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Small Ruminant Research 16 (1995) 21–25

Small Ruminant Research

Effect of genotype and plane of nutrition on carcass characteristics of Thai native and Anglo-Nubian × Thai native male goats

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Accepted 25 April 1994

Abstract

Eighteen (six Thai native (TN); six 25% F_2 TN × Anglo-Nubian (AN) and six 50% F_2 TN × AN) entire male weaner kids were used to study the effect of genotype and feed intake level (maintenance (M), 1.2 M and ad libitum (1.9 M)) on carcass composition. When compared at the same empty body weight (EBW), there was no difference between genotype or plane of nutrition on dressing percentage (55.0%), body components (head plus horns 9.45%, hide 10.3%, shank plus tail 3.7%, digestive tract 7.5%, organs (liver, lungs plus trachea, spleen, heart, diaphragm, kidneys) 4.8%), omental fat (2.3%), carcass dissectible muscle (61.6%) or carcass dissectible fat (12.9%). However, TN kids had lower ($P<0.05$) carcass bone (%), higher muscle-to-bone ratios (MBR) and edible meat (muscle + fat)-to-bone ratios than did 50% AN kids. Care needs to be taken that MBR are not lost in crossbreeding programs with introduced European goats.

Keywords: Thai native goat; Anglo-Nubian crossbred; Carcass; Nutrition

1. Introduction

In 1988 approx. 2.4 million t meat was produced annually from about 520 million goats (FAO, 1988). Of the total goat production, most is found in Asia and Africa. Goats in the tropics and sub-tropics provide not only meat and milk for consumption but also some income through sale. Goat meat is widely consumed in all countries where goats are reared. In many regions of Southeast Asia, Africa, the West Indies and Latin America people prefer goat meat to other kinds of meat (Devendra and Owen, 1983). However, there is little research undertaken into the biology and physiology of growth between different goat genotypes.

In 1990, approx. 700 t of meat was produced annually from about 121 000 goats in Thailand (FAO, 1991). This small population of goats is particularly significant for the Thai muslim population of southern Thailand, since they represent a major source of income for this group. There have been few studies on carcass characteristics of Thai goats. Pralomkarn et al. (1990) found that Thai native goats raised under good management had significantly higher percentages of carcass fat, but lower percentages of muscle when compared to goats raised under poor management systems in villages. Furthermore, there was some significant difference among different genotypes (0–75% Anglo-Nubian) (Pralomkarn, 1990). The aim of the following study was to investigate the effect of different planes of nutrition on the body composition of Thai

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SSDI 0921-4488(94)00042-6

native and crossbred (Anglo-Nubian × Thai native) weaned kids.

2. Materials and methods

Animals and their management

Animals and their management have been previously described in detail by Pralomkarn et al. (1995). The study was conducted at Small Ruminant Research and Development Centre, Faculty of Natural Resources, PSU, Thailand. In October 1990, TN, 25% and 50% AN does were joined to TN, 25% AN (F_1) and 50% AN (F_1) bucks to produce TN, 25% AN (F_2) and 50% AN (F_2), respectively. The does kidded over a 7-wk period from mid-February to early April 1991. Kids were weaned at 83 to 87 d of age and after treatment with a coccidiostat and vaccination against foot and mouth disease and haemorrhagic septicemia. Selected male weaner kids ($n = 18$; mean body weight (BW) 15.7 ± 0.45 kg) were held in individual pens and drenched again with Mansonil-M and also injected with 1 ml of Ivomec (1% w/v ivermectin) to control internal and external parasites. Six goats of each genotype (TN, 25% AN and 50% AN) were used, and two goats were randomly allocated to three different levels of concentrate intake (maintenance (M), 1.4 M and ad libitum). The diet used consisted of palm kernel cake (30%), corn (44%), soybean meal (17%), fishmeal (5%) plus minerals and vitamins (see Pralomkarn et al. (1994) for further details). The experiment lasted approx. 3 months.

Experimental design

The experimental design used was a 3 × 3 factorial in a completely randomised block design. Factors were genotype (TN, 25% AN and 50% AN) and plane of nutrition (Maintenance (M), 1.2 M and ad libitum (1.9 M)), each sub-treatment containing two kids.

Slaughter and dissection methods

At the end of the growth period, 18 goats (three genotypes × three levels of feeding × 2 replicates) were deprived of feed and water overnight. Kids were slaughtered by exsanguination and re-weighed after bleeding. After removal and weighing digesta (contents of reticulo-rumen, omasum, abomasum, small and large intestines and rectum), the empty body was separated into: carcass, head + horns, hide, shanks + tail and digestive tract (reticulo-rumen, omasum, abomasum, intestines and hind gut). The organs were composed of liver, lungs + trachea, spleen, heart, diaphragm, kidneys. The carcass was sectioned down the dorsal midline with a bandsaw. Half right carcasses were weighed and stored in polyethylene bags at −20°C pending dissection. The carcasses were dissected into muscle, fat, bone and fascia (largely connective tissue), taking care to minimize weight loss by dissecting in the air-conditioned room and covering the tissue with polyethylene bags. Following dissection, the fractions were weighed and discarded.

Statistical methods

The significance of differences between treatments were statistically analysed as a factorial experiment, and where appropriate, using covariance to correct comparisons to the same empty body weight (Steel and Torrie, 1960).

3. Results

3.1. Effects of genotype and nutrition on kid growth

The results for the feeding trial have been presented in detail in an earlier paper (Pralomkarn et al., 1995), and may be summarised as follows. There were no significant main effects of genotype on kid growth rates over the 14-wk feeding period, but growth rates (g/d) increased ($P < 0.05$) with level of feeding (maintenance 13, 1.4 M 76 and 1.9 M 100 g/d). Final liveweights for these treatments were: maintenance 16.5, 1.4 M 22.7 and 1.9 M 26.4 kg.

3.2. Genotype and nutrition effects on dressing percentage, body components and organs

Table 1 shows least-squares means with SEM (corrected for differences in empty body weight (EBW)) for the main effects of genotype and plane of nutrition on body components. Kids fed ad libitum (1.9 M) had higher ($P < 0.01$) EBW than did kids at 1.2 M, and 1.2 M kids had higher ($P < 0.01$) EBW than did goats fed at the maintenance level. There were no significant effects of genotype, nutrition level or their interaction

Table 1
Least-squares means with SEM (corrected for differences in empty body weight (EBW)) for the main effects of genotype and plane of nutrition on body components (%) of Thai native (TN) and TN× Anglo-Nubian (AN) goats

Treatment	EBW (kg)	Total digesta	Carcass	Head and horns	Hide	Shank and tail	Digestive tract	Organs	Omental fat
Genotype									
TN	18.2	9.8	55.5	9.5	10.8	3.5	7.6	5.1	2.2
25% AN	18.4	9.3	55.1	9.4	10.2	3.7	7.2	4.5	2.4
50% AN	19.0	8.7	54.5	9.3	9.9	4.0	7.8	4.9	2.4
Feeding level									
1.9 M	23.1a	8.8	55.5	9.3	9.7	3.8	7.5	5.2	2.8
1.2 M	18.1b	10.0	55.5	9.1	10.0	3.7	8.0	4.8	2.5
Maintenance (M)	14.4c	9.1	54.2	9.8	11.1	3.7	7.1	4.4	2.8
SEM[a]	0.63	0.52	0.33	0.10	0.23	0.05	0.11	0.14	0.09
Genotype (G)	NS	NS	NS	NS	NS	NS	NS	NS	NS
Feeding level (F)	**	NS	NS	NS	NS	NS	NS	NS	NS
G × F	NS	NS	NS	NS	NS	NS	NS	NS	NS

Values within columns between treatments with differing scripts differ significantly; $^{**}P < 0.01$, NS = not significant.
[a]SEM = standard error of overall mean.

Table 2
Least-squares means, with SEM for the main effects of genotype and plane of nutrition on carcass weight (kg), dressing percentage and dissectible carcass fractions (%) (means adjusted by covariance for differences in EBW (mean = 18.5 kg)

Treatment	Carcass weight	Muscle (%)	Fat (%)	Bone (%)	Muscle/bone	Muscle + fat/bone
Genotype						
TN	10.4	63.5	12.7	16.2a	3.95a	4.77a
25% TN	10.3	60.6	13.7	16.5a	3.70b	4.54a
50% TN	10.1	60.7	12.2	17.7b	3.47c	4.20b
Feeding level						
1.9 M	10.3	59.0	14.2	16.8	3.50	4.36
1.2 M	10.3	61.6	14.4	16.5	3.78	4.67
Maintenance (M)	10.1	64.2	10.1	17.2	3.84	4.48
SEM[a]	0.05	0.62	0.55	0.18	0.03	0.06
Genotype (G)	NS	NS	NS	*	**	*
Feeding level (F)	NS	NS	NS	NS	NS	NS
G × F	*	NS	NS	NS	NS	NS

Values within columns between treatments with different letters differ; $^{*}P < 0.05$, $^{**}P < 0.01$, NS = not significant.
[a]SEM = standard error of mean.

on dressing percentage, head plus horn, hide, shanks plus tail, digestive tract, organs and omental fat.

3.3. Genotype and nutrition effects on dissectible carcass fractions

Table 2 shows least-squares means, with standard errors, for the main effects of carcass weight and dissectible carcass fractions adjusted for difference in EBW. There was no ($P>0.05$) effect of either genotype or plane of nutrition on carcass weight, muscle (%) and fat (%). TN kids had lower ($P<0.05$) bone (%), higher muscle and edible meat (muscle plus fat) to bone ratios than did 50% AN kids and higher muscle-to-bone ratios than did 25% AN kids. However, there was no ($P>0.05$) difference between 25% and 50% AN kids for bone (%) and meat plus fat-to-bone ratios. Plane of nutrition had no significant effect on any of these values.

4. Discussion

Dressing percentage (carcass weight as % BW) is an important parameter for assessment of meat production potential in animals. Devendra and Burns (1983) reported that dressing percentage may be affected by age, sex and plane of nutrition. Baruah and Saikia (1989) found that dressing percentage of Assam local (AL) and Beetal × AL goats increased with increasing levels of concentrate (decreasing levels of roughage) in the diet. In the present study, dressing percentage also increased as feed intake increased (M 53.3, 1.2 M 55.4 and 1.9 M 56.5%), but there was no significant effect of either genotype or plane of nutrition on dressing percentage after adjustment for differences in EBW. The higher dressing percentages found in larger goats is associated with relatively lower proportion of digesta and higher proportions of fat in the carcass.

Because Thai goats are principally raised for meat production, their characteristics as meat producers have been examined. In this study, although there was no significant difference among the three genotypes in growth rate, TN kids had significantly higher muscle-to-bone ratios (MBR) and muscle plus fat-to-bone ratios with lower percentages of bone. The proportion of muscle in the carcass and the MBR decreased with increasing level of AN inclusion in the kids (4.77–4.20). Within a breed, MBR increases with the increasing carcass weight during progress to maturity. In Australian cashmere goats, this ratio increases from 2.4 (carcass weight 4.9 kg) to 5.0 at maturity (carcass weight 19.5 kg). Females have higher ratios than males at the same carcass weight (Ash, 1986). Pralomkarn (1990) has reported that MBR in Thai native male goats increased from 3.0 (8.8 kg BW) to 5.2 (21.6 kg BW) as these goats mature. In this and earlier studies TN and Australian cashmere goats have higher MBR at similar liveweight than Malawi male goats (3.7; Owen, 1975) and Alpine male goats (3.0; Fehr et al., 1976). Goats with high MBR ratios are mole desirable as a meat breed than those with low ratios, and it would seem that Thai goats have desirable attributes as meat animals and care needs to be taken that these characteristics are not lost in cross-breeding programs with introduced European goats. If breeding objectives are to be set for meat goats then these should perhaps be in terms both increased carcass weight and maintenance of high MBR.

Pralomkarn (1990) has reported that at the same EBW (20.4 kg) Australian cashmere × Anglo-Nubian kids (AC × AN) had lower fat contents (11.2 vs. 14.0% EBW), but higher dissectible muscle (61.9 vs. 59.2% EBW) than did Australian cashmere (AC) kids. In this study, AC × AN kids voluntarily consumed more feed and had higher growth rates than AC kids, which in turn, was associated with higher rates of protein and lower rates of fat gain in the AC × AN kids. On the contrary, in this study, there was no significant difference between TN and crossbred kids (mean EBW 18.4 kg) in dissected muscle (61.6% EBW) or fat (13.2% EBW) content, or in voluntary feed consumption and growth rates. Pralomkarn et al. (1995) have noted that voluntary feed consumption was much lower for goats in this Thai study (54.2 g DM/kg$^{0.75}$/d) than that for goats in the Australian experiment (81.1 g DM/kg$^{0.75}$/d) and it is suggested that genotype differences may have been expressed if the genetic potential of the TN × AN kids had not been masked by limitations in feed intake.

Ash and Norton (1987) found that ad libitum feeding (2.4 M) resulted in significantly more fat (19.5%) and less muscle (60.1%) in the carcass of AC goats when compared with goats slaughtered at the same weight (16.3% fat, 62.0% muscle) after restricted feeding (1.3 M). A similar trend was observed in this experiment where omental fat increased from 1.8 to 2.8% EBW, fat content of the carcass increased from 10.1 to 14.2% and the muscle content decreased from 64.2 to 59.0% as the level of intake was increased from maintenance (M) to ad libitum (1.9 M). However, these differences were not statistically significant due mainly to the small number of animals used and the limited range of intakes used (1.2 to 1.9 M).

It may be concluded from these studies that cross-breeding TN with AN goats has no significant effects on the dressing percentage (% carcass), distribution of body components or fat and muscle content of the carcass. However, increasing AN proportions in the genotype were associated with higher bone contents and decreased ratios of edible meat-to-bone in the carcass. It is possible that this higher bone content is simply an index of immaturity, and that at maturity, TN × AN will be larger than TN goats and the edible meat-to-bone ratios may be different. There is a need to extend these studies to mature animals to confirm this hypothesis. However in the absence of other evidence, cross-breeding TN with AN goats produces carcasses with lower meat-to-bone ratios, and this fact needs to be considered where cross-breeding schemes are planned.

Although level of feeding had no significant effect on the body composition of goats in this study, there were clear indications that goats became fatter as intake increased. There is a need to assess the economic and nutritional significance of goat meat of higher fat content than usually available in this culture before high levels of feeding are recommended.

Acknowledgments

The authors wish to thank the Australian International Development and Assistance Bureau which funded these studies through the Thai-Australian Prince of Songkla University Project and the Thai Government for providing facilities and staff for the conduct of this study.

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