Declawing ostrich (*Struthio camelus domesticus*) chicks to minimize skin damage during rearing

A. Meyer[1,3,#], S.W.P. Cloete[2] C.R. Brown[3,*] and S.J. van Schalkwyk[1]
[1]Klein Karoo Agricultural Development Centre, P.O. Box 351, Oudtshoorn 6620, South Africa
[2]Elsenburg Agricultural Development Centre, Private Bag X1, Elsenburg 7607, South Africa
[3]School of Animal, Plant & Environmental Sciences, University of the Witwatersrand, Private Bag 3, Wits 2050, South Africa

Abstract

Leather is one of the main products derived from ostrich farming. Current rearing practices lead to a high incidence of skin damage, which decreases the value of ostrich skins. In the emu and poultry industry, declawing is commonly practiced to reduce skin damage and injuries. We consequently investigated declawing of ostrich chicks as a potential management practice to minimize skin lesions that result from claw injuries. A group of 140 day-old ostriches was declawed and a second group of 138 chicks served as the control. The two groups were reared separately to slaughter, but were rotated monthly between adjacent feedlot paddocks to minimize possible paddock effects. Overall, the declawed group had fewer scratch and kick marks on the final processed skin than the control group, which resulted in the proportion of first grade skins in the declawed group being more than twice that of the control group. Behavioural observations at nine and 13 months of age indicated that declawing resulted in no impairment in locomotive ability or welfare. There was a tendency for the declawed group to have higher average live weights towards the end of the growing-out phase that resulted in a 3.7% higher average skin area at slaughter than in the control group. Survival to slaughter was independent of the treatment group, but absolute means favoured the control group. It was concluded that declawing does not compromise the wellbeing of ostriches and has a significant benefit in terms of the quality and the grading of the skin, with important economic implications for ostrich farmers.

Keywords: Ostrich, declawing, leather, skin damage, behaviour
[#] Corresponding author. E-mail: anelm@wcape.agric.za
*Present address: Hartpury College, Hartpury, Gloucestershire, GL19 3BE, England

Introduction

Ostrich farming has been practiced for over a century in South Africa. The main products currently derived from commercial ostrich farming are meat and leather. Of these, ostrich leather contributes up to 60% of the total income generated from a slaughter ostrich. Producers are under increasing pressure to deliver better quality skins in order to be profitable, due to fluctuating supply and demand, increasingly stricter skin grading, variation in skin size, and inconsistent leather prices. A high prevalence of scratch and kick marks has been identified as the main reasons for skins receiving poor grading (W.A.G. Goussard, 2000, personal communication). The formidable claw of the main toe and the powerful kicking action of the ostrich lead to the assumption that skin lesions arise from aggressive interactions between birds. Claw-related skin injuries may also result from their sharp claws when young ostrich chicks that huddle together when cold, often climbing on top of each other; and during handling, when ostriches are stressed and tend to run over each other. Skin damage, and specifically lesions inflicted by the claws, is, therefore, thought to be associated with the normal behavioural patterns that ostriches exhibit. Such injuries are persistent to slaughter age (Meyer *et al*., 2002b) and affect the final quality of the skin. Limiting skin damage without compromising the natural behaviour and welfare of ostriches can thus be considered a major objective for the industry. Scientific research to address this issue is lacking. A survey was conducted to investigate the influence of current management practices on the quality and grading of ostrich skins, but failed to identify any specific management practice or factor that guaranteed the production of better quality skins (Nel *et al*., 2000). Alternative management practices that will ensure better skin grading, therefore, need to be investigated. Declawing of ostrich chicks may be a feasible option to minimize the incidence of claw injuries.

The practice of declawing farmed ratites began around 1994 in Australia with emus (Minnaar, 1998). Today it is commonly practiced in the emu industry both to alleviate skin damage during aggressive encounters and to reduce the risk of injury to handlers (Glatz, 2001). Results include a marked improvement in emu skin quality, with an estimated saving to farmers of about five million Australian dollars (Lunan &

Glatz, 2000). No feasible alternative to declawing has yet been found and declawing apparently did not compromise the wellbeing of the emus (Lunam & Glatz, 2000). Despite this, the possibility remains that declawing of ostriches could result in chronic pain, loss of locomotive ability and mortality of the birds. In Australia, declawing of ostriches has recently been attempted and preliminary results indicate that the welfare of the ostriches was not compromised (P.C. Glatz, 2002, personal communication). Against this background, we investigated the effects of declawing ostriches to assess the potential of the practice for improving ostrich skin quality in the local industry.

Material and Methods

Experimental birds used in the study were African black ostriches (*Struthio camelus domesticus*) from the commercial flock maintained at the Klein Karoo Agricultural Development Centre near Oudtshoorn, South Africa. Management practices for rearing chicks and juveniles as described by Bunter & Graser (2000) were implemented, with minor changes as necessitated by the experimental design. The trial was carried out from February 2001 to March 2002.

Two batches of ostrich chicks (hatched in two successive weeks) were used. Each batch was randomly divided into two, and one half of each batch was subsequently declawed one day after hatching. In total 140 chicks were declawed over a period of two weeks (65 and 75, respectively). The untreated control group consisted of 138 (64 and 74, respectively). The clawed control group and the declawed group were reared separately to slaughter at 14 months of age, but were otherwise subjected to similar management practices throughout. To minimize possible paddock effects, the treatment groups were rotated through the same set of adjacent paddocks on a monthly basis. Live weights were also recorded monthly.

To permanently remove the toenails, the clawed toe was partially amputated by removing the distal phalangeal joint. A manual method, similar to that described by Minnaar (1998), was used. A scalpel, sterilized with methylated spirits and flame-heated, was used to make a slanted cut from underneath the toenails upward to remove the growth point and toenail, whilst keeping the footpad intact. The wound was then cauterised by touching the toe to a heated soldering bit for about three seconds. As an additional precaution, Stockholm's tar was applied to the wound, for both its antiseptic qualities, and the prevention of toe pecking (Deeming *et al*. 1996). The declawed chicks were moved to a clean surface (iron grids on cement flooring) directly after the procedure. Due to limited facilities, it was not possible to use additional groups of animals as replicates. Individual birds were thus treated as experimental units.

Behavioural observations were carried out when the chicks were nine months (November 2001) and 13 months (February 2002) of age. This was done to assess whether tissue and bone damage resulting from declawing might result in persistent pain (Lunam & Glatz, 2000) that could manifest itself in behavioural changes. Because ostriches are inactive at night (Lambrechts & Cloete, 1998), observations were limited to daylight hours. Observation periods were spread over 22 periods of 2.5 h. average duration to encompass two full days, starting about 30 min. before sunrise and ending about 30 min. after sunset. In total, 57 h. of observations were done. Scan sampling (Altmann, 1974) was used to determine diurnal time activity budgets, with scan samples of both groups being taken every 15 min.

Preliminary observations were done to investigate the range of behaviours exhibited by the birds. Behaviours of importance were identified and pooled to obtain seven predominant categories of behaviour that were subsequently recorded. The categories of behaviour that were used are defined in Table 1. Incidents of aggression were recorded by means of all occurrence sampling (Altmann, 1974). The categories of aggression that were recorded are defined in Table 2.

Table 1 Behaviour categories recorded during scan sampling behaviour studies of a declawed and an untreated control group of ostriches

Behaviour category	Definition
Inactive	Standing, sitting or lying down without showing another defined behaviour
Locomotion	Walking, running or twirling without showing another defined behaviour
Ingestive	Eating from food troughs or surrounding area, or drinking water
Ground pecking	Foraging or pecking at ground while walking, standing or sitting
Object Pecking	Pecking at inedible objects (e.g. fence or stones) with the beak
Preening	Use the beak to preen (nibble, stroke or comb) its own or another birds' feathers
Aggression	Hissing, beak gaping, threat displays, chasing, chest ramming or kicking

Table 2 Categories of aggression that were recorded for a declawed and an untreated control group of ostriches during behavioural observations

Aggression category	Definition
Hiss/beak gapes	Opening beak wide either producing no sound or a hisslike sound
Threat display	Standing with tail erect, hissing, feathers puffed and wings open
Chase	Chasing a bird away without running after it, causing it to flee, retreat or react
Run-chase	Chasing another bird by running after it, causing it to flee
Chest ramming	Two birds ram into each other with chests held high
Kicking	A bird kicks its legs forward and up in an attempt to kick another bird
Mounting	A bird attempts to mount another bird by sitting down on top of a sitting bird
Trample	A bird stands over sitting bird, trampling with its feet on the sitting birds' back and sides

The number of birds participating in each of the seven general behaviour categories was subsequently recorded at predetermined sampling intervals. Quantitative weather data, treatment, group size and time of day were recorded accordingly. Observational data were pooled to obtain means per hour for each treatment.

The two treatment groups were transported separately to a commercial abattoir at 14 months of age. Live weight at slaughter, carcass weight, skin area and skin grading were recorded. In total, 35 declawed and 45 control birds were slaughtered. The lower legs of all 35 declawed birds as well as 15 of the 45 control birds were obtained from the abattoir. The lower leg weight, tarsometatarsus length, tarsometatarsus width and hind and front footpad widths were measured. The toe stumps were removed for future histological assessment. Skin grading of the raw skins was determined subjectively without knowledge of the declawing treatment by the Klein Karoo Co-operative's grading personnel. The number, location and type of damage (scratches, kick marks, chafe marks, ingrown feathers and bacterial damage, as defined by the grading personnel) of discernible marks on the skins were identified and noted. The number of lesions was subsequently determined for the crown area and the area outside of the crown, respectively. The crown is defined as the diamond shaped area on an ostrich's back covered by quill follicles and damage in this area determines skin grading.

Survival of ostrich chicks to slaughter was expressed as proportions and compared by standard non-parametric Chi² procedures (Siegel, 1956). The proportion of first grade skins from the ostriches that were eventually slaughtered was similarly assessed. Chi² procedures were also used to compare observed frequencies of bouts of aggressive behaviour to expected frequencies. Continuous data were analysed by least squares procedures to account for uneven subclasses (Harvey, 1990). Fixed effects fitted included chick batch, gender and treatment, as well as two-factor interactions between these effects. Means were only tabulated for treatment effects in the absence of significant ($P < 0.05$) interactions of treatment with the other fixed effects. The covariation between measurements on full sibling chicks was accounted for by the inclusion of random breeding pair effects in the analysis model (Harvey, 1990). The intra-class correlation derived in this manner is indicative of the repeatability of breeding pair performance (Turner & Young, 1969).

Results

Between breeding pair variances for the respective continuous traits (skin, weight and lower leg measurements) ranged from barely discernable to highly significant. Expressed as proportions of the overall phenotypic variances of the respective traits, the derived repeatability estimates (±s.e.) ranged from 0.07±0.30 for tarsometatarsus width to 0.59±0.17 for front footpad width and 0.63±0.10 for skin size. The exception in this regard was the skin damage data, where the between breeding pair variance component was either absent or very low ($P > 0.50$). It was assumed that the data were sufficiently uncorrelated to allow analysis without accounting for between breeding pair effects.

Survival to slaughter age averaged 25 and 33% in the declawed and control groups, respectively. Although slightly lower in the declawed group, the difference was not statistically significant (Table 3). Most mortalities occurred in the first three months and the general pattern of mortality was similar in both groups, although cumulative proportions of chick deaths were higher ($P < 0.05$), or tended to be higher ($P < 0.10$), in the declawed group than in the control group between 85 and 135 d post hatching. Three chicks in the control group that died at an unknown date were excluded from this analysis.

Table 3 Least square means (±s.e.) for production parameters and foot and leg measurements, as recorded in a group of declawed ostriches and an untreated control group

Parameter	Treatment		Significance
	Control	Declawed	
Initial size of treatment groups (n)	138	140	
Number of ostriches slaughtered	45	35	
Survival to slaughter (proportions)	0.326	0.250	Chi²=1.927n.s.
Production traits:			
Day-old chick weight (kg)	0.897±0.033	0.916±0.033	n.s.
14-month live weight (kg)	90.7±2.7	101.0±2.7	**
Slaughter weight (kg)	82.0±2.5	90.2±2.5	**
Carcass weight (kg)	39.5±1.5	44.0±1.5	*
Foot and leg measurements:			
Number of individuals measured (n)	15	35	
Lower leg weight (kg)			
Left	1.54±0.05	1.50±0.04	n.s.
Right	1.49±0.05	1.47±0.04	n.s.
Tarsometatarsus length (cm)			
Left	44.0±0.4	44.0±0.3	n.s.
Right	43.8±0.4	44.0±0.3	n.s.
Tarsometatarsus width (mm)			
Left	27.4±0.5	28.0±0.4	n.s.
Right	27.6±0.5	28.0±0.4	n.s.
Hind footpad width (mm)			
Left	47.9±1.1	47.2±1.0	n.s.
Right	45.7±1.0	46.6±0.8	n.s.
Front footpad width (mm)			
Left	54.8±0.9	58.1±0.8	**
Right	53.8±1.0	58.7±0.9	**

n.s. - Not significant (P > 0.10); * Significant (P < 0.05); ** Significant (P < 0.01)

There was no difference (P < 0.01) between the weight of day-old chicks assigned to the control and declawed groups, averaging 0.897 and 0.916 kg, respectively (Table 3). Body weight increased steadily with age in both groups (Figure 1), but there was a tendency for the weights of declawed birds to be higher towards the end of the growing-out phase. By 14 months of age, the declawed birds averaged 101 kg and the control birds 91 kg, significantly less than the declawed group (P < 0.01; Table 3). The declawed group was correspondingly heavier at slaughter with an 11.4% advantage in carcass weight (P < 0.05; Table 3).

Foot and leg measurements were generally independent of treatment (P > 0.10; Table 3). The only exception was front footpad width, which was 6.0% wider in the right feet and 9.1% wider in the left feet of the declawed group compared to the control group (P < 0.01).

Consistent with the larger body weight in the declawed group at slaughter, the average skin size of ostriches in this group was 141 dm^2, about 4.0% larger (P < 0.05) than in the control group (Table 4). Furthermore, the proportion of ostriches with first grade skins in the declawed group was nearly 89%, more than twice that of the control group (38%; P < 0.01; Table 4). The number of discernable kick and scratch marks on the crown area of control birds was also more than twice as many as recorded in the declawed group (P < 0.01). This resulted in a marked group difference in the overall damage on the crown area. Damage on the area outside of the crown was, however, independent of treatment (P > 0.10). Other types of damage (chafe marks, ingrown feathers and bacterial damage) only rarely occurred in both groups and were not tabulated.

On average, all animals (treated and control groups) were inactive for most of the time they were observed (Table 5). There was no evidence that declawing had any significant effect on the time budget of the experimental animals. The only type of behaviour that differed between treatment groups was object-pecking behaviour (3.2% for the control group and 5.2% for the declawed control group, P < 0.01).

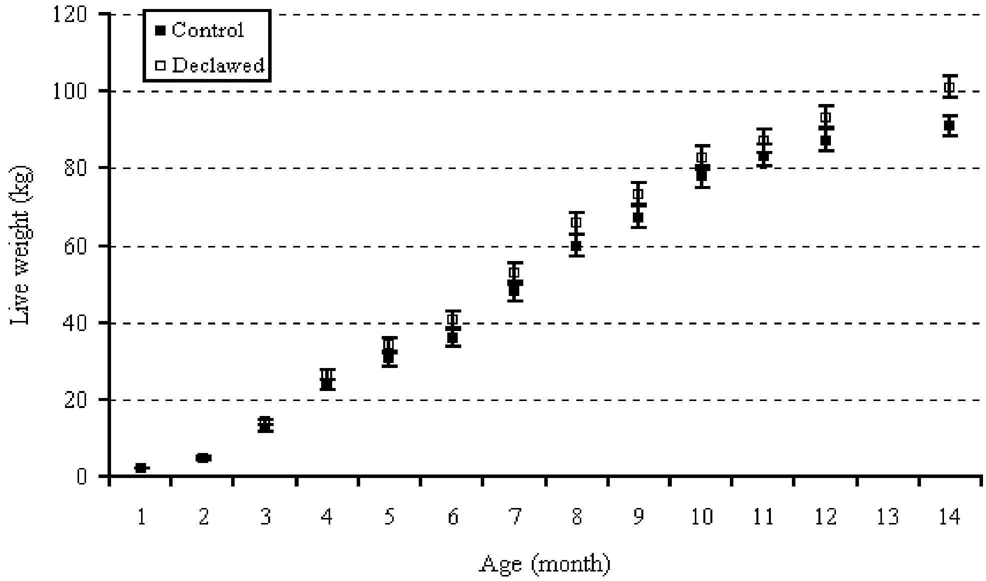

Figure 1 Mean live weight of declawed and untreated control ostriches from hatch to slaughter age

Table 4 Least square means (±s.e.) for skin grading and skin damage, as recorded in a group of declawed ostriches and an untreated control group. A standard square root transformation was applied to the skin damage data to normalize the distribution. Back transformed means are provided in brackets

Parameter	Treatment		Significance
	Control	Declawed	
Number of ostriches slaughtered	45	35	
Skin area (dm^2)	136±2	141±2	*
Skin grading:			
Proportion of first grade skins	0.378	0.886	Chi^2=19.1**
Skin damage on crown area:			
Kick marks (n)	0.650±0.096 (0.423)	0.260±0.098 (0.068)	**
Scratch marks (n)	1.062±0.117 (1.128)	0.250±0.120 (0.063)	**
Total (n)	1.445±0.114 (2.088)	0.426±0.116 (0.181)	**
Skin damage on outside area:			
Kick marks (n)	0.889±0.119 (0.790)	0.756±0.122 (0.572)	n.s.
Scratch marks (n)	0.087±0.049 (0.008)	0.060±0.050 (0.004)	n.s.
Total (n)	1.086±0.116 (1.179)	1.058±0.118 (1.119)	n.s.
Overall skin damage:			
Kick marks (n)	1.128±0.116 (1.272)	0.911±0.119 (0.830)	*
Scratch marks (n)	1.096±0.119 (1.201)	0.293±0.122 (0.086)	**
Total (n)	1.992±0.107 (3.968)	1.289±0.109 (1.662)	**

n.s. - Not significant ($P > 0.10$); * Significant ($P < 0.05$); ** Significant ($P < 0.01$)

It was assumed that the number of aggressive interactions would be proportional to the number of animals in the experimental group (47-48 in the control group and 36 in the declawed group), but very few differences were observed for any of these traits. The observed frequencies for chasing differed ($P < 0.05$) from the expected frequencies during the October-November observation period (Table 6). There was also a tendency ($P < 0.10$) for run-chase to differ from the expected frequencies during the October-November observation period. In both instances, it was suggested that these behaviour patterns were more likely to occur in the control group than in the declawed group. The other observed frequencies of aggressive behaviours did not differ from those expected, both for the October-November and February observation periods. The frequencies of aggressive interactions that could cause skin damage (kicking and trampling) were too low to allow meaningful analysis, and are, therefore, not tabulated. Respectively 26 and 13 occurrences of kicking were observed during the October-November and February observation periods. Corresponding overall frequencies for trampling were 22 and four, respectively.

Table 5 Time-budget as recorded in a group of declawed ostriches and an untreated control group

Behaviour category	Treatment		Significance
	Control	Declawed	
Inactive	49.2±1.4	49.0±1.4	n.s.
Locomotion	10.4±0.6	10.0±0.6	n.s.
Ingestive	17.6±0.7	16.3±0.7	n.s.
Ground pecking	13.7±0.8	13.2±0.8	n.s.
Object pecking	3.2±0.3	5.2±0.3	**
Preening	5.3±0.3	5.6±0.0.3	n.s.
Aggression	0.64±0.11	0.75±0.11	n.s.

n.s. - Not significant (P > 0.10); ** Significant (P < 0.01)

Table 6 Observed frequencies for displays of aggression, as observed during two periods on the experimental animals. Expected frequencies, based on the number of birds in each group are given in brackets

Period and display	Treatment		Chi²
	Control	Declawed	
Oct.-Nov. (9 months old):			
Hiss/Beak gapes	74 (67.4)	44 (50.6)	1.51
Threat display	79 (70.3)	44 (52.7)	2.51
Chase	85 (67.3)	33 (50.7)	10.83**
Run-chase	40 (33.7)	19 (25.3)	2.74
Febr. (13 months old):			
Hiss/Beak gapes	52 (52.1)	40 (39.9)	0.00
Threat display	62 (61.2)	46 (46.8)	0.02
Chase	56 (55.5)	42 (42.5)	0.01
Run-chase	16 (19.3)	18 (14.7)	1.31

Critical Chi²: P = 0.05 – 3.84; P = 0.10 – 2.71; ** Significant (P < 0.01)

Discussion

Results pertaining to the between breeding pair variances are relevant in the sense that breeding pair may control significant quantities of variation for specific traits. If this variation is accounted for, smaller differences between treatment means could be detected as significant. In the absence of significant between breeding pair variances, observations are sufficiently uncorrelated to allow analysis of variance without the intra-class correlation between full siblings being accounted for. It is notable that live weight and skin area of ostriches were recently reported to show genetic variation, while skin grading was not heritable (Meyer *et al*., 2002a). The present study accorded with these findings; with between family variation being found for live weight and skin size, but not for skin damage.

Struggling observed during the declawing procedure could be attributed to discomfort and stress that lead to the typical “fight and flee” response. Directly after being declawed, this response disappeared, indicating that it was due to short-term stress, rather than chronic pain experienced. The recuperative ability of chicks after declawing proved to be excellent, with no visible impairment in walking ability observed even directly after being declawed. Wounds healed well with only a few cases of inflammation detected during post mortem investigations of chicks that died during the rearing phase. Partial regrowth of the toenail was seen in less than five chicks, but little more than a small rudimentary claw, usually deformed, developed. Measurements of the feet and toes indicated an increase in the width of the front footpad, which suggests that the total surface area of the footpad increased. Weight distribution on the footpad thus appears to have been altered. This is consistent with findings on declawed emus in which the footprint area increased, presumably to accommodate for the reduction in length of the declawed toes (Lunam & Glatz, 2000). While this could potentially lead to a slight alteration in gait, no obvious differences between the two groups of birds could be detected throughout the trial.

There was a tendency for birds in the declawed group to have higher average body weights towards the end of the growing-out phase, with a correspondingly higher average skin area in the slaughter birds. It is tempting to attribute this to a general reduction in injuries and stress in the declawed group. It is also possible, however, that the tendency towards a higher mortality rate in the declawed group might have differentially affected the smaller, presumably weaker, birds in the group, thereby increasing the average weight of the surviving birds. It has been shown that chicks with a low live weight were more likely to succumb in the first three months after hatching (Cloete *et al*., 2001). Chicks with a low live weight at 28 days of age are particularly at risk.

Declawing significantly decreased skin damage, presumably by reducing the severity of claw injuries. Accordingly, skin grading was markedly improved. That both scratch and kick marks were significantly reduced in the declawed group supports the contention that both originate from claw injuries. Grading results of raw skins indicate that scratches, as defined by grading personnel at tanneries, are mostly scars that result from injuries caused by the sharp claws of young chicks. Scratches incurred at a young age are persistent through to slaughter age (Meyer *et al.,* 2002b). These scratch marks can probably be limited by good management practices such as keeping groups small, supplying adequate heating in cold conditions and minimising stress. Ostrich chicks, however, still exhibit some clawing behaviour, regardless of these preventative measures. Declawing may, therefore, be advantageous in reducing skin damage that results from this behaviour. Declawing also effectively reduced kick marks. Kicking as a normal behaviour of juvenile and adult ostriches (Samson, 1996), cannot be minimized; therefore, the only way to minimize lesions that result from kicking is to declaw the ostriches. The proportion of aggressive encounters, and specifically those that could cause skin damage, was the same for both treatment groups, indicating that behaviour was not influenced. The improved skin grading of declawed birds can, therefore, be solely attributed to the declawing treatment, which minimizes the lesions that result from these behaviours.

There was no evidence to indicate loss of locomotive ability. The time budget of declawed ostrich chicks was similar to that of control birds, indicating that the practice of declawing does not influence ostrich behaviour. The only behavioural category that was affected by treatment was pecking behaviour (3.2 ± 0.3 and $5.2 \pm 0.3\%$ in the control and declawed groups, respectively). Pecking is a stereotyped behaviour most often associated with stress in ostriches (Huchzermeyer, 1997). At this stage, it is unclear whether the increased occurrence of pecking in the declawed group of birds could be attributed to stress, and further research is indicated, since the other behavioural evidence could not substantiate this. There were no significant differences in aggressive interactions between declawed and control birds, except for chasing during the October-November observation period. The observation that clawed emus tended to be more aggressive than declawed emus (Lunam & Glatz, 2000) could thus not be confirmed for ostriches. Overall, the behavioural observations on declawed and control groups of ostriches are consistent with preliminary results from Australia that indicated that the welfare of ostriches was not compromised by declawing (P.C. Glatz, 2002, personal communication).

Toe clipping is used extensively in the poultry industry to reduce injuries and injury-related mortality with no apparent effect on any aspect of hen performance (Goodling *et al*., 1984). Declawing is also currently being used in the emu industry, and is gathering support in the Australian ostrich industry where farmers have reported improvements of 25% in the percentage of first grade skins from declawed birds (P.C. Glatz, 2002, personal communication). There are some concerns with the implementation of the technique. Severing nerves during the removal of the claw and surrounding tissue may result in the development of abnormal masses of regenerating nerves known as neuromas, which could result in persistent long-term pain (Lunam & Glatz, 2000). Toe stumps that were obtained at the ostriches used in the present study are currently under histological assessment to determine the presence of such painful neuromas or inflammation in the tissue. However, since no evidence of reduced survival, impaired growth or behavioural anomalies, all indicators of poor welfare (Broom, 1991), were found, the preliminary results suggest that declawing does not compromise the wellbeing of the ostriches. To ensure that this practice is implemented in a responsible way, certain guidelines are proposed. Firstly, declawing should be performed as soon after hatch as possible. At this stage, the bird's bones are still soft, the chick's nervous system is still immature, the rapid growth rate of young chicks promotes healing, and the chicks learn to walk without claws so there is no adjustment phase (Minnaar, 1998). Regarding the declawing method, use of a sharp blade, correct positioning to remove the entire last phalanx, quick effective control of bleeding and good cauterisation is vital (Minnaar, 1998). Declawing is performed without the use of anaesthesia, which is not recommended in very young chicks due to a high potential for overdose and other ill effects (Minnaar, 1998). Various declawing methods have already been investigated for emus (O'Malley & Snowden, 1999) and can be useful in the development of an optimal method for ostriches.

Conclusions

The main causes of skin damage in ostriches are kick and scratch marks, which can mostly be attributed to claw injuries. Declawing the chicks can minimize these and markedly improve the quality of ostrich skins, without affecting any other production variable. Declawing ostrich chicks soon after hatch effectively reduces skin damage with no apparent negative effects on growth, mortality or behaviour. It is, therefore, recommended that ostrich farmers declaw potential slaughter birds. The method used in this study proved successful, but time-consuming. Other declawing methods will have to be tested and evaluated in order to determine a standard method that is effective, practical and causes the least distress to chicks. Declawing can in future serve as an important management tool to minimize skin damage whilst minimizing injuries and stress of growing ostriches under commercial rearing conditions. Declawing, however, has certain welfare implications and can, therefore, only be endorsed as a recommended husbandry practice once it is included in the Code of Conduct for ostriches and regulated accordingly.

Acknowledgements

We thank A.J. Morley for his expert advice on the declawing procedure, as well as P.C. Glatz for his willingness to share information about the situation in Australia. The technical assistance of the Klein Karoo Co-operative Ostrich Research Laboratory and the financial assistance, as well as their co-operation during data and material collection from experimental animals at slaughter, are acknowledged. We also wish to express our gratitude to the technical and other staff of the Klein Karoo Agricultural Development Centre for their support in the execution of the project. Finally, we want to express our gratitude to the Animal Production Research Trust and Department of Agriculture of the Western Cape for making this project possible.

References

Altmann, J., 1974. Observational study of behaviour: Sampling methods. Behaviour 49, 227-267.

Broom, D.M., 1991. Animal welfare: Concepts and measurement. J. Anim. Sci. 69, 4167-4175.

Bunter, K. & Graser, H., 2000. Genetic evaluation for Australian ostriches. A report for the Rural Industries Research and Development Corporation, RIRDC Publication No 00/, Project No UNE.57A.

Cloete, S.W.P., Lambrechts, H., Punt, K. & Brand, Z., 2001. Factors related to high levels of ostrich chick mortality to 90 days after hatching in an intensive rearing system. J. S. Afr. Vet. Assoc. 72, 197-202.

Deeming, D.C., Dick, A.C.K. & Ayres, L.L., 1996. Ostrich chick rearing: A stockman's guide. Ratite Conf., Banbury.

Glatz, P.C., 2001. Effect of declawing ostriches on behaviour of ostrich chicks. Proc. 6th European Symp. on Poultry Welfare, pp. 302-304.

Goodling, A.C., Satterlee, D.G., Cerniglia, G.J. & Jacobs-Perry, L.A., 1984. Influence of toe-clipping and stocking density on laying hen performance. Poultry Sci. 63, 1722-31.

Harvey, W.R., 1990. User's guide for LSMLMW and MIXMDL. PC-2 version, Mimeograph.

Huchzermeyer, F.W., 1997. Behaviour problems in farmed birds. Ostrich News 4, 17-21.

Lambrechts, H. & Cloete, S.W.P., 1998. Activity budgets of adult breeding ostriches classified according to annual egg production of the previous breeding season. Animal production in harmony with the environment. Proc. 36th Nat. Congr. South African Society of Animal Science, April 1998, University of Stellenbosch. pp. 93-94.

Lunam, C.A. & Glatz, P.C., 2000. Declawing of farmed emus: Harmful or helpful? RIRDC Publication No 99/177.

Meyer, A., Cloete, S.W.P., Bunter, K.L., Van Schalkwyk, S.J., & Brand, Z., 2002a. Genetic parameters for live weight and skin traits in ostriches. Proc. 1st Joint Congr., Grassland Society of Southern Africa & South African Society for Animal Science, 13-16 May, Christiana, South Africa. p. 82.

Meyer, A. Cloete, S.W.P., van Schalkwyk, S.J., Brown, C.R., Brand, Z. & Pfister, A.P., 2002b. The transfer of skin damage inflicted at different ages to ostrich leather. Proc. 1st Joint Congr., Grassland Society of Southern Africa & South African Society for Animal Science, 13-16 May, Christiana, South Africa. p. 188.

Minnaar, M., 1998. The Emu Farmer's Handbook. Vol. 2. Nyoni Publ. Co., USA.

Nel, C.L., Cloete, S.W.P., Lambrechts, H. & Clark, J., 2000. Bestuurspraktyke wat die gradering van volstruisvelle kan beïnvloed. Elsenburg J. 2000, 52-58.

O'Malley, P. & Snowden, J.M., 1999. Emu products: increasing production and profitability (Part B). RIRDC Publication No 99/143.

Samson, J., 1996. Behavioural problems of farmed ostriches in Canada. Can. Vet. J. 37, 412-414.

Siegel, S., 1956. Non parametric statistics for the behavioural sciences. McGraw-Hill Book Company Inc., New York, USA.

Turner, H.N. & Young, S.S.Y., 1969. Quantitative genetics in sheep breeding. MacMillan Publ. Co, Melbourne, Australia.