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Ameliorative effects of *Ficus* and *Harrisonia* diets on Small East African goat meat yield

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ABSTRACT

The effect of supplements based on *Ficus natalensis* and *Harrisonia abyssinica* foliages on intake, growth and carcass yield of tethered goats was assessed on-farm using fourty growing intact male indigenous goats. Five diets were tested, which included the control (tethering on natural pastures), tethering supplemented with molasses (CM) and the three diets whereby tethering was supplemented with molasses as well as *F. natalensis* and *H. abyssinica* as follows: *Harrisonia*/ molasses (HM), *Ficus*/molasses (FM) and *Ficus/Harrisonia*/molasses (FHM). The supplements were formulated to supply crude protein (CP) and energy levels required for an average daily gain of about 50 g/day. Four farms in the same geographical location were used. Each farm had all the five diets with two goats per diet. The goats were tethered during the day (10:00–18:00 h) and the supplements offered overnight (after tethering). The dry matter (DM) intake from tethering ranged between 124 and 162 g/day, and was not affected ($P > 0.05$) the basal DM intake. However, the total DM and CP intakes were increased ($P < 0.05$) by supplementation with the browse foliages. The total DM and CP intakes were highest ($P < 0.05$) for FM (572 and 91 g/day, respectively) and FHM (638 and 102 g/day, respectively). Compared with the control, supplementation with browse foliages increased ($P < 0.05$) the average daily gain, hot carcass weight and dressing percentage by up to 37.2, 2.3 and 6%, respectively. Average daily gain was 17, 34, 45, 52 and 54 g/day for control, CM, FM, HM and FHM, respectively. The hot carcass weight was 6.9, 8.2, 8.8, 9.1 and 9.2 kg for control, CM, FM, HM and FHM, respectively. In conclusion, *Ficus natalensis* and *Harrisonia abyssinica* foliages have the potential to be used as low cost protein supplements in low-input goat feeding systems. However, there is need to establish best presentation methods of the browse foliages to the goats.

1. Introduction

Tethering goats on areas that are unsuitable for crop cultivation (road sides, marginal farrow lands, etc.) is a common way of rearing goats in eastern Uganda. The goats are normally allowed between 6 and 8 h of grazing daily. This practice limits the time of grazing as well as quantities from which goats can select their diet; thereby decreasing both the quantity and quality of feed supply to the goats. Besides, the pastures in these marginal lands are usually of poor nutritional quality. Several studies (Animut et al., 2005; Goodwin et al., 2004) have shown that where goats are allowed sufficient quantities from which to browse they are capable of selecting diets with high crude protein as well as low fiber; hence ensuring adequate feed intake and consequently good performance.

Under such conditions of limited feed supply, farmers would consider supplementing their goats with cultivated pastures or concentrates in order to improve performance. However, these options are not feasible given that arable land is increasingly becoming scarce and in many developing countries the use of concentrates is not a realistic option because of high cost and inaccessibility (Teferedegne, 2000; Katongole et al., 2012). However several studies have reported the wide availability of browse trees and shrubs such as *Acacia spp*, *Flueggea virosa, Albizia zygia, Rhuss natalensis, Ficus natalensis*, *Harrisonia abyssinica* (Tabuti and Lye, 2009; Nampanzira et al., 2015) in eastern Uganda. These browses are mainly used for firewood, construction wood, herbal medicine, but rarely used as animal feed. However, the foliages of these browse species have been reported to contain sufficient levels of protein (Yayneshet et al., 2009), they can remain green and hence maintain

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their nutritional value long in the dry season (Safari et al., 2011) and they are readily available at low or no cost. Use of these browse species would be an important strategy for improving feed supply to tethered goats in eastern Uganda, especially during the dry season when little pasture is available.

Results of one previous study (Nampanzira et al., 2016) indicated that the foliages of *Ficus natalensis* and *Harrisonia abyssinica* (widely available browse species in eastern Uganda) have a CPcontent that ranges between 110.3 and 112.2 g/kg DM, with DM degradability ranging between 632 and 743 g/kg, as well as N retention ranging between0.16 and 0.37 (as fraction of N intake). These qualities make them possible options for improving the feed quality and supply to tethered goats in eastern Uganda. Therefore, this study was conducted to evaluate the effect of supplements based on *Ficus natalensis* and *Harrisonia abyssinica* foliages on intake, growth and carcass yield of tethered indigenous goats.

2. Materials and methods

2.1. Experimental site

This study was conducted in Buyende District at 4 farmers' homes. The four farmers were selected from those who were involved in a previous ethno botanical study. The farmers were rearing goats (irrespective of herd size), willing to provide grazing land and space for the construction of structures were the supplementary diets were offered.

2.2. Experimental animals and their management

Fourty indigenous intact growing male goats 5–8 months of age and weighing between 12 and 18 kg were used. The goats were bought from local farmers. They were ear tagged, treated against intestinal parasites and sprayed with an acaricide. At the start of the feeding trial, the goats were weighed individually for three consecutive days in the morning before being tethered on pastures and the mean taken as the initial weight. At night, the goats were housed in group pens (with reference to the experimental diet allocated to them). The goats were given 10 days to adapt to the experimental conditions prior to the onset of the study. They had free access to a maclick mineral brick and drinking water in their night pens

2.3. Experimental diets

The five experimental diets (Tethering, Tethering+ molasses, Tethering + F, Tethering + H and Tethering + F & H) are described in Table 1. Tethering alone without any supplement and Tethering with mollase were the control diets. The three experimental diets (Tethering + H; Tethering + F; and Tethering + H & F) were formulated to be isocaloric (equal levels of metabolisable energy) and isonitrogenous (equal levels of crude protein) targeting an average daily gain of about 50 g/day. All the 40 goats were tethered on natural pastures during the day from 10:00 to 18:00 h as was the practice in the study area. The Supplements were offered overnight (after tethering). The ingredients for the supplements were leaves of *Ficus natalensis, Harissonia abyssinica* and Molasses. The leaves of *Ficus* and *Harrisonia* were harvested daily from the existing trees and stored under roof. The molasses were bought from the open market.

Table 1
Feedstuff composition of experimental diets (%, as fed basis).

	Experimental diet				
Feedstuff	Control	CM	HM	FM	FHM
Basal diet (natural pastures)	Tethering	Tethering	Tethering	Tethering	Tethering
Supplements (% of BW, as fed basis)					
Ficus natalensis leaves (F)	–	–	–	7.0	3.5
Harissonia abyssinica leaves (H)	–	–	6.0	–	3.0
Molasses[a] (g/day) (M)	–	200	200	200	200

Control, tethering on natural pastures alone; CM, control/molasses; HM, *Harissonia*/molasses; FM, *Ficus*/molasses; FHM, *Ficus/Harissonia*/molasses.

[a] Molasses were mixed with water at a ratio of 1:2 and sprinkled on the leaves.

2.4. Experimental design

The 40 goats were divided into 8 groups of 5 goats according to body weight. One goat from each group was randomly allocated to one of the five experimental diets. Each farmer received 2 goats for each of the experimental diets. This translated into a total of 10 goats per farmer. During the day (10:00–18:00 h), each of the 4 farmers tethered each goat allowing it movement within a radius of 3m. Each goat was tied to a pole using a rope around its neck. The location of each tethered goat was changed daily. At 18:00 h the goats were untied and walked to the night pens where they were offered the supplements. Each pen housed two goats receiving the same experimental diet. The amount of supplements offered were adjusted weekly basing on the previous week's intake, so that each group of goats was offered an amount equivalent to 110% of the group's average intake of the previous week.

2.5. Data collection

2.5.1. Botanical composition of the pastures selected by the tethered goats

Direct observations method was used to determine the botanical composition of the pastures consumed by the tethered goats and their representative samples were obtained (Risenhoover, 1989). A total of 20 goats out of 40 goats were observed (5 goats per farmer) irrespective of experimental diet. The observations were done five times (every after 21days) during the study period. This translated into 100 observations. Each goat was observed for 10 min. During the observations, the observer stood in a good distance in order not to interfere with the feeding activities of the goat. The observer followed each goat, taking note of the plant (grass, shrubs trees) and morphological part consumed. Materials physically similar to those selected by the goat were clipped for botanical identification and chemical analysis. Where necessary, specimens pastures clipped were prepared and taken to Makerere University Herbarium, for botanical identification.

2.5.2. Chemical composition of consumed pastures

The different pasture species clipped from the observation of each goat were pooled by farm and weighed. This translated into 20 pasture samples. The samples were placed in plastic bags, sealed and labeled pending transportation to the laboratory for oven drying. The samples were analyzed for DM, CP and ash according to AOAC (1990). NDF, ADFand ADL according to Van Soest and Robertson (1985).

2.5.3. Voluntary intake

The voluntary intake of the pastures by the tethered goats was estimated from the total daily production of faeces (total faecal output) and digestibility.

For total faecal collection, five goats on each farm (one goat per experimental diet) were randomly selected and fitted with a faecal collection bag designed to collect all the faeces released. The bags were emptied twice a day at 10.00 and 18.00 h and the faeces from each goat weighed. The goats were given 5 days to adapt to the faecal bags. Thereafter the data was collected for 5 days and oven dried. The faecal samples collected were pooled by diet and farm. This procedure was done four times at an interval of 21 days. This translated into a total of 80 feacal samples

For digestibility of pastures, the marker/indicator method was used.