Change in growth of Galla goats fed different cultivars of Brachiaria grass in the coastal lowlands of Kenya

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Inadequate quality and quantity of feeds is the major constraint to livestock production in the arid and semi-arid regions of Kenya. A study was conducted to determine the chemical composition and dry matter digestibility of three *Brachiaria* cultivars namely; *Brachiaria brizantha* cvs. Piata and MG4, and *B. hybrid* cv. Mulato II and their effects on live weight changes of Galla goats in the coastal lowlands of Kenya. They were compared with the commonly grown grass, Rhodes grass. Sixteen Galla goat bucklings ranging from 10-24 kg were randomly allocated to four dietary treatments with four animals per treatment. Each goat was supplemented with 100 g/day of maize germ. Mineral licks and water were provided *ad libitum*. Piata and MG4 had higher ($P<0.05$) crude protein (12.6 and 12.1% respectively) than Mulato II (3.0%) and Rhodes grass (6.7%). The cvs. Piata and MG4 were also more digestible than Mulato II and Rhodes grass. There was no difference ($P>0.05$) in grass dry matter intake of among the goats and it ranged from 513-661 g/goat/day. Average daily live weight gain was higher ($P<0.05$) for goats fed on Piata (45.2 g/day) and MG4 (41.3 g/day) than those fed on Mulato II (2.0 g/day) and Rhodes grass (9.6 g/day). Likewise goats fed on Piata (3.8 kg) and MG4 (3.5 kg) had the highest ($P<0.05$) total weight gain compared with bucklings fed on Mulato II (0.2 kg) and Rhodes grass (0.8 kg). Based on body weight gain and nutritive value, Piata and MG4 showed the greatest potential to address feed quality constraint in livestock production.

Key words: Chemical composition; crude protein; dry matter digestibility; livestock production; live weight gains.

Introduction.

Arid and semi-arid lands (ASALs) cover 80% of Kenya's landmass (Mganga *et al*., 2010). These areas are characterized by low rainfall, high temperatures, poor quality feed resources, and high incidences of livestock diseases (Kahi *et al.,* 2006). The ASALs support 60% of the livestock population and the largest proportion of wildlife (Ngugi and Nyariki, 2003). According to Mbogoh and Shaabani (1999) agro-pastoralism and pastoralism are the main economic activities in ASALs from which majority of the people attain their livelihoods. This is mostly based on cattle (the small East African zebu – SEAZ and Boran), goats, sheep and camels, and thus constitutes a major source of Kenya's meat (Herlocker, 1999).

According to Njarui *et al.* (2011), the productivity of livestock in Kenya is strongly linked to feed availability. The reason for this is that; feed is the major input factor in livestock production systems and account for between 60–70% of the production cost. The authors reported that, the productivity of ruminants is considered low due to inadequate and poor quality feeds. There is a feed resource deficit for about 4-6 months in a year across many regions in Kenya particularly during the dry season when there is limited pasture growth. Livestock is considered one of the key assets for rural households in most parts of the world and it is a primary livelihood resource for most rural communities. According to FAO (2012), about 752 million of the world's poor keep livestock mainly to; generate cash income, produce food for subsistence use, manage risks and to build up assets for security purposes. Another limitation of livestock production is that there is lack of suitable fodder crops that can produce green forage throughout the year (Leeuw *et al*., 1992). This situation becomes even worse in the areas that are constrained by low rainfall.

Most small ruminants in the ASALs suffer from nutritional stress (Bruinsma, 2003). Most of the grasses have low crude protein (CP) falling below 7% minimum level that is required for optimum microbial growth (Wambui *et al*., 2006). When this occurs, it prompts supplementation, which is not always possible for resource poor farmers (Gitunu *et al*., 2003). There is a need, therefore, for pasture species that can improve the quality of the natural pastures and significantly increase dry matter production to enhance livestock productivity. One of these pastures has been found to be *Brachiaria* (Machogu, 2013).

Lascano and Euclides (1996) and Brighenti *et al*. (2008) reported that apart from the good adaptability, tolerance and resistance of *Brachiaria* species, the grasses have high forage quality and high dry matter production making them capable of meeting the nutritional requirements of animals especially during the dry season.

Goats are found in many parts of Kenya and are an important source of income to many small-holder farmers. They are preferred to cattle as they can be converted to cash easily. They also provide a higher offtake compared to cattle because of their shorter generation interval and higher prolificacy (Ahuya and Okeyo, 2006). Galla goats also known as Somali or Boran goats are indigenous to the arid and semi-arid regions of northern Kenya and are kept mainly for meat (Ahuya and Akeyo, 2006).

The full potential of the ASALs for livestock production can be exploited by expanding the forage resource base by introducing climate smart forage species to boost nutrient quality and quantity hence supplying the nutritive requirements of livestock. Studies on climate smart *Brachiaria* grass species developed elsewhere have shown that they could be the key to improvement of livestock production and also serve to boost composition and nutritive values of local *Brachiaria* cultivars.

However, there are hardly any studies on goat feeding on *Brachiaria* grasses. The study was therefore done to determine its suitability on goat performance. The objective was to evaluate the growth of Galla goats fed selected *Brachiaria* grass cultivars.

Materials and Methods

Site

The feeding trial was conducted at the Sheep and Goat Multiplication Centre at Matuga (4^o 9'6'S, 39^o 32'40'E), in Kwale County, Kenya. The Centre is located at 60 m.a.s.l in coastal lowlands 3 (CL3) agro-ecological zone, also referred to as the Coconut-cassava zone (Jaetzold *et al.*, 2006). The average annual rainfall is 1100 mm while the relative humidity ranges from 70 - 80% and an average temperature from 22 - 30^oC.

Management of Animals

Sixteen Galla goat bucklings aged between 6-12 months and weighing 10-24 kg were selected from Centre herd. They were divided into four groups of four animals which were balanced for age and weight. The groups were randomly assigned to four dietary treatments; *Brachiaria brizantha* cvs Piata and MG4, *Brachiaria hybrid* cv. Mulato II and Rhodes grass (*Chloris gayana*). The goats were kept in well ventilated individual pens. Dry grass was used for bedding. Both the feeding and sleeping areas were disinfected before the goats were brought in. During the adjustment period, animals were dewormed against endo-parasites and sprayed weekly against ecto-parasites. The pens were cleaned every morning and beddings changed weekly.

Feeds and feeding

The *Brachiaria* cultivars used for feeding were *Brachiaria brizantha* cv. Piata and MG4 and *B. hybrid* Mulato II). Rhodes grass was used as the control grass. The cv. Piata, MG4 and Rhodes grass were grown at KALRO-Katumani in the semiarid region of eastern Kenya while Mulato II was grown at KALRO-Mtwapa in the coastal lowlands. The recommended agronomic practices were followed in order to provide good quality forage for feeding. The grasses were harvested 5cm above ground and allowed to dry, baled into hay and transported to Matuga.

During the feeding, all the animals were supplemented with a 100g/day of maize germ that was purchased from a commercial maize miller to last for the whole experiment. The supplement was given before the basal diets were offered at 7.00 hrs. Water and a mineral supplement were provided *ad libitum*. The hay made up of stem and leaves were chopped using a motorized chaff cutter to approximately 5 cm length and mixed thoroughly to prevent selection. The feeds were offered for a 14 days adaptation period and 12 weeks experimental period from 20th April to 13th July 2016. The grass basal diet was offered *ad libitum* by offering feed in the morning and adding during the day to ensure feed availability at all times. Any left overs were removed and weighed the following day before fresh feed was added. Animals were weighed weekly before feeding (fasting weight) using a portable electronic weighing scale.

Chemical composition of feeds

A small amount of herbage was taken from each bale used for feeding and a composite sample of about 2 kg per treatment constituted for analysis. The samples were ground to pass through 1 mm screen. The samples were then analysed in duplicates for chemical composition at the Animal and Nutrition Laboratory at KALRO-Muguga. The CP was determined using the micro-Kjeldahl according to the method of the Association of Official Analytical Chemists (Association of Official Analytical Chemists 2000). Neutral detergent fibre (NDF), acid detergent fibre (ADF), lignin, and digestibility were determined according to the procedure of Goering and Van Soest (1970). Ash was determined by heating the samples at 600^{o}C for 2 hours in a muffle furnace. Total P and Ca were determined according to the methods described by Okalebo *et al.*, (2002).

Data collection and calculation

Feed intake was estimated from the difference between the feed offered and refused. Live-weight changes were calculated as the difference between the initial and final weight while the average daily weight gain was obtained by dividing the weight change by number of experimental days (90 days). Daily feed dry matter (DM), organic matter (OM), crude protein (CP), were calculated as the difference between feed offer and refusal corrected for the respective contents in the original sample (Balehegn *et al*., 2014). Feed conversion ratio was obtained by dividing the feed intake and average daily gain.

Data analysis

The nutritive quality composition (DM, CP, OM, Ash, NDF, ADF, ADL, Ca, P) and digestibility of feeds were analysed using the general linear model (GLM) procedures of the Statistical Analysis System (SAS, 2010). Values for feed intake and live weight gain were subjected to analysis of variance (ANOVA) in a completely randomised design using GLM procedures of the Statistical Analysis System (SAS, 2010) based on the following model:

$Y_{ij} = \mu + T_i + e_{ij}$

Where Y_{ij} = the $_j$th observation of the $_i$th treatment

μ = overall mean

Ti = the effect of the feed of the $_i$th grass treatment (1-4)

e_{ij} = the residual error

Means were separated by least significance difference (LSD) (Steel and Torrie, 1981).

Results

Feed quality composition

The quality composition of the grass used in the feeding the goats are presented in Table 1. There were significance ($P<0.05$) differences in the CP content, dry matter digestibility, ADF, ADL, ash, Ca and P content among the forages (Table 1). Piata had the highest CP content (12.6% of DM) while Mulato II had lowest ($P<0.05$). Similarly, the MG4 and Piata were more digestible than Mulato II and Rhodes grass. All the Brachiaria cultivars had similar ($P>0.05$)

amount of Ca but were significantly (P<0.05) lower than that of Rhodes grass while P content was not different (P>0.05) among all the grasses.

Table 1. Chemical composition (%) and digestibility (%) of feeds used in feeding the goats

Feeds	CP	NDF	ADF	ADL	Ash	DoMD	DMD	Ca	P
Maize germ	13.9	27.5	7.7	0.4	3.6	84.7	87.4	0.03	0.73
Piata	12.6	57.9	35.4	3.6	10.8	49.0	55.0	0.27	0.20
MG4	12.1	57.1	36.9	4.3	10.7	48.7	55.5	0.27	0.22
Rhodes	6.7	68.6	44.3	5.5	7.7	39.8	44.6	0.39	0.08
Mulato II	3.0	70.7	46.9	6.3	5.0	38.2	41.4	0.27	0.19
LSD (P<0.05)	0.8	2.6	1.5	2.9	0.7	32.8	4.1	0.03	0.15
CV (%)	3.0	1.6	1.6	25.6	3.5	2.3	2.6	4.1	18.9

Feed intake

The goats ate all (100g) the maize germ supplements offered. The average feed intake on weekly basis for the entire feeding period is shown in Figure 1. There was no difference (P>0.05) in the basal feed intake in all the weeks among the goats. Generally the average feed intake increased over time and ranged from 513-661 g/goat/day.

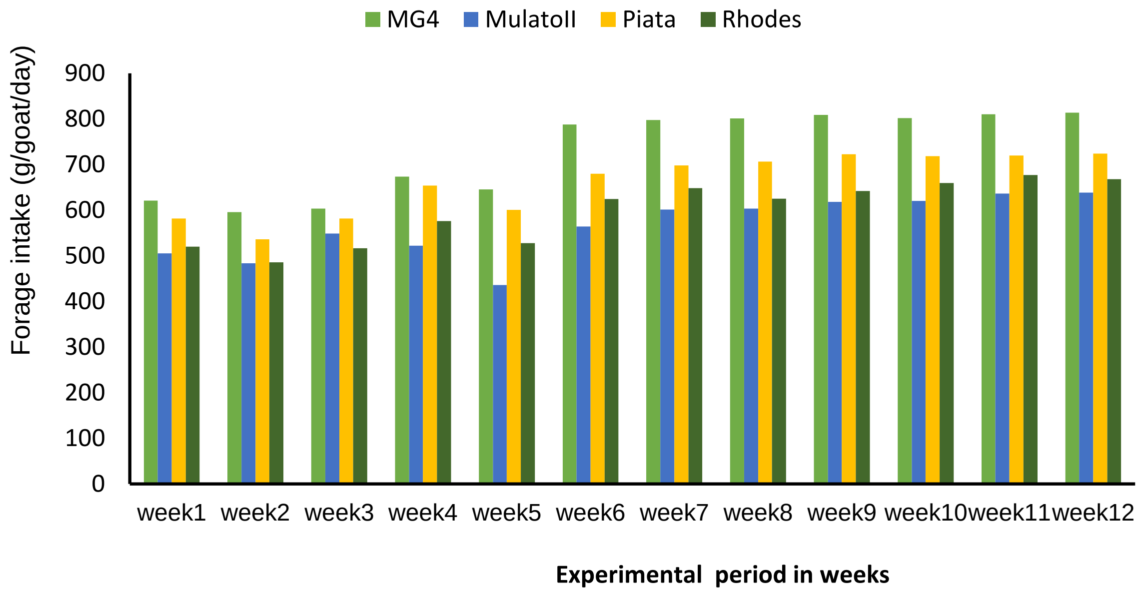

Figure 1. Average weekly feed intake of goats fed on Brachiaria and Rhodes grass

Live weight gain and feed conversion ratio

Live weight increased marginally with goats fed on Piata and MG4 maintaining the highest weights during the entire period (Figure 2). Goats fed on Mulato II lost weight initially and gained from week 9. The average daily weight gain (ADWG) differed significantly ($P<0.05$) with bucklings fed on Piata (45.21g/day) and MG4 (41.28g/day) having the highest daily weight gain while those fed on Mulato II had the lowest. Likewise, the average weight change (AVC) was also highest in goats fed Piata (3.80 kg) and MG4 (3.47 kg) than those feed on Mulato II (0.17 kg) and Rhodes grass (0.81 kg). The Piata and MG4 had the lowest feed conversion ratio (FCR) for all parameters (OM, CP, DM) meaning the animals were efficient in utilizing these grasses which is reflected in the high body weight gain.

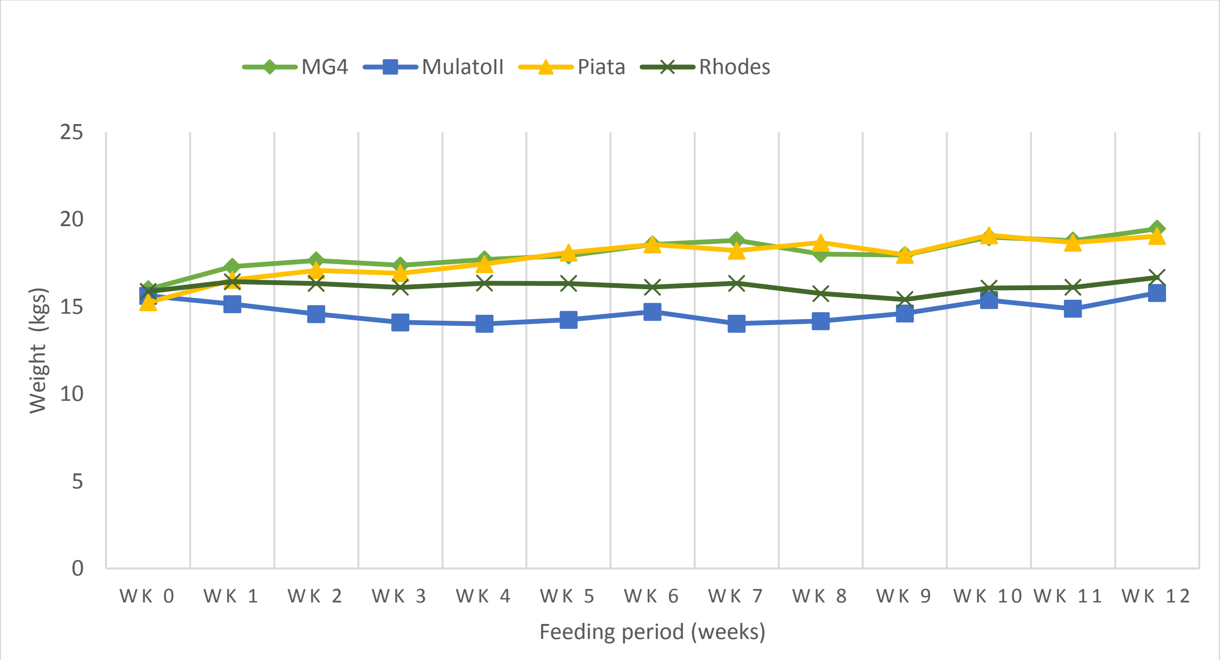

Table 2. Total and average weight gain and feed conversion ratio of Galla goats fed Brachiaria cultivars and Rhodes grass.

Feeds	IBW (kg)	FBW (kg)	ADWG (g/day)	AWC (kg)	FCR DM	FCR OM	FCR CP
MG4	16.00	19.47	41.3	3.47	16.0	9.6	2.1
Mulato II	15.63	15.80	2.0	0.17	259.5	113.8	8.5
Piata	15.25	19.05	45.2	3.80	13.4	7.6	1.8
Rhodes	15.87	16.68	9.6	0.81	56.2	26.6	4.1
LSD ($P<0.05$)		0.4	17.2	1.45	6.2	2.7	0.2
CV (%)		0.06	43.9	43.9	0.5	0.5	0.4

IBW=Initial body weight; FBW =Final body weight, ADWG =Average daily weight gain; AWC=Average weight change; FCR=Feed conversion ratio

Discussion

Feed quality composition

In this study, Piata and MG4 were found to be better sources of protein than Mulato II and Rhodes grass. They contained the minimum CP of 7.5% suggested as necessary for optimum rumen function and production by Van Soest (1994). Afzal and Ullah (2007) reported that crude protein (CP) and digestible dry matter are the most important components of a feed. Crude protein requirement for small ruminant maintenance is 9.6, 11.2 and 11.7% for pregnant ewes, does and kid finishing respectively (NRC, 2007). The CP content of Mulato II content was low compared to that reported by Nguku (2015) of 7-12.8% in a semi-arid region of Kenya, 15% in central Kenya (Nyambati *et al*. 2016) and 12-17% by Vendramini *et al*. (2011) in Florida, USA. The low CP of Mulato II was attributed to poor management of the grass at harvesting and baling. Further Mulato II was grown in the coastal lowlands and generally due to the high temperatures experienced in the region, the growth was fast and accumulated more fibre resulting to low CP and digestibility. On the contrary Piata, MG4 and Rhodes were grown in mid-altitude region where it is cooler resulting in slower growth.

The DMD of Mulato II and Rhodes was lower than that reported by De Gues (1977). The digestibility of tropical grasses ranges between 50 and 65%, while that of temperate grasses is slightly higher and ranges between 65 and 80%. Coward-Lord *et al*. (1974) reported that the age of cutting forage crops has an influence on the digestibility, and is a function of the chemical constituents of forages. These results agree with what Njarui *et al*. (2003) who reported that the proportion of potentially digestible components decline as the fibrous content increases.

Live weight gains

Bucklings fed on cvs. Piata and MG4 gained more weight on daily basis and had the highest total weight gain at the end of experiment. This weight gain was higher than that reported by Njarui *et al*. (2003) for Kenya Dual Purpose goats fed different forage legumes supplements and by Nyako *et al*. (2012) when fed on Pangola grass and supplemented with cotton seed cake. In another study by Wambui *et al*. (2006) on German Alpine crosses supplemented with

Tithonia, Calliandra and Sesbania, the goats showed a high average daily weight gain of up to 82.7, 57.3 and 39.3 g/day, respectively. High weight gain for goats fed on Piata and MG4 is attributed to their high CP content, digestibility and low fibres. On the contrary bucklings fed Mulato II had the lowest gain due to low CP content. From FCR, for the goats to gain 1 g of live weight per day it should eat less forage of Piata and MG4 and more of Mulato II and Rhodes grass. A smaller FCR indicates how efficient a feed is (Sani, 2009). The FCR also showed that diets that had low CP had poor FCR.

Conclusion

Piata and MG4 contributed to the highest growth of the Galla goats and were superior to Rhodes grass. Thus these grasses could replace Rhodes grass in the coastal lowlands as livestock feeds. Further research should be conducted on Mulato II taking into consideration its management to maintain high quality.

Acknowledgements

This study was a collaborative work between Bioscience eastern and central Africa (BecA-ILRI) Hub and KALRO and was funded by the Swedish International Development Agency (Sida). Our gratitude goes to the KALRO staffs at Matuga, Muguga and Katumani for their support during experimental period. We are so indebted to Mr. Japheth for his assistance in data collection. We thank the staff of the Sheep and Goat Multiplication Centre-Matuga and especially Mr. Mathew Papa, the officer in-charge for allowing us to use the goats and the facility to carry out the experiment.

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