Finishing crossbred goats on concentrate supplement: carcass and meat quality

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Abstract

To assess effects of finishing crossbred goats on concentrate diet on carcass and meat quality, 32 Small East African x Norwegian goats (9.5 months old, 17.1 kg BWT) were allotted into four levels of concentrate supplementation for 90 days. The levels were: no concentrate given (T0), 33% of *ad libitum* concentrate (T33), 66% of *ad libitum* concentrate (T66) and 100% of *ad libitum* concentrate allowance (T100). T100 had 2 kg (17%) heavier carcasses than T66 goats. T100 and T66 goats were similar in carcass fatness, but both were fattier than other diet groups. Except for commercial dressing percentage (DP), T100 were comparable to T66 goats in other forms of DP, but both were superior over the other diet groups. pH-values for T0 and T33 goats remained above 6 after 24 h post-mortem. Cooking loss increased with increasing levels of concentrate supplementation. *M. supraspinatus* had the highest cooking loss, *M. rectus abdominis* had the least. *M. biceps femoris* had the highest Warner-Bratzler shear force values, *M. psoas major* had the least. Finishing Small East African x Norwegian goats on 66% of *ad libitum* concentrate allowance gives adequate carcass and meat quality; any increase above this level seems not to improve meat production.

Introduction

Small East African goats (SEA), the main goat breed in Tanzania, are kept mainly for meat production. The productivity of these goats is still low, attaining a market weight of 20 kg at 2 years of age (Mushi, 2004). Moreover, these animals produce low quality meat, mainly of low tenderness. The major causes of low productivity and quality of meat from SEA goats under traditional systems are poor nutrition and genotype. Attempts to finish SEA goats on higher plane of nutrition caused limited improvement on carcass gain and meat tenderness (Safari et al., unpublished). It can thus be hypothesized that crossbreeding SEA goats with improved breeds will improve productivity and quality of meat from local goats. This study therefore seeks to determine carcass and meat quality of SEA x Norwegian (F1) goats finished on different levels of concentrate supplementation.

Materials and methods

Thirty-two castrated SEA x Norwegian goats (9.5 months old, 17.1 kg BWT) were allotted into four levels of concentrate supplementation for 90 days. The levels were: no concentrate given (T0), 33% of *ad libitum* concentrate (T33), 66% of *ad libitum* concentrate (T66) and 100% of *ad libitum* concentrate allowance (T100). Each animal had *ad libitum* access to grass hay (70% Bracharia spp, 30% Bothrocloa spp). The Concentrate supplement (13.4 MJ ME, 16.2% CP) consisted of 28 % sunflower seed cake, 70 % maize bran and 2 % minerals.

Before slaughter, animals were fasted for 16 h to get slaughter live weight (SLW). Empty body weight (EBW) was computed as the difference between SLW and gut fill. Hot carcass weights (HCW) were recorded, and then carcasses were scored for conformation and fatness based on EUROP classification system for goats. Carcass pH was measured 45 min and 6 h post-mortem (PM) at the geometrical centre of M. *biceps femoris* from the right half-carcasses using a portable pH-meter (Knick-portamess 910). Carcasses were then chilled at 0 ^{o}C for 24 h after which ultimate pH (pHu) was recorded on the same muscle. Weights of right half-carcasses were recorded and doubled to obtain cold carcass weights (CCW). Abattoir dressing percentages (CCW x 100/ SLW), commercial dressing (HCW x 100/ SLW) and true dressing (HCW x 100/ EBW) were derived.

M. semimembranosus, semitendinosus, biceps femoris, vastus lateralis,rectus abdominis, longismuss dorsi, psoas major, supraspinatus, infraspinatus and *triceps brachii* were excised from the left half-carcasses, 6 h PM. The muscles were weighed (W1), packed in PVC bags and stored in a fridge (4 ^{o}C) for 24 h, then moved into a freezer (-25 ^{o}C) until use. The remaining edible tissues from the left half-carcasses were minced for proximate analyses. The 10 muscles were thawed and boiled in a water bath set at 70.5 °C for 50 minutes. After cooling (4 °C) for 12 h, the muscles were blotted dry and weighed (W2). Cooking loss was calculated as ((W1 – W2)/ W1) x 100. A minimum of six cubes measuring 1 x 1 x 1 cm, 2 cm long were prepared from each muscle for Warner-Bratzler shear force (WBSF) assessment. A blade, with a triangular cutting slot, attached to Zwick/Roell (Z2.5) instrument sheared through each muscle cube at right angle to the muscle fiber direction. The average shear force (N /cm2) for 6 to 10 cubes per muscle was considered as a peak force.

Results and discussion

The *ad libitum* concentrate intake for SEA x Norwegian goat (663 g/d) supported a daily body weight gain of 96 g/d. Although similar to T66, the final live weight for T100 goats was 11 kg and 6 kg heavier ($P < 0.05$) than that of T0 and T33 goats, respectively. HCW for T100 was 56 % and 17 % heavier ($P < 0.05$) than that of T33 and T66 goats, respectively. T100 and T66 goats were comparable based on EUROP scores for fatness, but both were 5 and 8 units fattier ($P < 0.05$) than T33 and T0 animals, respectively. Dressing percentages (DP) ranged from 33% through 57%. In all forms but commercial DP, T100 had DP values comparable to T66 goats, which were all higher than that for T33 and T0 goats. Increasing concentrate supplementation decreased ($P < 0.05$) content of carcass water and ash and increased that of carcass chemical fat, without affecting that of protein.

Decline in carcass pH-values was faster in the first 6 h PM while the decline more-or-less levelled off afterwards (Fig. 1). Whereas pH-values for T66 and T100 were below 6 after 6 h PM, values for T0 and T33 goats remained above 6 even after 24 h PM. Carcass pHu for T66 and T100 goats was within the acceptable range, 5.6–5.8 (Pratiwi et al., 2007). Since animals in the present study were not stressed, the observed higher pHu for both T0 and T33 goats can be associated with low glycogen reserves due to nutritional insufficiency.

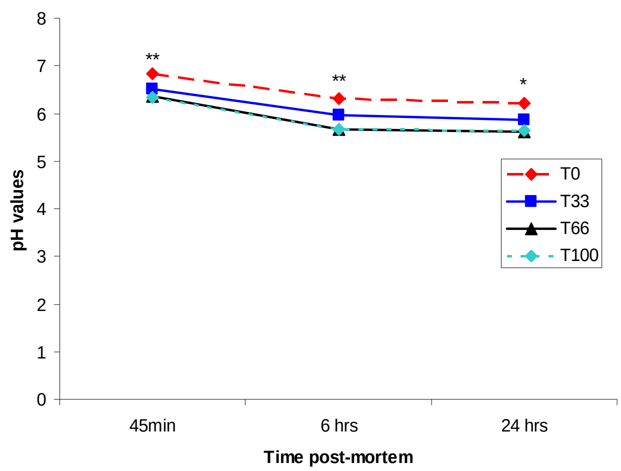

Figure 1. pH decline post-mortem for carcasses from castrated crossbred goats under different levels of concentrate supplementation.

Cooking loss increased ($P < 0.05$) with increasing levels of concentrate supplementation (Table 1). The observed lower cooking loss for T0 goats can be linked to their higher pHu than in other diet groups. High pH promotes high water binding (low cooking loss) due to higher net charges and greater space between myofilaments. Moreover, *M. supraspinatus* had the highest ($P < 0.05$) cooking loss while *M. rectus abdominis* had the least, which might be linked to their difference in fatness.

The shear force value tended ($P < 0.1$) to be reduced, but only by 7–10%, by increasing levels of concentrate supplementation (Table 1). Generally, meat with WBSF values that exceed 55 N is considered as objectionably tough (Abdullah and Musallam, 2007). Therefore, WBSF values obtained in the present study for the muscles (pooled) from castrated crossbred goats on different diet groups can be considered acceptably tender. The displayed highest ($P < 0.05$) WBSF values for *M. biceps femoris* and lowest values for *M. Psoas major*, however, indicate that certain goat muscles may be suitable for use in individual muscle applications while others may not. This variation is associated with their content and structure (degree of cross-links of collagen fibres) of connective tissue due to differential involvement in physical activities.

Table 1. Cooking loss and Warner–Bratzler shear force values by treatments and muscles of castrated crossbred goats under different levels of concentrate supplementation

	Variable	
	Cooking loss (%)	Shear force (N)
Treatment:		
T0	22.4 ± 0.6[b]	52.4 ± 1.7
T33	24.3 ± 0.5[a]	50.7 ± 1.5
T66	24.4 ± 0.5[a]	48.4 ± 1.4
T100	25.0 ± 0.5[a]	47.0 ± 1.4
Muscles:		
Triceps brachii	25.9 ± 0.9[b]	53.4 ± 2.5[cd]
Infraspinatus	21.1 ± 0.8[f]	32.5 ± 2.4[g]
Supraspinatus	29.8 ± 0.8[a]	47.3 ± 2.4[de]
Longismus dorsi	26.0 ± 0.9[bc]	51.1 ± 2.8[d]
Psoas Major	23.3 ± 0.9[de]	31.7 ± 2.4[g]
Rectus Abdominis	9.6 ± 0.8[g]	NA
Semimembranosus	29.3 ± 0.9[a]	64.7 ± 2.4[b]
Semitendinosus	24.8 ± 0.8[cd]	44.4 ± 2.4[e]
Vastus lateralis	28.5 ± 1.1[ab]	66.5 ± 2.5[ab]
Biceps femoris	25.3 ± 0.8[c]	73.2 ± 2.4[a]

NA = not analysed.

Conclusions

Increasing the proportion of concentrate in the diet resulted in an improvement in carcass dressing. Carcass fatness score improved ensuring protection against drying out during transportation and against cold shortening during cold storage. Meat tenderness tended to increase with concentrate supplementation, although only by 7–10%. Although the duration for which goats should be on concentrate finishing diets will depend on economics of such enterprise, finishing SEA x Norwegian goats at 66% access to their *ad libitum* concentrate intake gives adequate carcass and meat quality; any increase above this level seems not to improve meat production.

References

Abdullah, A.Y. & Musallam, H. S., 2007. Effect of different levels of energy on carcass composition and meat quality of male black goats kids. Livest. Sci. 107(1), 70-80.

Mushi, D.E., 2004. Studies on marketing of meat goats and carcass composition – A case study of Gairo auction markets. MSc (TAP), Sokoine University of Agriculture, Morogoro, Tanzania.

Pratiwi, N. M. W., Murray, P. J. & Taylor, D. G., 2007. Feral goats in Australia: A study on the quality and nutritive value of their meat. Meat Sci. 75(1), 168-177.