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Effects of concentrate levels on fattening performance, carcass and meat quality attributes of Small East African × Norwegian crossbred goats fed low quality grass hay

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ABSTRACT

To assess the effects of finishing Small East African × Norwegian crossbred goats with concentrate diets on the fattening performance, carcass and meat quality, 32 castrated crossbred goats (9.5 months old, 17.1 kg BWT) were equally allocated into four levels of concentrate supplementation. The concentrate levels were: Zero access to concentrate (T0), 33% access to ad libitum concentrate allowance (T33), 66% access to ad libitum concentrate allowance (T66) and 100% access to ad libitum concentrate allowance (T100). Each animal had access to ad libitum grass hay. Ad libitum concentrate intake for the goats was 663 g/d, which supported ME intake of 8.7 MJ/head/d. The attained maximum daily gain was 96 g/d. T100 and T66 goats were comparable in slaughter weight but the former had 2 kg heavier ($P<0.05$) carcasses than the latter. T100 and T66 goats were similar in carcass fatness scores, though both were fattier ($P<0.05$) than other diet groups. Dressing percentage (DP) was expressed in three different ways. In all but commercial DP, T100 were comparable to T66 goats, but all were higher than the other diet groups. For T0 goats, pH-values remained above 6 even after 24 h post-mortem. Cooking losses increased ($P<0.05$) with increasing levels of concentrate supplementation. Moreover, among the muscles assessed, *M. rectus abdominis* had the least cooking loss. Warner–Bratzler shear force values of cooked muscles were highest ($P<0.05$) in *M. gluteobiceps*, followed by *M. vastus lateralis*, while *M. psoas major* and *longismus dorsi* aged for 6 days had the least values. Finishing Small East African × Norwegian crossbred goats at 66% access to their *ad libitum* concentrate intake gives optimum carcass and meat quality, and that any increase above this level seems not to improve meat production.

1. Introduction

The economic importance of goats especially for smallholders in developing countries as a source of animal protein and income is on increase (Atti et al., 2004; Mahgoub et al., 2005). In Tanzania, Small East African goats (SEA), the main goat breed, are kept mainly for meat production. However, 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 poor quality meat, mainly of low tenderness. This situation has caused lack of prime prices for locally produced meat, especially in niche markets. Despite the large population of goats in Tanzania (13.1 million), large amount of chilled and frozen meat products are imported into the country. The major causes of low production levels of local goats under traditional systems are poor nutrition and

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genotype. These animals are mainly raised and finished on poor quality range pastures.

Growing animals on concentrate-based diets generally have higher average daily gain, dressing percentage and carcass quality than those on pasture (Priolo et al., 2002; Kosum et al., 2003). Moreover, adjusting energy levels in a diet in order to produce high quality goat carcasses could be beneficial to goat producers, especially if they satisfy consumer desire by altering carcass composition and the quality of meat (Abdullah and Musallam, 2007). However, attempts to finish SEA goats on higher plane of nutrition showed limited improvement with respect to carcass gain and meat tenderness (Safari et al. *in preparation*). It can thus be hypothesized that in order to obtain better quality products, crossbreeding SEA goats with improved breeds is desirable. In Tanzania, Norwegian dairy goats were introduced in 1980s, such that crosses of SEA and Norwegian dairy goats are in relatively big numbers (Safari et al., 2005). The available F1 male crosses are not used for breeding purposes and could be used for meat production. Nonetheless, there is limited published information on the feasibility of feedlotting such goat crosses to improve their carcass yield and meat quality. Further investigation on the carcass and meat attribute of SEA × Norwegian crossbred goats finished under intensive management is needed to evaluate their future role in meat production in Tanzania. This study therefore seeks to determine carcass yield and meat physicochemical properties of castrated SEA × Norwegian crossbred goats (F1) finished under different levels of concentrate supplementation.

2. Materials and methods

2.1. Animals and treatments

Thirty-two castrated Small East African × Norwegian crossbred goats (9.5 ± 0.5 months old, 17.1 ± 1.2 kg BWT), were bought from Mulbadaw Farm in the Northern part of Tanzania. The animals were transported to the Department of Animal Science farm, Sokoine University of Agriculture, for the study. Goats were castrated 2 weeks after birth using a burdizo.

Goats were then divided into 8 weight blocks and assigned at random, within blocks, to one of four dietary treatments. Dietary treatments were T0 where no concentrate supplementation was offered and T33 and T66 where amount of concentrate on offer consisted 33% and 66%, respectively of ad libitum concentrate intake (as fed basis). The fourth treatment, T100, involved feeding concentrate ad libitum allowing 10% refusal rate. Grass hay, as a basal diet, was offered ad libitum to each goat. Goats were group-fed whereby a group of four goats under the same dietary treatment were maintained in a 3.7 m × 29.3 m pen, for a total of 8 goats per dietary treatment.

2.2. Feeding management and kid growth

Animals were given a three-week adaptation period during which they were group-fed with access to ad libitum amount of hay and 150 g of concentrate feed per goat per day. Animals were treated against internal and external parasites using Ivermectin during this period. The experiment started on 20th September 2007 and lasted for 90 days. For both hay and concentrate, goats were fed twice daily and water was available ad libitum. Amount of both hay and concentrate on offer and refusals were weighed daily to derive feed intake. Goats were weighed weekly, before offered the morning feed. Live weight gain was calculated as a difference between initial and final live weight over specified intervals.

2.3. Measurements at slaughter

Animals were weighed in two consecutive days before slaughter to obtain final live weight (FLW), fasted for about 16 h and weighed again to get the slaughter live weight (SLW). All goats were slaughtered according to Islamic tradition, Halal, on the same property where they were raised. The head was removed at the atlanto-occipital joint and fore and hind feet removed at the carpal and tarsal joints, respectively. Gut fill was calculated as the difference between the weights of full and empty digestive tract. Empty body weight (EBW) was computed as the difference between slaughter weight and gut fill.

Carcasses (with kidneys, kidney and pelvic fat) were weighed immediately after slaughter to get hot carcass weight (HCW), and were scored for conformation and fatness based on EUROP classification system for goats (Kosum et al., 2003; Johansen et al., 2006). Carcasses were classified for conformation (scale from E = excellent to P = poor and fatness (scale from 1 = none or low fat cover to 5 = entire carcass covered with fat) according to the visual scores in the EUROP system. Each of the five classes for conformation and five classes for fatness were divided into three subclasses: −, 0, or +, to form 15 grades. Grade 1 is P− for conformation class and 1− for fat class. Grade 15 is E+ for conformation class and 5+ for fat class. High value for conformation class indicates a carcass with well to excellent rounded muscles. High value on fat class indicates a carcass with a high degree of external fat (subcutaneous).

2.4. Measurements on carcasses

Carcasses were dissected into two halves through the median plane using a band saw. The weights of half-carcasses were recorded. Temperature and pH of the carcasses were measured 45 min and 6 h post-mortem (PM), at the same point on the *M. gluteobiceps* from the right half-carcasses. A penetrating electrode (Mettler Toledo) of a portable pH-meter (Knick-portamess 910, Germany) was inserted at the geometrical centre of the muscle. The choice of the muscle based on its massive nature and the incision (for pH and temperature probes) not being detrimental to the carcass value. Carcasses were then chilled at 0 °C overnight. Ultimate pH (pHu) and temperature were recorded on the same muscle in the right half-carcasses at 24 h PM.

After chilling the carcasses overnight, the weights of right half-carcasses were recorded and doubled to obtain cold carcass weights (CCW). Cold carcass weights were used with the data obtained previously to calculate abattoir dressing percentages and chilling losses. Chilling loss was calculated as the weight lost after chilling the right half-carcasses at 0 °C for 24 h. Various linear measurements were taken on the cold right half-carcasses to determine carcass conformation: