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Energy and nitrogen retention of Merino and Dohne Merino lambs receiving a feedlot diet

J. van E. Nolte and A.V. Ferreira[#]
Department of Animal Sciences, University of Stellenbosch, Private Bag X1, Matieland 7602, South Africa

Abstract

The energy and nitrogen retention of Merino and Dohne Merino lambs offered a feedlot diet were measured. The energy retentions of the two breeds were relatively similar (0.96 *vs*. 1.00 MJ/kg $BW^{0.75}$), but the Merino lambs had a higher nitrogen retention than the Dohne Merino lambs (1.38 *vs*. 1.04 g/kg $BW^{0.75}$).

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[#] Corresponding author. E-mail: avf@sun.ac.za

Introduction

Sheep and goats comprise a significant part of the wealth of the African society (Peacock, 1996) and are often the predominant source of meat and milk for the population. These flocks are kept in a variety of ecological areas with different climates and vegetation. At times these animals survive in environments too harsh for cattle (El Khidir *et al*., 1998), effectively utilising large parts of hostile agricultural land.

However, when harsh environmental conditions limit natural grazing, lambs have to be finished in feedlots to ensure commercial viability. The efficiency of feed conversion to product, i.e. meat and/or wool, which impacts on profitability criteria such as average daily gain and feed conversion ratio, can be measured as energy and nitrogen retention. The Merino and Dohne Merino are among the most prominent sheep breeds in South Africa and form a significant portion of lambs finished in feedlots. However, the composition of empty body weight gain of growing animals can vary significantly between species, breed or sex (McDonald *et al*., 1995). Therefore, the purpose of this study was to measure the energy and nitrogen retention of Merino and Dohne Merino lambs during feedlot finishing, to establish possible differences in nutrient utilisation.

Material and Methods

Seven male Merino and Dohne Merino lambs each, with respective average body weights of 35.6 ± 2.18 kg and 40.1 ± 2.79 kg were housed in 1x2 m metabolism cages in a ventilated, enclosed barn with a slatted floor and continuous lighting. The lambs had *ad libitum* access to water and a feedlot diet after being adapted to the diet for 14 days. The diet consisted (g/kg; as-is basis) of 560 maize meal, 19.2 gluten 60, 19.2 gluten 20, 53.3 soya oilcake, 85.0 lucerne hay, 141.7 wheat straw, 93.6 molasses, 10.4 limestone, 6.8 salt, 10.0 ammonium chloride and 0.8 vitamin/mineral premix. The vitamin and mineral (micro and macro) supplements were formulated according to the daily requirements of finishing lambs (NRC, 1985). The chemical composition of the diet is shown in Table 1. At 07:00 and 19:00 each day, the lambs were fed and the faeces collected. Urine was only collected at the morning feedings. To prevent volatilisation of ammonia from the urine, 20 mL of urine preservative (80 g potassium dichromate and 20 g mercuric chloride dissolved in 1 L distilled water) was added each morning to the urine collection jugs. Daily sub-samples of 10% from the faeces and urine of each lamb were composited and frozen at –10 °C pending proximate chemical analyses. Methane gas production was calculated as 8% of the gross energy intake (McDonald *et al*., 1995). Nitrogen excretion was corrected for metabolic faecal nitrogen (MFN) and endogenous urinary nitrogen (EUN) according to McDonald *et al.* (1988) and calculated as follows:

MFN = 5 g N/kg dry matter intake

EUN = 0.18 g N/kg $BW^{0.75}$/d

N retention (g N/kg $BW^{0.75}$/day) = $[N_{intake} – (N_{faeces} – MFN) – (N_{urine} – EUN)]/BW^{0.75}$/days

The faeces was dried at 50 ºC for 96 h, air-equilibrated, ground through a 1 mm screen and analysed for DM, nitrogen and gross energy (AOAC, 1995). The urine samples were also analysed for nitrogen and gross energy content (AOAC, 1995). Nitrogen was measured with a Leco Auto Analyser (Model FP 428) and gross energy was determined by adiabatic oxygen bomb calorimetry (CP500 calorimeter).

Six wethers with an average body weight of 68.4 ± 3.7 kg were used to determine the protein degradability of the diet according to the *in situ* technique, described by Mehrez & Ørskov (1977) and Weakly *et al*. (1983).

Analysis of variance was performed on the data, using the GLM procedure of SAS (2000).

Table 1 Chemical composition of the feedlot diet

Items	Contents (g/kg)
Chemical composition (Dry matter basis)	
Dry matter	892.89
Metabolisable energy[1] (MJ/kg)	10.82
Crude protein	135.12
Undegradable protein	51.06
Fat	39.29
Crude fibre	130.45
Acid detergent fibre	122.78
Neutral detergent fibre	246.61
Calcium	6.94
Phosphorus	2.83

[1]Metabolisable energy = Digestible energy x 0.82 (NRC, 1985)

Results and Discussion

Dohne Merino lambs had a higher daily dry matter and energy intake, as well as methane gas production, than Merino lambs (P = 0.007; Table 2). This can probably be attributed to their higher feed intakes as a result of their heavier live body weights. According to McDonald *et al*. (1995) higher feed intakes reduce the metabolisability of feed energy. However, the dry matter and energy intake on a metabolic weight basis did not differ between breeds (P = 0.36), which are consistent with the similarities in faecal, urinary or total energy excretion (% of energy intake), energy retention (% of energy intake) and the calculated ME content of the diet (P ≥ 0.18).

Table 2 Energy metabolism (LS Means ± s.e.m.) of Merino and Dohne Merino lambs receiving a feedlot diet

Item	Merino	Dohne Merino	s.e.m.	P
Dry matter intake (g/day)	1244.70	1428.76	37.20	< 0.01
Energy intake (MJ/day)	22.55	25.89	0.67	< 0.01
Methane gas production[1] (MJ/day)	1.80	2.07	0.05	< 0.01
Dry matter intake (g/kg $BW^{0.75}$/day)	85.76	89.84	2.15	0.36
Energy intake (MJ/kg $BW^{0.75}$/day)	1.55	1.63	0.04	0.36
Faecal energy (% of energy intake)	26.97	27.38	0.99	0.85
Urinary energy (% of energy intake)	2.92	3.35	0.16	0.18
Total energy excreted (% of energy intake)	37.88	38.73	0.93	0.67
Energy retention (% of energy intake)	62.12	61.27	0.93	0.67
Energy retention (MJ/kg $BW^{0.75}$)	0.96	1.00	0.02	0.38
Dietary ME content (MJ/kg)	11.25	11.10	0.17	0.67

[1]Calculated as 8% of energy intake (McDonald *et al*., 1995)

The higher daily nitrogen intake of the Dohne Merino lambs is consistent with their dry matter intake (P = 0.007; Table 3). In corroboration of the energy intake, dry matter and N intake on a metabolic weight basis did not differ between the two breeds (P = 0.36). This is consistent with the similarity in faecal nitrogen excretion between the two breeds (P = 0.95), indicating a relatively similar nitrogen digestion and/or absorption (Nolte & Ferreira, unpublished data). However, the Dohne Merino lambs excreted more urinary and total nitrogen than Merinos (P < 0.0001), which may indicate an excessive ammonia production within the gut (Giraldez *et al*., 1997; Cole, 1999). Scott (1975) also reported that ammonium is a primary carrier of hydrogen in the urine of ruminants fed high concentrate diets and might be required for renal and systemic buffering (Galyean, 1996). Since mammals have no endogenous urease, excretion is the only means of removing urea from the body (Nolan, 1993). Therefore, the higher urinary nitrogen levels of the Dohne Merino lambs might indicate an inferior nitrogen utilisation and/or recirculation (Ørskov, 1992; Nolan, 1993) in comparison to the Merino lambs, resulting in a lower nitrogen retention ($P \leq 0.007$).

The external offal (head, feet, skin and wool) of Merino lambs also had a 21% higher proportional nitrogen contribution to the whole empty body than Dohne Merino lambs, which may help explain the higher nitrogen retention of Merino lambs (Nolte & Ferreira, 2004).

Table 3 Nitrogen retention (LS Means ± s.e.m.) of Merino and Dohne Merino lambs receiving a feedlot diet

Item	Merino	Dohne Merino	s.e.m.	P
N intake (g/day)	26.91	30.89	0.80	0.007
N intake (g/kg $BW^{0.75}$/day)	1.85	1.94	0.05	0.36
Faecal N (% of N intake)	31.85	31.67	1.24	0.95
Urinary N (% of N intake)	26.53	47.24	3.26	< 0.0001
Total N excreted (% of N intake)	58.37	78.92	3.17	< 0.0001
N retention (% of N intake)	74.56	53.53	3.20	< 0.0001
N retention (g/kg $BW^{0.75}$)	1.38	1.04	0.06	0.003

Conclusion

Merino and Dohne Merino lambs metabolised the energy content of the feedlot diet with similar efficiency. However, the Dohne Merino lambs had a much higher urinary nitrogen excretion than the Merino lambs. Therefore, Merino lambs appear to utilise nitrogen more efficiently than Dohne Merino lambs under feedlot conditions.

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