PREFERENCE OF NAPIER GRASS, TITHONIA *(Tithonia diversifolia*) AND SAPIUM *(Sapium ellipticum)* AND THEIR NUTRITIVE CONTENT AS FORAGES FOR SHEEP IN KENYA

Maragara, E.N.[1], Wahome, R.G.[2], Badamana, M.S.[2], Musalia, L.M.[3] and Njoka, E.N.[3]
[1]P. O. Box 172-60400, Chuka
[2]Department of Animal Science, University of Nairobi, P. O. Box 29053, Nairobi
[3]Department of Animal Science, Chuka University, P. O. Box 109-60400, Chuka
Email: ernest.nyaga@yahoo.com, rgwahome@uonbi.ac.ke, badamana@uonbi.ac.ke, enjoka@chuka.ac.ke

ABSTRACT
There is limited information on preference of tithonia (*Tithonia diversifolia*) and sapium (*Sapium ellipticum*) as forages for sheep in Kenya. This study compared the preference of napier grass, tithonia and sapium as forages for sheep. It had five (one and half year old male sheep) selected on the basis of uniformity in live weight, averaging 23 kg. The sheep were housed in individual pens (metabolic unit), measuring 1.5m x1.5m x2.0m and mounted on the concrete floor at Kenya Agricultural and Livestock Research Organisation, Embu. The feeding period lasted for 10 days. Data were collected and recorded for 5 days. A sample of each offered and refused experimental diet was collected and recorded for 5 days and oven-dried for determination of moisture content, crude protein, ash content, neutral detergent fiber, acid detergent fiber and acid detergent lignin. The neutral detergent fibre levels for wilted napier grass, tithonia and sapium fodder were 80.1%, 33.57% and 39.52%, respectively. The acid detergent fiber levels for napier wilted grass, tithonia and sapium hay were 43.58%, 27.98% and 22.4%, respectively. The acid detergent lignin levels for the napier grass, tithonia and sapium were 6.12%, 11.3% and 8.87%, respectively. Napier grass, sapium and tithonia forages were preferred by the sheep in this order, with an average daily intake in kg/DM of 0.26, 0.11 and 0.18, respectively. Knowing preference of the forages could assist in their utilization in improvement of sheep nutrition and productivity.
Key words: Ruminant animals, Corriedale sheep, Neutral detergent fiber, Acid detergent fiber and lignin

INTRODUCTION
Ruminants such as goats and sheep may be fed with a wide variety of plant material differing in nutrient content and quality. Free choice is used to determine palatability of feed. This measured as the difference between the amount of feed offered and the amount of feed refused. Palatability may be affected by visual appearance, taste, flavour and texture (Ngwa *et al*., 2003). Grazing ruminants also select to make favourable combinations of various plant materials to maximize their biological performance and minimize toxicosis (Provenza, 1995). An ideal alternative fodder crop for napier grass would be one that is approximately equally productive, acceptable and nutritive. However, although a dry matter yield study on the two potential alternatives had been carried out (Ngwa *et al*., 2003), there is little information regarding preference of *Tithonia diversifolia* and *Sapium ellipticum* as fodder for sheep. This study was conducted to compare the preference of napier grass, *Tithonia diversifolia* and *Sapium ellipticum* forage fodder by sheep.

MATERIALS AND METHODS
Research Site
The study was carried out at Kenya Agricultural and Livestock Research Organisation centre in Embu County. The centre is in a subhumid agroecological zone, located 1490 meters above sea level at 0°30'S and 37°27'E. The soils in the area are humid Nitisol derived from basic volcanic rocks and classified by United State Department of Agriculture under humid patehumult. The region has a bimodal rainfall pattern with long rains falling in May to June, amounting to an average of 750 mm and short rains falling in October to December, averaging 350 mm. The monthly temperature ranges from 18°C to 21°C.

Experimental Animals and Animal House
The five 1.5-year-old male Corriedale sheep were selected based on uniformity in live weight, averaging 23 kg. The sheep were housed in individual pens (metabolic unit), measuring 1.5m by 1.5m by 2.0m and mounted on the concrete floor of the wooden animal house.

Experimental Diets
Three different experimental fodders, namely napier grass, *Tithonia diversifolia* and *Sapium ellipticum* forages were fed to the sheep. The feed materials for both tithonia and sapium were initially cut as green fodder and then dried under shade. After drying, the leaves and twigs were separated from the stems, and then the materials were kept in gunny bags (100 kg) and put in a well-ventilated store. The experimental diet was weighed a day before feeding using a weighing balance (Ohaus™). Tithonia and sapium were fed as hay, while napier grass was fed as wilted

green chop. The three types of fodder were fed separately in three marked containers firmly fixed on the timber of the metabolic crates.

All feeds were presented to all the sheep simultaneously at 8.00 am. The sheep were allowed to feed for a period of four hours in the morning (Kalio *et al*., 2006). The feed refusals from the three diets were then removed and emptied into labeled paper bags, weighed using a weighing balance (Ohaus™) and a sample taken for drying in an oven set at 60^{o}C.The feeding study lasted for 10 days. The first 5 days were allowed to adapt the sheep to the crates, feed samples and feeding data was collected during the last 5 days.

Laboratory Analysis

Feed on offer and refused samples were submitted to the laboratory for proximate analysis (AOAC, 1990). Neutral Detergent Fiber, Acid Detergent Fiber, Acid Detergent Lignin analysis were done as described by Van Soest *et al*. (1991).

Data Analysis

The amounts of each fodder type offered to the five Corriedale sheep and refusals were recorded over a period of 5 days. The feed intake by the sheep was determined by subtraction. The average daily feed intake for each test diet and each sheep was calculated over the 5 days. The intake of the three types of fodder was assessed using one way analysis of variance.

RESULTS

Chemical Composition of the Fodder under Test

The dry matter of a feed indicates the form in which the feed was offered. The wilted napier grass was offered as green chop with a DM content of 13.6%. Sapium and tithonia forages were fed as hay with a DM content of 85.2% and 89%, respectively (Table 1). The crude protein for the three fodders wilted napier grass, tithonia and sapium was 4.29%, 20.7% and 11.8%, respectively. The ash content for the three fodders wilted napier grass, tithonia and sapium was 10.2%, 16.24% and 7.06%, respectively (Table 1).

Table 1: Nutrient composition of napier grass, tithonia and sapium forage fed to sheep

Diets	Napier grass	Tithonia fodder	Sapium fodder
Dry Matter, %	13.6	89	85.2
Crude Protein, %	4.29	20.7	11.8
Neutral Detergent Fiber, %	80.1	33.57	39.52
Acid Detergent Fiber, %	43.58	27.98	22.35
Acid Detergent Lignin, %	6.12	11.3	8.87
Ash, %	10.2	16.24	7.06

Table 2a: Mean napier grass, tithonia and sapium fodder intake (kg/DM) over the five days

Day of intake recording	Wilted napier grass fodder (13.6% DM)	Tithonia hay (89% DM)	Sapium hay (85.2% DM)
1	0.27	0.10	0.16
2	0.27	0.13	0.17
3	0.28	0.13	0.19
4	0.22	0.11	0.18
5	0.26	0.10	0.20
Average daily intake	0.26	0.11	0.18

Table 2b: Analysis of variance of fodder and day of recording effects on fodder intake

Source	Df	MS	F	Sig.
Day	4	0.002	0.339	0.850
Fodder	2	0.113	23.150	0.000
Day * Fodder	8	0.001	0.267	0.974
Error	56	0.005		

R Squared = 0.472 (Adjusted R Squared = 0.340)

DISCUSSION

This study showed that napier grass is low in protein and as such should be supplemented (Muia, 2000). The crude protein of napier was quite low compared to the crude protein of tithonia and sapium and this may have contributed to less preference than was expected despite the fact that it was fed as green chop in the present study. Grasses like napier grass need to be supplemented with protein-rich forages because the pasture crude protein levels are usually inadequate. Crude protein contributes generally to the acceptability of a feed (Kongmanila, 2005). Indigenous fodder are known to contain high level of crude protein due to their deep rooted characteristics that stabilize crude protein levels across seasons and age unlike that of grasses like napier (Roothaert *et al*., 2001). Forage intake is modified by its quality in addition to energy demands. Intake of ruminants foraging on low quality forages (below 50% digestibility) appears to be limited by bulk fill.

Neutral Detergent Fiber (NDF) levels of forage above 60%, cause a decrease in digestibility and subsequently slow down the rate of passage and eventually reduce forage intake. On the contrary, lower NDF content correlates to higher forage digestibility and rate of passage allowing greater intake (Van Soest *et al*., 1991). In this study, the NDF levels for the three fodder species wilted napier grass, tithonia and sapium fodder were 80.1%, 33.57% and 39.52%, respectively (Table 1).

The high NDF levels of wilted napier grass caused a decrease in the rate of passage which limited its preference. Feeds that are least preferred in times of abundance and variety, such as tithonia forage, could be relished during periods of scarcity and severe feed shortages, based on animal survival instinct (Ngwa *et al*., 2003). The intake of all the three diets fluctuated during the five days of the sample collection probably because the sheep aimed at balancing their protein requirements which were different each day.

The Acid Detergent Fiber (ADF) levels for the three diets wilted napier grass, tithonia and sapium hay were 43.58%, 27.98% and 22.4%, respectively (Table 1). ADF reflects the fibrous portions of the feed resistant to acid hydrolysis. It represents the cell wall materials that also account for the lignin and silica and imply a limitation to nutrient availability to the animal. The difference between the NDF and ADF of a feed may show the proportion of the cell wall material that is degradable by the ruminants. The digestibility of forage is negatively related to both increase in ADF and lignification level. Forages at advanced maturity stage are characterized by high content of acid detergent fibers and lignin and low total nitrogen content. High proportions of the former fractions are bound within the indigestible vascular bundles resulting in low digestibility, low nutrient intake and low animal performance (Van Soest *et al.*, 1991).

The Acid Detergent Lignin (ADL) levels for the diets napier grass, tithonia and sapium fodder were 6.12%, 11.3% and 8.87%, respectively. Though the DM intake of roughages is inversely proportional to the filling capacity and NDF content, this does not seem to be the case when ruminants are offered more than two feeds that vary in chemical composition as was the case in this study (Ngwa *et al*., 2003).

Ruminant's dry matter intake level depends on parameters which are related to the animal or to the diet. Independent of the quality of the forages, ruminants prefer vegetable fractions with a high leaf to stem ratio, with a low fiber and high nitrogen content. It has been observed that they are sensitive to substances such as tannins. The most important factor influencing performance of ruminant animals consuming forage diets is dry matter intake (Wilson *et al*., 1991). The average daily intake for wilted napier grass fodder, tithonia and sapium hay in kg/DM was 0.26, 0.11 and 0.18, respectively. Each sheep was taking an average of 0.56 kg DM per day, which was about 2.4% of their body weight (Wilson *et al*., 1991). The sheep took two times more napier than sapium and three times more than tithonia. The difference of napier grass taken was not significant (Tables 2a and 2b). All the three forages were accepted by the sheep although at different levels.

The effect of past experience did not contribute much to the preference since the sheep had been allowed to adapt to the other two fodder species for five days. The daily intake increased from the first day of recording up to the third day. Thereafter the daily feed intake decreased possibly due to the satiety process of ruminants (Smith *et al.*, 2001). The preference for the three fodder species by the sheep in a decreasing order was wilted napier grass, sapium and tithonia (Kalio *et al*., 2006). The fact that tithonia was the least preferred in this study agreed with the findings of KARI, Embu (1996), but contrasted with those of Premaratne *et al.* (1998), who compared *T. diversifolia, L. leucocephala* and *G. sepium* on ewes. Premaratne *et al.* (1998) found that tithonia was the best preferred.

The physical form in which a fodder is offered to the ruminant is important. Ruminants generally discriminate dry and brittle fodder materials when

they are given a chance to do so. Napier grass in the present experiment was offered as a succulent green chop compared to the other two fodders which were offered as hay. The experimental animals probably found it easier to consume the former as compared to the latter two. Ruminants will discriminate dustiness in the feed. Tithonia and sapium forages had some levels of dustiness which probably denied the sheep quick acceptance as compared to napier grass which was relatively soft (Ngwa *et al*., 2003).

Ruminant animals select some pasture plants and leave others. Some forage has been described as being more palatable than others. However, if variety and availability of forages is limited even the relatively unpalatable forages may be eaten (Saskatchewan University Agriculture Specialists, 2008). The sheep apparently selected more napier grass than tithonia and sapium since the former one was more succulent than the later two fodder species. The apparent ability of the ruminants to select the more digestible components of a diet is well known. The NDF and ADF levels of the three diets highly influenced the preference with wilted napier grass being affected most although its succulent status caused a bias in the choice.

CONCLUSION

Napier grass, sapium and tithonia forages were preferred by the sheep in that order with an average daily intake in kg/DM of 0.26, 0.11 and 0.18, respectively. However, the sheep consumed constant proportions of both sapium and tithonia probably to balance their protein requirements. This indicated that the two indigenous fodder species could be suitable supplements for napier grass particularly during the dry season.

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