

Evidence of scrotal fat mobilisation during periods of restricted energy intake in young Dorper rams

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Abstract

A study with the aim of evaluating the reversibility of the nutritionally induced changes in the scrotal and testicular characteristics of young rams was conducted. Thirty-six Dorper rams, 11 to 12 months of age were randomly divided into three groups of 12 rams each and fed at different energy levels for 127 days. At the end of this period, half of the animals from each group (n = 6) were slaughtered. In the second phase of the trial, the energy level of the diet was standardised and all animals were fed on the same low energy diet for 90 days, before being slaughtered. The carcass, scrotal and testicular characteristics of the slaughtered animals were assessed at the end of each phase and the results compared within groups to evaluate the reversibility of the nutritionally induced changes. Results indicate that scrotal fat deposited during periods of high-energy intake was mobilised during periods of restricted energy availability.

Keywords: Energy intake, feeding, scrotum, testicular characteristics

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Introduction

The effect of nutrition on male fertility has been poorly studied in the different livestock species. In South Africa, young breeding rams are commonly fed high-energy diets during performance testing trials and in preparation for sales and auctions (Fourie *et al.*, 2003). Very little is known about the effect of such feeding practices on ram fertility. According to Brown (1994) overfeeding of sires can have detrimental effects on their subsequent reproductive capacity. In a recent study, Labuschagné *et al.* (2002) demonstrated the detrimental effect of high-energy diets on the fertility of young bulls. Both semen quantity and quality were significantly and negatively affected by the diets containing high-energy concentrations. Coulter *et al.* (1997) suggested that fat deposition around the neck of the scrotum over the *pampiniform plexus*, impairs testicular thermoregulation by reducing the amount of heat that can be radiated from the scrotal neck - thereby increasing the temperature of the testis. Similar findings were reported by Fourie *et al.* (2003) in young Dorper rams. The short-term impairment of high-energy diets on sire fertility thus seems to be well accepted now. The long-term effects and the reversibility of these negative nutritional effects on semen characteristics of males are not known. There are no previous reports on the mobilisation of scrotal neck fat deposits during periods of dietary energy restrictions in livestock. Skinner (1981) observed no reduction in scrotal neck fat deposits after reducing the energy level of young bulls and it was speculated that it might be extremely difficult for a bull to rid himself of residual testicular fat once it has been laid down.

The aim of this study was to determine whether scrotal fat deposits, accumulated both in the neck of the scrotum and subcutaneously in young Dorper rams, during fattening or conditioning for sale, are mobilised during a subsequent period of restricted energy intake on pastures.

Materials and Methods

Thirty-six 11-12 months old Dorper rams with a mean (\pm s.e.) body weight of 42.4 ± 0.52 kg were randomly allocated to one of three groups of 12 rams each.

The rams were housed in individual metabolic cages in a closed, well-ventilated building. During the first phase of this trial (phase 1) each group received different energy diets balanced on a crude and degradable protein, Ca and P equivalent basis. The NRC (1985) feeding standards were used to formulate the medium energy diet, as was described by Bester *et al.* (2004). The energy content of this diet was increased to exceed the energy requirements for growing rams to represent a conditioning diet before sale and decreased to represent a forage diet. The low energy diet contained on a dry matter basis 8.23 MJ ME/kg the medium energy diet 9.77 MJ ME/kg; and the high-energy diet 11.32 MJ ME/kg. All three diets had approximately 136 g crude protein/kg, 85 g degradable protein/kg, 6.5 g Ca/kg and 2.3 g P/kg on a dry matter basis. The rams in each group received the experimental diets on an *ad libitum* basis.

After 127 days, six rams were randomly selected from each group and slaughtered at a commercial abattoir. The carcasses, scrotal and testicular characteristics evaluated. The remaining six rams from each group received the low energy diet for a further period of 90 days (phase 2), before being slaughtered. In this way, the low energy group acted as a control group, while the energy concentration of the medium and high-energy groups was reversed to simulate the situation when rams conditioned for sale are placed back on pastures. The empty stomach body weight and scrotal circumference (measured with a measuring tape) of each ram were determined prior to slaughtering. After skinning and evisceration, the warm carcass weight and the carcass grade were recorded (SAMIC, 2004). The scrota were excised from the carcasses by severing them at their base as close to the body as possible, preserved in refrigeration (4 °C) for 24 h and then weighed and dissected into scrotal skin, testis, fat and epididymis. The weight of each component was recorded and the total volume of the testicles was estimated using the volume of water displaced after submerging both testes in a volumetric measuring cylinder.

The carcass, scrotal and testicular parameters were measured on the six animals slaughtered per group at the end of each phase and compared within dietary treatments, using Proc GLM of SAS (1995).

Results and Discussion

The results of the body weights as well as the most important carcass, scrotal and testicular characteristics of young Dorper rams are summarised in Table 1.

Table 1 Body weight, carcass, scrotal and testicular characteristics (mean ± s.e.) of young Dorper rams at the end of each feeding regime

Parameter	Energy level	Phase 1	Phase 2	Difference
Body weight (kg)	Low	56.5 ± 1.5	62.7 ± 2.0	6.2*
	Medium	65.5 ± 1.1	70.4 ± 0.7	4.9*
	High	71.0 ± 1.4	70.7 ± 1.1	-0.3 ^{ns}
Warm carcass weight (kg)	Low	22.8 ± 1.2	26.6 ± 0.9	3.8*
	Medium	28.8 ± 0.8	32.6 ± 0.5	3.8*
	High	36.0 ± 1.5	34.0 ± 0.3	-2.0 ^{ns}
Carcass grade (0-6)	Low	3.0 ± 0.4	2.5 ± 0.2	-0.5 ^{ns}
	Medium	5.2 ± 0.4	4.2 ± 0.5	-1.0 ^{ns}
	High	6.0 ± 0.0	3.7 ± 0.3	-2.3*
Scrotal circumference (cm)	Low	29.5 ± 1.1	32.2 ± 1.2	2.7 ^{ns}
	Medium	34.5 ± 0.9	33.5 ± 0.6	-1.0 ^{ns}
	High	35.5 ± 0.7	34.7 ± 0.4	-0.8 ^{ns}
Total scrotal weight (g)	Low	646 ± 50	738 ± 36	92 ^{ns}
	Medium	920 ± 54	864 ± 37	-56 ^{ns}
	High	1062 ± 53	877 ± 38	-185*
Scrotal fat (g)	Low	106 ± 16	122 ± 22	16 ^{ns}
	Medium	180 ± 14	172 ± 21	-8 ^{ns}
	High	280 ± 28	194 ± 25	-86*
Scrotal skin weight (g)	Low	161 ± 14	163 ± 13	2 ^{ns}
	Medium	198 ± 6	175 ± 9	-23 ^{ns}
	High	221 ± 12	181 ± 8	-40*
Testes weight (g)	Low	263 ± 27	337 ± 32	74 ^{ns}
	Medium	408 ± 40	373 ± 17	-34 ^{ns}
	High	399 ± 24	359 ± 13	-40 ^{ns}
Epididymis weight (g)	Low	54 ± 1	60 ± 1	6 ^{ns}
	Medium	68 ± 2	66 ± 2	-2 ^{ns}
	High	68 ± 2	60 ± 1	-8 ^{ns}
Testes volume (mm ³)	Low	246 ± 30	324 ± 32	39 ^{ns}
	Medium	380 ± 44	357 ± 16	-11 ^{ns}
	High	384 ± 21	348 ± 10	-18 ^{ns}

ns – Not significant difference between means; * significant difference between means (P < 0.05)

Low energy (8.23 MJ ME/kg DM)

Medium energy (9.77 MJ ME/kg DM)

High energy (11.3 MJ ME/kg DM)

During the second phase of this trial, animals in both the low and medium energy groups gained ($P < 0.05$) body and carcass weight without significant changes in carcass grade as well as scrotal and testicular characteristics. These results suggest that the energy content of the low energy diet (to maintenance level) was still above maintenance requirements. However, reversing the energy levels in the diet of high-energy group resulted in a significant ($P < 0.05$) reduction in carcass grade, scrotal weight, scrotal fat and scrotal skin weight. These changes were observed without significant changes in body and carcass weights as well as scrotal circumference, testis weight, testis volume and epididymis weight.

The detrimental effects of diets with a high-energy concentration on the testicular and seminal characteristics of young males referred in the literature (Coulter *et al.*, 1997; Labuschagné *et al.*, 2002; Fourie *et al.*, 2003) are ascribed to scrotal fat deposition, resulting in impaired testicular thermoregulation. Skinner (1981) suggested that scrotal fat is not mobilized in bulls during periods of energy shortages. The results of the current study indicate that once the energy level of rams previously maintained on a high energy diet was restricted, the animals mobilized fat to maintain their body weight. Fat from various parts of the body including scrotal fat deposited subcutaneously and around the *pampiniform plexus* in the neck of the scrotum were mobilised, as indicated by the significant reduction of both these parameters (Table 1).

Conclusion

Contrary to the suggestions of the literature, it seems that scrotal fat deposits are mobilised during periods of energy restriction and consequently the reported detrimental effects on spermatogenesis may be reversible. What still remains to be evaluated is if the degeneration of the seminiferous tubules reported by Schwalbach *et al.* (2003) as a result of scrotal fat accumulation and consequent thermo-insulation in bulls is reversible. This will determine if the reported negative effects of high-energy diets on the seminal quality of males is truly reversible. Further research is warranted on the long-term effects of highly concentrated diets (above recommended levels) on the fertility of young males of all livestock species.

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