Performance and Feed Utilisation in Saanen Goats as Influenced by Castration and Diet

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Abstract

A growth performance study was conducted on 30 male and 30 castrate growing Saanen goats. Observations were made in 3 stages; from 5 days to weaning at 36 days; from weaning to 24.5 kg live weight and from 24.5 kg live weight to 36.5 kg live weight. The number of animals per treatment was decreasing with period as three animals and six animals were slaughtered at weaning and at 24.5 live weight for carcass composition studies. The goats were either fed ad libitum barley - based concentrate diet or lucerne pellets. During the weaning to 24.5 kg live weight period, 12 goats (6 males and 6 castrates) were allocated to the two dietary treatments and assessed for feed digestibility, nitrogen utilization and water intake. There were little castration and diet effects on performance of goats from arrival to weaning. Males grew faster (222 vs 183 g/day), had lower feed conversion ratios (3.13 vs 4.11 g DM/g gain) and higher dry matter intake (751 vs 744g/day) than castrates during the weaning to 24.5 kg live weight period. However, in the 24.5 to 36.5 kg live weight period, castrates were superior to male goats in most parameters studied. Digestibility coefficients were higher in barley - based diet. Dry matter intake as percentage of live weight ranged from 2.51 to 3.86. Nitrogen was better retained in goats on barley concentrate. Goats consumed water equivalent to 8 to 12 % of their live weight with higher values being for goats fed lucerne diet.

Key words: *Castration, diet, feed conversion, Saanen goats*

Introduction

There is scarce information on the effect of castration on growth rate and feed utilisation in goats under intensive systems in temperate countries. Differences in the rate of gain between castrates and males are unclear in goats. It has been conclusively shown that male animals grow faster and utilise feed better than castrated animals in cattle and sheep (Bradfield, 1968; Hedrick, 1968; Turton, 1969; Price and Yeates, 1971; Field, 1971). Mackenzie (1970), working with British Toggenburg goats concluded that castration makes full use of meat potentialities of surplus male goats as castrated goats grow faster and are heavier than male goats. In agreement with this view, Kyomo (1978) found that castrated Small East African goats are heavier than entire males from weaning to 72 weeks of age. However, Nitter (1975), found that male German Fawn breeds of goats grow faster than castrates, a conclusion also reached by Louca *et al.* (1977) with Damascus goats. Recently Aregheore (1995) with dwarf goats of West Africa found that males grew faster than castrates, the magnitude of difference depending on the level of feeding. The potentials for growth and feed utilisation in Saanen male and castrate goats based on concentrate and grass diets have not been documented. The aim of the present study was therefore to investigate the effects of castration and diet on performance of Saanen goats.

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Material and Methods

Sixty male British Saanen goats were used in an experiment to test the effect of castration (males vs castrates) and the diet (barley - based concentrate vs lucerne pellets) on growth performance and feed utilisation in a 2x2 factorial experiment. Animals were purchased from farmers at 2 - 3 days of age and were randomly allocated to the four treatments. Arrival weight was obtained by weighing the kids on the day of collection from the farms around Reading University (U.K) where the experiment was conducted. Castration took place on 11 ± 1 days of age using rubber rings. Besides the treatments, all kids were fed artificial milk (Denkavit Lamb 211) *ad libitum* from arrival to weaning at 35 days of age. The number observations per treatment was decreasing with period as three animals and six animals were slaughtered per treatment at weaning and at 24.5 live weight for carcass composition studies.

Table 1. Chemical composition of the diets (g/kg dry matter)[1]

	Barley concentrate	Lucerne pellets
	Mean ± SD	Mean ± SD
Dry matter (g/kg air dry weight)	900 ± 4	900 ± 12
Crude protein	199 ± 3	199 ± 5
Ether extract	27 ± 1	26 ± 1
Ash	65 ± 5	98 ± 1
Calcium	18 ± 1	31 ± 5
Phosphorus	4 ± 0.3	2 ± 0.8
Lignin	14 ± 2	89 ± 8
Energy (MJ/kg DM)	18.62 ± 0.79	18.68 ± 0.29

[1]**Mean of 8 samples.**

The barley - based concentrate and lucerne pellets were fed *ad libitum*. The barley diet consisted of milled barley, soybean meal, fish meal, molassine meal, ground limestone, salt and Isaac Spence minerals at 800, 100, 50, 30, 15, 4 and 1 g/kg DM. According to the manufacturer's specifications each 1000 g of Isaac Spence minerals consisted of 105.5g Ca, 34.7 g P, 97.9 g Na, 150.8 g Cl, 137.5 g Mg, 9.7g Fe, 0.8 g Mn, 0.13 g Co, 0.21 g I and 110 000 1U Vitamin D. The barley diet was not pelleted. Lucerne was dehydrated, milled and pelleted at the Reading University Farm. The pellets measured 30 mm long and 10 mm thick. Animals were individually penned. Water was available all the time. Animals were weighed weekly and daily dry matter intake was recorded.

Six male and six castrate goats in the weaning to 24.5 kg live weight period were randomly allocated to the two dietary diets in digestibility, nitrogen utilisation and water intake studies. There was an 8 - day collection period. During the collection period, daily intake of feed and water was measured. Faecal and urine outputs were also recorded. Faeces and urine were preserved according to Schneider and Flatt (1975). AOAC (1975) methods were used in analysing the chemical components.

Results

The chemical analyses of the barley concentrate and lucerne diets are shown in Table 1. The two diets were almost *iso*-caloric and *iso*-nitrogenous in content.

Castration and diet had no significant ($P > 0.05$) effects on weaning weight, feed intake and feed conversion ratio from arrival to the University Farm (about 4 days of age) to weaning at 35 days of age (Table 2). Male goats grew faster ($P < 0.001$) than castrates, the difference being 39 ± 9 g/day. Castrates took longer (16 days) time to reach the target weight of 24.5 kg and hence consumed more dry matter. Castrate goats had higher ($P < 0.001$) feed conversion ratios than male goats, i.e they had poorer feed utilisation. Goats fed barley concentrate diet exhibited higher ($P < 0.001$) growth rates than those fed lucerne and the difference in growth rate was 25 g/day. Daily dry matter intake was higher ($P < 0.001$) in goats fed lucerne. Feed utilisation was poorer in lucerne fed goats compared to goats on barley concentrate ($P < 0.001$).

Table 2. Effect of castration and diet on performance of goats in different weight periods[1, 2]

	Castration			Diet		
	Male	Castrate	SED	Barley	Lucerne	SED
Arrival - weaning						
No. of animals	30	30		30	30	
Weight at weaning (kg)	8.16	8.10	0.31	7.98	8.27	0.31
Daily DM intake (g)	184	182	10	183	183	10
Daily energy intake (MJME)	3.73	3.84	0.16	3.81	3.76	0.16
Growth rate (g/day)	130	125	10	124	128	10
FCR (gDM/g gain)	1.44	1.49	0.09	1.49	1.44	0.09
Weaning - 24.5 kg						
No. of animals	24	24		24	24	
Weight at weaning (kg)	7.91	7.75	0.34	7.62	8.05	0.34
Actual weight at 24.5 (kg)	26.03	25.59	0.44	25.42	26.48	0.48
Age at 24.5 kg (days)	117	132	5.0**	118	131	5.0*
Daily DM intake (g)	751	744	30	605	830	30
Daily energy intake (MJME)	7.67	7.50	0.24	7.72	7.45	0.24
Growth rate (g/day)	222	183	9***	215	191	9*
FCR (gDM/g gain)	3.13	4.11	0.16**	3.13	4.39	0.16***
24.5 - 36.5 kg						
No. of animals	12	12		12	12	
Actual weight at 24.5 kg (kg)	25.29	25.02	0.32	24.94	25.37	0.32
Actual weight at 36.5 kg (kg)	37.84	38.00	0.16	37.84	38.00	0.16
Age at 36.5 kg (days)	194	184	9	174	204	9**
Daily DM intake (g)	1094	1290	76**	1055	1334	76*
Daily energy intake (MJME)	10.99	12.69	0.59	12.19	11.48	0.57
Growth rate (g/day)	185	234	21.7**	237	182	21.7*
FCR (gDM/g gain)	5.94	5.51	0.56	4.45	7.32	0.56

[1]Animals on arrival weighed 4.0 - 4.45 kg
[2]In this and subsequent tables, * P < 0.05, ** P < 0.01, and *** P < 0.001. Figures without these asterisks are not significantly different P > 0.05.

There was a change in sex effect on most characteristics studied in the 24.5 to 36.5 kg live weight. Castrate goats grew faster (P< 0.05) than males and the difference in growth rate was 49 ± 21 g/day. Castrate goats had also higher dry matter intake (P< 0.05) and higher but not significant (P>0.05) metabolizable energy intake. The trend in performance of goats fed barley concentrate within the 24.5 - 36.5 kg growth period was similar to earlier periods. Animals on barley concentrate grew faster by 55 ± 22 g/day (P< 0.05) compared to those

offered lucerne and had lower (1055 vs 1334g) dry matter intake but higher (12.19 vs 1.48MJ) metabolizable energy intakes and feed conversion ratios. Goats on barley concentrate consumed dry matter, which was equivalent to 2.51% of live weight while goats on Lucerne consumed dry matter, which was 3.86% of live weight (Table 3).

In general, digestibility coefficients (Table 3) were not affected by castration (P> 0.05) although there was a tendency for castrates to exhibit lower digestibility coefficients. However, differences in digestibility coefficients in favour of goats fed barley concentrate were significant (P< 0.001).

Table 3. Digestibility as influenced by castration and diet

	Castration			Diet		
	Male	Castrate	SED	Barley	Lucerne	SED
No. of animals	6	6		6	6	
Daily intake						
Dry matter (g)	946	1056	74	775	1222	74***
DM(% live weight)	2.95	3.46	0.14*	2.51	3.86	0.14***
Gross energy (MJ)	17.62	19.59	1.38	14.43	22.78	1.38***
Crude protein (g)	185	206	14	154	236	14***
Digestibility coefficients (%)						
Dry matter	68	66	0.9	77	58	0.9***
Organic matter	70	68	0.9	79	59	0.9***
Energy	69	67	0.9	78	58	0.9***
Protein	75	73	0.8	80	68	0.8***

Goats fed barley concentrate were more efficient (P< 0.001) in nitrogen utilisation than goats fed lucerne (Table 4), the differences being 14.24 ± 1.93 and 11.69 ± 2.65g per 100 g of nitrogen intake and digestible nitrogen intake respectively. The differences between male and castrate goats were small (P>0.05). Castration had no effect on voluntary water intake (Table 4). Goats fed lucerne consumed more water (P<0.001) in absolute amounts, as a proportion of live weight and per kg dry matter, the differences being 2.29 ± 0.052 kg, 7.22 ± 1.585 kg and 1.15 ± 0.48 kg respectively. Lucerne-fed goats consumed about one and half times of dry matter and about twice of ash compared to barley-concentrate-fed goats.

Table 4. Nitrogen retention and water utilization as influenced by castration and diet

	Castration			Diet		
	Male	Castrate	SED	Barley	Lucerne	SED
No. of animals	6	6		6	6	
Dry matter intake (g/day)	946	1051	84	775	1222	84***
Ash intake (g/day)	76	89	7	50	115	7***
Nitrogen intake (g/day)	29.56	32.86	2.92	24.71	37.74	2.29***
Nitrogen retention						
g/day	9.20	10.66	1.07	9.97	9.89	1.07***
% intake	32.78	33.56	1.93	40.29	26.05	1.93***
% digested	43.19	44.99	2.65	49.94	38.25	2.65***
Water intakes						
Kg/day	2.58	2.76	0.05	1.53	3.82	0.05***
kg/kg DM	2.72	2.62	0.48	1.97	3.12	0.48***
% live weight	8.00	9.0	1.58	4.94	12.16	1.58***

Discussion

Diets in the present study were formulated in such a way as not to be limiting in energy and protein according to nutrient requirements of growing dairy goats (Devendra and McLeroy 1982). It can be concluded that from birth to weaning, growth rate of Saanen goats can range from 124 to 130 g/day while from weaning to 24.5 kg live weight and from 24.5 to 36.5 kg live weight expected growth rate can range from 183 to 222 and 182 to 234 g/day respectively.

Similar growth rate values have been reported with other dairy goat breeds in Europe under intensive systems (Fehr *et al.* 1976, with Alpine goats; Nitter 1975, with German goats; Ladipo 1973, with a mixture of dairy goats). In Tanzania and other parts of the tropics, growth rate ranging from 20 to 60 g/day has been reported for tropical goats under varying degrees of intensity of management (Mtenga and Shoo 1990; Mtenga and Kitalyi, 1990; Aregheore, 1995) Thus a great potential apparently exists for improving tropical breeds of goats by crossing with European breeds provided proper consideration is given to management and feeding.

The influence of castration on pre-weaning growth rate was small and non-significant in agreement with Peters and Heaney (1974) findings. Performances of kids were not influenced by dam milk yield as they were artificially reared. The performance characteristics in the weaning to 24.5 kg interval, in favour of males have been reported in other breeds of goats (Louca *et al.* 1977; Nitter, 1975) and in cattle and sheep (Turton, 1969). This is mainly attributed to sex hormones (Turton, 1969; Field, 1971). The claim by Mackenzie (1970) and later by Kyomo (1978) that castrates grow faster than males is difficult to reconcile with the present findings.

An interesting and important aspect in the present study is the reduced growth rate observed for male goats in the 24.5 to 36.5 kg live weight period, which was accompanied by slight reduction in feed intake. Similar reductions in growth rate in male goats have been observed in Damascus goats (Louca *et al.* 1977) and are attributed to breeding season effect, which was in August to October in the present study. During this period, the male goats exhibited strong sexual activity and were restless. This could to a large extent account for the reduced feed intake and lower growth rate in these animals. The findings by Fehr *et al.* (1976) and Louca *et al.* (1977) that feed conversion ratio (FCR) increases with increasing live weight in goats are in agreement with the present findings.

During the weaning to 24.5 kg live weight and 24.5 to 36.5 kg live weight intervals, daily dry matter intakes were 37% and 26% more for lucerne-fed than for barley-fed goats respectively. The metabolizable energy concentration of the

barley was 33% greater than that of lucerne. However, the greater intake of the lucerne diet were such that ME intakes on the barley diets were only 4 - 6% greater than those on the lucerne diets. These suggest that goats on low energy diets (lucerne in the present study) tend to increase their dry matter intake in an attempt to sustain the same metabolizable energy as that of goats on high-energy diets (Barley concentrate). However, in the present study animals on low energy diets failed to compensate fully. Similar arguments were advanced by Forbes (1977) and Kearl (1982) who argued that animals tend to consume dry matter to meet their physiological energy requirements until gut fill becomes a limiting factor. Digestibility coefficients of 0.75 - 0.82 have been quoted for barley diets and 0.55 - 66 for lucerne (Ørskov *et al.*, 1974; Wainman, 1977). These values are similar to those in the present study (Table 3).

Voluntary food intake as percentage of live weight is a much used measure of intake capacity. The dry matter intakes of 2.51 - 3.86% obtained in the present study are in the agreement with those reported in other breeds of goats, as reviewed by Devendra and Macleroy (1982). The elevated proporttion of nitrogen appearing in the urine and faeces of goats fed lucerne as reflected in less nitrogen retention is suggestive of a greater extent of formation of ammonium and other related non-protein nitrogenous substances in the rumen and hind gut which are then absorbed and subsequently lost via the kidney and undigested protein. Mtenga and Shoo (1990) and Mtenga and Kitalyi (1990) came up with the same conclusion.

Water intake increases with increase in dry matter intake (Anand, 1961). The present study shows that the goat is no exception. It has been recommended that water intake for growing lambs has to be regarded as 2.00 and 2.50 kg/kg dry matter consumed respectively at environmental temperatures of 15° C and 15 - 20°C (Devendra and Macleroy, 1982). A similar value of 2.52 -2.62 kg/kg dry matter was obtained in the present study under a mean temperature of 17°C. Higher water intake for goats fed lucerne in the present study may have been simply a reflection of higher dry matter, ash and nitrogen intake observed in these animals. It has been demonstrated that animals have the capacity to cope with high levels of ash and nitrogen by consuming more water (Roubicek, 1969) and through renal adjustment which favours increased filtration (Andersson and Olsson, 1970). The excess water is excreted as urine and with it the excess ash and nitrogenous products.

Conclusion

It can be concluded that diet and castration has little effect on growth performance and feed utilization in goats from birth to weaning. However, castration has influence on growth performance depending on the interval period under study. Goats on high-energy diets grow faster and utilize feed more efficiently than those on low energy diets.

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