COMPARATIVE EVALUATION OF NUTRITIVE QUALITY OF FORAGE GRASSES (MAIZE AND ELEPHANT GRASS) AND FORAGE LEGUMES (LABLAB AND MUCUNA)

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ABSTRACT

This study evaluated the nutritional value of maize (*Zea mays*), *elephant grass* (*Pennisetum purpureum*), *mucuna* (*Mucuna pruriens*) , *and lablab* (*Lablab purpureum*) *forages, aiming to address feed quality and availability constraints in tropical ruminant animal production. Forages were sampled in three replicates at 12 weeks post-planting, and proximate and fiber composition were analyzed. The data obtained was subjected to ANOVA using the GLM procedure of SAS (2005). Results showed that elephant grass had higher crude protein (CP), ether extract (EE), ash, NFE, NDF, and ADF compared to maize, while maize had higher dry matter (DM) and crude fiber (CF). Mucuna had higher CP, EE, and ash, while lablab had higher CF, NDF, and ADF. Elephant grass and mucuna were found to be nutritionally superior. A feeding trial is recommended to assess feed intake and animal performance.*

Keywords: Maize, Elephant grass, Lablab, Mucuna, Analysis

INTRODUCTION

Feed quality and availability are major constraints in increasing ruminant animal productivity under tropical conditions. In the Savannah, under the typical tropical pasture production pattern, a sustainable supply of feeds can be achieved through judicious choice of suitable plant species, soil fertility management, and fodder conservation practices (Kallah, 1990). Manipulation of forage species selection, production technique, and conservation practices effectively bridge the gap in feed supply during the dry season to improve growth, milk yield, and survivability. Maize (*Zea mays*) is the third most important crop in the world (Bilal et al., 2008), and many countries make it available for livestock feeding. Forage maize provides high-quality yields of palatable forage. It is an important crop for silage making due to its ease of cultivation, high dry matter yields, low buffering capacity, and high concentration of water-soluble carbohydrates, and it ensiles easily (Griffith's et al., 2004). Elephant grass (*Pennisetum purpureum*) is a robust perennial crop considered an important forage in animal production due to its high yields, ease of propagation, and broad ecological adaptation (Trisha, 2010). Young growth makes good hay, which can be fed as hay or pellets, and can produce good quality silage. It can be established from seed, although it is almost invariably planted from setts or splits. Legumes are considered superior animal feed to grasses because of higher voluntary intake of digested nutrients (Goering et al., 1991; Thomson et al., 1991) and higher nutrient contents. The tropical legumes such as *Lablab purpureum* (Lablab) and *Mucuna pruriens* (Mucuna) may be used in improving the ensiling quality of maize and elephant grass. There is a sporadic year-round shortage in the supply of pasture, both in quantity and quality, despite the abundant availability of feed during the late rainy season (Muhammad et al., 2009). Therefore, the aim of this study is to evaluate the nutritional value of maize, elephant grass, mucuna, and lablab forages.

MATERIALS AND METHODS

Experimental site

The study was conducted at Central Laboratory of National Animal Production Research Institute, Shika. Field grown forage materials were sampled at twelve weeks post planting in triplicates. Fresh weight was determined using a weighing scale and sub-sample taken (200-350g) and oven dried at 65˚C for 48hrs, and reweighed to a constant weight to estimate the dry matter yield using the equation:

$$Dry\,matter\,percentage = \frac{weight\,of\;fresh\,sample - weight\,of\;dry\,sample}{weight\,of\;fresh\,sample} \times 100$$

Chemical and Statistical Analysis

The dried samples of forages material were ground using a hammer mill and passed through 1-2mm sieve. Proximate analysis was carried out to determine Nitrogen (N) for crude protein determination (Nx6.25), Crude Fibre (CF), Ether Extract (EE) and ash content according to (AOAC, 2005). Neutral Detergent Fibre (NDF) andAcid Detergent Fibre (ADF)according to Van-Soest *et al.* (1991). The data collected were subjected to

Analysis of Variance using the General Linear Model Procedure of SAS, (2005). Differences between the means were considered significant at 0.05 probability level.

RESULTS

Proximate and fibre composition (%) of 12 weeks post-planted maize and elephant grass forages

The proximate and fibre fractions of maize and elephant grass harvested at 12-weeks post planting is presented in Table 1. The percent (%) dry matter (DM) of the forages varied significantly ($p<0.05$) from 90.50 to 95.50%. Higher DM was recorded from maize forage. Elephant grass forages had higher %CP (12.01%) compared to maize forage (8.36%). Significant ($p<0.05$) variation exists in CF content with the highest value observed in maize forage (30.77%). Elephant grass had significantly ($p<0.05$) higher percent EE, Ash, NFE, NDF and ADF (2.12, 2.40, 72.76, 58.87 and 40.70 respectively) compared to maize.

Table 1. Proximate and fibre composition (%) of 12 weeks post-planted maize and elephant grass forages

Grasses	DM	CP	CF	EE	ASH	NFE	NDF	ADF
Maize	95.5^{a}	8.36^{b}	30.77^{a}	1.29^{b}	1.77^{b}	61.73^{b}	46.20^{b}	37.40^{b}
Elephant grass	90.5^{b}	12.01^{a}	20.71^{b}	2.12^{a}	2.40^{a}	72.76^{a}	54.87^{a}	40.70^{a}
SEM	0.29	0.007	0.007	0.007	0.009	0.007	0.102	0.041

Means with same letter superscript within column were comparable ($p>0.05$)
DM=dry matter, CP=Crude protein, CF=Crude fibre, EE=Ether Extract, NFE Nitrogen detergent fibre, NDF=Neutral Detergent Fibre, ADF=Acid Detergent Fibre

Proximate and fibre composition (%) of lablab and mucuna forages at 12 weeks post-planting

The proximate and fibre composition of lablab and mucuna legume forages is presented in Table 2. There is no significant ($p>0.05$) difference in DM and NFE contentsbetween the forages. Mucuna had significantly higher CP (27.33%). The variation in CF ranges from 11.57 to 13.23%, higher value was recorded from lablab forage. Mucuna had higher ($p<0.05$) EE and Ash compared to lablab (1.77% and 4.93%) and (0.86% and 4.67%) respectively. Lablab forage had significant ($p<0.05$) higher NDF (48.47%) and ADF (34.70%) compared to mucuna (43.49% NDF and 32.81% ADF).

Table 2. Proximate and fibre composition (%) of lablab and mucuna forages at 12 weeks post-planting

Legumes	DM	CP	CF	EE	ASH	NDF	ADF	NFE
Lablab	91.70	24.06^{b}	13.23^{a}	0.86^{b}	4.67^{b}	48.47^{a}	34.70^{a}	57.11
Mucuna	91.43	27.33^{a}	11.57^{b}	1.77^{a}	4.93^{a}	43.49^{b}	32.81^{b}	57.32
SEM	0.36	0.007	0.001	0.013	0.009	0.05	0.129	0.007

Means with same letter superscript within column were comparable ($p>0.05$)
DM=dry matter, CP=Crude protein, CF=Crude fibre, EE=Ether Extract, NFE Nitrogen detergent fibre, NDF=Neutral Detergent Fibre, ADF=Acid Detergent Fibre

DISCUSSION

Nutrient composition of maize and elephant grass harvested at 12 weeks after sowing

Maize and elephant grass forages are two popular forage crops used in animal husbandry. Understanding the factors influencing their DM content is crucial for optimizing their use as animal feed. The higher DM content in maize compared to elephant grass of the same age can be attributed to differences in leaf structure. Maize forage has a more compact leaf structure than elephant grass (Fritz *et al*., 2018), which can lead to higher DM content. In contrast, the more open leaf structure of elephant grass can result in higher water content and lower DM content. Additionally, genetic control of soluble carbohydrate content plays a role. Maize forage tends to have higher levels of soluble carbohydrates, such as sugars and starches, which contribute to its higher DM content. This is due to genetic differences in the regulation of carbohydrate metabolism (Zhang *et al.,* 2018). The differences observed in the CP contents between the two grasses could be attributed to their varying maturity rates; elephant grass takes longer time to mature than maize, allowing for more protein accumulation (Osuji *et al.,* 2015). Additionally, the difference in nitrogen uptake may play a role, as elephant grass has a more extensive root system than maize, enabling better nitrogen absorption and utilization (Mekonnen *et al.,* 2018). The higher CF content of maize compared to elephant grass could be attributed its higher lignin complex polymer that contributes to fibre content (Jung and Allen, 2017) and thicker cell walls (Grabber *et al.,* 2015). Ether extract represent the oil/fat forage fraction. The higher EE concentration of elephant grass compared to maize forage could be attributed to higher lipid content in elephant grass leaves (Adebowale *et al.,* 2016; Oliveira *et al*., 2017). Similarly, the ash content in elephant grass may be attributed to differences in mineral uptake efficiency, with elephant grass having a higher efficiency, particularly for potassium and calcium, which contribute to its higher ash content (Lima *et al.,* 2018).The neutral detergent fibre (NDF) and acid detergent fibre (ADF) contents are also higher in elephant grass is be attributed to differences in cell wall composition, with elephant grass having a higher cell wall content, particularly in the stems, which contributes to its higher NDF and ADF content (Melo *et al.,* 2019). Additionally, the fibre structure of elephant grass is more complex, with a higher proportion of sclerenchyma cells, which contribute to its higher NDF and ADF (Oliveira *et al.,* 2017, this will further explain the higher NFE to the higher soluble carbohydrate content, particularly sugars and starches in elephant grass leaves (Santos *et al.,* 2019; Pires *et al.,* 2020).

Nutrient composition of Lablab and Mucuna at 12 weeks post planting

Higher nutrient profile is among the yardstick for determining forage quality. Mucuna forage prove superior in term of CP, EE and ash content compared to lablab. The higher CP, EE and ash could be attributed to its higher amino acid and fatty acid composition (Adebowale *et al.,* 2017; Ogunwole*et al.,* 2017) and mineral density (Adebowale *et al.,* 2017). Lablab, on the other hand, exhibits higher crude fibre (CF), acid detergent fibre (ADF), and neutral detergent fibre (NDF) compared to mucuna, as observed in this study. This disparity might be attributed to higher cell wall content and lignin levels (Ezeagu *et al.,* 2015; Kumar *et al.,* 2017). It might also be due to differences in the proportion of soluble fibre, with lablab containing a greater proportion of insoluble fibre compared to mucuna, leading to higher CF, ADF, and NDF values (Ezeagu *et al.,* 2015).

CONCLUSION AND RECOMMENDATION

Based on the results of this study, elephant grass and mucuna were superior to maize and lablab forages due to their higher CP, EE and ash contents with corresponding CF, ADF and NDF. Feeding trial is recommended to ascertain voluntary feed intake and animal performance of such forages.

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