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Comparing the effect of age and dietary energy content on feedlot performance of Boer goats

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ABSTRACT

The effects of three dietary energy treatments on the feedlot production characteristics of Boer goats were investigated, along with the time spent under feedlot conditions. A total of 66 goat kids with an average weight of 22.2 ± 3.51 kg were housed in individual pens at Elsenburg research farm. At the start of the trial, the goats were randomly allocated to one of three finisher diets that vary in energy content; low, medium and high energy (11.3, 12.0, and 12.7 MJ ME/kg feed, respectively). The goats were divided further into groups of about 15 goats that were slaughtered at a registered abattoir after 40, 76, 112 and 146 days in the feedlot. During the trial period, goats were supplied their respective trial diets *ad libitum*. Orts were weighed back once a week in order to determine feed intake. Growth was monitored by weighing the goats weekly. The live weights of the goats increased linearly ($20.939 + 0.191x$, where x represents days in feedlot) throughout the trial period. Overall, goats on the high energy diet had the lowest growth rate (202.0 g/day *versus* 221.9 and 234.9 g/day for goats on the low and medium diets, respectively; $P < 0.05$). This may be as a result of the high starch content affecting the rumen environment and thus the utilization of nutrients for growth. Goats fed the low and medium energy diets presented the higher feed intakes (1236.4 and 1168.6 versus 1002.4 g/day for low, medium and high energy diets, respectively; $P < 0.01$). A tendency was observed for the feed conversion ratio (FCR) of goats on the high energy diet to be lower than that of the low and medium energy diets ($P = 0.06$), while the FCR of the goats did not vary with time spent in the feedlot ($P = 0.40$). Goats on the low energy diet had a lower dressing out percentage (45.8%, compared to 46.1 and 47.1%, for the low medium and high energy diets, respectively). This may be attributed to the higher proportion of fibre in the feed, which increases the gut fill and affects the digestibility of the feed. It was also observed that goats were able to adjust their level of feed intake in response to the amount of energy supplied in the diet. It is suggested that the diet with a medium energy content (12.0 MJ ME/kg feed) closely resembles the requirements of Boer goats for growth and exhibits the best production characteristics.

1. Introduction

The Boer goat was developed by early settlers in South Africa, who reared goats to clear bush in order to make way for other agricultural practices. Farmers bred the goats using existing indigenous breeds, selecting for fertility, higher growth rates and greater body conformation (Casey and Van Niekerk, 1988). This led to the improved Boer goat as we know it today, which is considered to be the standard to which other meat goat breeds are compared to (Malan, 2000; Steyn, 2010). Due to their good production characteristics, the breed is ideally suited to be used in crossbreeding systems by communal farmers in order to improve the meat production characteristics of their smaller indigenous goats (Owen and Norman, 1977). Boer goats are commonly reared in extensive production systems by commercial farmers in arid and semi-arid regions, where the vegetation mostly consists of bushes rather than grasses. Goats show a preference to consuming browse material rather than grass, unlike other livestock species, and exhibit a very selective feeding behaviour (Animut and Goetsch, 2008). Along with their high level of adaptability and greater tolerance towards diseases and environmental stressors, goats can thus be farmed in areas that would otherwise be considered unsuitable for the production of other livestock species.

Nutrition plays an integral role in feedlot production, and is the governing factor that influences the rate of animal growth and profit margins. The main focus in feedlot nutrition is to supply the animal with sufficient energy and protein in the diet, as these nutrients greatly

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affect growth and the level of feed intake (Wang et al., 2014). To do this, feedlot diets largely consist of grains and oilseeds (Stanton and Levalley, 2006), in order to provide the animals with sufficient quantities of highly digestible energy and protein sources. Dietary energy is often taken as the baseline requirement as it also affects the utilization of other nutrients (Lawrence et al., 2012). Goats are able to utilize high concentrate diets just as well as sheep under feedlot conditions, though it is also suggested that goats may be better at utilizing diets with a higher roughage content (Sheridan et al., 2003). In intensive systems, growth rates and feed conversion efficiencies of most sheep breeds are more superior to that of goats (Van Niekerk and Casey, 1988; Sheridan et al., 2003). The pattern of fat partitioning in goats also differs from sheep; goats tend to deposit more fat in the abdominal cavity rather than in subcutaneous fat depots (Casey and Webb, 2010). The differences in growth rates and fat deposition indicate differences in the maturation rates of the two species, and therefore the nutritional requirements of goats differ from that of sheep. It can be deduced from nutrient requirement tables that goats weighing about 30 kg require between 10.0–11.5 MJ ME per day to attain growth rates of 150–200 g/day (NRC, 1981; AFRC, 1998). However it has been suggested that these energy values are more applicable to goats of smaller frame sizes and potentially underestimate the requirements of the larger Boer goat, which also exhibits higher growth rates. In order to optimize goat production, diets that meet the specific requirements of the growing Boer goat should be formulated for feedlot production.

The aim of this study was therefore to determine the effect of feeding goats finisher diets with different dietary energy levels on their feedlot production parameters. The effect of age or time spent in the feedlot was investigated along with the dietary energy treatments on the feedlot production parameters and dressing percentage over time. The objective is to thus determine an optimal dietary energy level that can be used in feed formulations to finish Boer goats, as well as to determine an optimal finishing period for goats in the feedlot.

2. Materials and methods

Ethical clearance for this study was obtained from the Western Cape Department of Agriculture Departmental Ethical Committee for Research on Animals (DECRA R12/49). The experimental design used in this study was a completely randomised design with about five replications for each of the 12 treatment combinations (Table 1). The treatment combinations consisted of three diets varying in metabolisable energy content (11.3, 12.0 and 12.7 MJ ME/kg feed) and four feeding periods (42, 76, 112 and 140 days). For this trial, 71 castrated Boer goat kids were weaned at an average age of five months (22.2 ± 3.51 kg) and were transported to Elsenburg experimental farm, where they were housed individually in 1m × 2 m pens. Upon arrival, the goat kids were drenched and vaccinated with a broad spectrum vaccine against *Pasteurella* and *Clostridia* bacteria. The three treatment diets and feeding periods were randomly assigned to individual slaughter kids, housed in individual pens that were randomly arranged.

Table 1
The layout of the trial, to determine the effect of time in the feedlot and dietary energy content on the production parameters of goats, and the number of goats that were allocated to each treatment group.

Slaughter Group (period in feedlot)	Dietary Treatment			Total
	Low	Medium	High	
Day 40	4	5	3	12
Day 76	5	5	5	15
Day 112	5	3	5	13
Day 146	8	9	9	26
Total	22	22	22	66

Table 2
The formulation of the trial diets, differing in energy level, fed to Boer goat kids.

Ingredients	Diets (% As fed)		
	LE	ME	HE
Maize	44.30	54.90	65.50
Lucerne hay	39.00	24.90	10.80
Cottonseed oilcake	8.00	11.44	14.89
Molasses Powder	2.50	2.50	2.50
Salt, NaCl	1.00	1.00	1.00
Bicarbonate of Soda	2.00	2.00	2.00
Ammonium Sulphate	1.00	1.00	1.00
Slaked Lime	0.90	1.10	1.30
Urea	0.50	0.50	0.50
Mono calcium phosphate	0.34	0.18	0.02
Vitamin and Mineral premix	0.25	0.25	0.25
Sulphur	0.20	0.20	0.20
Commercial growth promoters and coccidiostat premix	0.020	0.020	0.020
Total	100	100	100

LE − Low energy diet. ME − Medium energy diet. HE − High energy diet.

Table 3
The nutrient composition of the three different energy trial diets fed to Boer goat kids.

Nutrients	Nutrients of Diets (as fed)		
	LE	ME	HE
Dry Matter, %	89.41	89.85	89.64
In vitro organic matter digestibility, %	74.41	79.30	86.25
Total digestible nutrients (TDN) % [a]	64.09	68.00	70.69
Metabolisable energy, MJ/kg [b]	11.30	12.00	12.70
Nitrogen free extract, % [c]	51.16	55.16	59.54
Protein, %	14.30	14.28	14.98
Rumen undegradable protein (UDP), %[d]	5.76	5.77	5.78
Fibre, %	12.7	10.4	6.3
Neutral detergent fibre, %	29.24	28.29	22.85
Acid detergent fibre, %	15.84	12.78	8.57
Ash, %	10.12	8.63	7.57
Fat, %	1.16	1.37	1.31
Calcium, %	1.25	1.08	1.00
Phosphorous, %	0.45	0.41	0.40

LE − Low energy diet. ME − Medium energy diet. HE − High energy diet.

[a] Calculated total digestible nutrients = (0.8 x protein) + (0.4 x fibre) + (0.9 x nitrogen free extract) + (2.025 x fat).

[b] Formulated metabolisable energy values.

[c] Calculated Nitrogen free extract = 100–(moisture + ash + protein + crude fibre + fat).

[d] UDP calculated from protein degradability values for maize (63.0%), lucerne meal (68.9%) and cottonseed oilcake (54.5%), at an outflow rate of 0.05/hr (Erasmus et al., 1988; Erasmus et al., 1990a; Erasmus et al., 1990b).

The three different feedlot diets were formulated to varied in energy content, to give a low (11.3 MJ ME/kg feed), medium (12.0 MJ ME/kg feed) and high energy (12.7 MJ ME/kg feed) diet. The compositions of the diets are presented in Tables 2 and 3. Goats were gradually adapted from roughage (oat hay) to the concentrate diets using a stepup-programme for a period of 10 days, where the proportion of concentrate fed was increased daily by 100 g until the goats consumed the concentrate diets *ad libitum* After the adaptation phase, the respective feeds were supplied to the goats *ad libitum*. During the trial period, feed refusals were weighed weekly and individual daily dry matter intake was calculated for each goat. The growth rate of the goats was also monitored through weekly weightings at the same time, prior to feeding. Goats were not starved prior to weighing, in order to ensure that goats grow at their maximal potential. During the adaptation phase, three goats died as a result of pneumonia and complications with adaption to the feedlot diet, while two goats died of other causes later in the trial. These mortalities resulted in some of the treatment groups having unequal numbers of goats as depicted in Table 1.

The slaughter groups consisted of ~15 goats, ~five goats per