The effect of the anabolic agent, nandrolone laurate, on certain production and reproduction parameters in ram lambs, under intensive and extensive feeding regimes

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Forty Dorper ram lambs were allocated to two trials. In the first trial (intensively housed) and second trial (extensively maintained), one group (*n* = 10) in each trial was treated weekly with an intramuscular injection of an anabolic steroid (50 mg nandrolone laurate) for a 12-week period. The other group (*n* = 10) in each trial served as a control. Several body parameters were measured during this treatment period and monitored for an additional 12-week period. In the intensively and extensively housed groups, treatment with the anabolic steroid did not significantly increase the growth rate when compared to the controls. There was, however, a significant ($p<0.01$) difference in ADG and final body weight between intensive and extensively housed animals. Shoulder height (66.3 vs 66.6 cm and 65.0 vs 66.5 cm); shoulder width (29.7 vs 28.0 cm and 19.0 vs 19.3 cm); bodylength (85.9 vs 86.0 cm and 74.5 vs 75.4cm); cannon bone diameter (2.4 vs 2.2cm and 2.1 vs 2.0 cm); serum testosterone concentration (1.15 ± 0.97 vs 2.21 ± 0.83 ng/ml and 0.15 ± 0.1 vs 0.89 ± 0.58 ng/ml) and FCR (measured only in the intensively housed animals) (7.6 vs 9.4) did not differ significantly between the treated and control animals over the entire observation period for the intensive and extensively housed animals respectively. No significant difference in semen quality was recorded in the intensively housed animals from 3 months following treatment. Scrotal circumference was significantly ($p<0.01$) less in the treated groups (intensive and extensive groups) during the treatment phase, when compared to the controls, with a decrease of 9.5% and 18.4% respectively. Scrotal circumference recovered and increased during the recovery phase. Although use of the anabolic steroid did not result in a significant increase in growth rate (intensive and extensive conditions), it would seem that nutrient availability (metabolisable energy) effected the response. With higher energy diets, a better ADG and FCR could possibly have been attained. The androgenic effect of the steroid treatment retarded testicular development, but this phenomenon was temporary and fertility was normal (when compared to the controls) by 12 weeks following treatment.

Veertig ramlammers is geallokeer tot twee proewe. In die eerste proef (intensief gehuisves) en tweede proef (ekstensief onderhou), is 'n groep lammers (*n* = 10) in elke proef weekliks behandel met 'n binnespierse inspuiting van 'n anaboliese steroied (50 mg nandroloon lauraat) vir 'n periode van 12 weke. Die ander groep (*n* = 10) in elke proef het as 'n kontrole gedien. Verskeie liggaamsparameters is tydens hierdie behandelingsperiode gemeet en vir 'n addisionele 12 week-periode gemonitor. In die intensief en ekstensief gehuisvesde groepe, het behandeling met die anaboliese steroied nie die groeitempo betekenisvol verhoog nie, wanneer vergelyk word met die kontrole diere. Daar was egter 'n betekenisvolle ($p<0.01$) verskil in GDT en finale liggaamsgewig tussen die intensief en ekstensief gehuisvesde diere. Skouerhoogte (66.3 vs 66.6 cm en 65.0 vs 66.5 cm); skouerbreedte (29.7 vs 28.0

cm en 19.0 vs 19.3 cm); liggaamslengte (85.9 vs 86.0 cm en 74.5 vs 75.4 cm); pypbeendeursneë (2.4 vs 2.2 cm en 2.1 vs 2.0 cm); serum testosteroon konsentrasie (1.15 ± 0.97 vs 2.21 ± 0.83 ng/ml en 0.15 ± 0.1 vs 0.89 ± 0.58 ng/ml) en VO (slegs gemeet by intensiewe groep) (7.6 vs 9.4) het nie betekenisvol verskil tussen die behandelde en kontrole diere vir die intensief en ekstensief gehuisvesde diere respektiewelik, oor die hele waarnemingsperiode. Geen betekenisvolle verskil in semenkwaliteit is waargeneem in die intensiewe groep diere, drie maande na behandeling nie. Skrotale omtrek was betekenisvol ($p<0.01$) kleiner in die behandelde diere (intensief en ekstensiewe groepe) tydens die behandelingsperiode, wanneer vergelyk word met die kontrole diere, met 'n afname van 9.5% en 18.4% respektiewelik. Skrotale omtrek het herstel en toegeneem tydens die herstelfase. Alhoewel die gebruik van hierdie steroied nie 'n betekenisvolle verhoogde groeitempo tot gevolg gehad het nie, is dit duidelik dat die beskikbaarheid van nutriente (verteerbare energie) die respons beïnvloed. Met hoër energie diëte, kon 'n veel beter GDT en VO waarskynlik verkry word. Die androgeniese effek van steroiedbehandeling het testikulêre ontwikkeling beïnvloed, maar hierdie verskynsel blyk slegs tydelik te wees en vrugbaarheid (wanneer vergelyk met die kontrole diere) is normaal 12 weke na behandeling.

Keywords: Ram lambs, anabolic steroid, body parameters, nutritional regimes.

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Introduction

In our consumer-driven economy, livestock producers are looking at a variety of techniques to accelerate red meat production in order to meet current human dietary needs (Lough *et al.*, 1993). Anabolic steroids are known to increase muscle protein accretion and should produce high lean:fat carcasses when fed high forage diets (Solomon *et al.*, 1986). Synthetic steroids with androgenic properties are known to alter growth of sheep and cattle when given exogenously. The mode of action of some of these agents is reviewed by Hancock *et al.* (1991) and it would seem that differences in the mechanism of action in naturally occurring and synthetic androgens appear to exist. Growth is not simply an increase in the size of an animal. It is convenient to define it in terms of an increase in body protein, which is maximal at an earlier age and decreases substantially by the time that fat deposition becomes apparent later in life (Lindsay, 1983). Growth can be seen as a complex, biological phenomenon involving interactions between hormonal, genetic, nutritional and metabolic factors (Roche & Quirke, 1986). Although body weight is an important indicator of growth, it fails to indicate the composition of the animals (Mahgoub & Lodge, 1994) and therefore measurements of the animal's frame can be considered as indirect indicators for the determination of meat leanness (Boggs & Merkel, 1984).

The manipulation of protein synthesis with the aid of anabolic agents affords a practical way of increasing the efficiency of meat production. These agents are usually substances with physiological properties similar to those of the sex steroids and their biological activity is classified as oestrogenic, androgenic or gestagenic, depending on their chemical structure (Heitzman, 1980; De Haan *et al.*, 1990; Lough *et al.*, 1993). Although the use of anabolic steroids such as nandrolone laurate (a synthetic testosterone which is most potent), has been shown to increase nitrogen retention and protein deposition, its androgenicity could prevent its use as anabolic stimulant (Brander & Pugh, 1977). Growth without feed or nutrition is an oxymoron, as it can only occur when sufficient nutrients are consumed and absorbed on a daily basis (Reeds *et al.*, 1993). When anabolic agents are used for an enhanced growth rate, this demand for essential nutrients can only increase. A lack of nutrients could thus place a limitation on the response obtained.

The anabolic agent nandrolone laurate (used in this trial) has allegedly been used by sheep breeders to achieve the same effect as in athletes — increased muscle deposition and improved performance. However, the implications on the long-term fertility of rams (owing to the negative feedback effect of the androgens on the hypothalamus), are a matter of concern. This study was thus initiated to evaluate the production and reproduction performance of ram lambs, following treatment with nandrolone laurate (which differs from testosterone only in the absence of a methyl group at the C-19), under intensive and extensive nutritional regimes.

Material and methods

Forty Dorper ram lambs at weaning (3 months of age), were used in two trials. In the first trial (intensive phase), 20 ram lambs were individually housed and fed a pelletted diet (10.3 MJ ME/kg) *ad lib* for a period of 6 months (April to October). In the second trial (extensive phase), 20 ram lambs were maintained (south-western Free State) extensively on natural pastures (Karoo-type) for a period of 6 months (April to October).

During both phases each group ($n = 20$) was divided into two groups of 10 animals each. Ten ram lambs per trial were treated with a weekly intramuscular injection of 1 ml (50 mg) each of the anabolic steroid, nandrolone laurate (Laurabolin, Intervet, Netherlands) for a period of 12 weeks. The remaining 10 animals in each trial acted as controls. Treatment with the anabolic steroid thus started at 3 months of age and ceased at 6 months of age. The observation period of 3 months following treatment was seen as the recovery phase in which no exogenous agents were administered and only measurements were taken (total observation period of 6 months).

During the intensive and extensive phase, the following parameters were recorded weekly:

(i) Body weight (kg), following a 12 h fasting period;
(ii) Shoulder height (cm), measured vertically from the thoracic vertebrae to the ground;
(iii) Shoulder width (cm), determined with the aid of a special caliper, as the horizontal distance between the processes on the left shoulder blade (tuber spinae) and that on the right shoulder blade;
(iv) Body length (cm) as measured from the sternum (manubrium) to the aitch-bone (tuber ischiadicum);
(v) The diameter (cm) of the cannon bone (metacarpus) in the middle of the right fore-leg;
(vi) Testicular size (cm) was determined by measuring scrotal circumference (Knight, 1977);
(vii) In the intensive housed group, weekly feed intake (kg) was recorded for a 16-week period (12 weeks of treatment and 4 weeks recovery) to determine the feed conversion rate (FCR);
(viii) In the intensive housed group, semen quality tests were carried out every second week from the age of 9 months (end of observation period) for an 8-week period. Semen quality parameters recorded following semen collection with the aid of the artificial vagina, were: volume (ml), motility (scale of 0 to 5), percentage live sperm (smear), semen density (determined with the aid of a haemocytometer) and semen pH (with the aid of a pH-meter) (Greyling & Grobbelaar, 1982);
(ix) Serum testosterone concentrations were determined in five animals in each group. Blood was sampled from the vena jugularis at weekly intervals for the total 24-week observation period. Serum was recovered and stored at –20°C until assayed for serum testosterone concentration by RIA, which was performed with a Coat-A-Count kit for solid phase radio-immunoassay, based on testosterone specific antibody immobilized to the wall of a polypropylene tube (Coat-A-Count, total testosterone; Diagnostic Products Corporation, Los Angeles). The intra and interassay coefficients of variation for serum testosterone were 7.7% and 12.9% respectively.

All data were statistically analysed with the aid of repeated measures analysis, at the 1% and 5% level of significance. To determine which group performed best, the smallest significant differences were determined and compared (Snedecor & Cochran, 1980).

Results and discussion

The mean body weights of the ram lambs for the intensive phase observation period of 24 weeks are set out in Figure 1 and Table 1. No significant difference in growth rate between the treated and control groups was observed for the treatment period or the entire observation period. This is in agreement with results reported by Greyling *et al.* (1993), but the 15.3% difference in body weight gain for the Dorper ram lambs during the treatment phase and 26.9% for the total observation period is higher than that reported by Greyling *et al.* (1993) for Ile de France ram lambs and in line with that obtained by Sulieman *et al.* (1986) and Heitzman (1980). In the extensive trial (Figure 1) there was no difference between the treated and control ram lambs in the percentage body weight gain for the treatment period (21.7% vs 21.6% for the steroid tested and control lambs respectively). It is evident that the use of nandrolone laurate under extensive conditions with no feed supplementation had no beneficial effect on growth. This is in agreement with Stamataris *et al.* (1991) who stated that animals may experience a stage during which, through nutritional limitation, they may grow at a sub-optimal rate relative to their genetic capacity or the potential of the growth promoting agents. The physiological stage (age) of the animals could also make it more difficult for the anabolic agent to make a significant difference in growth rate. Growth as such can only occur when appropriate quantities of nutrients (energy, protein, vitamins and minerals) are consumed on a daily basis (Baker *et al.*, 1993). As a result of the relatively low energy and protein content of the diet fed in the intensive trial (10.3 MJ ME/kg and 13% respectively) and the very low energy and protein content (7.6 MJ ME/kg and 3.6% respectively) in the extensive group maintained on natural pastures, a smaller growth response was obtained, compared to the intensive group, following the use

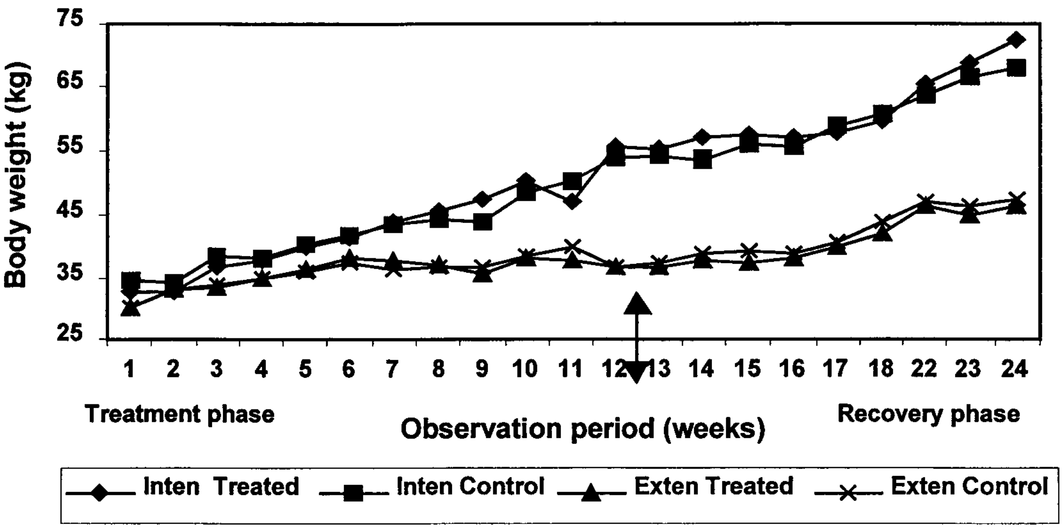

Figure 1 The effect of nandrolone laurate treatment on body weight for intensively and extensively maintained Dorper ram lambs.

Table 1 Mean (± *SD*) values of parameters measured following treatment with nandrolone laurate at the end of different phases, in intensive and extensive nutritional regimes

	Intensive Regime		Extensive Regime	
Parameter	Treated	Control	Treated	Control
Initial Measurements (week 1)				
Body weight (kg)	32.5 ± 7.9	34.6 ± 7.9	30.0 ± 2.6	30.1 ± 1.1
Shoulder height (cm)	57.3 ± 2.1	57.5 ± 2.5	57.1 ± 2.9	59.0 ± 3.1
Shoulder width (cm)	18.0 ± 3.2	17.9 ± 2.5	15.6 ± 1.2	15.8 ± 1.3
Body length (cm)	61.7 ± 3.4	63.5 ± 3.0	65.3 ± 3.2	64.9 ± 1.8
Cannon bone diameter (cm)	2.0 ± 0.1	2.0 ± 0.1	1.8 ± 0.3	1.9 ± 0.3
Scrotal circumference (cm)	27.3 ± 7.3	26.1 ± 4.8	22.8 ± 3.6	23.9 ± 1.3
FCR	5.8	6.2	NM	NM
Serum testosterone concentration (ng/ml)	1.09 ± 0.77	4.46 ± 2.33	0.35 ± 0.38	0.83 ± 1.02
Treatment Phase (week 12)				
Body weight (kg)	55.8 ± 78	54.1 ± 11.8	36.5 ± 3.8	36.6 ± 1.8
Shoulder height (cm)	63.8 t 2.2	60.7 ± 3.0	62.6 ± 2.0	63.1 ± 4.1
Shoulder width (cm)	23.3 ± 1.2	22.8 ± 2.8	17.5 ± 1.4	18.1 ± 0.6
Body length (cm)	77.9 ± 4.5	78.3 ± 6.0	68.4 ± 3.5	67.2 ± 3.3
Cannon bone diameter (cm)	2.3 ± 0.1	2.2 ± 0.2	2.1 ± 0.2	2.0 ± 0.1
Scrotal circumference (cm)	24.7 ± 4.5	31.7 ± 5.2	18.6 ± 1.7	27.4 ± 2.1
FCR	7.0	8.4	NM	NM
Serum testosterone concentration (ng/ml)	0.51 ± 0.43	2.05 ± 1.47	0.24 ± 0.26	0.5 ± 0.64
Recovery Phase (week 24)				
Body weight (kg)	72.6 ± 8.1	68.0 ± 5.9	46.7 ± 5.6	47.5 ± 4.3
Shoulder height (cm)	66.3 ± 3.3	66.6 ± 2.1	65.0 ± 2.3	66.5 ± 4.1
Shoulder width (cm)	29.7 ± 2.6	28.0 ± 3.6	19.0 ± 1.3	19.31 ± 1.1
Body length (cm)	85.9 ± 4.2	86.0 ± 2.2	74.5 ± 2.8	75.4 ± 4.0
Cannon bone diameter (cm)	2.4 ± 0.2	2.2 ± 0.3	2.1 ± 0.1	2.0 ± 0.3
Scrotal circumference (cm)	32.3 ± 4.2	32.6 ± 3.4	23.0 ± 4.9	31.5 ± 2.0
FCR	7.6	9.4	NM	NM
Serum testosterone concentration (ng/ml)	1.15 ± 0.97	2.21 ± 0.83	0.15 ± 0.1	0.89 ± 0.58

NM = Not measured

of the anabolic steroid, nandrolone laurate. This would probably not have been the case had a finishing diet (high energy content) been used. This can be attributed to the fact that part of the protein is utilized to provide for the energy needs where inadequate energy is provided for growth, thus resulting in a decreased protein utilization and deposition rate (Van der Merwe *et al.*, 1975).

Several significant correlations between body weight and certain body parameters for lambs were recorded. According to Hall (1991), the relationships among body dimensions were strong and predictable, but Atkins & Thompson (1986) suggested the correlation of parameters with body weight to be the true link and the only one to be of any importance. For the intensively treated ram lambs and their controls, the correlations between bodyweight and body length, shoulder width, shoulder height and scrotal circumference were $r = 0.92$ ($p<0.01$) vs $r = 0.94$ ($p<0.01$); $r = 0.95$ ($p<0.01$) vs $r = 0.94$ ($p<0.01$; $r = 0.76$ ($p<0.05$) vs $r = 0.81$ ($p<0.01$) and $r = 0.95$ ($p<0.01$) vs $r = 0.96$ ($p<0.01$) for the treated and control animals respectively. In the extensively maintained ram lambs, the correlations of body weight with body length, shoulder width, shoulder height and scrotal circumference were only significant ($p<0.01$) in the steroid treated animals ($r = 0.86$; $r = 0.83$; $r = 0.90$ and $r = 0.79$ respectively).

In the intensively housed group, the shoulder height of the ram lambs at the end of the 24 week observation period did not differ significantly between the treated and control animals (66.3 cm vs 66.6 cm respectively). During the treatment phase however, the steroid treated rams showed a 6.5 cm increase, compared to the 3.2 cm increase of the control group. The extensively kept animals showed a less pronounced response compared to the intensive group regarding shoulder height. At the end of the treatment phase, the treated and control rams showed an increase of 5.5 cm and 4.1 cm in shoulder height respectively (compared to 2.4 cm and 3.4 cm in the recovery phase). There was no significant difference in the end values obtained for shoulder height for the lambs kept in the intensive or extensive environments (Table 1).

Regarding the shoulder width of the intensively housed males, a 29.4%, 27.5%, 27.4% and 22.8% rate of increase was recorded for the steroid treated and control groups, during the treatment and recovery phases respectively (total 6 month period). For the extensive phase, the differences between and within groups were once again far less prominent than during the intensive trial. The increase in shoulder width for the steroid treated rams during the treatment phase (12 weeks) was 12.2% and for the recovery phase (12 weeks) was 8.6%. These values did not differ significantly from those of the control animals. The total increases in shoulder width over the 6 month observation period for the intensive and extensive phases in the steroid treated males were 65% and 21.8%, compared to 56.4% and 22.2% for the controls respectively.

Body length for the intensively housed lambs showed no significant difference following treatment with nandrolone laurate (77.9 cm for the treated and 78.3 cm for the control animals respectively). The same tendency was recorded for the recovery period. Highly significant ($p<0.01$) correlations were obtained for body length and shoulder height ($r = 0.86$), shoulder width ($r = 0.8$), body weight ($r = 0.92$) and scrotal circumference ($r = 0.86$) in these steroid treated males. According to Mahgoub & Lodge (1994) and Fossceco & Notter (1995), most body measurements e.g. body length are associated with bone growth. Some parameters like shoulder height and shoulder width grow at a slower rate than body length, while these linear body measurements are also highly correlated with live weight. The extensively maintained males showed an increase in body length of 14.1% and 16.9% (treated and control respectively), over the entire observation period. Although early closure in the growth plate of bone in growing animals is suggested following treatment with the anabolic steroid nandrolone, with a resultant retardation of bone growth rate (Brander & Pugh, 1977), no significant response to nandrolone treatment was induced in this trial. There was, however, a tendency for shoulder height and body length to be less in treated animals, compared to the controls. The treatment period was possibly either too short or the dose of nandrolone too small to have a significant inhibiting effect.

Cannon bone diameter (as a possible indicator of the retardation of bone growth following steroid treatment) in the intensively housed males showed an increase of 16.5% in the treated and 11% in the control group — which is contradictory to what was expected. These parameters measured during the intensive phase are comparatively higher (though not significant) than in the extensively maintained animals. For the extensive phase, no significant correlations were recorded between cannon bone diameter and other body parameters.

The most obvious changes were recorded for scrotal circumference (Figure 2). However, at the end of the entire observation period (6 months), there was no significant difference between the nandrolone treated and the control rams in the intensive group. This implies a relatively fast recovery in the development of testicular function. The percentage decrease in scrotal circumference during the nandrolone treatment phase was 9.5%, compared to an increase of 21.5% ($p<0.01$) in the control animals during the same period. The treated males compensated significantly ($p<0.01$) during the recovery phase, with an increase of 30.8% in testicular growth, compared to 2.8% in the controls. Scrotal circumference was significantly ($p<0.01$) correlated in the treated and control animals respectively with body length ($r = 0.86$; $r = 0.92$), shoulder width ($r = 0.89$; $r = 0.98$) and body weight ($r = 0.95$; $r = 0.96$). The same tendency, although less dramatic was observed in the rams maintained on natural pastures. In the extensive group, a significant ($p<0.05$) difference in the increase in scrotal size for the entire observation period was recorded for the treated and control animals (8.8% vs 31.8% respectively). In the treated group, the scrotal circumference decreased by 18.4% (4.2 cm), compared to an increase of 14.6% (3.5 cm) in the control group. Following both the treatment and recovery phase, the extensive control animals had significantly ($p<0.05$) larger testes than the treated animals — indicating a slower recovery rate in the latter. Scrotal circumference was not significantly correlated to serum testosterone concentrations (treated and control animals) in both the intensively and extensively housed groups. This is in agreement with Greyling *et al.* (1993) and the low serum testosterone values obtained in all groups are in line with the values obtained by Field *et al.* (1989). The differences in serum testosterone concentrations between the treated and control animals (intensive and extensive) were not significant. The lower serum testosterone concentration recorded in the steroid-treated animals can possibly be attributed to the negative feedback of exogenous testosterone on the hypothalamus and hence on endogenous

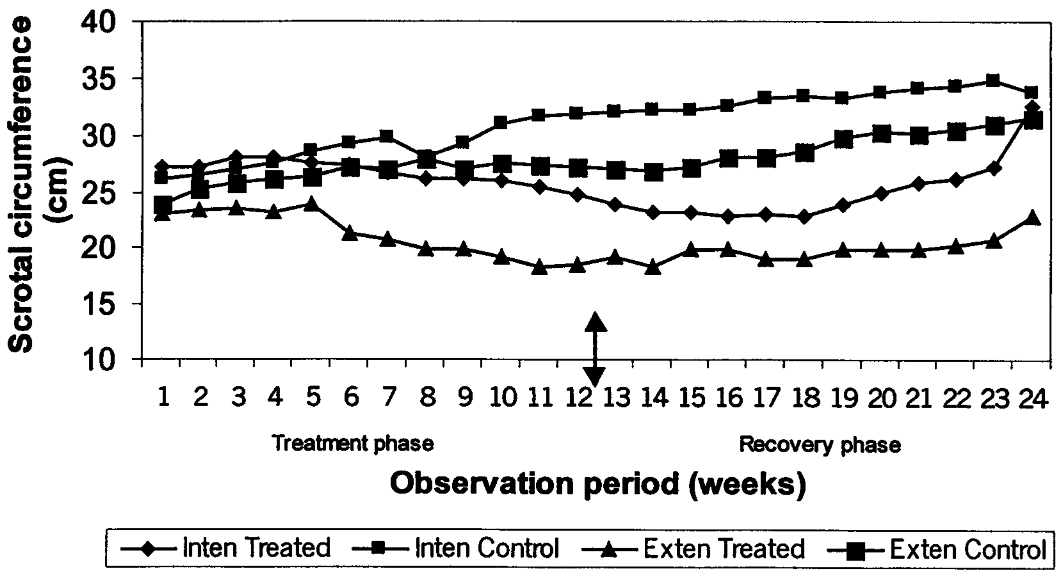

Figure 2 Effect of nandrolone laurate treatment on scrotal circumference for intensively and extensively maintained Dorper ram lambs.

testosterone production. The age of the lambs (3 to 9 months of age) could play a role in the testosterone levels recorded. According to Hunt *et al.* (1991) the circulating serum testosterone concentration was decreased by anabolic implants (TBA) in cattle and increased to normal levels within 60 days following treatment. Owing to the pulsatile nature of natural testosterone secretion, the exact recording and interpretation of the serum testosterone levels is difficult (Sanford *et al.*, 1977). Deprivation of physical heterosexual contact (and age) is generally associated with an absence in endocrine testosterone response (Illius *et al.*, 1976). It is interesting to note the lower serum testosterone concentrations initially recorded and experienced throughout the extensively housed ram lambs, when compared to the extensive group. Nutrition is essential in maintaining and increasing the endocrine system of the body. The pattern of testis development shows a definite inhibition in growth following the administration of the anabolic steroid, nandrolone laurate. Following the cessation of treatment there is compensatory growth and by 3 months following treatment, all rams were "back to normal" regarding scrotal circumference (in the intensive group). This compensatory response was much greater with the higher energy diet of the intensively housed males.

Feed conversion rate (FCR) was only determined in the intensively housed animals for the first 16 weeks of the observation period. The treated rams had a significantly ($p<0.05$) better FCR over the entire period, compared to the controls (7.6 vs 9.4 respectively). The best FCR was obtained during the treatment period (7.0). This best FCR coincided with the period of highest weight gain (ADG of 277.4 g) and the period of highest daily feed intake (1.93 kg). These FCRs in the trial are substantially higher than the 6.53 quoted for Dorper lambs, using a finishing diet (Van der Merwe *et al.*, 1975), implicating nutritional limitations in the diet used in this trial.

The semen quality parameters monitored for the steroid treated and control animals in the intensively housed group are set out in Table 2. From the sperm motility, percentage live and the ejaculate volume, it is evident and would seem that the treated rams in the intensively housed group were fully fertile by 8 weeks (repeatable measurements) following the 12 week recovery phase and possibly even earlier. It would thus seem that although testicular development was retarded during treatment with anabolic steroids, normal testicular function was possibly soon restored. It would seem that treatment had no long-term effect on ram fertility in this trial. It is evident from the parameters recorded, that by 3 months following steroid treatment, the rams had sufficiently recovered and spermatogenesis appeared 'normal'. It would thus seem as if the inhibitory effect of nandrolone laurate on testicular development and testis function by steroid treatment is only temporary and the males recover without any apparent loss in potential fertility, as measured by semen quality (Hunt, *et al.*, 1991). By 3 to 5 months after the last steroid treatment, there was no significant differ-

Table 2 Mean values (±*SD*) for semen parameters in steroid treated and control rams in the intensive housed group, over an 8-week period

	Steroid Treated*		Control*	
Parameter	Mean	±SD	Mean	±SD
Volume (ml)	0.97	0.21	0.91	0.31
Motility (0–5)	2.99	0.31	3.11	0.34
% Live sperm	82.54	8.2	85.05	4.44
pH	6.97	0.22	7.0	0.19
Sperm concentration ($\times 10^9$/ml)	2.39	0.41	2.44	0.3

* No significant differences

ence regarding semen quality or quantity. Anabolic hormones are said to have an effect on the hypophyseal-testes axis, via LH hormone concentration as is reflected in decreased testes function (Gettys *et al.*, 1984).

Conclusions

Although no significant difference in growth rate was obtained in the intensively and extensively housed groups, this could be ascribed to a lack in high energy diets. FCR obtained in this trial was relatively high, once again owing to lack of high-forage diets. There were strong correlations between body weight and the other parameters measured. The most dramatic androgenic effect of the use of anabolic steroids was on scrotal circumference — which could imply testicular disfunction. This phenomenon was, however, only temporary and fertility was not affected in the long term. Additional studies are needed to record maximum growth and FCR responses following anabolic steroid treatment in rams, especially post pubertal males with complete semen, libido and serum testosterone analyses.

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