidding and the region. The growth performance used was the birth weight (BW). The significance of fixed effects was tested by conducting least-squares analyses of variance using the general linear model procedure of the Minitab statistical software. Tukey's honestly significant difference procedure was used for mean separation at the 5% level of significance.

Results and Discussion: Kids born in the Northern region were heavier (3.33 ± 0.158 kg) than those born in the Eastern regions (2.45 ± 0.571 kg). However, region had no significant effect ($P>0.05$) on BW. Breeder effect was significant ($P<0.05$). Kidding interval was not significant ($P>0.05$). The average birth weight of male kids was higher than female kids (3.05 ± 0.21 kg vs 2.89 ± 0.20 kg), and the difference was significant ($P<0.05$). The research found a significant effect of birth status ($P<0.05$) on BW. The kids that were born as single were heavier than those that were born as multiple (twins, triplets and quadruplets). The season of birth was found to be highly significant ($P<0.05$). Kids born in the year 2015 had heavier BW (3.39 ± 0.23 kg) than those born in the other years. However, year of birth had significant effect ($P<0.05$). Age of dam and sire age had a significant effect ($P<0.05$) on BW. It was then concluded that season of birth, sire age, sex of kid, dam age, breeder, year of birth and birth status significantly influence birth weight. Therefore, need to be included in genetic evaluation models.

Conclusion/recommendations: This study identified non-genetic factors influencing birth weight, which should be accounted for in genetic evaluation models for Kalahari Red goats. These results, therefore, provide an important perspective on the selection objectives of Kalahari Red goats by considering different environmental factors, reproductive factors, and parental age factors. Adjustment procedures and adjustment factors often diverge for different populations within species. Many breeds have their own set of adjustment factors.

Registration of Natural Scientists Practising in South Africa

P. Rampersadh[1]
[1]Private Bag X540, Silverton, 0127, Gauteng Province, South Africa.
landi@sacnasp.org.za

The South African Council of the Natural Scientific Professions (SACNASP) is a statutory Council established by an Act of Parliament - The Natural Scientific Professions Act, (Act No. 27 of 2003) as amended (hereby referred to as the NSP Act) and is the registration and regulation authority for natural science professionals in South Africa.

A 'Practising natural scientist' means a person who practises in the disciplines of the natural sciences in any of the fields of practice (outlined in Schedule 1 of the Act) who is self-employed or employed by any company, organisation or by any sphere of government. Employers or members of the public engaging the skills of professionals related to the natural scientific profession need to ensure these activities are only performed by a registered scientist. Currently, there are 25 fields of practice gazetted by the Minister of Science and Technology and they represent the fields that have a significant enough impact on the economy or safety of the public. This includes fields such as chemistry, physics, mathematics, biology, food sciences, zoology, and geology. Scientists are registered in fields of practice and are not allowed to do natural science work outside their registered fields of practice to ensure a high quality of work.

Registration at SACNASP sets a baseline for professional training, skills and competence required by the professional as determined and evaluated by their peers. It is a mark of excellence, ensures public confidence, international recognition, marketability and professionalism. Once registered, natural scientists are expected to remain relevant in their fields of practice by attending industry related events, training and reading relevant material throughout their careers as natural scientists. This is monitored via the Continuing Professional Development Programme. These activities will be regularly audited by SACNASP to ensure that the registered scientists, in their fields of practice, are still actively involved in the field and can hence maintain their registration as a professional natural scientists. It can be noted that recently, the White Paper on Science, Technology and Innovation highlighted the importance of continuing professional development (CPD) for the natural sciences.

Registered Scientists must also comply with a Code of Conduct. If a registered scientist is responsible for substandard work or has displayed behaviour not in compliance with the Code of Conduct, SACNASP can take appropriate action. As indicated, the key role of SACNASP is as a registration and regulation body for natural scientists and in so doing, provide protection to the public and the profession. By employing a Registered Scientist, industry benefits in terms of risk mitigation in that their scientists were evaluated by the statutory registration authority and are regulated by such.

The presentation from SACNASP will focus on professional registration, CPD, some of the latest activities of SACNASP and on engagement with the South African Veterinary Council.

Determination of selection criteria for socio-economic breeding objectives of communal goat farmers in Limpopo province: Preliminary results

T.C. Rasekgoalo[1], P.E. Kubjana[1], M. Mulaudzi[1], K.F.M. Madia[1], H.K. Magabe[1] & M.L. Mashiloane[1]

Limpopo Department of Agriculture and Rural Development, Mara Research Station, Private Bag X2467, Louis Trichardt, 0920, South Africa.
rasekgoalotinah@gmail.com

Background: Communal goat farmers keep goats for several purposes including economic, social and cultural. It is not clear what selection criteria are used when selecting animals for the different purposes. The knowledge of the breeding objectives and trait preferences of the goat farmers is important in designing effective goat breeding programs.

Aim: To determine the selection criteria applied by communal goat farmers to attain their socio-economic breeding objectives.

Methodology: A total of 728 farmers were interviewed in Mopani, Vhembe, Capricorn and Waterberg districts of Limpopo Province. A structured questionnaire was used to acquire production information, aspects of purpose of goat keeping and selection traits of value to the communal farmers. Simple frequencies were used to analyse farmer selected objectives and selection criteria. Means procedure of SAS was applied on flock composition, annual inflow and outflow of goats, as well as to obtain the mean ranks of objectives of goat farming and selection traits of communal goat farmers.

Results and Discussion: Goat farming for the purpose of selling live animals had the highest mean rank (1.49±0.66); followed by meat for home consumption (1.96±0.74) and social and cultural purposes (2.13±1.05). Similarly, the sale of live animals was identified with the highest frequency (0.36) as the main objective, meat for consumption (0.32) the second most preferred objective followed by social and cultural purposes (0.29). The top ranking objectives show that communal goat farmers combine social and economic objectives in managing their herds. Intervention breeding programs should therefore take this into consideration to ensure holistic improvement of farmer's livelihoods. Body size (1.30±0.62) and growth rate (1.86±0.76) with respective frequencies of 0.31 and 0.24 were the highest ranked production traits. Means±SD and frequencies for reproduction traits of fecundity, birth status, and mothering ability were 1.42±0.61 and 0.31, 1.52±0.71 and 0.36, and 1.95±0.72 and 0.22 respectively. Adaptability traits of interest to the farmers were drought resistance (1.49±0.69) and disease resistance (1.51±0.63) with the frequencies of 0.38 and 0.36 respectively. Of the non-production trait, colour ranked highest (1.11±0.42), with the frequency of 0.57. The average output proportion is just above half the average flock size, of which about a quarter is live sales. This suggests that farmers are not making much from their flocks considering that they are losing almost one third of the stock annually to mortality.

Conclusion/recommendations: Farmers reared goats mainly for live sales, followed by meat for home consumption then social and cultural purposes. Selection criteria for production includes body size and growth rate while fecundity, birth status and mothering ability were important as reproduction traits. The farmers preferred drought and disease resistance as their selection traits for adaptability. The prominent non-production trait of colour was the one most used for selection. The study is ongoing and proper conclusions will only be derived when the remaining district in the province has been completed.

An analysis of incidence of stillbirth in South African Holstein cattle

M.P. Ratshivhombela[1], B. Dube[2], O. Tada[1], M.A. Madilindi[2] & C.B. Banga[2,3]
[1]Department of Agricultural Economics and Animal Production, University of Limpopo, Private Bag X1106, Sovenga, 0727, South Africa, [2]Agricultural Research Council, Animal Production, Private Bag X2, Irene, 0062, South Africa, [3]Department of Animal Sciences, Faculty of Science, Tshwane University of Technology, Private Bag X680, Pretoria, 0001, South Africa.
ratshivhombela.m@gmail.com

Background: Stillbirth is a major problem in dairy herds worldwide and is increasingly being included in national breeding objectives. In South Africa, however, there is limited information on stillbirth that can be used to improve this trait genetically. Currently, there are no estimated breeding values (EBVs) for any measures of calving performance produced under the national genetic evaluation programmes.

Aim: To assess the incidence of stillbirth and determine environmental factors affecting the trait in South African Holstein cattle.

Methodology: The original data set consisted of 1 048 575 calving records of 314 049 cows, from 3 908 herds, recorded under the South African National Dairy Animal Recording and Improvement Scheme between 1994 and 2018. After editing, the final data set comprised of 13 143 records of 7 723 Holstein cows, from 41 herds, calving during the period 2014 to 2018. Data were statistically analysed using the PROC FREQ and General Linear Models (GLM) procedures of SAS (SAS 9.4, 2016). Environmental effects tested for their influence on stillbirth were herd-year-season (HYS) of calving, calf sex and parity.

Results and Discussion: Live calves represented 93.62% of the animals born and 6.38% of the calves were born dead. Herd-year-season, calf sex, and parity all had a highly significant ($P<0.0001$) effect on stillbirth, in agreement with various other studies elsewhere. The frequency distribution of stillbirth for first, second and third parity was 8.72%, 4.38% and 5.47%, respectively. Increased rates of calving difficulty at first calving, relative to later parities, is a widely observed phenomena, and is believed to be the cause of higher incidences of stillbirths. Calving year followed parity as the next most important factor affecting stillbirth. Cows which calved in the year 2014 had the highest incidence of stillbirth (8.26%) and 2018 had the lowest incidence of stillbirth (4.54%). There was a general decline in incidence of stillbirth from 2014 to 2018, which may partly be a reflection of biological variation within the population over time. Cows calving in autumn had the highest incidence of stillbirth (7.16%) and those calving in winter had the lowest (5.82%). Male calves had a higher incidence of stillbirth (8.48%) compared to females (4.41%), as widely reported in the literature.

Conclusion/recommendations: The incidence of stillbirth in South African Holstein cattle observed in the current study is slightly lower than those observed elsewhere. This might be due to under-recording of stillbirth by South African farmers. Herd-year-season of calving, parity and calf sex are significant sources of variation in stillbirth, in South African Holstein cattle. These factors should be included in statistical models for the genetic analysis of stillbirth in the South African Holstein cattle population.

The effect of an anti-tick vaccine on cattle-host tick populations

J.M. Rust[1], K. Goosen[2], D.J. Goosen[2], I. Rautenbach[2], J.J. Nel[2], T. Rust[1], N. Nyangiwe[1] & Y. Mkabile[1]

[1]Döhne Agricultural Development Institute, Private Bag X15, Stutterheim, 4930 South Africa, [2]Institute for Disease Control Africa, 33 Eland Street, Koedoespoort, Pretoria, 0186, South Africa.
jean.rust@gmail.com

Background: The innate immunity of livestock against ticks is not sufficient for effective protection during severe tick challenges. Acaricide dosage/chemical composition, frequency of application and potential tick resistance in cattle herds of developing and commercial farmers, remain a problem. One alternative is the immunization against ticks via the application of vaccines containing concealed tick antigens. These antigens are the proteins of ticks not exposed to the host immune system during feeding. Anti-tick immunity can be achieved by vaccination with antigens from tick organs such as gut, mid-gut, small intestine, salivary gland and ovary. The development of an environmentally/user-friendly, alternative anti-tick treatment, which is effective, non-chemical, of which the application is less frequent, is of paramount importance.

Aim: This study was done as a pilot trial to assess the effectiveness of an experimental anti-tick vaccine on cattle host tick populations over a 12 month period.

Methodology: The trial was conducted at the Bathurst experimental station situated at (33°30′14″S 26°49′26″E) over a twelve month period (Döhne Ethical Certification Nr. 14/2017). Twenty five (25) mature Bonsmara cows were used in the study. The vaccine contained antigens isolated from the whole organs of multiple tick species, a nucleic acid derived adjuvant and an immune system enhancer (Institute for Disease Control Africa). Vaccination was performed by means of a subcutaneous injection in the neck region. The dosage was 28 mg vaccine combined with 10 μg adjuvant. Animals received an initial vaccination followed by a booster vaccination twenty one days later. Animals were re-vaccinated at three (3) months after initial vaccination. A group of five (5) Bonsmara cows (pilot group) was initially vaccinated to assess any side effects, effect on reproduction and to determine whether a sufficient blood antibody count was achieved. The other twenty (20) animals were divided into an experimental (n=10) and control (n=10) group whilst incorporating the pilot animals into the experimental group. Groups were kept totally separate on one (1) ha (group specific) kikuyu camps. Whole body tick counts were performed on a fortnightly basis and animals were only dipped (whole body spray), once a threshold number of fifty engorged adult ticks per animal were reached.

Results and Discussion: The tick species recorded were *Rhipicephalus decoloratus/microplus, Rhipicephalus appendiculatus, Rhipicephalus evertsi evertsi, Hyalomma spp., Amblyomma spp. and Rhipicephalus simus*. The mean tick count per animal per observation was significantly lower ($p<0.05$) for *R. appendiculatus* (3.50 ± 4.79 vs. 5.59 ± 5.32), *R. evertsi evertsi* (0.58 ± 1.14 vs.1.18 ± 1.68) and *Amblyomma spp.* (4.86 ± 5.32 vs. 9.08 ± 7.91) in the experimental group. The overall mean tick count (2.84 ± 6.37 vs. 3.71 ± 6.75) was also significantly lower ($P<0.05$) than the control group. Both groups were spot treated with acaricide once at the start of the trial and the vaccinated group was dipped once and the control group three times during the rest of the recording period.

Conclusion/recommendations: Preliminary results suggest that the application of this specific anti-tick vaccine had a definite positive effect on the reduction of host tick populations as well as a reduction in the frequency of acaricide usage. This study should be extended over a longer period and the effect on vegetation tick populations incorporated.

Ewe reproduction performance in a communal environment of the Eastern Cape Province

T. Rust[1], J.M. Rust[1], N.S. Nongauza[2], N.A. Faku[2] & S. Moss[2]
[1]Döhne Agricultural Development Institute, Private Bag X15, Stutterheim, 4930, Republic of South Africa,
[2]Eastern Cape Rural Development and Agrarian Reform, Extension Services, Amathola District, East London, 5200, Republic of South Africa.
tina.rust@drdar.gov.za

Background: The developing agricultural sector is faced with a number of serious limitations resulting in the efficiency of meat, wool and milk production from communal livestock estimated to be only a quarter of that in commercial farming. There are an estimated 100,000 small-scale wool producers in the former Ciskei/Transkei area of the Eastern Cape. In many rural communities, livestock is often the only asset of the poor which is also highly vulnerable to climate variability and extremes.

Aim: The aim of the study was to record ewe reproduction performance in a communal environment that will contribute to baseline information that can be used to track change over time.

Methodology: The study was conducted in Gwaba village, Buffalo City Metropolitan Municipality, Eastern Cape Province over a 2 year period (2014 – 2015). Animals were kept on Eastern Cape Thornveld and False Thornveld and subjected to normal communal husbandry practises. At the initial visit, each animal was identified individually and the gender and estimated age, determined by inspecting their incisor teeth, was recorded. Animals were then assigned to age classes, i.e. 2 years, 3 years, 4 years and 5 years and older. The reproduction status of all post pubertal females were assessed by using a real-time ultrasound scan. Animals were observed bi-annually (winter and summer season) for the duration of the project to assess the reproduction status and body weights of the ewes. The sample size varied between 337 to 506 animals over the study period. Data was statistically analysed with StatSoft, Inc. (2013) using Restricted Maximum Likelihood (REML) stepwise regression and variance component estimation models.

Results and Discussion: Real time ultrasound scans during the winter season indicated a pregnancy percentage of 86% and 70% with ewes on average being 3.17 and 2.83 months pregnant during May for the 2014 and 2015 season respectively. The stepwise regression analysis indicated that the fixed effect of season of observation had the largest significant effect ($P<0.05$) on pregnancy status, followed by year of observation ($P<0.05$) and age class of ewe at observation ($P<0.05$). The REML variance component analysis indicated a significant interaction ($P<0.05$) between fixed effects season and year of observation. The month of real-time ultrasound scan had a significant effect ($P<0.05$) on gestation stage. When considering data recorded during May, year of observation and ewe weight at observation significantly ($P<0.05$) explained the variation in gestation stage. Age classes 2 and 3 years old both differed significantly ($P<0.05$) for gestation stage from age class 5 years and older.

Conclusion/recommendations: From the results it can be deducted that most of the ewes fall pregnant during February and lamb during July of every year. The pregnancy percentage recorded indicate that ewes are fertile and do not struggle to conceive, however the annual climatic conditions and age class of the ewes will influence the number of ewes recorded as pregnant by May and will also influence the gestation stage of the ewes during May. These preliminary results can be utilized to plan and expand sheep reproduction benchmarking studies in communal areas.

Milk solid composition of lactating ewes in a communal environment of the Eastern Cape Province

T. Rust[1], A.M. Ras[1], J.M. Rust[1] & N.S. Nongauza[2]

[1]Döhne Agricultural Development Institute, Private Bag X15, Stutterheim, 4930, Republic of South Africa,
[2]Eastern Cape Rural Development and Agrarian Reform, Extension Services, Amathola District, East London, 5200, Republic of South Africa.
tina.rust@drdar.gov.za

Background: It is perceived that high lamb mortalities in the communal environment are caused by malnutrition and extreme environmental conditions the ewes are under. Nutrition level of the ewes are the main factor affecting milk yield and milk composition.

Aim: The aim of the study was to investigate milk solid composition of ewes in a communal environment after lambing.

Methodology: Milk samples were collected from communal ewes from the Gwaba village, Buffalo City Metropolitan Municipality, Eastern Cape Province. Animals were kept on Eastern Cape Thornveld and False Thornveld and subjected to normal communal husbandry practises. Milk samples were collected from lactating ewes with lambs from different age groups, during June and July of 2016. The lamb age groups were one (born during June), two (born during May) or three (born during April) months old lambs. During the June sampling there were few ewes suckling three month old lambs and ewe milk sample collection quantity was small, resulting in a pooled milk sample available for analysis. Milk samples were analysed after heating to 40^{0}C using the Milko Scan 104 (Foss Electric) to determine the milk solid composition. The Milko Scan 104 was calibrated using store bought full cream UHT dairy milk.

Results and Discussion: The average milk composition of ewes with one month old lambs was 9.74 ± 2.80% fat, 4.36 ± 0.39% protein and 5.09 ± 0.08% lactose during the June sampling. Similarly the milk solid composition in June for two and three month old lambs were 8.30 ± 2.43% and pooled 9.23% fat, 4.67 ± 0.36% and pooled 4.51% protein and 4.99 ± 0.17% and pooled 4.90% lactose, respectively. During the July sampling, there were no one month old lambs and the milk solids measured for ewes with two and three month old lambs were 7.13 ± 1.25% and 9.49 ± 1.63% fat, 4.16 ± 0.19% and 4.40 ± 0.30% protein and 5.06 ± 1.03% and 4.39 ± 0.08% lactose, respectively. When considering the standard deviations the variation measured for both protein percentage (3.78% vs. 5.26%) and lactose percentage (4.37% vs. 6.82%) was small over all lamb age groups. Fat percentage showed variation of a high of 14.5% to a low of 3.6%. Most of the variation (11.1% *vs.* 3.6%) was observed for ewes suckling two month old lambs. However, there was no significant difference (P<0.05) between the fat percentages measured for different age groups or months measured.

Conclusion/recommendations: From the results it seems as if the quality of milk just after, and up to three months after lambing, is adequate and agrees with what is reported in the literature. In this study, it was not possible to measure milk quantity due to the communal environment where the study was performed. It is hypothesised that the poor mortality rates measured in communal flocks are not necessarily due to the quality of the milk the ewes produce and investigations should be extended to investigate the quantity of milk produced.

Preliminary results: Means of the pH profile, dressing percentage and drip loss in meat of Tankwa goats

T. Sako[1], H.A. O'Neill[1], T. Sedumedi[2], T. Jonker[2] & M.D. Fair[1]
[1]Department of Animal, Wildlife and Grassland Sciences, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa, [2]Department of Agriculture, Land Reform and Rural Development Northern Cape, Vaalharts Research Station, Jankempdorp, 8550.
sakothabang@gmail.com

Background: The discovery of the Tankwa goat has evoked the interest of researchers to further investigate its conservation and breeding to ensure survival and effective utilization of this breed. In the past, preference for goat meat in South Africa has been relatively low due to traditional misconceptions of unappealing colour and toughness. Meat acidification is often a predictor of meat tenderness while dressing percentage (DP) and drip loss (DL) may indicate the marketability and possible economic losses.

Aim: This is a preliminary report on the pH profile over time, dressing percentages and drip losses from the carcasses of Tankwa goats. It forms part of a study that evaluated the most acceptable age and gender of Tankwa goats to be marketed as a meat product.

Methodology: Experimental procedures were approved by the Animal ethics committee of the University of the Free State (UFS-AED2018/0066). Animals were reared extensively at the research station of the Department of Agriculture Northern Cape (Carnarvon) with little to no human interaction. Twenty four (n = 24) animals were grouped into five groups according to age and gender. Goats with 0-2 permanent teeth were classified as young and animals with 4 or more permanent teeth were classified as old. Gender was classified as intact males, castrated males and females. The treatment groups were old intact males (n=4), young castrates (n=5), young females (n=5) and old females (n=5). Goats were slaughtered at a registered abattoir in Carnarvon using standard slaughtering procedures for small stock. pH measurements were taken from *m. longissimus* using a handheld pH meter. Readings were taken at 1, 3, 6, 9, 12 hours post slaughter and ultimate pH was taken at 24 hours after slaughter. Dressing percentages (DP) and DL were calculated from live, warm and cold carcass weights. Means for each group and standard deviation for pH readings were analysed using Excel for Window 10.

Results and Discussion: pH decreased from slaughter up until 9 hours for all groups. There is an increase in pH between 9 and 12 hours for all groups after which pH decreased from 12 hours until ultimate pH. The average rate of pH decrease is higher for older animals in comparison with younger animals. Average DP were 47.8±1.9%, 49.8±1.5%, 48.4±2.2%, 49.01.5% and 47.8±1.9 for young males, young females, young castrates, old males and old females respectively which is lower than the recommend 50% measured in other goat breeds. Average DL were 2.8±0.2%, 3.0±0.2%, 3.1±0.1%, 3.1±0.2% and 3.0±0.2% for young males, young females, young castrates, old males and old females respectively. This is lower than the average 8% of other goat breeds and could indicate different energy metabolism in the muscle of Tankwa goats.

Conclusion/recommendations: Preliminary results indicated differences in DP between age and gender groups. This information can be used to determine the most favourable age and gender to be marketed. pH results differed between young and old animals. Differences in meat quality may be expected from further analyses as pH often correlates with meat tenderness.

Evaluation of Nguni cattle performance from CPA and private ownership types across three ecological zones of Mpumalanga province

J.M. Sambo[1,2], O. Tada[1], T. Chitura[1] & N. Mararakanye[3]

[1]Department of Agricultural Economics and Animal Production, Faculty of Science and Agriculture, University of Limpopo, Private Bag X1106, Sovenga 0727, South Africa, [2]Directorate: Animal Research, Department of Agriculture, Rural Development, Land and Environmental Affairs, Private Bag X9019, Ermelo 2350, South Africa, [3]Directorate: Information Services, Department of Agriculture, Rural Development, Land and Environmental Affairs, Private Bag X9019, Ermelo 2350, South Africa.
Sambojohan1@gmail.com

Background: The Nguni cattle is currently under threat of diminishing in South Africa due to the farmer's preference of exotic breeds and cross breeding. In recognition of the above, the Industrial Development Corporation together with the Mpumalanga Department of Agriculture and the University of Limpopo established the Nguni cattle breed preservation project, where a flock of 30 Nguni heifers and 1 bull were each allocated to the 34 Communal Property Associations (CPA) and 40 private farming enterprises. In the Mpumalanga province, animals have to adapt across three distinct ecological zones (Highveld, Midveld and Lowveld), in order to grow and reproduce efficiently.

Aim: The aim of this study was to evaluate the reproductive performance of the Nguni cattle from the CPA and private enterprises across the three ecological zones of Mpumalanga province.

Methodology: All experimental procedures were approved by the Animal Ethics Committee at the University of Limpopo, 015 268 2812. Eight CPA's and eight privately owned farming enterprises from a total of 74 Nguni cattle projects were selected. The following traits were evaluated: age at first calving, conception rate, calving rate, calves birth weight, calves weaning rate and weaning weight. Interviews and cattle measurement tape were used to study the above traits. Weighing was carried out in the mornings, within a day after the calves were born and six months after (when the calves have started weaning). Measurements were repeated five days after the calves were born and seven days after they have started weaning. For the newly born calves, the final weight was considered as the average weight of the calves at birth and five days later. For the weaning calves the final weight was the average of the initial measurement with the measurements taken seven days' after. Data were statistically analysed (alpha of 0.05) using a two-way Analysis of Variance (ANOVA) with interaction in XLSTAT tool developed for Microsoft Excel. A Tukey multiple pairwise comparison was also used to evaluate the results.

Results and Discussion: Significant differences were observed on ecological zones and the age at first calving, weaning rate, calves birth weight and calves weaning weight ($p < 0.05$). On age at first calving, the Midveld performed better (24 months) on both ownership types compared to Highveld (28.09 months for private and 26.00 for CPA) and the Lowveld (28.35 months for both ownerships). The Highveld performed better on weaning rate for both private and CPA ownerships, where the weaning rate were 93% and 80% respectively. Calves birth weight was lower from both ownership types in the Midveld zone (22.17 kg), whereas in the CPA, the Lowveld zone had higher calves birth weight (26.80 kg). In the private ownership, the highest calves birth weight (25.35 kg) was on the Highveld. The calves weaning weight were significantly higher ($p < 0.05$) on Highveld in private ownership (190.16 kg) and lowest (160.39 kg) in the Midveld zone. For the CPA, the highest calves weaning weight was also on the Highveld (187.55) and lowest on Midveld (167.50 kg).

Conclusion/recommendations: Results of the current study suggests that ecological zones seems to be the most determining factor on most of the growth and reproduction performance traits of the Nguni cattle in the Mpumalanga province where the Highveld seems to perform better than the other zones. Allocation of Nguni cattle should consider the adaptability of these animals across different ecological zones.

Breeding strategies to lower the carbon footprint of livestock

M.M. Scholtz[1,4], M.C. Chadyiwa[1], F.J. Jordaan[1], G.M. Pyoos[1], A. Theunissen[2], N.P. Bareki[3] & F.W.C. Neser[4]

[1]ARC-Animal Production, Private Bag X2, Irene 0062, South Africa, [2]Department of Agriculture, Land Reform and Rural Development, Private Bag X9, Jan Kempdorp 8550, South Africa, [3]Department of Rural, Environment and Agricultural Development, Private Bag X 804, Potchefstroom 2520, South Africa, [4]Department of Animal, Wildlife and Grassland Sciences, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa.
GScholtz@arc.agric.za

Background: An effective way to reduce the carbon footprint from ruminants is to reduce animal numbers and increase the production per animal unit. Increased productivity generates less greenhouse gas (GHG) emission per unit of product. The goal of any breeding strategy must be to improve production efficiency and revenue and not merely to achieve genetic change or higher production. Selection for many of the traditional traits may increase production, but not necessarily productivity or efficiency of production.

Aim: This presentation will discuss (1) Selection for parent-offspring efficiency and the main components affecting it, (2) selection for alternative post weaning efficiency traits and (3) alternative production systems (crossbreeding).

Discussion: The parent-offspring production cycle is responsible for most of the energy consumed, and in beef cattle it represents approximately 72% of the energy consumed from conception to slaughter. If parent maintenance requirements per unit product can be reduced, it will decrease the carbon footprint. In sheep, the trait total weight of lamb weaned per ewe joined, has been used with success in recent years. This led to the following two investigations in beef cattle: (1) kg of calf weaned per Large Stock Unit (cow efficiency), with $h^2 = 0.21–0.52$ and (2) kg of calf weaned per year over the cow's lifetime (accumulated productivity) with an $h^2 = 0.39$. In the Afrikaner breed it was estimated that the carbon footprint (measured as enteric methane emission) reduced by 12% as a result of changes in the component traits of cow productivity (weaning rate [deducted from inter-calving period] x 205 day weaning weight) / cow Large Stock Unit). The component traits (and the changes observed) are calf weaning weight (+20.4 kg), cow weight (-8.3 kg) and inter-calving period (-19.7 days). In beef cattle alternative post weaning efficiency traits have been identified, viz. residual daily gain and residual feed intake. The latter is also associated with lower methane production. These traits are also a recent focus in dairy cattle as alternative efficiency traits. The effective use of crossbreeding in both beef and dairy cattle will also reduce the carbon footprint. In addition, crossbred genotypes can survive the harsh conditions of climate change better. In sound beef cattle crossbreeding programmes, cow productivity can be increased by approximately 26%. In the case of Charolais x Afrikaner, a 27% increase in the value of the meat was demonstrated, whereas 27% less feed was consumed from weaning to harvest.

Conclusion/recommendations: The impact of global warming and continued uncontrolled release GHG has twofold implications for the livestock industry, and consequently food security. The continuous increase in ambient temperature will have a negative effect on livestock production as it is currently known in most southern hemisphere counties. Although the contribution of livestock to GHG production is relatively low, livestock production has the responsibility to limit the release of GHG or its carbon footprint, in order to ensure future sustainability.

Origin and genetic diversity of Zulu sheep assessed by Mitochondrial DNA D-Loop sequence

M.M. Selepe[1], S. Ceccobelli[2], E. Lasagna[2] & N.W. Kunene[1]
[1]Department of Agriculture, University of Zululand, Kwadlangezwa, South Africa, [2]Department of Agricultural, Food and Environmental Sciences, University of Perugia, Perugia, Italy.
selepemm1@gmail.com

Background: Domestic sheep are assumed to be derived from the wild mouflon in Europe and Asia. The routes of introduction of sheep into Africa and their subsequent dispersal, was through the northeastern part and the horn of Africa. However, due to the lack of mitochondrial DNA (mtDNA) analysis the origin of African sheep and details of their domestication are still something of a mystery. In addition, the maternal origin of the Zulu sheep population is unknown.

Aim: This study was conducted to assess the maternal origin and genetic diversity of Zulu sheep using mtDNA.

Methodology: The use of animals and collection of blood was approved by the university of Zululand research ethics committee (Reg No: UZREC 171110-030), with the certificate number (UZREC 171110-30 PGM 2015/227). A total of 118 mtDNA sequences of 110 individual Zulu sheep from 8 populations (Eshowe, Jozini, Makhathini research station, Mtubatuba, Nongoma, Nquthu, Ulundi, University of Zululand) were analysed to assess the genetic diversity and maternal origin. mtDNAs were amplified and sequenced from nucleotide position (np) 15,436 to np 157, which included the D-Loop (displacement loop). The mitochondrial sequences of 110 analysed Zulu sheep were aligned with the reference sequences of different haplogroups around Africa to identify the haplogroup lineages to which the analysed populations belong. Indices such as haplotype diversity (Hd), nucleotide diversity (π), and average number of nucleotide differences (k) were estimated by DnaSP 5.10 software. The evolutionary relationship of sequences was evaluated through a median-joining network of control-region haplotypes constructed using Network 4.6 software.

Results and Discussion: The mean haplotype and nucleotide diversity were 0.8113 and 0.0115, respectively, thus showing a high level of genetic diversity within eight analysed Zulu sheep populations. Phylogenetic analysis showed two haplogroups (A and B). Haplogroup B predominates among Zulu sheep with a frequency of 93%, while the frequency of the A lineage stands at 7%. The dominance of haplogroup B in Africa and Europe suggests that both African and European sheep share common ancestry in the Near East, consequently having a similar mtDNA profile. The presence of slight haplogroup A in African sheep is probably due to the ancient migration of Arabian tribes into East Africa.

Conclusion/recommendations: The mitochondrial DNA D-Loop sequence analysis revealed a high level of genetic diversity in Zulu sheep. The predominance of haplogroup B lineage in the Zulu sheep is in agreement with the results from other African sheep breeds studies. However, future studies should be conducted by evaluating more populations of Zulu sheep mtDNA.

Effect of supplementing different proportions of cellulase and xylanase enzyme mixtures on intake and digestibility of high forage total mixed ration by sheep

K. Selzer[1], A. Hassen[1] & A.M. Akanmu[1]

[1]Department of Animal and Wildlife Sciences, University of Pretoria, Private Bag X20, Hatfield, 0028, South Africa.
Abubeker.hassen@up.ac.za

Background: Forages play important role in ruminant animal production worldwide. It comprises the biggest part of feeding under semi-intensive and extensive production system. Unlocking the nutritional potential of poor quality tropical forages using fibrolytic enzymes and their combinations will improve feed digestibility and feed utilisation and consequently result in a reduction in gross energy waste.

Aim: To investigate the effect of supplementing different proportions of cellulase and xylanase enzyme mixtures on *in vitro* gas production, *in vitro* and *in vivo* digestibility, and ruminal fermentation parameters in sheep fed a high roughage total mixed ration (TMR).

Methodology: This study was approved by the Animal Ethics Committee of the University of Pretoria (Ref No: EC113-13). For the *in vitro* study, Smutsfinger hay (*Digitaria eriantha*) was pre-treated for 24 hours with different fibrolytic enzyme solutions (100% cellulase; 75% cellulase and 25% xylanase; 50% cellulose and 50% xylanase; 25% cellulase and 75% xylanase; 100% xylanase and a control with no enzyme). *In vitro* gas, dry matter (DM), neutral detergent fibre (NDF) degradability and volatile fatty acids (VFA) were determined using standard procedures. The same treatments were used for the *in vivo* trial by including Smutsfinger hay pre-incubated for 24 hr in TMR diets containing 34% yellow maize, 6.2% wheat middling and 8% molasses. A digestibility trial was conducted on rumen cannulated Merino sheep using a 6 X 6 Latin square design. Feed intake, feed orts, and faecal and urine outputs were recorded, sub-sampled and analysed to estimate nutrient digestibility. Rumen fluid samples were collected daily through the rumen cannula and preserved for VFA analysis. Data was analysed separately for *in vitro* and *in vivo* data using the GLM procedure of SAS 9.4.

Results and Discussion: The addition of 100% cellulase enzyme to Smutsfinger hay, increased (P<0.05) *in vitro* NDF degradability and total gas production when compared with the control and 100% xylanase enzyme inclusion. Both the inclusion of 100% cellulase and 100% xylanase enzymes reduced (P<0.05) *in vitro* end time fermentation pH. However, during *in vivo* evaluation the 50:50 mixture of cellulase and xylanase enzymes increased (P<0.05) the acetate, total VFA concentrations, intake, and NDF and acid detergent fibre (ADF) digestibility of the TMR diet. The 50:50 enzyme mixture was followed by the 75:25 cellulase: xylanase treatment in increasing (P<0.05) DM intake in g/unit metabolic weight/head.

Conclusion/recommendations: Different proportions of cellulase and xylanase enzyme mixtures have improved the nutrient digestibility, rumen fermentation parameters, fibre digestion and gas production. However, the best response was obtained with the 50:50 cellulase and xylanase enzyme mixture.

Laying hen blood ionized calcium as influenced by limestone particle size, time post oviposition and phytase inclusion

M. Sinclair-Black[1,3], T. Nkukwana[1], <u>K.M. Venter</u>[1,3], R. Angel, W. Li[2] & P.W. Plumstead[3]

[1]Department of Animal, Wildlife Sciences, University of Pretoria,[2]University of Maryland, College Park, Maryland, [3]Chemunique PTY LTD, Randburg, South Africa.

micaela@chemunique.co.za

Background: Blood ionized calcium (iCa) is an indication of the calcium (Ca) that is physiologically active and available for the hen to utilize for bone remodeling and eggshell formation. iCa can be influenced by both physiological factors and dietary factors.

Aim: This study was conducted to investigate the influence of limestone (LS) particle size (PS), time post oviposition (OP) and phytase inclusion level on the blood ionized calcium levels in commercial laying hens. The effects were investigated over a 24-hour time period after oviposition.

Methodology: A total of 64 Amberlink hens at 31 weeks of age were used, with approved ethics clearance EC052-18. A basal diet was mixed to contain no limestone or inorganic P, (1.14 g Ca/kg DM and 3.6 g P/kg DM). The basal diet was then used to mix four (T1-T4) dietary treatments in a 2x2 factorial design containing two (2) particle sizes of limestone, grit (coarse 1.5 mm or fine 0.2mm geometric mean diameter (GMD)) and two levels of added phytase from *Buttiauxella spp.* (0 or 600 FTU/kg). Limestone was analyzed for Ca and 35.8 g Ca/kg from LS added to each basal diet. Each hen received a meal of 130 g of feed daily and the exact time of OP was recorded. For the same hen, blood collection commenced within 5 minutes of OP, and continued in 3-h intervals for 24h following OP. iCa and blood pH were measured using an i-STAT point-of-care laboratory system (Abbott Point of Care, East Windsor, NJ). The effects of PS, phytase, sampling timepoint and their interactions on blood pH and iCa concentrations were tested by SAS MIXED model using repeated measurement (SAS, 9.4). Individual hens were treated as random effect and pre-trial average daily feed intake and body weight included in the model as covariates.

Results and Discussion: Blood pH and iCa of hens changed (*P*<0.05) over the 24h period and were not affected by phytase. An interaction (*P*<0.05) of limestone particle size x time was observed with hens fed LS grit having higher blood iCa from 12 to 24 hours post OP. Eggshell formation imparts a large drain on the iCa levels in the blood. The higher iCa provided by the limestone grit during the period 12 to 24 hours post oviposition is likely beneficial as it improves the metabolically available calcium to the hen during eggshell formation.

Conclusion/recommendations: The findings suggest LS grit does increase iCa during the time the next egg is in the shell gland.

Comparison of different methods of Assisted Reproductive Technologies in evaluating the ovarian structures in small ruminants

M.S. Siphugu[1,2], K.C. Lehloenya[2], M.L. Mashiloane[3] & D.M. Barry[1]

[1&3]Center of Excellence in Animal Assisted Reproduction (CEEAR), Department of Animal Sciences, University of Venda, Private Bag X5050, Thohoyandou, 0950, South Africa, [2]Department of Animal Sciences, University of Zululand, Private Bag X1001, KwaDlangezwa, 3886, South Africa, [3]Mara Research Station, Private Bag X2467, Makhado, 0920, South Africa.
LehloenyaK@unizulu.ac.za

Background: In small ruminants, application of ultrasonography technique is quickly becoming a popular diagnostic tool for managing herd reproduction in extensive production systems. When compared with reference methods such as laparoscopy and laparotomy, ultrasonography has welfare acceptance as other methods are associated with invasive surgical procedures. However, the successful use of ultrasonography depends on its ability to correctly and reliably observe what reference methods can observe.

Aim: To compare ultrasonography, laparoscopy and laparotomy techniques in evaluating ovarian structures of goats and sheep.

Methodology: Five female Boer goats and five female White Persian sheep were used in this study. Ethical clearance was obtained from the Research Ethics Committee of the University of Venda (SARDF/16/ANS/01/2804). All animals were restricted from feed for 16 to 24 hours prior to ultrasonography (ULTS), laparoscopy (LAPSC) and laparotomy (LAPT) examinations. Animals had access to water at *ad libitum*. The ovarian structures of both goats and sheep were examined using an A-mode ultrasound with 3.0 - 8.0 MHz trans-rectal probe and a Sony Olympus Model laparoscope with a camera probe. The preparatory steps of LAPT were similar to those of LAPSC except for the amount of Lignocaine injected and also the size and position of incision. The ovary size, ovary shape, number of follicles and size of follicles were observed. Follicles of diameter ≥ 3 mm were selected for analysis. The means of ULTS measured parameters were compared to those of LAPT and LAPSC for verification of their accuracy. The parameters observed include ovarian size and shape as well as follicular size and number in both goats and sheep. Data on was analysed using ANOVA methods of SAS.

Results and Discussion: When using all methods, the shape and size of the ovaries as well as follicular size and number were repeatedly identified in all animals in the study. The ovaries of goats and sheep appeared to be almond-shaped. In both goats and sheep, there was no statistical difference ($p > 0.05$) when observing the ovarian size (length vs. width) by ULTS, LAPSC and LAPT. In goats, the observed total number of follicles counted under category 3.0 - 4.9 mm was lower when using ULTS and LAPSC than with LAPT method ($p < 0.05$). There was significant difference ($p < 0.05$) when observing the total number of follicles counted under category 5.0 - 7.9 mm by all methods. However, there was no significant difference ($p > 0.05$) when observing follicles with a diameter of ≥ 8 mm by all three methods. In sheep, the mean number of follicles between 3.0 - 4.9 mm category in both ovaries were significantly different ($p < 0.05$) between ULTS and LAPT. However, for categories 5.0 - 7.9 mm and ≥ 8.0 mm in both ovaries the mean numbers of follicles observed were similar ($p > 0.05$). In sheep the operational time of all the techniques was shorter than in goats. Post-surgical complications were observed with LAPT as it is an invasive method.

Conclusion/recommendations: The current results show that ULTS method using 3.0 - 8.0 MHz trans-rectal probe can accurately monitor ovarian structures of small ruminants as would laparoscopy and laparotomy. Although LAPT and LAPSC techniques are efficient and accurate, they have their limitations with regards to extensive livestock production. In this production where facilities are not suitable for application of LAPT and LAPSC, the administration of ULTS can be suitable, accurate and reliable in its measurement of ovarian structures.

Effect of feed rations on livestock performance and impact of effective microorganism on litter odour and other gases emission: A review

V.W. Sithole[1], F.N. Fon[1] & T.N. Suinyuy[2]

[1]Department of Agriculture, Private Bag X1001 University of Zululand, KwaDlangezwa, 3886, South Africa.
[2]University Road Westville, Private Bag X 54001 Durban, 4000, South Africa.
sitholevictor5@gmail.com

Background: The livestock industry is facing challenges to produce high protein food without being a nuisance to the environment. The odour emitted from livestock consists of gases (Carbon dioxide, Nitrous Oxide, Methane, Ammonia, Hydrogen sulphide, etc.) that are potentially hazardous to humans, animals and the environment if accumulated. This paper briefly reviews the use of effective microorganism (EM) to reduce gases emission from livestock manure and how different feed rations geared towards livestock performance affect litter odour emissions in terms of gases types and concentrations.

Aim: The aim of this review was to evaluate the effect of feed rations on litter odour and other gases emission and potential mechanisms and ways of reducing emissions.

Discussion: Livestock production results in odour emissions from three basic areas; animal buildings (30%), fertilizer storage facilities (20%), and applying manure on fields (50%) (Rappert and Müller, 2005). The use of effective microorganisms has been recommended by numerous researchers to decrease the spread of odour in the environment (Higa, 1991; Li and Ni, 2001; Mafiri, 2014). EM is a mixture of cultured microbes (lactic acid bacteria, photosynthetic bacteria, actinomycetes, yeast, and fermenting fungi) that are beneficial and naturally occurring microorganisms (Higa, 1991). The presence of fungi in EM produces alcohol, esters and antimicrobial substances at a great rate by decomposing organic matter (Mafiri, 2014). Hence, these substances suppress odours produced by organic matter or waste material from livestock and prevent infestation of destructive or harmful insects and maggots. Amon *et al.* (2006) reported that the application of EM in cattle slurries relatively reduced the emissions of Hydrogen sulphide (NH_3) and Nitrous oxide (N_2O), but slightly increased methane (CH_4). This showed the potential of EM as an agent to reduce NH_3 and other greenhouse gas emissions from stored slurry. Bastami (2016) treated cattle manure with a mixture of actiferm EM and glucose and observed a decrease in greenhouse gases (CH_4, CO_2, and N_2O) emissions. However, NH_3 emissions were not observed. Mpendulo (2012) added high fiber ingredients (lurcen hay, sunflower husk and maize) on pig rations to measure their effect on odours emitted from pig slurry tanks. The results were not clear and concluded that more work still needs to be done to characterize compounds from the large variety of locally available fiber sources that reduce water and air pollution from pig enterprise. Four possible mechanisms of odour reduction will be suggested as well is their effect on production.

Conclusion/recommendations: There is a need to evaluate the full potential of the use of EM in the reduction of all the harmful gases present in animal manure or slurry because it is generally becoming an environmental worry. The use of EM in treatment of animal manure, particularly swine and beef cattle has not been well explored. Using EM on these animals might generate information which will help in improving sustainable production and protection of the environment.

Social interactions and haemato-biochemical responses of Nguni and Boran steers post relocation to novel environment and herd-regrouping

M. Slayi, V. Muchenje & Y.Z. Njisane
Department of Livestock and Pasture Science, University of Fort Hare, Alice, Republic of South Africa.
mslayi@webmail.co.za

Background: Selecting cattle breeds with excellent genetic or phenotypic features related with specific behavioural and physiological characteristics has emerged as an essential tool to improve well-being in the modern beef industry. In addition, the process of keeping animals under natural environmental conditions is perceived to be a welfare benefit by many researchers since it allows animals to live "freely" and express their natural behaviour. On the other hand, several researchers claim that extensive conditions may also create a substantial number of welfare problems in cattle production. Consequently, research concerning the complementary breeding of high producing cattle breeds and local genotypes under natural environmental setups has been increasing over the past years. Indigenous cattle breeds such as Nguni, Mashona, Tuli and Boran are highly reputable for their capacity to adapt in harsh and heterogeneous environmental conditions. However, not much is known about how these indigenous cattle genotypes might also facilitate adaptation to a new environment and unknown social groups by using their behavioural attributes and blood-based physiological indices of social stress.

Aim: This study was conducted to examine the behavioural qualities and haemato-biochemical indices of social stress that may additionally be related to regrouping and relocation of Nguni and Boran steers to a new social group and unfamiliar environment in semi-arid rangeland conditions.

Methodology: Twenty steers (10 Nguni and 10 Boran) aged 9 months were bought from two farms of similar conditions and were studied over a period of 16 weeks; 1 week for acclimatization in original groups and 15 weeks for recording post regrouping data. For 3 consecutive days in each sampling week, direct visual observations of aggressive and affiliative interactions, and their durations were recorded over 14 hours (between 05h00-19h00) period. Blood samples were drawn though jugular venipuncture for plasma cortisol, glucose, CK and haematological analysis. Data were statistically analysed ($P < 0.05$) using PROC GLM of SAS 2003.

Results and Discussion: Boran had higher instances of head butting (P=0.0311), mounts (P=0.0142) and threats (P=0.0241) than the Nguni steers in the first five weeks. However, the occurrence of these aggressive interactions significantly declined from weeks 5-15 in both genotypes. Grooming behaviour in both genotypes (P=0.0214) showed a consistent increase with observation weeks. Head butting was negatively correlated with cortisol (r =-0.116), CK (r = -0.095) and neutrophil to lymphocyte ratio (r= -0.144). Positive correlations (r=0.037) were observed between grooming and white blood cell count.

Conclusion/recommendations: Results of the current study revealed that the complete change in environment and regrouping temporarily disrupted the social behaviour of the steers, which resulted to increased stress secretion of blood metabolites and hormones. Nevertheless, it is evident that the two genotypes were able to tolerate the series of stressors they were exposed to and this shows a vital adaptation capacity of these breeds to the current changes in husbandry practices at farm level.

Foraging behaviour patterns and weight gain of Nguni and Boran steers post relocation and herd regrouping in semi-arid regions

M. Slayi[1], V. Muchenje[1] & Y.Z. Njisane[1]

[1]Department of Livestock and Pasture Science, University of Fort Hare, Alice, South Africa.
mslayi@webmail.co.za

Background: Increased occurrence of droughts and fluctuating climatic conditions in recent times has put less fortunate beef farmers at a disadvantage by forcing them to sell some of their stock to avoid financial and production losses. The newly bought animals are usually kept in their new environment until they reach target slaughter weight and sold for better financial returns. Upon arrival at the new farm, the animals are sorted according to their weight, age and sex as a standard husbandry practice to create homogenous groups. The transition of animals from their original habitat to the new environment is often stressful and may interfere with everyday activities and productive performance of the herd. Time budgets of beef cattle in relation to regrouping and relocation have received little research attention even though animals are often exposed to various groupings nowadays. It has also been noted that high producing cattle breeds are experiencing some difficulties to adapt when sent into some regions with both warmer climate and a lower feed allowance than their area of origin. Matching of genotypes to production environments assume that there are genotypes that could be matched more easily with the environment. For example, indigenous cattle genotypes such as Nguni and Boran are known to thrive under harsh and heterogeneous climatic conditions. However, these cattle breeds are hardly recognized and their response to natural selection presented to heterogeneous environments is still unresolved.

Aim: This study was conducted to examine the effects of regrouping and relocation on the range of activity time budgets and performance indices of Nguni and Boran steers reared on natural pastures.

Methodology: This study was carried out in accordance with the recommendations and approval of the University of Fort Hare's Research Ethics Policy for the accommodation and care of animals under the ethical clearance certificate number MUC551SSLA01. Twenty steers (10 Nguni and 10 Boran genotypes) aged 9 months were sourced from various stud breeders and were studied for 16 weeks. Upon their arrival at the new farm, the steers were allocated into 2 separate paddocks based on their source of origin for a period of 7 days to record baseline information on time budgets and performance parameters. After seven days, the animals were regrouped into 1 paddock and continuously monitored for a period of 15 weeks. Body condition scores (BCS) and live weights were recorded once per week as production indices. Activity budgets were gathered at fortnight basis using direct focal observations every 20-minutes intervals within 15 hours of daylight. Data were statistically analysed ($P < 0.05$) using PROC GLM and CORR of SAS 2003.

Results and Discussion: Nguni (NG) and Boran (BR) steers showed significant differences ($P < 0.0001$) in their principal activity budgets, such as grazing (NG: 47.78%, BR: 52.22%), walking (NG: 58.42%, BR: 41.48%), resting (NG: 46.70%, BR: 53.30%), and vigilance (NG: 51.05%, BR: 48.95%). Selection of foraging sites varied between observation weeks, with steers spending more ($P < 0.0001$) time along fencelines and upper areas of the paddock. There was a drop in average daily gain (ADG; $P = 0.0381$) and BCS ($P = 0.0374$) in both genotypes. However, this trend showed a positive increase from week 3 till the end of the trial. Negative correlations ($r = -0.428$) between walking and grazing time was the main factor responsible for the sudden decline in ADG and BCS.

Conclusion/recommendations: Results of the current study revealed that the complete change in environment and herd mates temporarily disrupted the weekly budgeting of activities and growth performance of the two genotypes. Nevertheless, it appears that these breeds quickly habituated to environmental changes and unstable social companionship irrespective of their differences in activity budgets and this reflects an important adaptation capacity to the series of stressors at farm level.

An assessment of woody biomass as a sustainable energy source in a bush thickened area of northern Namibia

G.N. Smit[1], J.N. de Klerk[2] & M.B. Schneider[3]

[1]Dept. of Animal, Wildlife and Grassland Sciences, University of the Free State, P.O. Box 339, Bloemfontein, Republic of South Africa, [2]P.O. Box 5846, Ausspannplatz, Windhoek, Namibia, [3]DRFN-Desert Research Foundation of Namibia, P.O. Box 20232, Windhoek, Namibia.
gnsmit@ufs.ac.za

Background: Bush thickening can be defined as the increase in the density of indigenous woody plants that exploit disruptions of the grass/bush balance at the expense of grasses. Bush thickening is considered the biggest threat to sustainable cattle farming in northern Namibia. Due to the cost of bush control measures there is an increasing awareness of woody plants as a harvestable resource with a monetary value.

Aim: The aims of the study were to conduct a detailed assessment of the woody biomass resource in a selected area of Namibia and to make recommendations regarding the sustainable harvesting of woody plants as a source of energy, specifically for the generation of electricity.

Methodology: The study area is located north-west of Otjiwarongo in northern Namibia with a long-term average annual rainfall of 457 mm. A total of 28 plots were selected on eight commercial farms. A belt transect of 50 x 2.5 m was demarcated at each plot and all rooted, live woody plants measured according to the BECVOL 3-model (Smit, 2014). Values calculated included: Tree density, Evapotranspiration Tree Equivalents (1 ETTE = leaf volume equivalent of a tree 1.5 m in height), leaf dry matter (DM), shoot DM (<0.5 cm diameter), stem DM (>0.5-2.0 cm diameter) and wood DM (>2.0 cm diameter).

Results & Discussion: A total of 30 woody species were recorded. The total wood DM varied from 7 291 kg/ha to 190 942 kg/ha with an average of 36 222 kg/ha (SD ± 4 022). The wood >2.0 cm made up 70.1 % of the total wood mass, while the stems >0.5-2.0 cm and shoots <0.5 cm made up 20.8 and 9.1 %, respectively. The leaves added another 6.8 % to the total biomass. A high wood DM/ha was without exception related to the presence of very large trees. Based on the average of 36 222 kg/ ha the study area of 45 000 ha carries a wood biomass of 1.63 mil. tons. It was estimated that a target value of 4 500 ETTE/ha can be retained without adversely affecting the grass layer. Based on this target an average of 10 811 kg/ha wood can be harvested, which represents approximately 30 % of the total wood biomass. Reducing the target to 2 700 ETTE/ha will increase the wood harvest to 12 653 kg/ha, which represents approximately 35 % of the total wood.

Conclusion/recommendations: It was concluded that wood harvesting at a target retention density of 4 500 ETTE/ha will meet the minimum requirement of 10 000 kg/ha for the viability of an electricity generation plant. It is recommended that trees be selectively harvested, starting with the smallest plants and progressively moving to larger plants until the target of retaining 4 500 ETTE/ha has been reached. This approach will ensure the preservation of valuable trees that suppresses new woody seedlings and benefit grass production. Harvesting should concentrate on the potential problem species.

Preliminary results on the knowledge and perceptions of South African citizens towards farmed ostrich welfare

M. Snyders[1], M. Bonato[1], A. Engelbrecht[2] & S.W.P. Cloete[1,2]

[1]Department of Animal Sciences, University of Stellenbosch, South Africa, [2]Western Cape Department of Agriculture, Directorate Animal Sciences, Elsenburg 7607, South Africa.
mbonato@sun.ac.za

Background: As the world leader in ostrich production South Africa mainly exports products, especially to European countries. Consumers have increasingly high expectations of livestock welfare and production and prefer ethically produced products where animal welfare is prioritised. Perceptions and concerns of producers and consumers often differ and in the absence of direct knowledge about livestock production systems, consumers may view an industry unfavourably and adapt their buying decisions accordingly.

Aim: To determine and compare the knowledge and perceptions of South African consumers, farmers and other stakeholders in the ostrich industry to obtain insight into their opinions regarding farmed ostrich welfare.

Methodology: A survey was distributed from September 2018 on online platforms (GoogleForms®), via e-mail and as physical copies to consumers, farmers and stakeholders in the ostrich industry. The survey consisted of two sections: the first contained demographic questions (age, gender, education, and dietary preference), the second was related to knowledge and perceived welfare importance of husbandry practices in the industry and product buying decisions. The second sections' answers were scored on a Likert scale (1-5) ranging from what respondents considered as least to most important. Data was analysed using a non-parametric one-way ANOVA to investigate potential differences between two or more groups of independent variables on ordinal dependent variables. Fractional ranks were computed to perform a general linear model with multiple comparisons to establish which specific independent variables differed.

Results and Discussion: Consumers lacked knowledge of the ostrich industry ($P<0.0001$) with a mean (±SD) score of 2.1±1.0 compared to other respondents (farmers: 3.7±1.0; stakeholders: 3.6±1.1). Respondents aged 20-35 years and women appeared less knowledgeable than other respondents (20-35: 2.2±1.2; 36-50: 3.1±1.4; 51-65: 3.0±1.1; >65: 3.2±1.2; women: 2.2±1.2; men: 3.0±1.2; $P<0.05$). This could reflect the lack of involvement of the public, particularly youth and women, in the industry. Vegetarians appeared less knowledgeable about ostrich handling than respondents with other dietary preferences (vegetarian: 1.7±0.7; meat preference: 3.0±1.4; no preference: 2.8±1.3; vegan: 3.0±2.8; $P<0.05$). Women were more likely to buy and pay more for welfare conscious products (women: 4.3±0.8, 4.0±1.1; men: 3.8±1.1, 3.5±1.2 respectively; $P<0.05$) and respondents with lower levels of education were less likely to buy such products (secondary educated: 3.4±1.0; tertiary educated: 4.1±1.0; $P<0.05$).

Conclusion/recommendations: These preliminary results highlighted a substantial lack of knowledge about the ostrich industry amongst consumers. This shortcoming could be addressed in future to enable consumers to make informed buying decisions. These results need to be compared with global perceptions to determine whether they differ and can ultimately be used to optimize marketability of ostrich products. Further investigations are underway to address both local and international stakeholders' opinions on the welfare importance of management and production processes in the industry.

Prediction of lifetime productive and reproductive performance of Angora ewes from early production traits

M.A. Snyman[1]
[1]Grootfontein Agricultural Development Institute, Private Bag X529, Middelburg EC, 5900, South Africa.
GrethaSn@daff.gov.za

Background: The ewe flock plays an important role in the generation of income from any small stock enterprise. In the case of Angora goats it generates income from the current flock through hair production and reproduction. The ideal is to have a high producing ewe flock in terms of reproduction as well as mohair production. It is therefore important to identify ewes at an early age that will maintain a high level of mohair production and reproduction throughout their flock life.

Aim: The aim of this study was to predict from the information available at an early age which ewes will be the highest producers and reproducers over their lifetime in the flock.

Methodology: The project protocol was approved by the Ethical Committee of the Grootfontein Agricultural Development Institute (GVE/AP2/18). Data collected on the flocks of three South African Angora goat producers from 2000 until 2015 were included in this study. During kidding, full pedigrees, birth date, sex and birth status of each kid were recorded. The following production data were recorded on the kids: Body weight at birth, weaning, 8-, 12- and 16 months of age, as well as fleece weight, fibre diameter profile, style and character at the second and third shearings. Full reproduction data, body weight before mating, as well as fleece weight, fibre diameter profile, style and character at the winter shearing were recorded on the ewe flocks. Estimation of genetic parameters was done with the ASReml program, while prediction of lifetime performance was done by various logistic regression analyses (PROC REG procedure of SAS with the LOGISTIC option).

Results and Discussion: Early fleece weights were genetically favourably correlated with all the adult traits, except with adult fibre diameter. The opposite was true for early fibre diameter, which was genetically unfavourably correlated with all the adult traits, except with adult fibre diameter. Early body weights were also genetically favourably correlated with all the adult traits, except with adult fibre diameter. Maiden ewe reproductive performance at the first parity was favourable genetically correlated with lifetime reproductive performance. Although maiden ewe reproductive performance was favourably correlated with adult fleece weight and fibre diameter, the standard errors of these correlations were very high. Ewes that had higher 12- and 16-month body weights were more likely to kid, less likely to abort, more likely to have multiple kids and more likely to wean multiple kids. Ewes with higher total weight of kids weaned and number of kids born at their first parity were more likely to kid, less likely to abort, more likely to have multiple kids and more likely to wean multiple kids than ewes with corresponding lower early values.

Conclusion/recommendations: The negative relationship between reproduction and fleece production in the adult ewes emphasises the fact that positive selection pressure on early fleece weight should not be done at the cost of reproduction. Only young ewes with unacceptably low fleece weights should be culled, while too much selection pressure on early fibre diameter in the ewes should also be avoided. Positive selection pressure can be put on early body weights. As far as the early reproductive traits are concerned, emphasis should be placed on total weight of kids weaned and number of kids born at first parity.

Application of Check-All-That-Apply method to visual evaluation of the South African A2 fresh beef steaks from three different breeds

Z. Soji[1] & V. Muchenje[1]
[1]Department of Livestock and Pasture Science, University of Fort Hare, Alice 5700, Republic of South Africa.
zsoji@ufh.ac.za

Background: The socioeconomic and cultural diversities among current consumers are strongly influencing meat quality preferences, consequently leading to an increasingly changing market. Meat classification systems on the other hand, particularly that of South Africa, are unable to meet these current preferences. Thus ongoing research to assess changes in consumer preferences is essential to develop a classification system that will be relevant to the current consumer.

Methodology: Ethics no (MUC411SSOJ01). An 80-member consumer panel (40 males and 40 females) aged between 21 and 30 was used in the study. Three A-class South African beef breeds (Bonsmara, Hereford and Simbra) processed from different feedlot systems were studied. Nine representative *muscularis longissimus dorsi* muscles from the left side were processed into beef steaks from each carcass. All samples were vacuum packed for visual analysis. During the experiment, coded samples were evaluated on the display cabinets using the CATA profiling method as follows: Consumers were asked to check all attributes perceived in each steak and evaluate the overall liking of each attribute and each steak. With the intention of testing the knowledge and expectations of the consumers on red meat classification, a market research was also conducted using a CATA questionnaire where consumers were asked five questions regarding the South African red meat classification system. They were also given a chance to include any other information/ quality attributes they would want to see at retail points during meat purchasing. The XLSTAT version 2018.5 statistical software for excel was used to analyse the sensory data.

Results and Discussion: Consumers indicated how they would prefer to pay premium for meat with guaranteed muscle and fat colour, low fat content, high marbling and tenderness. Consumers observed breed differences in muscle fibre separation and muscle colour while fat colour, marbling, fat content were rated similar across breeds. Bonsmara steaks were strongly associated with a slight separation between muscle fibres and a very slight amount of marbling. Hereford steaks were strongly associated with a slightly abundant muscle fibre separation and a slightly coarse surface structure. While Simbra steaks were strongly associated with a moderately dark red muscle colour, greyish white fat, moderate marbling and a very smooth surface structure. The overall liking of each attribute was more on moderate bright cherry red lean colour, moderate yellow fat, very abundant marbling and slight separation of muscle fibres. Differences on discrete liking of each attribute among consumers had an effect on the overall liking of each steak with Hereford steaks being more preferred by consumers. Organoleptic quality of meat assumed more importance among consumers in this study.

Conclusion/recommendations: The current study has shown that variations in meat quality within the same class of animals may be detected when overlaid with consumer sensory profiles. Thus fat cover and age are not the only quality related attributes that the current consumers in South Africa are interested in when purchasing beef. There are some health related and organoleptic properties of meat that consumers would want to see at selling points when purchasing beef, which are influenced by the current socioeconomic and cultural diversity.

Evaluation of mineral composition of browse fruits for grazing ruminants in Alice, Eastern Cape Province

B. Sondzaba[1,2] & C.S. Gajana[1]

[1]Department of livestock and pasture science, University of Fort Hare, Private bag X 1314 Alice 5700,
[2]Dohne agricultural development institute, Private Bag X 15, Stutterheim, 4930 South Africa.
201203101@ufh.ac.za

Background: Mineral imbalance and deficiencies exist widely in ruminants and the severity of the deficiency depends upon the type of diet, age, physiological status of the animals and the agro-climatic conditions of the region. Ruminants depend mainly on rangelands to obtain feed and nutrients, however during drought season veld condition become deteriorated and nutrients become depleted, thus cannot maintain productivity of ruminants. Browse plants have reported to contain essential macro and micro nutrients, which can play a major role for the maintenance of ruminants during drought season.

Aim: The aim of the study was to determine the mineral composition of browse fruits for grazing ruminants in Alice, Eastern Cape Province.

Methodology: All experimental procedures were approved by the Animal Ethics Committee at the University of fort hare (Ethics clearance number: GAJ021SSON01). Fruits from four browse species (*Vachellia karroo, Grewia Occidentalis, Diospyros Lycioides and Ziziphus Mucronata)* were randomly harvested from Alice grazing rangelands. Alice is situated at 32.78° South latitude, 26.83° East longitude and 542 meters' elevation above the sea level. All samples were analysed for Ca (Calcium), Mg (Magnesium), K (Potassium), Na (Sodium), P (Phosphorous), Zn (Zinc), Cu (Copper), Fe (Iron) and Mn (Manganese) using an atomic absorption spectrophotometer.

Results and Discussion: It was found that the browse fruits had variable levels of Ca, Mg, K, Na and P which ranged from 2.006%-6.665%, 0.244%-0.475%, 0.721%-1.15%, 16.6%-388.8% and 0.122%-11.4% on a DM basis, respectively. Micro-nutrients which include Fe, Cu, Zn and Mn values ranged from 21.7-68.4 ppm, 3.8-14.5 ppm, 5.2-19.9 ppm and 4.5-65.5 ppm on a DM basis respectively. The results show that the majority of macro (Ca, K, Na and Na) and micro (Fe, Zn and Mn) mineral content of browse fruits are adequate for the maintenance requirement of ruminants and thus they can be used as supplementary feed during scarcity of feed.

Conclusion/recommendations: In conclusion, based on the mineral composition, the fruits of certain browse plants can be used as alternative low-cost sources of minerals in ruminants feeding. *Vachelia karroo* contained lower amounts of P, whereas *Ziziphus Mucronata* contained lower amounts of Mg. *Diospyros Lycioides* had less P and Cu. It is therefore recommended that mineral supplementation of Mg, Cu and P for ruminants should be available during the grazing period.

Sex and breed effects on HSPA1A and blood stress indicators in relation to the quality of meat from lambs slaughtered at a commercial abattoir

T. Stempa[1], G. Bradley[1] & V. Muchenje[2]

[1]Department of Biochemistry and Microbiology, [2]Department Livestock and Pasture Sciences, University of Fort Hare, P.Bag X1314, Alice 5700, South Africa.
tstempa@ufh.ac.za

Background: Animals exposed to stress during the pre-slaughter period a higher meat pH and they increase heat shock protein (HSP) expression thus affecting the overall meat quality. Furthermore, exposure to pre-slaughter stress leads to an increase in some stress indicators in the blood. However, there is limited information on the effects of sex, breed, pre-slaughter environment on HSPs and their relationship with blood stress indicators and meat quality attributes, especially in lambs.

Aim: The objective of this study was to examine sex and breed effects on heat shock proteins (HSPA1A), blood stress indicators (cortisol, glucose, lactate) and meat quality attributes of lambs slaughtered at a commercial abattoir.

Methodology: Permission to conduct the study was approved by the Research Ethics Committee of the University of Fort Hare, South Africa (UFH/UREC, MUC371SSTE01). A hundred eight-month-old male and female lambs from the Dorper (n=50) and Merino (n=50) breeds were used in this study. Blood samples were collected for the analysis of glucose, lactate, cortisol and HSPA1A levels. The pH and temperature were measured 45 minutes after slaughter and carcass measurements (warm carcass weight, cold carcass weight, carcass fatness) were taken. The ultimate pH, temperature and meat colour coordinates (lightness, redness, yellowness) were measured on the *Muscularis longissimuss thoracis et. lumborum* 24 hours after slaughter; and hue angle and Chroma were calculated. After that, LTL samples were stored at -20 ⁰C and thawing loss percentage, cooking loss percentage and Warner Braztler Shear Force were measured 7 days post-slaughter. Data was statistically analysed using the PROC GLM procedure of SAS (2009).

Results and Discussion: Breed and sex had a significant effect on the levels of plasma HSPA1A; where the Merino lambs (34.89 ± 4.462) had higher levels than Dorper (15.94 ± 4.405), and female lambs (32.86 ± 4.610) had higher levels than male lambs (17.97 ± 4.250). Merino lambs had significantly higher levels of plasma lactate (5.01 ± 0.235), WCW (22.96 ± 0.349) and CCM (22.27 ± 0.415) compared to Dorper (3.58 ± 0.232, 19.71±0.344 and 18.74 ± 0.409; respectively); while Dorper lambs had a significantly higher pH45 value (6.06 ± 0.022) compared to Merino (5.99 ± 0.022).Meat temperature at 45 minutes was significantly higher in Merino (23.29 ± 0.209) than Dorper (22.16 ± 0.206); whereas at 24 hours it was significantly higher in Dorper (25.95 ± 0.073) than Merino (25.42 ± 0.073). However, Dorper had significantly higher L*, TL% and WBSF values (41.27 ± 0.483; 14.51 ± 0.81; 37.78 ± 1.230, respectively) than the Merino (37.33 ± 0.489; 11.62 ± 0. 819; 37.52±1.246, respectively). The interaction of sex and breed had a significant effect on the meat CL%. Sex had a significant effect on the pHu, where female lambs (6.03±0.022) had a higher pHu than male lambs (5.95±0.020).Significant positive correlations were found amongst plasma HSPA1A, glucose, lactate, L*, a*, b* and WBSF.

Conclusion/recommendations: The results indicate that female lambs were more stressed than males, while the Dorper breed was observed to have been more negatively affected by the pre-slaughter stressors compared to the Merino. It was therefore concluded that the sex and breed of animals should be considered when selecting meat animals, since females appear to have been more fearful during the pre-slaughter period. Similarly, the Dorper was also more negatively affected by the slaughter period, hence interventions should be implemented at abattoirs in order to reduce stress levels for improved meat quality.

Predation management on a farm in the Central Free State Province, South Africa

A.J. Strauss[1]

[1]Free State Department of Agriculture and Rural Development, Private Bag X01, Glen 9360, South Africa.
andriess@fs.agric.za

Background: Nationally, the impact of predation on the livestock industry is seen in a variety of farming sectors, as indicated by studies done on large stock farms, small stock farms and wildlife ranches. Various studies confirm the advantages of predation management strategies. Contrary to this, some studies report on unsuccessful strategies and the impact thereof. Despite these contradictory studies, predation management on farms is vital to ensure an increase in household and national food security. The Free State Wool Sheep Project was initiated in 1998 with the aim to develop profitable and sustainable wool farming systems on the resource combination (veld and planted pastures) of Glen Agricultural Institute (Glen AI). However, this wool sheep project was severely impacted by predation with an average annual loss of 18.6% of the total flock size, despite various attempts of lethal and non-lethal predation management strategies.

Aim: This study aimed to describe the impact of predation management strategies on sheep flocks at Glen AI.

Methodology: Lethal (hunting, cage traps and leg holding device) and non-lethal (fencing, kraaling, sheep bells, collars) methods were applied to reduce the losses due to predation. Lethal methods were applied during the peak breeding season of the Black-Backed Jackal (August, September and October). Non-lethal methods like kraaling were applied throughout the year. Fences were inspected twice a week. Sheep bells and collars were applied to 2-week old lambs for a period of a month.

Results and Discussion: From 1999 to 2007 legal and non-lethal methods were applied to reduce the impact of predation on the small stock at Glen AI. These actions were not coordinated and the annual post - weaning losses as a percentage of all sheep flocks at Glen actually increased from 6.7% in 1999 to 25.8% in 2007. After a predation management program was introduced hereafter the annual percentage losses decreased to 2% in 2018. However, it must be highlighted that the current sheep number of 109 is far more manageable than the 1130 sheep in 1999. Non-lethal methods did not have a marked influence on the impact of predation, except kraaling. Kraaling had a very positive effect on reducing the impact of predation on the sheep at Glen AI. However, theft increased due to this practice. In 2017 the losses due to theft (12% of the total flock) were exactly the same as predation (12 % of the total flock). Kraaling together with the severe drought in 2017 impacted negatively on production (e.g. wool staple strength) and reproduction (8 % weaning) performances. Lethal methods that were applied according to the methodology reduced the impact of predation noticeably.

Conclusion/recommendations: Non-Lethal methods (e.g. fencing and kraaling) and lethal methods (e.g. hunting) in the peak breeding season of the black-backed jackal contributed positively to the decline of predation. This co-ordinated predation management plan can reduce the impact of predation markedly.

Determining an optimal lysine: energy ratio for lean growth in a modern commercial pig genotype

I. Taljaard[1], C. Jansen van Rensburg[1] & F. Crots[2]
[1]Department of Animal and Wildlife Sciences, University of Pretoria, Pretoria 0002, South Africa, [2]AFGRI Feeds, 12 Byls Bridge Boulevard, Highveld Ext 73, Centurion.
irmarie@picrsa.co.za

Background: Intense genetic selection for reduced back fat thickness and improved feed utilisation in pigs has resulted in modern genotypes with high lean gain potential, which now deposit a greater amount of lean tissue at faster rates than 20 years ago. Consequently, higher levels of lysine relative to energy are required in their diets. The lysine: energy ratio can be largely influenced by genotype, sex, age and health status of the pig. Continued efforts are required to characterise the effects of increasing dietary lysine in evolving modern pig genotypes reared in commercial production environments.

Aim: The aim of this study was to determine the optimal lysine: energy ratio required for lean growth of a modern pig genotype (PIC337), as well as to determine the growth performance potential under typical commercial conditions.

Methodology: All experimental procedures were approved by the Ethics Committee at the University of Pretoria (Experiment No. NAS103/2019). One-hundred-and-eighty PIC 337 entire male pigs were used in a 2 x 3 factorial experimental outlay, including two energy levels (10.7 MJ NE/kg and 9.05 MJ NE/kg) and 3 lysine levels (80%, 100%, 120%; where 100% equals to current PIC recommendations). Thirty-six pens, with 5 pigs per pen, were randomly allocated to 6 treatments (n=6 replicates/treatment). The boars were 9 weeks (63 days) of age at the start of the trial and reared for a period of 17 weeks until slaughter under typical commercial conditions. Average feed intake per pen was measured weekly and all pigs were weighed bi-weekly along with P2 back fat measurements. Average daily feed intake (ADFI), average daily gain (ADG), and feed conversion ratio (FCR) were calculated. The trial continued until 26 weeks (182 days) of age after which all the boars were slaughtered to determine carcass characteristics including hot carcass weight, cold carcass weight, drip loss %, pH initial, pH ultimate, as well as back fat thickness. Data was statistically analysed ($P<0.05$) using a complete randomised block design two-way ANOVA.

Results and Discussion: During the grower phase (20.3 – 82.9 kg), energy had an effect ($P<0.05$) on body weight gain and FCR, but had no effect ($P>0.05$) on ADG or ADFI. During the same phase, lysine had no effect ($P>0.05$) on body weight gain, ADG, ADFI or FCR. The Lys: NE ratio had an effect ($P<0.05$) on FCR and ADFI. During the finisher phase (82.9 - 145.3 kg), energy and lysine had an effect ($P <0.05$) on body weight gain, as well as FCR, but not on ADG. Also, the energy as well as the Lys: NE ratio had an effect ($P<0.05$) on ADFI during the finisher phase. However, pigs from the high energy treatments (T1, T2, and T3) and the high lysine treatments (T3 and T6) had higher body weight gains and ADG as well as reduced FCR and ADFI compared to the low energy and low lysine treatments for both the grower and finisher phases. Lysine had no effect ($P>0.05$) on carcass characteristics, whereas energy only influenced ($P<0.05$) the hot and cold carcass weights as well as back fat thickness. However, the low energy and the two high lysine treatments (T3 and T6) resulted in leaner carcasses compared to the high energy treatments.

Conclusion/recommendations: Results of the current study suggest that increased energy as well as lysine levels allow for better growth performance but due to pig producers being paid for carcass composition as well as carcass weight, a low energy diet with high lysine levels will allow for greater return on investment. The study also suggests that the lysine requirements for the modern pig has increased, especially during the finishing phase.

Effect of production system on growth performance, carcass and meat quality characteristics of Malawian native Muscovy ducks

J. Tanganyika[1,2] & E.C. Webb[1]

[1]Department of Animal and wildlife Sciences, Faculty of Natural and Agricultural Sciences, University of Pretoria, Private Bag X20, Hatfield 0028, South Africa, [2]Animal Science Department, Faculty of Agriculture, Bunda Campus, Lilongwe University of Agriculture and Natural Resources, P. O. Box 219, Lilongwe, Malawi.
jtanganyika@gmail.com

Background: Duck production is increasing in Malawi and is mostly combined with indigenous chickens under traditional systems with little or no supplementation. Duck meat is one of the alternative sources of animal protein alongside chicken meat and other livestock. However, animal protein is still not self-sufficient, particularly in the rural areas with an average of 6g/capita/day, partly due to rapid increasing human population. Generally, duck meat consumers are unaffected by cultural or religious taboos, therefore it provides a huge opportunity for sustainable food security but needs to be explored in terms of production, hence the current study.

Aim: This study was conducted to determine the effect of production systems on growth performance, carcass and meat quality characteristics of native Muscovy ducks in Malawi.

Methodology: All experimental procedures were approved by the Animal Ethics Committee at the University of Pretoria (EC-032-17). 120 (60 males and 60 females) ducks were raised under three production systems, intensive (IS), Duck-rice integration (DR) and Free range (FR) and fed starter (20% CP, wk1-wk4) and finisher (17% CP, wk5-wk10). Weekly data on feed intake and growth performance were collected. After 10 weeks the ducks were humanely slaughtered and data of hot carcass characteristics were collected. The carcasses were chilled for 24 hrs at 4^0C to determine cold carcass and meat quality, proximate and mineral composition. Carcass temperature, pH and meat colour were determined at 45 min, 3 hrs, 6 hrs, 12 hrs and 24 hrs post-mortem. Furthermore, the study included sensory evaluation to determine the effect of production systems, cooking methods and post-mortem ageing time on eating quality attributes of duck meat. Data were analysed using GLM Procedures, MANOVA of SPSS Version 20 and Duncan Multiple Range test was used to determine significance difference among variables ($P<0.05$).

Results and Discussion: Among the production systems, birds in DR had significantly higher values for ADGs and carcass characteristics ($P<0.05$). Dressing percentage for IS, DR and FR were 59%, 63% and 57%, respectively. However, production system had no effect ($P>0.05$) on carcass temperature, pH and proximate composition of duck meat but sex affected moisture content, whereby, males (65.56%) had significantly ($P<0.05$) higher moisture content than females (61.68%). On the other other hand, production system significantly affected ($P<0.05$) tenderness and mineral composition of duck meat. From the sensory evaluation, the panellists preffered duck meat from DR, grilling as the best cooking method and 12 hrs as the best post-mortem ageing period of duck meat.

Conclusion/recommendations: Farmers can adopt the duck-rice integrated system alongside supplementation to improve the size, nutritive content and quality of duck meat while maintaining its desirable sensory characteristics. However, further on-farm studies need to be conducted so that stakeholders at all levels have informed choices on best production systems of ducks, cooking method and ageing period to optimise duck production.

Growth performance, carcass and meat quality attributes of Angus steers fed dried grape pomace and citrus pulp

T. Tayengwa[1], O.C. Chikwanha[1], M.E.R. Dugan[2], T. Mutsvangwa[3] & C. Mapiye[1]

[1]Department of Animal Sciences, Faculty of AgriSciences, Stellenbosch University, Private Bag X1, Matieland, 7602, South Africa, [2]Lacombe Research and Development Centre, Agriculture and Agri-Food Canada, Lacombe, Alberta, Canada, [3]Department of Animal and Poultry Science, College of Agriculture and Bioresources, University of Saskatchewan, 51 Campus Drive, Saskatoon SK, Canada.
cmapiye@sun.ac.za

Background: Citrus and grapes are the most widely grown fruits globally, with one-third of total production used for juice and wine making, respectively. The preceding processes generate large quantities of citrus pulp (CP) and grape pomace (GP) which pose serious economic, environmental, and social challenges, especially in developing countries where financial and technological constraints limit their valorization. These fruit by products are, however, rich in valuable compounds which can be utilized in the ruminant livestock industry as novel, economical and natural sources of phytochemicals, which have bioactive properties. Despite having such potential, they remain underexploited by the livestock industry. Inclusion of CP and GP in ruminant diets could combine the desirable effects of enhancing animal production and meat quality attributes with the prevention of challenges associated with their environmental disposal.

Aim: The study was conducted to compare the effects of feeding Angus steers diets containing 15% of either GP or CP on growth performance, carcass and meat quality attributes.

Methodology: All experimental procedures were approved by the Animal Ethics Committee at Stellenbosch University (ACU-2018-6738).Twenty-four, Angus steers (7-8 month old) of similar weight (281±15.4 kg) were randomly assigned to three dietary treatments (8 steers/treatment) in a completely randomized design. The GP and CP were sun-dried for 7 days, milled and substituted for wheat bran at 15% of inclusion level in beef finisher diets. The three dietary treatments were: control (0 % supplement), CP diet (15% of CP, DM) and GP diet (15% of GP, DM). Steers were adapted to the diets for 21 days before a growth performance trial which lasted for 90 days. Feed intake and weights were recorded. At the end of the trial all the steers were slaughtered, carcass attributes recorded and left *longissimus thoracis* from each carcass was used for the determination of meat quality attributes. Data was statistically analysed *(P≤0.05)* using GLIMMIX procedures of SAS with diet as the fixed factor and animal as the random factor.

Results and Discussion: The animals fed the GP diet had higher ($P \leq 0.05$) dry matter intake (DMI), average daily gain (ADG), live, hot and cold carcass weights than CP and control diets. This could be linked to high palatability of GP and high content of proanthocynidins in GP diet. Proanthocyanidins enhance protein availability post-ruminally for absorption and deposition in tissues and consequently increase weight gain. Overall, diet had no effect on meat quality attributes ($P > 0.05$). Gross profit values were highest for the GP diet followed by the CP and control diets ($P \leq 0.05$). This could be due to the observed differences in feed costs, DMI and gross income.

Conclusion/recommendations: Current findings suggest that GP could be a better supplement than CP in improving growth performance, carcass attributes and profitability of Angus steers. Future studies are recommended to compare the effects of feeding GP and CP on shelf-life, fatty acid profiles and sensory quality in commercial feedlot cattle.

Limestone source and particle size effect on Ca and P digestibility and phytase efficacy in broilers

S.J. Taylor[1,3], M. Sinclair-Black[1], R. Angel[2], C. Jansen van Rensburg[1], & P.W. Plumstead[3]

[1]Department of Animal and Wildlife Sciences, University of Pretoria, Pretoria 0002, South Africa, [2]Department of Animal and Avian Sciences, University of Maryland, College Park, MD, USA, [3]Chemunique (PTY) Ltd, Randburg, 2194, South Africa.
Stuart.taylor@earlybirdfarm.com

Background: Standard industry practice is to formulate broiler diets to a total calcium (Ca) and available or digestible phosphorous (P) content. The limitation with this is that inherent characteristics of the limestone source (LS) and particle size (PS) of limestone added to feed may affect phytate P utilization and dietary Ca and P digestibility.

Aim: The objective of this study was to determine how LS and PS affected Ca and P digestibility with and without the use of phytase from *Buttiauxella* spp.

Methodology: The experiment was conducted under the rules and regulations set out by the animal ethics committee of the University of Pretoria with animal ethics certificate number EC047-17. Two groups of 600 Ross 308 male broilers were fed experimental diets in two blocks from D19-21 and D23-25, respectively, in order to determine the effects of LS, PS, and phytase on apparent ileal digestibility (AID) of Ca and P. The experiment layout was a 3 x 2 x 2 randomized block design with three limestone sources (A, B, C), two PS (0.8 mm and commercial) and two phytase levels (0 and 1000 FTU/kg feed). The particle size of the limestone was determined by using a set of fifteen sieves in a Roto-Tap particle size separator and solubility of the limestone was determined at three different time points in a glycine buffered solution. A basal maize/soy bean-based diet with no added inorganic P was mixed to which limestone and phytase was added to make 12 treatments. The experiment was repeated twice (block). Each block consisted of 360 birds in 60 cages, (6 birds/ cage), with 12 treatments. Each block consisted of five replicate cages per treatment, making a total of ten replicate cages per treatment over the entire experiment. Digesta from the distal half of ileum was collected at days 21 and 25 respectively, freeze dried, and analysed for Ca, P, and Cr marker to determine the AID of Ca and P. Data was analysed as a full factorial using Proc Mixed (SAS Institute 2012) with block included as a random effect.

Results and Discussion: Results showed AID of Ca was altered by LS and phytase (P <0.01), with no interaction between LS, PS and phytase on AID of Ca. A three-way interaction (P <0.05) between LS, PS, and phytase was observed for AID of P. In the absence of phytase, a larger limestone PS consistently increased AID of P. With phytase added, the effect of PS on AID of P differed between LS. The increment in AID of P from added phytase was also dependent on the LS (P <0.01). Effects of LS and PS on P digestibility were significantly correlated with the *in-vitro* solubility of limestone. These data suggest that LS and phytase can alter the utilization of total dietary Ca by broilers.

Conclusion/recommendations: Since LS and limestone PS altered the increment in AID P from added phytase, the characteristics (source, particle size and Ca content) of limestone should be considered when assigning matrix values to phytase in practical broiler diets.

Effect of replacing soybean meal with yellow mealworm larvae on performance and gut morphology of Ross 308 broiler chickens

M.E. Tema, J.W. Ng'ambi, D. Brown & T.G. Manyelo

University of Limpopo, Department of Agricultural Economics and Animal Production, School of Agricultural and Environmental Sciences, South Africa.

manyelo.t.g@gmail.com

Background: Soybean meal is one of important protein sources in poultry nutrition. However, high demand and consequent high price of conventional protein sources such as soybean meal are also leading to new research into the development of insect protein for poultry. Insects such as yellow mealworm are such a possible replacement.

Aim: A study was conducted to determine the effect of replacing soybean meal with yellow meal worm larvae on performance and gut morphology of Ross 308 broiler chickens between D0 and 21 of age.

Methodology: One hundred and sixty unsexed Ross 308 broiler chickens weighing 45±3 g were assigned to a complete randomized design with five dietary treatments and 4 replicates per treatment (n=8 birds/replicate). Five diets were formulated to contain yellow mealworm (YM) larvae replacement levels of soybean meal (SB) at 0% ($SB_{100}YM_0$), 25% ($SB_{75}YM_{25}$), 50% ($SB_{50}YM_{50}$), 75% ($SB_{25}YM_{75}$) and 100% (SB_0YM_{100}) during a 21-day trial. The Animal Ethics Committee of the University of Limpopo approved the experiment with the number AREC/13/2017: PG. All management and procedures in this study were carried out in strict accordance with the requirements of the University of Limpopo Code of Practice for Experimental Animals. Data on feed intake, growth rate, feed conversion ratio and live weight were determined. At 21 days, three chickens per pen were sacrificed for gut morphology. Gut digesta pH, gut organ lengths and weights were recorded. Results were analysed using analysis of variance. A quadratic regression equation was used to determine yellow mealworm larvae replacement levels for optimal crop, gizzard, small intestine digesta pH values, GIT, small intestine and caecum lengths and small intestine weights.

Results and Discussion: Growth rate and FCR were not affected ($P>0.05$) by replacing soybean meal with yellow mealworm larvae. Feed intake of chickens fed yellow mealworm replacement level $SB_{75}YM_{25}$ was higher ($P<0.05$) than those on other yellow mealworm replacement levels. Chickens fed a diet having $SB_{100}YM_0$ had higher ($P<0.05$) body weights than those on other yellow mealworm replacement levels. Crop, gizzard and small intestine digesta pH values, GIT, small intestine, caecum, large intestine lengths, GIT, crop, proventriculus, gizzard and small intestine weights were affected ($P<0.05$). Chickens on diets having $SB_{25}YM_{75}$ had heavier ($P<0.05$) GIT, crop and gizzard weights than those on other replacement levels. Chickens on diets having $SB_{100}YM_0$ had heavier ($P<0.05$) large and small intestine weights than those on other levels. However, a 75% replacement increased ($P<0.05$) GIT, crop, proventriculus, gizzard weights and GIT length, but decreased ($P>0.05$) crop and gizzard pH digesta values and small intestine lengths.

Conclusion/recommendations: It is concluded that soybean meal in the diets of broiler chickens between D0-21 of age can be replaced by yellow mealworm larvae. This might offer a solution to the problem of expensive feed faced by poultry farmers. Further studies are recommended to confirm these results.

Survey of aquaculture production in Vhembe district, Limpopo Province

<u>T.R. Thobejane[1]</u>, T. Raphulu[2], M.L. Mashiloane[2], K.F.M. Madia[2] & J. Theron[3]

[1]Limpopo Department of Agriculture and Rural Development, 67 Biccard Street, Polokwane, 0700, [2]Limpopo Department of Agriculture and Rural Development, Mara Research Station, R522, Makhado, Louis Trichardt, 0920, [3]Aquaculture Research Unit, University of Limpopo, P/Bag X1106, Sovenga, 0727.
refiloet@hotmail.com

Background: Aquaculture in Vhembe district is struggling and it may become a missed opportunity without comprehensive information on challenges and opportunities facing the sector. Lack of production figures and a central registry of fish farms are some of the biggest culprits for disappointing growth of this industry.

Aim: This survey was aimed at evaluating the potential aquaculture production in Vhembe district, Limpopo Province.

Methodology: Farmers participated voluntarily and their information was kept confidential. The semi-structured questionnaire and on-farm observations were used to collect qualitative and quantitative data from 58 farmers. Captured data was categorised in spreadsheets in Microsoft Excel and analysed using frequency procedure of Statistical Analysis Software (SAS) (SAS, Ver 9.4).

Results and Discussion: Aquaculture in Vhembe district is dominated by men (66%) aged 46-65 years (60%). There is limited participation of woman, youths and the elderly in fish farming. Almost half (48%) of farmers attained a senior secondary school education, and hence adoption of new aquaculture technologies by farmers should not be a challenge. Aquaculture in Vhembe district is a recent practice with 43% of farmers having 1-5 years of experience. It is also characterised by subsistence level management and are small scale. Most of the farmers (65%) practice aquaculture for home consumption and 26% own only one or two ponds/Aquadams. About 97% of farmers use various tilapia species, as 55% of fingerlings are sourced from the wild. Most farmers use earthen ponds (40%) and only 2% of famers aerate/filter the pond water. Farmers do not measure water quality due to lack of equipment (73%) and lack of knowledge (27%). About 83% of farmers lack information on the importance of fertilising their ponds, with 60% not knowing the nutrient composition of the fish feed. There is no proper marketing strategy and poor husbandry practices abound, as 47% of farmers have never received any aquaculture training or getting any technical assistance when starting their farms and also subsequently. Constraints were lack of information, predators, damaged ponds, lack of quality fingerlings, access to markets, access to funds, lack of equipment, etc. Besides the constraints, 95% of farmers are willing to expand with the intention of commercialising (29%) or improving food security (28%). Farmers highlighted the need for future support for infrastructure, feed supply, training and access to funds and supply of equipment (water quality measuring tools, seine net, weighing scale).

Conclusion/recommendations: There is potential for aquaculture in Vhembe district, but farmers lack knowledge to practice effective aquaculture, i.e. using manure from their additional farming activities (livestock manure and crop waste) as nutrient sources for their fish. Farmers in Vhembe district are registered as cooperatives and attained a formal education, hence it is likely that the potential of aquaculture can be unlocked by groups of farmers adopting new sustainable aquaculture practices through training and research.

Growth performance of weaned Large White x Landrace crossbred pigs fed on diets containing ensiled potato hash

R.S. Thomas[1], C. Ncobela[1], R.J.G. Kgopong[1,] A.T. Kanengoni[3,4], P. Sebothoma[1], O.G. Makgothi[1] & B.D. Nkosi[1,2]

[1]ARC - Animal Production, Private Bag x2, Irene, 0062, South Africa, [2]Centre of Sustainable Agric. Rural Development, University of the Free State, South Africa, [3]Joburg Zoo, Private Bag X13, Parkview, 2122, South Africa, [4]College of Agriculture and Environmental Sciences, University of South Africa, Florida Campus, Florida, South Africa.
ronaldt@arc.agric.za

Background: Affordability of conventional feeds has gone beyond the reach of smallholder pig farmers in South Africa due to declining grain production, increasing competition with humans for feed ingredients and rise in feed prices. Availability of agro-industrial by-products have compelled smallholder pig farmers to use alternative energy sources to replace cereals in pig diets. These by-products contain essential nutrients and might make excellent pig feed if further processed. Potato hash (PH), a by-product derived from the processing of snacks and chips, is produced at quantities of approximately 50 tons per day in South Africa. The by-product contains a dry matter (DM) of 150 g/kg, and a relatively small amount of yellow maize. However, its high moisture content makes it difficult to incorporate into animal diets. Ensiling can be considered as an efficient way of preserving PH.

Aim: The study aimed to evaluate growth performance of weaned Large White x Landrace crossbred pigs fed on diets containing ensiled potato hash (PHS).

Methodology: Three experimental diets containing either 200 or 400 g/kg potato hash silage (PHS) or no PHS (control) were formulated to provide 14 MJ DE/kg DM, 180 g CP/kg DM and 11.6 g lysine/kg DM. The diets were fed *ad-lib* to 36 weaned Large White x Landrace crossbred pigs (20±2.3 kg) that were individually housed for 56 days. Twelve pigs per treatments were allocated in a complete randomized design with six boars and six sows per treatment. The Agricultural Research Council Animal Ethics Committee approved the experiment (reference number: APIEC16/005).The effects of diet, gender and their interactions were analyzed using the PROC GLM of the SAS.

Results and Discussion: The control and 200 g PHS/kg had higher ($P<0.001$) final weights (67.5 kg and 66.7 kg respectively) and ADG (0.72 and 0.81 kg respectively) compared to pigs fed diet containing 400 g PHS/kg. However, the 200 g PHS/kg had a lower ($P<0.001$) ADFI (1.35 kg/d) compared to the control (1.75 kg/d) and 400 g PHS/kg (1.85 kg/d). Consequently, the lower feed intake of the 200 g PHS/kg resulted in the best FCR (2.08) compared to the control (2.37) and 400 g PHS/kg (2.59) treatments. An interaction ($P<0.05$) between diet x sex were recorded for ADG, ADFI and FCR in the growing pigs. The higher growth performance of pigs in the 200 g PHS/kg treatment differ from that of other studies, which reported lower growth performance when pigs were fed total ensiled mixed ration of potato hash and ensiled potato hash with or without inoculants compared to the control diet.

Conclusion/recommendations: It was concluded that diets containing a maximum of 200 g PHS/kg may be an alternative feed source for growing pigs as indicated by higher gain and lower intake compared to control.

Heterogeneity of variance for milk production traits between low and high input production systems of South African Holstein cattle

M.N. Tlabela[1,2]**, O. Tada**[2]**, B. Dube**[1]** & C.B. Banga**[1,3]

[1]ARC-Animal Production, Private Bag X2, Irene, 0062, South Africa, [2]Department of Agricultural Economics and Animal Production, University of Limpopo, Private Bag X1106, Sovenga, 0727, South Africa, [3]Department of Animal Sciences, Faculty of Science, Tshwane University of Technology, Private Bag X680, Pretoria, 0001, South Africa.
marcusnkete@gmail.com

Background The South African dairy industry is characterized by a dual production system, comprising of a high input commercial production system and low input smallholder and emerging dairy herds. Performance data from both systems are included in national genetic evaluations, with models that assume homogeneous variances. If variances are heterogeneous, above average animals in more variable herds will be favoured over high performing animals in the less variable herds . This may result in biased selection and inaccurate estimation of breeding values. With intensified selection, genetically inferior animals are chosen, thereby decreasing the realised genetic gain. Therefore, there is a need to investigate the exent of variance between the two dairy production systems in South Africa.

Aim: To investigate the possibility of heterogeneity of variances for milk production traits between the low and high input production systems in South African Holstein cattle.

Methodology: Milk Production data was obtained from the Integrated Registration and Genetic Information System of South Africa (INTERGIS). The high input production system data set consisted of 68 000 performance records from 741 herds recorded between 2006 and 2018. The pedigree file comprised of 38 126 daughters of 2 472 sires and 4 305 dams.The data set for the low input production system comprised of 32 388 records from 3 325 daughters of 134 sires and 253 dams from 59 herds recorded from 2006 to 2018. Preliminary analysis using the Proc GLM procedure of SAS (2012) was used to ascertain significant non-genetic factors affecting milk, fat and protein yields as well as mean milk, fat and protein analyses and their least square errors. The F_{max} procedure of SAS was used to test for heterogeneous variances.

Results and Discussion: Mean milk,fat and protein yields were 8123 KG $\pm$ 1269.67 SD, 310.65 KG $\pm$ 43.78 SD and 262.72 KG $\pm$ 24.53 SD for high input production system, respectively and 4127 KG $\pm$833.95,167.26 KG $\pm$ 28.88 SD and 136.41 KG $\pm$ 24.53 SD for low input production system.The averege mean, standard deviation and coefficient of variation increased with the production level, this could be attribute to general management and genetic superiority of animals. A significant ($P>0.0001$) heterogeneity of variance of milk, fat and protein existed between the two production systems. Heard-year-season, parity, age at calving affected milk production traits and contributed significantly to heterogeneity of variance ($P>0.05$).

Conclusion/recommendations: Heterogeneity of variance exists between the low and high input production systems in the South African dairy industry. Hence, this should be accounted for during cow and sire genetic evaluations. These results may optimise genetic evaluation models that may be useful in obtaining more accurate ranking of sires leading to improved genetic gain within the Holstein dairy cattle population of South Africa.

Antimicrobials in farmed animals: Usage and public health risks

B.A. Useni[1]

[1]Western Cape Department of Agriculture, Farmer Support and Development, Private bag X1, Elsenburg 7602, South Africa.
usenib@elsenburg.com

Background: Like in humans, advances in antimicrobial compounds (ACs) such as antibacterials, antifungals and antiprotozoals improved the health and welfare of farmed animals. This has been achieved through reduction and/or elimination of pain and suffering associated with bacterial, fungal and protozoal infections and/or diseases resulting in morbidity and death. This has resulted in an increasing rate of the use of ACs as part of routine management practices in animal production. Such an alarming rise of ACs causes public health risks since microbial resistances (MR, a global health threat) in humans and farmed animals are increasing and antimicrobial residues occur in farmed products.

Aim: This review discusses the usage of ACs in farmed animals and their consecutive public health risks.

Discussion: Essential ACs (during therapy) treat microbial infections and/or diseases routinely diagnosed in animals. Antimicrobials can also be used for prophylaxis to control the spread of a microbial infection and/or disease in a herd and to prevent a microbial infection and/or disease in healthy animals when exposure is imminent. Non-essential ACs such as growth promoters (e.g. beta-lactams, macrolides, coccidiostats and others) are used continuously over weeks or months of the animal's lifespan to increase the growth rate. In many parts of the world, lack of regulatory control in the distribution, sale and administration creates great concerns in disease management and food production. These transpire in easy access to ACs, under/over dosing, off label usage and misdiagnosis, lack of applying correct withdrawal periods respective to antimicrobial treatment. This antimicrobial imprudency in farmed animals contribute to the increased MR, poor response to antimicrobial therapy, increased environmental pollution through excretion of ACs in urines and faeces, and increased residues of ACs in the human food chain. Sustainable animal health consist of using subtracts and strategies that modulate gut health, boost the host immune system, and improved welfare, to generally prevent and control infection while enhancing growth. These can include: vaccination and immunotherapeutic treatments; improvements in biosecurity, sanitation and nutrition, addition of phytochemicals and the use of pro-, pre-, or synbiotics.

Conclusion/recommendations: The use of ACs in farmed animals showed benefits and inconvenients, with the later causing great health concerns. The acceptance of guidelines for the correct and prudent use of ACs by stakeholders in animal production should be a prerequisite step for sustainable health. Such step can achieve decrease and/or eradication of non-essential ACs, while judiciously using the essential ones where they are really needed.

Modelling the growth of seven commercial South African sheep breeds

D.A. van der Merwe[1], T.S. Brand[1,2] & L.C. Hoffman[1,3]

[1]Department of Animal Sciences, Stellenbosch University, Stellenbosch, South Africa, [2]Directorate: Animal Sciences, Western Cape Department of Agriculture, Elsenburg, South Africa, [3]Centre for Nutrition and Food Sciences, Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland, Health and Food Sciences Precinct, Coopers Plains, Australia.
tersb@elsenburg.com

Background: With the drive to intensify sheep finishing systems and the introduction of precision farming applications to aid farmers, it is essential to predict and interpret sheep growth trends. South Africa has a vast diversity of sheep breeds which vary in their production potential for meat or wool. Thus the growth rates and mature weights of the different breeds are expected to vary. Using mathematical models to describe the growth curves of the various breeds will allow producers to run simulations and so predict an ideal slaughter weight.

Aim: This study was conducted to determine and model the sigmoidal growth curves of seven South African sheep breeds used in commercial production systems.

Methodology: Ethical clearance for this study was obtained from the Western Cape Department of Agriculture (DECRA R14/110). Lambs from seven sheep breeds that are farmed in South African commercial sheep production systems were reared from birth until maturity and their growth monitored. The breeds included were Dohne Merino (DH), Dormer (DM), Dorper (DP), Meatmaster (MM), Merino (ME), South African Mutton Merino (SAMM) and White Dorper (WD). The lambs were reared under optimal growth conditions, receiving balanced creep feed and a feedlot diet postweaning *ad libitum*, so as to ensure uninhibited growth. A total of 9278 weights were recorded over the study period as animals were weighed on a weekly basis, from birth to one year of age, giving *ca* 48 consecutive recordings per animal. The Brody, Gompertz (GOM), Logistic (LOG) and Von Bertallanfy (VBF) models were fitted to the data and the respective model parameters were compared with sex and breed as main effects by two way ANOVA. The models were also tested for goodness of fit in describing the data.

Results and Discussion: The Brody model was found to overestimate the growth of all of the production groups. The LOG model was found to have the lowest root mean squared error, Akaike information criterion and the highest R-square value for each of the curves fitted, indicating that the LOG model best fit the data. However, the LOG model did overestimate early growth of the lambs. The GOM and VBF models were also deemed to be suitable in describing the growth of the various breeds. With each of the models, the SAMM and DM rams presented the highest mature weights (*A* parameter), while the DH and ME ewes attained the lowest mature weights. The Gompertz model showed that DH and ME ewes reach the point of inflection earlier than DM rams (105 days *vs* 142 days; $P < 0.05$), with other production groups not differing significantly. With the LOG curve, ME rams were found to have higher maturation rates than WD ewes (0.0179 and 0.0139 respectively, $P < 0.05$). The VBF curve also highlighted that the proportion of body weight to be gained after birth was highest in DM lambs (0.820), compared to WD ewes (0.637) ($P < 0.05$). It is expected that DM and SAMM lambs will present higher growth characteristics, as they have been bred for high growth rates and large carcasses at slaughter; while DH and ME breeds have been under greater selection pressure for wool production rather than for growth, when compared to other breeds.

Conclusion/recommendations: The growth curves of the production groups in this study can accurately be described using the LOG, GOM or VBF functions. However, the LOG model does overestimate body weights of the lambs between birth and 50 days of age.

The effect of varying canola oilcake meal dietary inclusion levels on the production traits and slaughter yields of ostriches (*Struthio camelus* var. *domesticus*)

J. van der Merwe[1], T.S. Brand[1,2], & L.C. Hoffman[1,3]

[1]Department of Animal Sciences, University of Stellenbosch, Private Bag X1, Matieland, 7602, South Africa, [2]Directorate: Animal Sciences, Department of Agriculture, Western Cape Government, Private Bag X1, Elsenburg, 7607, South Africa, [3]Centre for Nutrition and Food Sciences, Queensland Alliance for Agriculture and Food Innovation, University of Queensland, Australia.
tersb@elsenburg.com

Background: In order to reduce feeding costs in intensive ostrich production systems, it is important to identify and evaluate alternative, locally available raw materials that can be incorporated in the diets. It is also important to determine the level at which these raw materials can be included without negatively impacting production. Canola oilcake meal (COCM) is as a locally produced raw material which could potentially be used to replace expensive soybean oilcake meal (SOCM) as an alternative protein source in ostrich diets. COCM, however, contain some anti-nutritional constituents (high fibre, glucosinolates, sinapine, euricic acic) that may adversely affect production where fed at high inclusion levels.

Aim: To determine the effect of incrementally replacing SOCM with locally produced COCM in ostrich diets on the production levels and slaughter characteristics of birds.

Methodology: Ethical clearance was obtained from the Elsenburg departmental ethics committee (DECRA R14/108). After hatching, the South African Black ostrich chicks that were used for this trial were randomly assigned into five different treatment groups (0%, 25%, 50%, 75% and 100% SOCM replacement with COCM). Each of the five treatment groups had 3 replicates consisting of 15 chicks, resulting in 45 ostriches per treatment group for the starter, grower and finisher phases. Ostriches were reared from 77 to 337 days of age on the respective trial diets which were supplied *ad libitum*. The birds were monitored and weighed monthly during the entire growth period (starter, grower and finisher phases). Group feed intake was also measured monthly during this period. The birds were slaughtered at 337 days of age, where the yields of carcass components were determined. The mortality rate for this trial was 14.4%. Data was statistically analysed using one-way ANOVA and tested for significant differences between the different dietary treatments at the $P \leq 0.05$ level.

Results and Discussion: No differences ($P > 0.05$) were recorded between any of the experimental treatment in terms of live weight at the end of each growth phase, dry matter intake, average daily gain and feed conversion ratio over the different growth phases. With regards to the slaughter weight, differences ($P < 0.05$) between the treatments were observed with the lowest slaughtering weight for the birds reared on the diet with 100% replacement of SOCM (83.38 ± 2.00 kg). No differences ($P > 0.05$) between the experimental diets were observed for the fat pad weight, dressing percentage, weights of the thighs and weights of the big drum muscles.

Conclusion/recommendations: This study concluded that COCM can be regarded as a suitable alternative protein source which can replace up to 100% of SOCM (23% inclusion of COCM for the starter phase and 20% inclusion of COCM for the grower and finisher phases) in the diets of slaughter ostriches without adversely affecting production and slaughter yields.

Partial substitution of maize with soybean hulls in a concentrate supplement for grazing dairy cows

A. van der Vyver[1], R. Meeske[1,2] & C.W. Cruywagen[1]

[1]Stellenbosch University, Private Bag X1, Matieland, 7602, South Africa. [2]Western Cape Department of Agriculture, P.O. Box 249, George, 6530, South Africa.
anesmevdv@gmail.com

Background: In the southern Cape region of South Africa, dairy farmers make use of cultivated pasture as the main nutrient and feed source to produce milk. A commonly used pasture system in this region is kikuyu over-sown with ryegrass. Energy intake is the first limiting factor for milk production from pasture and therefor concentrates are fed to cows. Concentrates consist primarily of maize grain which is high in starch and may have a detrimental effect on rumen environment and fibre digestion. Including alternative feed ingredients with lower starch content and higher level of digestible fibre in concentrates may improve milk production and milk composition. Soybean hulls are a by-product of processing soybeans and could be considered as an alternative to maize. The soybean hulls are high in energy, crude protein and digestible fibre which make it a possible alternative to maize in dairy concentrates.

Aim: To determine the effect of partial substitution of maize in a dairy concentrate with soybean hulls, on milk production, milk composition, digestion of kikuyu-ryegrass pasture and rumen environment.

Methodology: Fifty-one lactating Jersey cows were blocked according to milk yield, days in milk (DIM) and lactation number for the production study. Cows used were 127±50.5 DIM. A complete randomised block design was used. Cows within each block were randomly allocated to one of the three treatments. Treatments were defined according to the level of soybean hulls included in the concentrate supplement: SH0, SH15 or SH30 containing 0%, 15% or 30% soybean hulls respectively. An additional nine ruminal cannulated cows were used for the rumen study in a 3 x 3 Latin square design, where all cows were subjected to all three treatments. Animals were treated according to standard operating procedures for the Outeniqua Research Herd with ethical clearance DECRA R12/74. Cows were randomly allocated to treatments. Concentrates were fed to cows at 6 kg/day (3 kg per milking session). After each milking session the cows grazed fresh kikuyu-ryegrass pasture as one group allocated at ± 13 kg dry matter (DM)/cow per day. The production study data (milk yield, milk composition, LW and BCS) was analysed using main effects analysis of variance (ANOVA). Rumen study data (pH, NH_3-N, VFA and *in sacco* Dacron bag study) were analysed similarly using a main effects ANOVA in a Latin Square design. The general Linear Model (GLM) procedure of Statistica (data analysis software system), Version 13 (TIBCO Software Inc., 2017) was used.

Results and Discussion: Milk yield, 4% fat corrected milk and energy corrected milk did not differ between treatments. Milk fat tended (P=0.06) to increase when 15% soybean hulls were included. Milk protein and lactose percentages increased (P<0.05) when soybean hulls were included (15 and 30%) in the concentrates. Rumen pH and acetate content did not differ among treatments. Rumen propionate and butyrate concentration was lower (P≤0.05) when 30% soybean hulls were included compared to the control. The ratio of acetate to propionate increased (P<0.05) when soybean hulls were included at 15 and 30% compared to the control. Rumen ammonia nitrogen increased (P<0.05) when 30% soybean hulls were included. The 30h *in sacco* DM disappearance in the rumen of kikuyu-ryegrass pasture and the *in sacco* neutral detergent fibre (NDF) disappearance increased significantly (P<0.05) when 15% soybean hulls were included, compared to 0% soybean hulls control treatment.

Conclusion/recommendations: Milk production was maintained when as much as 30% soybean hulls replaced maize in the concentrate. Replacing 15% of the maize tended to increase milk fat content and increased milk protein and lactose content significantly.

Reproduction performance of beef cattle before and after implementing a sustainable grazing system in a semi-arid grassland of southern Africa

H.C. van der Westhuizen[1], T.D. Mohlapo[1], J.D. de Klerk[1], S.E. Majola[1], H.A. Snyman[2] & F.W.C. Neser[2]

[1]Free State Department of Agriculture and Rural Development, Private Bag X01, Glen, 9360, South Africa, [2]Department of Animal, Wildlife and Grassland Sciences, University of the Free State, P.O. Box 339, Bloemfontein, South Africa.
mias@fs.agric.za

Background: The semi-arid grasslands of South Africa are a major resource for beef farming. However the reproduction performance of beef cattle is not optimal and it is stressed differently by the different agriculture sectors due to various management systems. Many studies have focused on issues such as breeding, selection, supplementary feeding and livestock management to increase livestock production. Efficient rangeland management, however, is seldom mentioned.

Aim: The aim of this study was to investigate the impact of sustainable rangeland management on reproduction of beef cattle and rangeland health.

Methodology: The research was conducted in semi-arid summer rainfall (annual average 556 mm) region of South Africa (26°20'E; 28°57'S) at the Glen experimental farm of the Free State Department Agriculture and Rural Development. The vegetation is classified as sweet grassland with *Themeda triandra* dominating when it is in an ecologically stable condition. Data on calving rate, weaning weight (205 days) and rangeland condition over a period of five years was sampled, beginning with no rangeland management in year one, comparing the results with the next four years after implementing sustainable rangeland management, utilizing the same herd of cattle. Analysis of variance (ANOVA) was used to compare calving rate and weaning weight data differences ($P<0.05$) between the five years. Species composition of the herbaceous layer was determined based on frequency of occurrence, using a fixed line transect (200 points per camp). The trends in rangeland condition was determined for every camp using the indicator specie technique, developed and tested against a degradation gradient technique specifically for this vegetation type.

Results and Discussion: Results showed a significant increase ($P<0.05$) in calving rate from the first year of rangeland management (+27%), with a 50% increase in year four. Weaning weight also increase significantly within the first year (+60 kg), with 72.8 kg in year four. Rangeland condition also started to improve in 31 of the 45 camps. The financial implication with respect to weaner calf income was also calculated with striking differences within the first year were it was ± two to three times higher and four times higher in year, four comparing with the income with no rangeland management.

Conclusion/recommendations: Results of this study prove that the implementation of sustainable rangeland management had a positive impact on rangeland health and reproduction of beef cattle and is therefore essential for sustainable livestock production while managing the ecological footprint. Results further indicated that the profitability of especially the communal and emerging sectors could be drastically increased, if efficient rangeland management practices can be implemented in these sectors.

Identification of genomic regions contributing to wet carcass syndrome in sheep

L. van der Westhuizen[1,2], M.D. MacNeil[1,2,3], M.M. Scholtz,[1,2] & F.W.C. Neser[2]
[1]ARC-Animal Production, Private Bag X2, 0062, Irene, South Africa, [2]Department of Animal, Wildlife and Grassland Sciences, UFS, P.O. Box 339, Bloemfontein, 9300, South Africa, [3]Delta G, 145 Ice Cave Road, MT 59301, Miles City, USA.
GScholtz@arc.agric.za

Background: Wet carcass syndrome (WCS) is a condition predominantly found in sheep which negatively affects the quality of carcasses. During the pre-slaughter period, the animal appears to be clinically normal, showing no symptoms of abnormality. However, post-slaughter and after removal of the hide, the carcass appears to be "wet" with a subcutaneous accumulation of watery fluid. Not all animals within a flock sent to slaughter at one time are afflicted and attempts to induce the condition experimentally have so far proved unsuccessful.

Aim: Therefore, the primary objective of this investigation was to scan the genomes of both afflicted- and unafflicted sheep in search of genomic regions of interest that may potentially harbour the genetic basis that predisposes sheep to WCS.

Methodology: Muscle samples from sheep carcasses (43 afflicted and 41 unafflicted) were collected from slaughterhouses in the Northern Cape Province of South Africa and Southern Namibia. Ethical approval was obtained from University of the Free State (UFS-HSD2017/1495). All DNA samples were genotyped, at the Agricultural Research Council - Biotechnology Platform, using the Ovine Infinium® HD SNP BeadChip (Illumina Inc., San Diego, CA, USA). The BeadChip features 685 734 SNPs that are approximately equally distributed throughout the domestic sheep (*Ovis aries*) genome. Tests against candidate genes implicated in pale soft and exudative pork proved uninformative as did runs of homozygosity. To further investigate the potential for an association between the phenotype (WCS) and an autosomal genetic marker, a case-control study design was implemented. Separate analyses for each sex were motivated by individual SNP on the X chromosome being suggestive of a QTL.

Results and Discussion: These analyses revealed significant associations between SNP and WCS in males, but not in females. However, X-inactivation significantly complicates association studies that involve the region of the X chromosome that is not pseudo-autosomal. The three SNPs reaching genome-wide significance in males are in strong linkage disequilibrium (LD) with the *DMD*, *HTR2C* and *TENM1* genes.

Conclusion/recommendations: Two of these genes, *HTR2C* and *DMD*, which are located in the region of the X chromosome that is not pseudo-autosomal with Y have been identified as positional and functional candidate genes for WCS in sheep.

Effect of ostrich age on egg production traits

J.P. van der Westhuyzen[1], T.S. Brand[1,2] & G.A. Tesselaar[1,3]
[1]Department of Animal Sciences, University of Stellenbosch, Private Bag X1, Matieland, 7602, South Africa,
[2]Directorate: Animal Sciences: Elsenburg, Department of Agriculture, Western Cape Government, Private Bag X1, [3]Packleader Pet Products, 19 Dipka Street, Stikland, Bellville, Elsenburg, 7607, South Africa.
tersb@elsenburg.com

Background: Studies described breeding ostriches as having a strict egg laying pattern, producing an egg every second day. Female breeding ostriches will produce a clutch of 20-24 eggs and rest for seven to ten days before starting again. Domesticated ostriches in South Africa can lay up to 80 eggs in a breeding season (from mid-May until mid-January), depending on management, genetic potential and nutrition. Thus with knowledge on the pattern of egg production and the factors affecting it, researchers will be able to construct a mathematical optimization model to ensure optimal nutrition for breeding ostriches during lay.

Aim: The aim of this study is to determine the effect of age of the female ostrich on her egg laying patterns as well as egg quality traits.

Methodology: Data collected for this study included the day to day egg laying and egg weight data of female breeding ostrich flock from the Oudtshoorn Research Farm during four breeding seasons (2004-2009). Ethical clearance was obtained (R1140). A total of 435 female ostriches between 2-8+ years of age and from three genotypes, South African Blacks (*Struthio camelus* var. *domesticus*), Zimbabwean Blue (*Struthio camelus australis*) and Kenyan Red Necks (*Struthio camelus massaicus*) and their crosses, produced 4500 eggs during the four breeding seasons of approximately 251 days each. Eggs were collected daily, weighed and identified by date and female of origin. The three egg components, (yolk, albumin and eggshell) were separated and weighed separately. The data was statistically analysed according to three age groups, i.e. 2 years of age (introduced to production system for first time), 3-7 years of age (peak production) and older than 8 years of age (production starts to decline). Statistical analysis of the data included the GLM procedure of SAS software (SAS, 2008).

Results and Discussion: Egg production in this trial followed a normal distribution. Egg production increased with the increase in daylight lenght, reaching a peak in September. A natural resting period follows in October; thereafter production starts again and reaches a peak in December. Between the three age groups results indicated that ostriches above eight years of age took the shortest time to produce their first egg (37.4±2.2 days), had the most days in lay (171.2±5.4 days) and produced the greatest number of eggs (88.2±3.1 eggs/female)($P<0.05$). Although this age group of females had the highest occurrence of dead in shell (DIS) eggs (17.9±3.1 %) and infertility rate (23.4±5.7%), they still produced the greatest number of ostrich chicks (51.8±1.8 chicks per female) during the breeding season. Conversely the young females took the longest time before producing their first egg (102.6±7.6 days), were in lay for the shortest time period (98.7±7.2 days), therefore producing the least number of eggs in a breeding season (40.0±3.6 eggs/female). For the egg quality parameters it was detected that the quantity of egg yolk produced ($P=0.001$) between the two year old females (286.5±10.8 g) and the older ostriches differed, where the older ostriches produced significantly larger yolks. Thus, also affecting the yolk: albumin ratio ($P=0.002$).

Conclusion/recommendations: Breeding ostrich females above 8 years of age produce more eggs and produce more regularly than younger ostriches. Higher occurrences of DIS chicks and infertility are however prevalent in this age category which could make older birds less favourable for breeding purposes.

Alternative random regression analyses as opposed to current fixed regression analyses for SA Holstein genetic evaluations under two production systems

M. van Niekerk[1,2], F.W.C. Neser[1] & V. Ducrocq[1,2]

[1]Department of Animal, Wildlife and Grassland Sciences, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa, [2]GABI, AgroParisTech, INRA, Université Paris-Saclay, 78350 Jouy-en-Josas, France.
michiel@ganna.co.za

Background: Fixed regression model (FRM) analyses that allow only fixed, non-genetic effects to vary over the lactation are currently used for genetic evaluation (GE) of production traits in South African Holstein (SAHST). With random regression models (RRM) the random animal and permanent environmental effects are allowed to also vary over the lactation. Hence, RRM can account for a persistency component, enabling selection for more persistent cows. Also, test-day (TD) records used for SAHST GE come from cows in diverse production environments and production system (PS) utilised (PAST or TMR), a choice often depending on local average rainfall where herds are situated.

Aim: Our objective was to estimate genetic parameters for milk (MP), butterfat (BP) and protein (PP) production (kg) as well as butterfat (B%) and protein (P%) content for herds utilising a PAST vs TMR PS comparing FRM and RRM analyses, which could be applied as an alternative GE for the SAHST breed.

Methodology: TD records from herds were divided into two datasets based on the PS utilised (PAST or TMR). Restricted maximum likelihood was used to analyse production for each of the first three lactations under different multitrait models. Goodness of fit was assessed using the Akaike Information Criterion (AIC) and mean square error (MSE). Various FRM were used, including the current FRM officially used for SAHST GE. Results of these various FRM were compared to the current SAHST model. Most fixed effects are clustered together and except for the calving season x calving age class effect, all are considered as constant. A final FRM that cumulates different curves over the lactation for different fixed effects was retained based on results in the PAST dataset. This FRM was also applied to the TMR dataset. The model was broadened to a RRM combining for each lactation an average production and a persistency effect, after which it was compared to the current SAHST model under both PS.

Results and Discussion: The RRM for both PAST and TMR had a better goodness of fit than the current SAHST model for all traits except P%. The MSE of RRM were lower for all traits. Generally, heritability estimates (h^2) using a RRM were higher than with a FRM at the beginning and the end of the lactation for most production traits in PAST while in TMR, h^2 from RRM were mostly higher during late-lactation. The h^2 from RRM for B% and P% in PAST and TMR were mostly lower up to approximately the middle of the lactation, but higher during the second half of the lactation. Overall, the h^2 in PAST were mostly higher than in TMR for all traits. Estimates of between-lactations genetic correlations from RRM were higher for MP, BP, PP and P% while being more similar for B% in both PAST and TMR. Genetic correlations for TMR from RRM were negative and stronger than for PAST.

Conclusion/recommendations: The extra source of information from RRM enables a genetic prediction of persistency and is expected to increase accuracy of genetic predictions. Genetic parameters were substantially different between the two production systems, denoting a strong genotype x environment interaction.

Egg laying patterns of the female breeding ostrich

W. van Rensburg[1], T.S. Brand[1,2] & T.R. Olivier[1,3]

[1]Department of Animal Sciences, University of Stellenbosch, Private Bag X1, Matieland, 7602, South Africa,
[2]Directorate: Animal Sciences, Department of Agriculture, Western Cape Government, Private Bag X1, Elsenburg, 7607, South Africa, [3]Wisium, Pineslopes Office Park, Fourways, 2191, South Africa.
TersB@elsenburg.com

Background: During sequential egg laying, female breeding ostriches typically produce an egg every second day. To maximize the productivity of breeders, all nutrient requirements must be adequate, as nutrition and body condition has been known to influence the egg-laying capabilities of laying hens. Egg production of breeding ostriches is highly variable and reasons for low egg production are still not fully understood. The limitation of feed intake to prevent obesity is a common practice in broiler breeders in order to increase the rate of lay.

Aim: This study was conducted to establish the egg laying patterns and frequency of the female breeding ostrich at different nutritional levels.

Methodology: Three trials (ethical clearance number: R1140) were performed in three consecutive years to determine the egg-laying pattern of breeding female ostriches, as well as to the effect of nutrition on the frequency of egg laying. The trials were performed at the Oudtshoorn research farm where male and female breeding pairs were kept in individual camps. Trial 1 was carried out to determine the effect of the level of dietary protein supplied to the ostriches on certain production parameters. In this study separate diets with protein levels (with accompanied amino acids profiles) of 75, 91, 108, 123 and 140 g CP/kg DM were fed to birds at an allocation of 2.5 kg/bird/day. In trials 2 and 3, different metabolisable energy (ME) levels were given to the birds, namely, 7.5, 8.0, 8.5, 9.0, 9.5, 10.0 MJ ME/kg feed and 8.0, 8.7, 9.4, 10.1, 10.8, 11.5 MJ ME/kg feed respectively. During trial 2 feed was supplied at 3.4 kg/bird/day, while in trial 3, feed was provided *ad libitum* to the birds. The breeding season extended from June to January (trial 1), June to January (trial 2) and June to November (trial 3) for three breeding seasons (2004-2006). Eggs were collected and recorded on a daily basis.

Results and Discussion: In each of the three trials, the level of nutrition did not affect (P<0.05) the egg laying patterns (eggs/week) or the frequency of egg laying (eggs/female/month) of female breeding ostriches. Egg laying patterns showed that for trial 1, 2 and 3 the birds laid on average 1.1±0.2, 1.4±0.2, 1.6±0.2 eggs/week respectively. Egg laying frequency averaged around 5.0±0.2 (8 month breeding period), 5.6±0.9 (8 month breeding period) and 6.2±0.8 eggs/month (6 month breeding period) in the three respective trials.

Conclusion/recommendations: Egg production in female breeding ostriches was highly erratic and was not influenced by different dietary protein or metabolisable energy levels supplied during these studies (both in the restricted and the *ad-libitum* feeding regime). The condition of the birds at the start of the breeding period may probably play a major role in the results obtained. Another factor that may affect egg production could be linked to management practices, such as breeding in pairs or in flocks.

Evaluation of methods to determine maize quality and hardness (vitreousness)

J.H.C. van Zyl[1] & C.W. Cruywagen[1]

Department of Animal Science, University of Stellenbosch, Private bag X1, Matieland, Stellenbosch, 7602.
brinkvz@sun.ac.za

Background: Maize (*Zea mays* L.) is the most important non-forage carbohydrate source in high yielding dairy cow diets. Both ruminal and total tract starch digestibility of ruminant animals are significantly impaired by high vitreous maize, compared to moderate floury or dent maize. Underlying genetic code, environmental conditions of cultivation and stage of maturity collectively affect vitreousness of maize. Various methods, including particle sieve (106 µm) index (PSI), near-infrared spectroscopy (NIR), rapid visco analyser (RVA) and x-ray micro-computed tomography (XCT), are currently exploited to determine maize hardness.

Aim: The aim of this study was to evaluate NIR technology and compare it with other methods of maize hardness determination in order to establish NIR as a useful and rapid method to determine maize hardness in the ruminant feed industry.

Methodology: Ninety maize samples, mainly from South Africa, but also including a few from Argentina and Ukraine, were collected to obtain a diverse set in terms of vitreousness. Vitreousness of all 90 samples was determined in Trial 1 by PSI, using a single 106 µm screen, and NIR at a single absorbance of 2230 nm. Trial 1 data were analyzed with a one-way ANOVA. Homogeneity of variance was tested with Levene's test. Vitriousness in relation to origin, colour (yellow vs white) and cultivation method (irrigated vs. dry land) were also determined. Based on the results of Trial 1, 10 hard and 10 soft samples were selected for Trial 2. These samples were used to evaluate the accurateness of maize hardness determination by means of three techniques, namely PSI, NIR and RVA. The XCT analysis was used as a reference. Data were again analysed with a one-way ANOVA. In Trial 2, Pearson (r) correlations and correlation coefficients (r^2) were used to explain variation. Spearman's rank correlation coefficients were further used to test the strength of the relationships between pairs. As the maize hardness measurement data collected in Trial 2 were not of the same units, data were subsequently sorted and ranked to perform Intraclass Correlation Agreement and Consistency (ICC) as well as Bland and Altman analyses in order to assess agreement between the methods of measurement. Significance was declared at $P \leq 0.05$ and tendencies at $P \leq 0.10$.

Results and Discussion: Maize colour and cultivation did not affect hardness. Climatic conditions of origin showed significant differences between humid subtropical and cold semi-arid production areas. In Trial 1, results indicated a significant relationship ($r^2 = 0.7437$; $P \leq 0.01$) between PSI (106 µm sieve) and NIR (absorbance at 2230 nm). Accurate vitreousness determination by both methods was established using specific intra-lab analysis. In Trial 2, it was concluded that all the methods (PSI, RVA, NIR and XCT) could be equally effective to determine maize vitreousness. While PSI and NIR are both practical, accurate, rapid and cost effective methods to determine maize vitreousness in the animal feed industry, neither XCT, RVA peak time nor RVA peak viscosity satisfied all requirements.

Conclusion/recommendations: As NIR technology is already available and exploited within the animal feed industry, it was concluded that NIR at a single absorbance of 2230 nm meets all the requirements of the animal feed industry to determine maize vitreousness.

Performance and bone integrity of broilers receiving feeds that contain calcium at lower levels than current recommendations

J.C. Venter[1], C. Jansen van Rensburg[1] & F. Crots[2]

[1]Department of Animal Sciences, Faculty of Natural and Agricultural Sciences, University of Pretoria, Private Bag X20, Hatfield, Pretoria, 0028, South Africa, [2]AFGRI Animal Feeds, 12 Byls Bridge Boulevard, Centurion, 0157.
jc.venter@afgrifeeds.co.za

Background: Various calcium inclusion levels have been tested in broiler diets to improve broiler performance without compromising leg integrity. Many studies have proved that dietary calcium inclusion levels below current recommendations improve average daily gain and feed conversion ratio. However, literature on the effect of lower calcium inclusion levels on bone ash percentage and bone breaking strength are inconsistent.

Aim: This study was conducted to determine calcium inclusion levels for improved broiler growth without compromising bone properties at slaughter.

Methodology: The trial was conducted in accordance with ethical guidelines followed by AFGRI Animal Feeds as set out by the South African National Standard for the care and use of animals for scientific purposes (SANS 10386; 2008). Eight diets were formulated in which the calcium inclusion levels were decreased below the current calcium inclusion levels recommended by Aviagen for Ross broilers. The control diet had calcium and phosphorus levels recommended by Aviagen for Ross broilers. The calcium to available phosphate ratio ranged from 1.54 to 2.50. Calcium inclusion levels from 0.70% to 0.95% of current recommendation was tested with three phosphorus levels. Treatments were as follows: Treatments 1-3 = Calcium inclusion levels of 0.80-0.90% with a phosphorus inclusion level recommended by Aviagen for Ross broilers; Treatments 5-7 = Calcium inclusion levels of 0.80-0.95% with a phosphorus inclusion level below the Aviagen for Ross broilers recommendation; Treatment 8 = Calcium inclusion level of 0.70% at a phosphorus inclusion level of 0.45% and a calcium to phosphate ratio of 1.54. Sixty Ross 308 chicks were placed per pen in 64 pens (n=3840) at 20/birds m^2 and were randomly allocated to eight dietary treatments (n=8 replicates/treatment). Birds received a starter, grower and finisher phase feeding regime and were slaughtered at 35 days of age. Feed intake and body weight of birds were determined on a weekly basis to calculate performance parameters. At 14 days of age, 32 birds/treatment was euthanised and the right legs removed for tibia ash determination. At 35 days of age, another 32 birds/treatment were euthanised and both legs were removed for tibia ash and bone breaking strength determination. Data were statistically analysed (P <0.05) as a randomised block design with the GLM model.

Results and Discussion: Dietary treatments had an effect (P <0.05) on cumulative feed intake (FI), cumulative feed conversion ratio (FCR), performance efficiency factor (PEF), bone breaking strength and bone ash at 14 and 35 days of age. A dietary Ca: P ratio of 1.80 had the highest (P <0.05) PEF (407.20) and also the highest (P <0.05) bone breaking strength (0.218kN). In contrast, the lowest (P <0.05) PEF was recorded for the dietary treatment with a Ca: P ratio of 2.30. The treatment with the lowest (P <0.05) bone breaking strength and bone ash percentage at 35 days of age was the treatment with a Ca: P ratio of 1.54.

Conclusion/recommendations: Results of the current study suggest that the calcium inclusion level should be decreased below current recommendations to enhance broiler performance. The broilers from treatments with higher calcium inclusion levels had higher bone ash percentage and bone breaking strength.

The *in vitro* analysis of acid binding capacity of South African feed ingredients for broiler chickens and possible effects on performance

K.M. Venter[1], T.T. Nkukwana[1], S.S.M. Nkabinde[1] & P.W. Plumstead[2]

[1]Department of Animal and Wildlife Sciences, University of Pretoria, Pretoria 0002, South Africa,
[2]Chemunique International (PTY) Ltd, Randburg, 2194, South Africa.
kyle@chemunique.co.za

Background: The Buffering capacity (BUF) of feed has previously been shown to potentially affect the life performance of pigs and chickens. The acid binding capacity (ABC) is measured as the amount of acid required to drop the pH of 1 kg feed to pH 3 and pH 4. Each feed ingredient will therefore contribute the ABC value of complete feed and has the potential to alter stomach pH by buffering the HCl secreted. Protein digestion begins with pepsin, which is secreted as the enzyme precursor pepsinogen that requires a low gastric pH to be activated. The pepsin enzyme has been shown to have an optimum pH of 2. Therefore, feed ingredients or diets that raise the pH above a critical threshold have the potential to reduce protein digestibility. This can have a greater effect in young birds due to their reduced ability to regulate their pH levels with reduced affinity for HCl secretion. The inability to adequately digest protein can lead to reduced performance and an impaired gut health due to greater amounts of undigested protein being made available to microbes in the hindgut.

Aim: The aim of this study is to create a survey of all commonly used feed ingredients, in South Africa for the pH and ABC values.

Methodology: Multiple duplicate samples of the 38 main feed ingredients used in South Africa, were acquired from feed mills throughout South Africa. The samples were passed through a 2 mm screen at the beginning of the trial in order to ensure a standard particle size. Two *in-vitro* experiments were conducted, namely the initial pH of each feed ingredient and it's ABC. The initial pH of the feed ingredient was determined by placing 10 g of sample in a beaker with deionized water. The pH was then measured at times of 2 minutes and 30 minutes, with a correctly calibrated pH meter. To determine the ABC of the feed ingredients, 1 g of each feed ingredient was placed into a beaker with 100 ml. of deionized water sitting in a water bath set to 42 °C. The beaker was then transferred to a hotplate magnetic stirrer and titrated with 0.1N HCl till the solution reached pH 3 and pH 4 using a calibrated pH meter. ABC was calculated as the amount of acid in milliequivalents (meq) to lower the pH of 1 kg of sample to the desired pH. The BUF was calculated by dividing the ABC by the total change in pH. The statistical analysis was run using ANOVA.

Results and Discussion: The pH value of cereal grains ranged between pH 6.5 and pH 7. Of the protein sources evaluated maize gluten (3.925) had the lowest and soybean meal (6.55) the highest pH. As expected, the ABC values for protein sources were higher ($P<0.05$) compared to the cereals that had a lower ABC value. The ABC-4 of vitamin and mineral premixes along with calcium sources such as limestone ranged between 5000 and 18 250 and were significantly higher.

Conclusion/recommendations: The values obtained from this experiment can be used by nutritionists to include an ABC value of different feed ingredients in diet formulation. Consideration of the ABC and BUF of the diet is expected to support digestive function of young broilers that may not yet have a fully developed capacity to secrete adequate amounts of HCl. Our future objective in this study will be to determine the effects of varying dietary ABC on the life performance of broilers during various phases of production.

Challenges facing farmers during silage production while striving to produce Precision-Silage®

R. Venter[1] & R. Meeske[2]

[1]AGSCI (Pty) Ltd Silage consulting, Postnet Suite no.16, Private Bag X132, Centurion, 0046, South Africa, [2]Western Cape Department of Agriculture, Outeniqua Research Farm, P.O.Box 249, George, 6530, South Africa.

richardt@agsci.co.za

Background: Silage has been produced in the world for centuries and some individual farmers today has personally been involved in silage production for decades. The on-farm challenges during silage production and feed-out has however increased significantly due to larger volumes produced and higher harvesting rates on ever-expanding and modern farms. This presentation explores some practical aspects encountered on farm, that has largely underestimated effects on quality and losses.

Aim: This summary serves as a review of some published data highlighting the quantum of silage losses and impact on quality due to challenges in silage production and management processes.

Methodology: Through consulting on silage production efficiencies, I encounter these types of challenges daily on South African farms and abroad. The data report here are extracts from a presentation as presented at the Wilmar Large Herds Conference in March 2019, in Tianjin, China.

Results and Discussion: The reality and quantum of silage losses, which is largely underestimated, is explored. Unfortunately, in the process of silage production, zero losses are not possible; but we should rather manage the losses during the process. Major challenges in delayed ensiling exist. Ever expanding farms produces increasing amounts of silage, but this puts pressure on the system to get the silage preserved in an anaerobic state quickly and efficiently. If not managed, delayed ensiling can again lead to large losses. The effect of contamination of silage is further explored, through the (again: underestimated) losses that is created. Secondary fermentation due to spoilage microorganisms, and aerobic instability after exposure to oxygen also has major effects on silage losses and puts pressure on management of the system.

Conclusion/recommendations: Silage is a losing process. However, through management inputs a lot of the losses that occur along the process of silage production can be reduced, if not eliminated. Awareness of these challenges is the start to improvement.

Performance of Boran cattle under feedlot conditions

Y. Venter[1], A. Engelbrecht[2], & H.E. Theron[3]

[1]Boran Cattle Breeders' Society, PO Box 506, Bloemfontein 9300, South Africa, [2]University of the Free State, PO Box 339, Bloemfontein 9300, South Africa, [3]South African Stud Book and Animal Improvement Association, PO Box 270, Bloemfontein 9300, South Africa.
Yolandav@stemma.co.za; arnebert13@gmail.com

Background: The Boran is regarded as an early maturing, medium frame breed. Feedlots categorize animals in early, medium or late maturing breeds, while they prefer later maturing breeds. Feedlots prefer beef breeds that have the potential to economically produce a final carcass of 450 – 470 kg after a 120-day feeding period. Long weaner calves could be used to more efficiently gain muscle mass in a feedlot.

Aim: To determine the performance of long weaner Boran cattle under feedlot conditions.

Methodology: The standard feedlot practice was followed where a humane environment was established for the handling and production of beef in intensive feeding systems**.** 32 Boran bulls which were on average 22±3.3 months old were entered in a feedlot, directly from the veld. Bulls were fed a high roughage ration with no added supplements for a period of 132 days. The bulls were tested for average daily gain (ADG) and carcass traits. No mortalities or morbidities were recorded and no animals were treated for health problems whilst in the feedlot.

Results and Discussion: The initial average weight of the group upon entering the feedlot was 289.17 kg and they were slaughtered at an average weight of 522.34 kg. The average daily gain (ADG) for this period was 1.77kg for the group and the dry matter feed conversion ratio (FCR) was 5.55 kg dry matter per kg weight gained. The group average dressing % (cold slaughter weight) was 55.45%. In this group 50% of the animals slaughtered achieved A-grade, 44% AB-grading and 6% B-grades. Half of the group scored a fat grading of 2 (lean), 41% scored a grading of 3 (medium), 0% of the group scored a grading of 4 (fat), 0% scored 5 (slightly overfat) and 9% scored a fat grading of 6 (excessively overfat). These animals were relatively older and the expected outcome would be that the majority of the group's carcass grading would be B or C grades, based on the age and stage of teeth development. Although the number of animals in this trail was limited, the majority of the group achieved a carcass grading of A. Although the group was slaughter ready at 100 days in the feedlot, the trial was extended for another 33 days for the purpose of further data collection. As it is normal for older animals to convert feed less efficiently into weight gain, older animals will deposit fat faster than muscle. This is a less efficient feeding process, because it requires far more feed to deposit fat versus muscle. It is expected that long-weaner cattle would grow with low efficiency and deposit high levels of fat. However, in this trail carcasses had relatively high carcass yield percentages, with an average of 55.45% of live weight. Post slaughter analysis also revealed that organ fat was within acceptable ranges. Results showed that 91% of the bulls had fat levels between lean and medium, with only 9% of the test subjects being moderately fat to overfat.

Conclusion/recommendations: Older Boran animals slaughtered from the feedlot produced promising results, although numbers were limited. They maintained acceptable fat grading with only 9% of animals having graded at levels which were considered as overfat. This study indicates that long weaner Boran cattle may have the ability to gain sufficiently and efficiently and do not tend to gain excessive fat under feedlot conditions.

Increasing hatchability of stored eggs varying in egg size using short periods of incubation

J.J. Viljoen[1], <u>G.C. Josling</u>[1], M.D. Fair[1] & F.H. de Witt[1]
[1]Department of Animal, Wildlife and Grassland Sciences, P.O. Box 339, University of the Free State, Bloemfontein, 9300, South Africa.
buitendachgc@ufs.ac.za

Background: Hatcheries synchronize the logistical flow of eggs by means of pre-incubation storage. It is widely known that a storage period of longer than seven days has a negative impact on hatchability. However, short periods of incubation during egg storage (SPIDES) have shown to improve hatchability – even at storage periods of more than seven days. The relationship between SPIDES and egg size has not been studied in full detail and warrants further investigation.

Aim: To determine the effects of SPIDES and egg size on subsequent hatchability of commercial broiler chicks.

Methodology: A total of 720 eggs were collected from Arbor Acre breeder hens on the day of oviposition (D0). Eggs were randomly divided into four treatments (n=180/treatment) according to pre-incubation storage handling, SPIDES and non-SPIDES (NSP); and egg size, medium (MED=48±2g) and extra-large (XL=63±2g). The four experimental treatments consisted of: (i) SPIDES-MED, (ii) SPIDES-XL, (iii) NSP-MED, and (iv) NSP-XL. All treatments were subjected to identical pre-incubational (D0-D21) cool (14±2°C) storage conditions as well as the incubation period (D21-D44). During the pre-incubation storage period, SPIDES eggs received four heat (37.5 °C) treatments (D4, D9, D13, D18) of four hours each, while NSP eggs were left untreated. After the cool storage period all four treatments were incubated for a period of 21 days - allowing a forty-eight hour window for hatching. All eggs were weighed at D0 and D21 pre-incubational to calculate the percentage weight loss during cool storage. The number of eggs hatched was recorded and unhatched eggs were opened and classified as either infertile or embryonic mortalities (early or late). Data were arranged in a 2 × 2 factorial design. Hatchability, fertility and mortality data were analyzed ($P<0.05$) using a using chi-squared tests, while egg weight loss data were analyzed using the general linear models procedure of SAS (2012).

Results and Discussion: Egg weight loss expressed as a percentage (%) during cool storage was higher ($P<0.01$) in the SPIDES (3.85%) compared to the NSP (3.32%) treatment, while MED eggs (3.93%) lost more weight than XL eggs (3.25%) – irrespective of SPIDES treatment. Overall egg fertility was high (>96%), but high mortality rates were recorded. Medium eggs had a higher ($P<0.01$) early embryonic mortality rate than XL eggs regardless of SPIDES/NSP, whereas XL eggs demonstrated a higher ($P<0.01$) late embryonic mortality rate. No interaction was recorded between the SPIDES and egg size for egg weight loss (pre-incubational) or embryonic mortality. Hatchability was not affected by SPIDES or egg size individually, but a significant combined effect was recorded. SPIDES-MED (50%) and NSP-XL (47%) had higher ($P<0.01$) hatchability than SPIDES-XL (26%) and NSP-med (29%). SPIDES increased the moisture loss of stored eggs but did not affect hatchability. Xtra-large eggs lost less moisture during cold storage and resulted in lower early embryonic deaths, but higher late embryonic deaths. The SPIDES technique alleviated the damaging effects of storage-induced cell death on embryo development of medium sized eggs, but was more detrimental to XL eggs than a NSP treatment.

Conclusion/recommendations: Results indicate that an interaction between SPIDES and egg size affects hatchability, suggesting that eggs varying in size might require different pre-incubational cool storage protocols in hatcheries.

The Mamre Model for sustainable sheep production

K. Wessels
Mamre farming, Vrede, Free State, South Africa.
kwessels@vodamail.co.za

Background: Sheep numbers in the world have dwindled to a dramatic low over the last three decades. This is mainly dew to the following three factors, namely; predation, theft and the vulnerability of the sheep in an extensive breeding environment.
The need for lamb and mutton is still high, and the crisis in the pig and chicken industries creates a market for sheep production.

Discussion: Dramatic changes have been taking place over the last few years in the sheep industry. The sheep industry is changing from extensive production system to semi-intensive and intensive production systems. These changes are driven by Technology in the sheep industry and leads to acceleration of lambing intervals and increased lamb production. The changes in the sheep industry are creating pressure on the sheep management proses and require a new outlook on sheep management. The challenge is to evaluate existing feeding regimes as well as breeds for increase production to overcome the changes in the sheep industry. Health management will have to change from a reactive antibiotic system to a Wellness approach.

Conclusion: There is a worldwide movement to use sheep production for poverty alleviation and job creation. The world is focusing on sheep production to play a substantial role towards food security.

In search of the *Rhipicephalus* (*Boophilus*) *microplus* in the western-central regions of the Eastern Cape Province, South Africa

M. Yawa[1], N. Nyangiwe[2], V. Muchenje[1], T.C. Mpendulo[1], C.T. Kadzere[2] & M.C. Marufu[3]

[1]Department of Livestock and Pasture Science, Faculty of Science and Agriculture, University of Fort Hare, Alice, 5700, South Africa, [2]Dohne Agricultural Development Institute, Stutterheim, 4930, South Africa, [3]Faculty of Veterinary Sciences, University of Pretoria, Onderstepoort 0110.
nyangiwe1@gmail.com

Background: The southern cattle tick, *Rhipicephalus* (*Boophilus*) *microplus*, is an economically important tick that parasitizes cattle and is found on other host species if they graze with cattle. The *R.* (*B.*) *microplus* is a highly adapted tick species prevalent in tropical and subtropical regions of the world. About 80% of the cattle population globally are subjected to tick infestation, resulting in low production and the transmission of tick-borne diseases.

Aim: The study aimed to determine the extent of *R.* (*B.*) *microplus* under different ecological zones in the western-central regions of Eastern Cape Province of South Africa.

Methodology: A total of 360 cattle were used to collect ticks from all different agro-ecological zones. At each locality, 10 animals were randomly selected monthly and ticks were collected while the cattle are restrained in a crush pen. Both engorged and free-living ticks were collected monthly across different seasons from April 2016 until March 2017. Ticks were collected mainly from one side of the animal and attention was paid to the predilection sites of blue ticks such as the ears, neck and dewlap, abdomen, feet, tail and perianal region of each animal were carefully examined. As the survey was aimed at determining the extent of *R.* (*B.*) *microplus* ticks and not their intensity of infestation, none of the collections that were made from cattle was intended to be complete. The ticks from each animal were preserved in separate labelled vials containing 70% ethanol, and subsequently counted and identified to genus and species level using a standard stereomicroscope. At each site, six replicate drags of 100 m, approximately 50 m apart, were performed. All instars of ticks were identified at the University of Fort Hare, Animal Science laboratory and those that could not be identified were confirmed at Dohne Research Institute.

Results and Discussion: Of the total 10975 ticks collected, 8090 ticks were collected from cattle while 2885 were free-living ticks from the vegetation. The ticks collected belong to 5 different genera, namely *Ambylomma*, *Haemaphysalis*, *Hyalomma*, *Ixodes* and *Rhipicephalus* including the subgenus *Boophilus*. From the vegetation, *R.* (*B.*) *decoloratus* was the most abundant species with a relative prevalence of 58.16%, followed by *R. appendiculatus* (18.37%) and *R. evertsi evertsi* (16.90%). Least abundant ticks were *Hyalomma rufipes* (2.98%), *Amblyomma hebraeum* (2.46%), *Haemaphysalis elliptica* (0.38%), *R. follis* (0.34%), *Ixodes pilosus* (0.24%) and *R. simus* (0.17%). Apart from larvae and adult ticks collected, 338 nymphs of *R. appendiculatus* were collected from the vegetation. Agro-ecological zones showed significant differences ($P<0.05$) in tick distribution. Significantly more engorged *R.* (*B*) *decoloratus* were collected in Thicket vegetation during the summer season and free-living ticks during the spring season. These findings concur with other studies showing a high prevalence of *R.* (*B.*) *decoloratus* adult ticks during the summer season. Warm-humid environment plays a key role in higher tick loads in cattle. However, it is of interest to note the absence of *R.* (*B.*) *microplus*, whose trend to invade new areas previously colonised by *R.* (*B.*) *decoloratus* has been demonstrated by various authors.

Conclusion/recommendation: The results of this survey indicate that *R.* (*B.*) *decoloratus* is widespread throughout the study areas. Therefore ecological preferences of ticks need to be considered when developing effective control strategies against ticks. Although *R.* (*B.*) *microplus* was not found in this study, therefore it could be key to investigate factors that promote its absence in the study area.