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Research paper

Grazing behavior and intake of goats rotationally grazing Tanzania-grass pasture with different post-grazing residues

Comportamiento y consumo de forraje de cabras en pastoreo rotacional del pasto Tanzania con diferentes niveles de forraje residual

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Abstract

This study aimed to evaluate intake and ingestive behavior of goats rotationally grazing Tanzania (*Panicum maximum* cv. Tanzânia 1) pastures with 2 levels of post-grazing residue. The experimental area consisted of 1.2 ha of Tanzania pasture divided into 12 paddocks (24 areas), managed under 2 post-grazing residues: low green (leaf + stem) herbage mass (GHM) post-grazing (LR, approximately 1,500 kg/ha GHM); and high GHM post-grazing (HR, approximately 3,000 kg/ha GHM). Each paddock was grazed for 3 consecutive days (D1, D2, D3) followed by 33 days rest and evaluated from October 2005 to April 2006. Animal behavior (grazing time, bite rate and bite size/weight) was evaluated on each grazing day. While goats spent more time grazing on LR than HR (P=0.02), bite rate did not differ between treatments or among days (P=0.31) and averaged 26.5 bites/min. In contrast, bite weight was greater in HR (0.15 g/bite) than in LR (0.12 g/bite), and decreased from D1 to D3 (P<0.001). Absolute dry matter intake of goats was greater in the HR (2.19 kg/d) than the LR (1.89 kg/d) treatment; however, differences were not significant (P>0.05) when intake was determined on a body weight or metabolic weight basis. Our findings are consistent with the general assumption that bite weight is a trade-off between quantity and quality of the herbage mass and is the main determinant of animal performance. More studies are needed to determine animal performance on the various treatments and to determine management strategies to provide a desirable balance between animal weight gain and pasture stability.

Keywords: Animal behavior, foraging, grazing systems, *Megathyrsus maximus*, plant - animal relations.

Resumen

En el estudio se evaluaron el comportamiento o hábito de pastoreo y el consumo del pasto Tanzania (*Panicum maximum* cv. Tanzânia 1) por cabras en pastoreo rotacional manejado con 2 niveles de residuos pospastoreo. El área experimental consistió en 1.2 ha de la pastura divididas en 12 potreros (24 áreas) que se manejaron con 2 niveles de residuos pospastoreo: baja masa de forraje verde (hoja + tallo) pospastoreo (LR, aproximadamente 1,500 kg de masa verde/ha); y alta masa de forraje verde pospastoreo (HR, aproximadamente 3,000 kg de masa verde/ha). Cada potrero fue pastoreado por 3 días continuos (D1, D2, D3), seguido por 33 días de descanso en el período octubre de 2005 a abril de 2006. Cada día de pastoreo se evaluó el comportamiento animal (tiempo de pastoreo, tasa de bocados y tamaño de bocados/peso). Los resultados mostraron que las cabras pasaron más tiempo pastando en LR que en HR (P=0.02) pero la tasa de bocados,

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con un promedio de 26.5 bocados/minuto, no difirió entre los tratamientos ni entre días (P=0.31). En contraste, el peso de los bocados fue mayor en HR (0.15 g/bocado) que en LR (0.12 g/bocado) y disminuyó del D1 al D3 (P<0.001). El consumo absoluto de materia seca fue mayor en el tratamiento HR (2.19 kg/d) que en LR (1.89 kg/d); sin embargo, las diferencias no fueron significativas (P>0.05), cuando el consumo se determinó con base en el peso corporal de las cabras o el peso metabólico. Nuestros resultados son consistentes con la hipótesis general de que el peso de un bocado refleja un compromiso entre la cantidad y la calidad del forraje y que es el principal determinante del rendimiento animal. Se necesitan más estudios para determinar el rendimiento animal en los diferentes tratamientos y para definir las estrategias de manejo para proporcionar un equilibrio deseable entre la ganancia de peso de los animales y la estabilidad de la pastura.

Palabras clave: Comportamiento animal, *Megathyrsus maximus*, relación planta - animal, sistemas de pastoreo.

Introduction

Due to their anatomical and physiological characteristics coupled with their acceptance of a wide range of forages, goats generally are quite adaptable to varying situations and are productive even in areas with low production potential. As a result, they are used widely throughout the world in native pasture systems but not necessarily in cultivated pasture systems. With the intensification of goat production, an understanding of goat behavior on cultivated tropical pastures is needed to define management practices that will allow effective forage intake and productivity.

According to Burns and Sollenberger (2002), several factors related to tropical forages, such as the amount of available forage, ease of prehension and chemical composition, can affect the voluntary intake of ruminants during grazing. Sward structure is generally characterized by height, bulk density and distribution of the morphological components (leaf and stem) of the canopy. In contrast with C3 grasses, the C4 grasses, such as Tanzania grass, *Panicum maximum* (now: *Megathyrsus maximus*) cv. Tanzânia 1, can accumulate high forage levels in tropical management systems with high percentages of stem and low bulk density, which can restrict the process of bite formation (Benvenutti et al. 2006). Consequently, the relationship between intake and animal performance is mainly influenced by sward structure, which can vary in tropical pastures depending on forage mass prior to and after grazing (Pedreira et al. 2005; Carnevalli et al. 2006). On the other hand, animals can alter grazing behavior in response to changes in sward structure by modifying the following variables: grazing time, bite rate and bite size.

A previous study with goats has demonstrated that increasing Tanzania-grass sward height (from 30 to 90 cm) resulted in increased forage and leaf mass, but decreased forage intake of the animals, so that 50-cm sward height was suggested as optimal (Ribeiro et al. 2012). Conversely, Rodrigues et al. (2013) observed that a pre-grazing sward height above 100 cm did not reduce the intake of the pasture by goats, attributing this fact to the high mass of green leaf, which constituted 76% of total forage dry matter. Even though management strategies based on sward height have been investigated with goats, inconsistent results indicate that height might not be the appropriate criterion on which to base management of tropical pasture.

In tropical pastures, post-grazing residue directly affects the potentially grazed strata as a consequence of changes in herbage bulk density (Difante et al. 2009), the main component of tropical grass sward structure that influences intake (Stobbs 1973b). Nonetheless, the appropriate post-grazing residue depends on the desired objective and type of animal being used in the system (Difante et al. 2009).

This study evaluated the intake and ingestive behavior (grazing time, bite rate, bite size/weight) of goats grazing pastures of Tanzania grass subjected to different rotational grazing intensities characterized by 2 amounts of post-grazing residue. This should assist in developing pasture management strategies to provide a desirable balance between individual animal performance and area productivity.

Materials and Methods

All animal procedures in this experiment were approved by the São Paulo State University's Institutional Animal Care and Use Committee.

The experiment was conducted at Jaboticabal, São Paulo, Brazil (21°15'22'' S, 48°18'58'' W; 595 masl), which experiences a tropical climate with dry winters and hot and rainy summers (Aw). During the experimental period (October 2005–April 2006), mean monthly temperature and rainfall were, respectively: 23.2, 24.6, 24.9, 25.1, 25.2, 25.3 and 24.9 ºC; and 135.4, 184.7, 138.7, 358.5, 81.2, 128.0 and 59.6 mm for October, November and December 2005, and January, February, March and April 2006.

Soil of the area under analysis was a clay oxisol (Soil Survey Staff 2010). According to pre-experimental soil analysis [65 ± 4% base saturation (V), 18 ± 5 mg P_{resin}/dm^3, 1 ± 0.3% K in Cation Exchange Capacity, CEC], 3,600 kg of a highly reactive dolomitic lime, 800 kg of simple superphosphate (8% P) and 5,300 kg of potassium chloride (50% K) were applied differentially (on a per-paddock basis, over the entire experimental area), so that soil was corrected to obtain high fertility levels: 80% V; 30 mg P/dm^3; 5% K in CEC. The experimental area consisted of a 1.2 ha Tanzania-grass (cv. Tanzânia 1) pasture that was divided into 12 paddocks (990 m^2), which were further subdivided into sub-paddocks and grazed rotationally in a 36-d cycle (3 days of grazing followed by 33 days of rest; Figure 1). Each sub-paddock was allocated to 1 of 2 treatments: low green (leaf + stems) herbage mass post-grazing (LR, approximately 1,500 kg of dry green herbage mass, GHM/ha); or high GHM post-grazing (HR, approximately 3,000 kg GHM/ha). Immediately after grazing, each paddock was fertilized with 40 kg urea (46% N)/ha and 33 kg K/ha, as potassium chloride (50% K).

On 31 October 2005, paddocks were mowed to about 45 cm for staging and standardization and the area was left ungrazed for 36 days. A 36-day pre-experimental grazing cycle was then introduced, during which stocking rate was adjusted regularly in each paddock, according to the visual analysis of the previous grazing day, to achieve a target post-grazing residue, according to future treatment.

Data were analyzed in a randomized block design using repeated measures (plots: high and low GHM post-grazing; sub-plots: cycles 11 January–15 February 2006, 16 February–23 March 2006, 24 March–28 April 2006; sub-sub-plots: days 1, 2 and 3 in an area). Grazing was carried out using F1 Boer x Saanen goats (approximately 18 months of age and 31.7 ± 5.7 kg body weight). Animals were permitted to graze between 07.00 and 19.00 h and were confined to pens during the night. The grazing strategy consisted of rotational stocking with stocking rate adjusted according to the put-and-take method to achieve the particular GHM post-grazing (Bransby and Maclaurin 2000).

Daily grazing times, including idle time plus rumination, were monitored in 4 tracer animals per treatment during 3 grazing cycles (sub-treatments) for the 3 days of occupation (sub-sub-treatments). Observations were made every 10 minutes during which time the types of activities executed by the grazing animals were recorded. At the same time, bite rate was determined by counting the number of bites in two 3-minute evaluations in both morning and evening, using a counter and a chronometer.

Bite weight was measured using 2 esophageal-fistulated (OF) goats each day in the areas being grazed. Early in the morning, cannulae of fistulated animals were removed and cotton collection bags attached to them. One OF goat was put into each area for 15 minutes, then they were swapped over for 15 minutes in a sequential manner: treatment/area grazing was reversed each day (or rather, the first paddock of the first treatment grazed by the first animal on the first day was the first paddock of the first treatment grazed by the second animal on the second day).

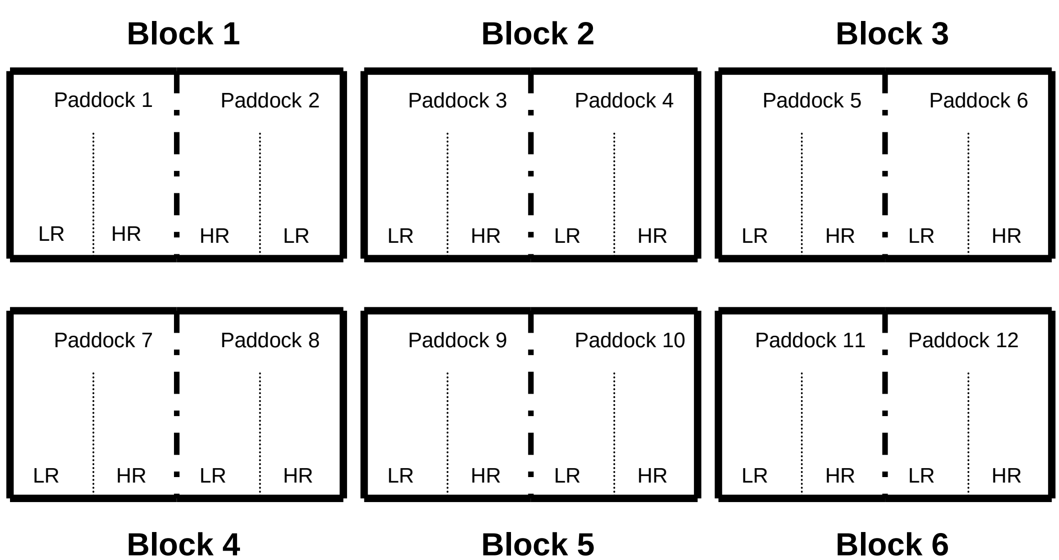

Figure 1. Arrangement of experimental area with pastures grazed rotationally, with 3 days grazing followed by 33 days rest. LR = low green herbage mass (GHM) post-grazing, approximately 1,500 kg/ha; HR = high GHM post-grazing, approximately 3,000 kg/ha.

During the 15-minute grazing, bites per animal were counted and the extrusa was collected. Extrusa samples were packed in plastic bags, weighed, placed in thermal boxes and stored at -18 °C. The samples were then thawed, dried, ground and analyzed for dry matter (DM; AOAC 1990; method number 930.15), ash (AOAC 1990; method number 920.39), indigestible neutral detergent fiber (NDF; Van Soest et al. 1991), indigestible acid detergent fiber (ADF) and lignin (Van Soest 1963).

Forage intake was estimated using an external marker technique in the same 4 tracer animals per treatment. A total of 1.2 g of chromium oxide (Cr_2O_3) was orally administered twice a day, starting 13 days before collection. Feces were collected twice a day (07.00 and 19.00 h) during the last 6 days of supplying the marker. Immediately after collection, samples were frozen, dried, ground and analyzed for DM, ash, NDF, ADF and lignin, following previously described procedures, and chromium as described by Williams et al. (1962).

Feces produced was estimated by the formula:

[1]

$$\text{Feces produced (g DM/d)} = \frac{\text{weight of } Cr_2O_3 \text{ supplied (g/d)}}{\text{concentration of } Cr_2O_3 \text{ in feces (g/g DM)}}$$

Hand plucked samples were collected daily in each pasture during the last 6 days of supplying the marker. The herbage was removed at approximately 10 locations per pasture based on the direct observation of number and type of bites of goats, which were grazing concomitantly. DM digestibility of hand-plucked samples (Bonnet et al. 2011) was calculated by the in vitro technique (Tilley and Terry 1963). Dry matter intake (DMI) was calculated from the production of feces and DM digestibility, according to the following equation:

[2]

$$\text{DMI (g DM)} = \frac{\text{feces produced (g DM/d)} \times 100}{(100 - \text{digestibility of DM})}$$

Owing to the difficulty in calculating intake of animals during each day of grazing using the marker technique, the relative intake was estimated by multiplying the variables of ingestive behavior (bite weight, bite rate and grazing time) and proportional intake was determined as a percentage of the highest intake per treatment.

Immediately before (pre-) and after (post-) grazing in the sampling paddocks, herbage mass was determined by harvesting material from 0.25 m^2 quadrats placed at 4 representative points, determined through visual appraisal within the experimental unit. Forage was then taken to the laboratory and the morphological components (leaf, stem and dead material) were separated manually. Components were dried in a forced-air oven at 55 °C for 72 h and the morphological composition of the harvested forage calculated.

Sward height was measured with a 1.5 m rule, as the mean height at 5 representative sites within each area.

Data were analyzed as a complete randomized block design with repeated measurements in time using the Mixed procedure of SAS version 9.2 (SAS Institute Inc., Cary, NC, v.9.2). The model included the fixed effects of treatments (1 d.f.), grazing cycle (2 d.f.), days of occupation (2 d.f.) and their interactions (4 d.f.) and the random effects of blocks (5 d.f.). Double error structures (UN@AR(1); UN@CS; UN@UN) were evaluated and the most adequate structure was chosen, following Bayesian Information Criterion (BIC). When no double error structure was convergent, only the error structure for the sub-sub-plot (days) was chosen by the above-mentioned criterion. The error structure of the sub-plot (Cycles) was CS (Compound Symmetry - matrix default of MIXED procedure). When significant, means were compared using Fisher´s protected LSD (DIFF option of LS MEANS). Significance was declared at $P<0.05$.

Results

Table 1 depicts the forage structural characteristics. Dry herbage mass (HM), GHM, dry stem mass (S), dry leaf mass (L), leaf:stem ratio (L:S) and height were lower in LR than in HR treatment ($P<0.05$). Increasing grazing time in a paddock (from Day 1 to Day 3) resulted in decreasing HM, GHM and L but did not affect S and dead material mass (D). In the LR treatment, the height decreased by 54% during grazing (from 57 cm at entry on Day 1 to 26 cm post-grazing), whereas in the HR treatment, the height decreased only 40% (from 61 cm on Day 1 to 37 cm post-grazing). Mean values for post-grazing GHM of treatments LR and HR were 2,006 ± 222 kg/ha and 3,133 ± 222 kg/ha, respectively (Figure 2).

Differing herbage mass on the 2 treatments affected goat behavior and intake with longer grazing time spent on the treatment with low post-grazing residue ($P<0.02$, Table 2). Time spent grazing on the third day was greater than on the first day on both a percentage basis and actual minutes ($P=0.03$).

Table 1. Mean (± s.e.; DM basis) total herbage mass (HM), green herbage mass (GHM), leaf (L), stem (S), dead material (D), leaf:stem ratio (L:S) and height of Tanzania pasture rotationally grazed by goats to 2 post-grazing heights (LR and HR).

	HM	GHM	L	S	D	L:S	Height
			(kg/ha)			ratio	(cm)
Treatment[1] (T)							
LR	5,520±362b[3]	3,078±204b	1,555±128b	1,522±92b	2,442±177	1.0±0.06b	38.2±1.0b
HR	6,173±362a	3,776±204a	2,085±128a	1,691±92a	2,397±177	1.3±0.06a	47.2±1.0a
P	0.006	<0.001	<0.001	0.01	0.63	0.001	<0.001
Day[2] (D)							
1	6,940±382a	4,361±242a	2,780±158a	1,581±98	2,579±242	1.8±0.07a	59.0±1.4a
2	6,152±382b	3,685±209b	2,062±130b	1,623±98	2,466±208	1.3±0.05b	45.4±1.0b
3	5,478±382c	3,090±209c	1,422±130c	1,667±98	2,387±221	0.9±0.08c	35.2±1.0c
Post-grazing	4,814±382d	2,569±204d	1,016±121d	1,553±98	2,244±193	0.6±0.03d	31.2±0.8d
P	<0.001	<0.001	<0.001	0.46	0.47	<0.001	<0.001
Interaction (P) TxD	0.23	0.12	0.06	0.35	0.79	0.08	0.01

[1]LR = low green herbage mass (GHM) post-grazing, approximately 1,500 kg/ha; HR = high GHM post-grazing, approximately 3,000 kg/ha.
[2]Day of grazing in the area.
[3]Means within columns and parameters followed by different letters differ at P<0.05 by Fisher's test.

Figure 2. Representation of post-grazing mass of treatments LR (low green herbage mass) and HR (high green herbage mass.

Table 2. Mean (± s.e.) grazing time, bite rate (BR) and bite weight (BWe) of F1 Boer x Saanen goats rotationally grazing Tanzania pasture (*Panicum maximum* cv. Tanzânia 1) with 2 levels of post-grazing residue (LR and HR).

	Grazing time[1]		BR	BWe
	(%)	(min)	(bite/min)	(g OM/bite)
Treatment[2] (T)				
LR	75±0.01a[4]	489±9a	27±1.9	0.124±0.004b
HR	71±0.01b	462±9b	26±1.9	0.155±0.004a
P	0.03	0.02	0.31	<0.001
Day[3] (D)				
1	71±0.01b	460±9b	27±1.9	0.184±0.005a
2	73±0.01ab	476±9b	27±1.9	0.133±0.005b
3	75±0.01a	491±9a	26±1.9	0.102±0.008c
P	0.03	0.03	0.30	<0.001
Interaction (P) T x D	0.22	0.30	0.65	0.82

[1]Time spent grazing daily: presented as % of time in the area and as actual minutes.
[2]LR = low green herbage mass (GHM) post-grazing, approximately 1,500 kg/ha; HR = high GHM post-grazing, approximately 3,000 kg/ha.
[3]Day of grazing in the area.
[4]Means within columns and parameters followed by different letters differ at P<0.05 by Fisher's test.

Bite weight of goats on the HR treatment was greater than on the LR treatment (Table 2) and bite weight decreased progressively with number of days in an area (P<0.001). On the other hand, bite rate did not differ among treatments (P=0.31) or grazing days (P=0.30).

Chemical composition of extrusa was not influenced by treatments (Table 3). However, NDF and ADF percentages in extrusa on the first grazing day in an area were lower than on the second and third grazing days.

Absolute DMI (kg/d) of goats was greater in the HR than in the LR treatment (P<0.05); however, differences were not significant (P>0.05) when intake was determined on a body weight (BW) or metabolic weight basis (Table 4). Using markers to estimate intake did not allow precise estimation of variation in forage intake as time in an area increased. While daily DMI can be overestimated using the variables of ingestive behavior (bite weight x bite rate x grazing time), to evaluate the impact of occupation day on pasture intake, we estimated DMI using these variables and calculated intake as a proportion of the highest intake per treatment (Figure 3). Dry matter intake, calculated using this methodology, decreased 25% between the first and second grazing day and 20% between the second and third day in an area. No interaction occurred between post-grazing residue levels and grazing days.

Table 3. Mean (± s.e.) acid detergent fiber (ADF), neutral detergent fiber (NDF), lignin (LIG) and dry matter (DM) concentrations in extrusa of F1 Boer x Saanen goats rotationally grazing Tanzania (*Panicum maximum* cv. Tanzânia 1) pasture with 2 levels of post-grazing residue (LR and HR).

	ADF	NDF	LIG	DM
		(g/kg DM)		(g/kg)
Treatment[1] (T)				
LR	370±10	730±5	60±8	110±4
HR	380±10	730±5	70±8	110±4
P	0.28	0.23	0.18	0.15
Day[2] (D)				
1	360±10b[3]	710±5b	60±8	110±4
2	380±10a	740±5a	60±7	110±4
3	380±10a	740±5a	60±9	100±4
P	0.004	<0.001	0.84	0.32
Interaction (P) T x D	0.33	0.55	0.31	0.44

[1]LR = low green herbage mass (GHM) post-grazing, approximately 1,500 kg/ha; HR = high GHM post-grazing, approximately 3,000 kg/ha.
[2]Day of grazing in an area.
[3]Means within columns and parameters followed by different letters differ at P<0.05 by Fisher's test.

Table 4. Mean (± s.e.) dry matter intake of F1 Boer x Saanen goats rotationally grazing Tanzania (*Panicum maximum* cv. Tanzânia 1) pasture with 2 levels of post-grazing residue (LR and HR).

Treatment[1]	Dry matter intake (kg/d)	Dry matter intake (g/d $BW^{0.75}$)	Dry matter intake (% BW)
LR	1.89±0.11b[2]	98.8±6.0	3.7±0.2
HR	2.19±0.11a	106.1±6.0	3.9±0.2
P	0.01	0.23	0.44

[1]LR = low green herbage mass (GHM) post-grazing, approximately 1,500 kg/ha; HR = high GHM post-grazing, approximately 3,000 kg/ha.
[2]Means within columns followed by different letters differ at P<0.05 by Fisher's test.

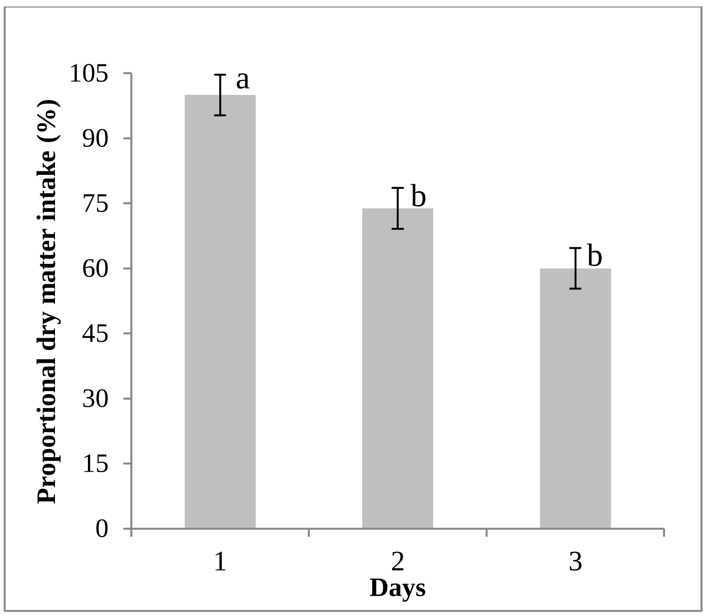

Figure 3. Estimated daily dry matter intake of goats (calculated using grazing time, bite number and bite weight), as a proportion (%) of the highest intake during 3 days of grazing, on rotationally grazed Tanzania (*Panicum maximum* cv. Tanzânia 1) pasture. Columns with different letters differ at P<0.05 by Fisher's test.

Discussion

This study has provided valuable information on the influence of management conditions of a tropical pasture on intake and ingestive behavior of goats. According to Burns and Sollenberger (2002), several forage variables, such as the amount of available forage, ease of prehension and chemical composition, can affect the voluntary intake of ruminants during grazing. This study has demonstrated the significant influence that forage mass exerts on the ingestive behavior of goats grazing tropical Tanzania grass (*Panicum maximum* cv. Tanzânia 1) and has provided evidence of why this occurs.

During daylight hours (07.00−19.00 h) when goats had access to pasture, 70–74% of the time was spent grazing. Solanki (1994) observed that goats in the field showed a diurnal pattern of grazing, preferring to graze during the morning and rest at other times; thus one might infer that the management used in this study did not unduly disturb the normal behavior of goats.

Daily intake of grazing goats is a function of bite rate and bite size (the amount harvested by an animal per bite), which depends on type of pasture (Stobbs 1973a; 1973b). We observed a strong relationship between bite weight and grazing time, with animals increasing grazing time to offset reduction in bite weight as supply of leaf in a pasture decreased, as occurred in the LR treatment or time spent in a particular area increased. Consistent with our results, Agreil and Meuret (2004) showed that, on temperate pastures, instantaneous intake rate of goats was affected more by bite mass than by bite frequency or rate, with bite weight varying between 0.01 and 1.72 g DM.

This study indicated no effect of plant structure on bite rate, corroborating the findings of Solanki (1994). As a result, animals had to graze longer to satisfy appetite as availability of leaf in the pasture declined and bite size was reduced but bite rate remained constant. In short pasture, Orihuela and Solano (1999) reported that the time spent foraging by grazing goats increased significantly as forage availability decreased. As pasture height increased above 50 cm, Ribeiro et al. (2012) observed a reduction in bite rate as searching for and handling bites in those pastures was more difficult than in shorter pastures or because leaves were sparse in the higher canopy strata. In our study, maximum pasture height was 59 cm, and the increase in the number of bites to satisfy appetite occurred in the shorter pasture by an increase in grazing time. Since the latter occurred when forage availability decreased, bite rate failed to respond to treatments and grazing days.

Ruminants adjust bite dimensions according to the force or effort involved in biting and the cost/benefit of consuming the bite (Benvenutti et al. 2006). Therefore, animals select forage that contains a high leaf:stem ratio because of the low physical resistance of leaves to being grazed (Flores et al. 1993). This preference for low-tensile resistance forage can be confirmed by a decrease in leaf percentage and leaf:stem ratio as animals spent more days in an individual area. As a result, ingestive behavior changed with grazing time in a particular area or with different pasture availability (Table 2), where both availability of leaf and leaf:stem ratio differed (Table 1). This type of behavior could be more relevant in goats due to their anatomical and physiological characteristics, which support feed selection (Van Soest 1994).

A decline in bite weight was proportional to a decrease in leaf mass and increase in stem percentage. However, when forage mass was low (treatment with low post-grazing mass), goats were forced to consume a higher percentage of stem, as evidenced by increasing ADF and NDF concentrations in extrusa as number of days grazing a particular area increased. This is due to lack of options with an increase in grazing time and a decrease in bite size. Estimates of daily intake showed a reduction in DMI as time in an area increased from 1 day to 3 days (Figure 3). As mentioned before, increases in time spent grazing failed to compensate for the decrease in bite size, resulting in lower intake in conditions with low forage availability. Therefore, our findings are consistent with the general assumption that bite weight is a function of trade-offs between quantity and quality of the herbage mass as well as configuration of the pasture.

We observed that goats grazed in a uniform manner (Figure 4), from top to bottom, through successive layers in contrast to the behavior of cattle and sheep, which tend to graze deeper resulting in a less evenly grazed sward (Del Pozo et al. 1998). Since the goats harvested forage from all layers of the sward, only minor height variation occurred within the area. Del Pozo and Osoro (1997) reported the same behavior in temperate pastures. These findings suggest that goats behave differently from other ruminant species when grazing tropical or temperate pastures.

The familiarity of animals with the observer should be taken into account when conducting studies of this nature. Similar to all ethological surveying, presence of the observer(s) should produce minimal disturbance to normal animal behavior. Our goats were familiar with humans and the 7-day adaptation period between the observer and the animal was designed to minimize interference with normal animal behavior. We consider this was achieved and our data truly reflect what would occur in a commercial situation. Agreil and Meuret (2004) evaluated the periods for goats and sheep to become familiar with an observer and verified that, whereas sheep took 45 days, goats took only 5 days to adapt to human presence and behave normally during observations.

This study has indicated that pasture availability is important in determining intake and performance of goats on improved pasture of Tanzania grass. Under the rotational grazing system used, animal intake declined dramatically by day 3 of grazing in a paddock. This would have resulted in a significant reduction in animal performance over the 3-day period. Since no liveweight data are reported in this study, we are unable to indicate how serious this reduction in performance might be.

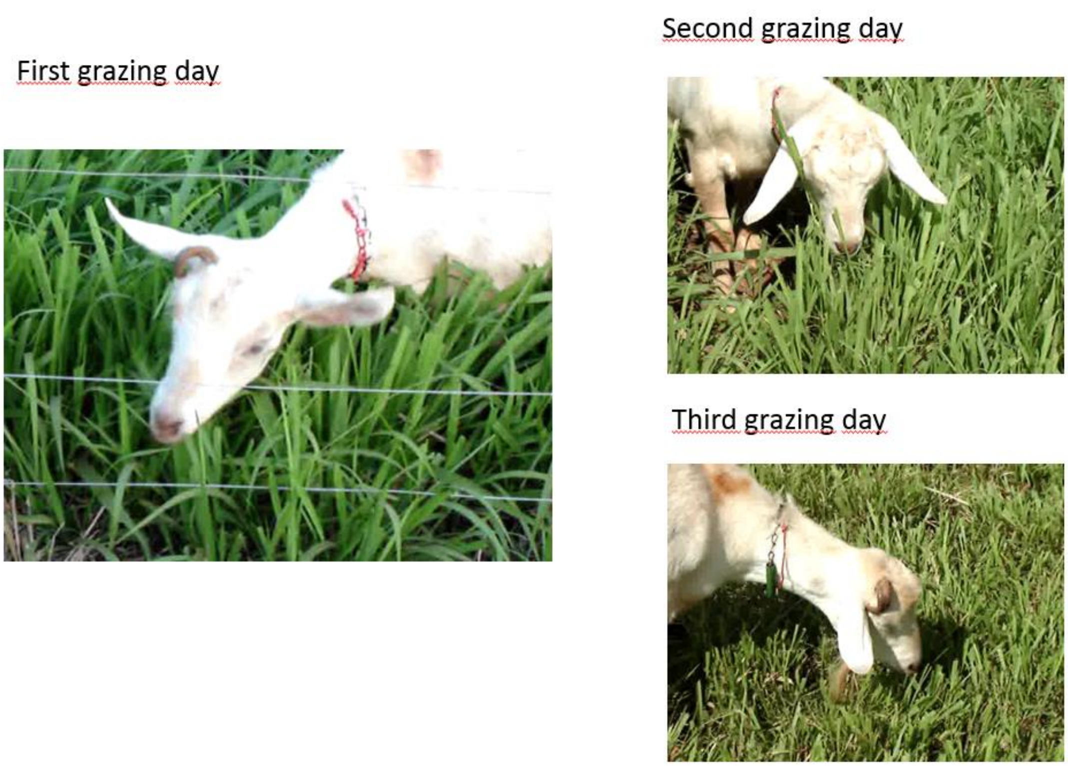

Figure 4. Representation of uniform grazing, from top to bottom, of goats during the 3 days of grazing in the paddock.

Further studies are needed where animal weight gains are measured to determine the effects of the changes in intake on animal performance. Based on the data generated it may be possible to speculate on what might be an appropriate grazing regime for utilization of Tanzania grass by goats to obtain an optimal balance between individual animal performance, production per unit area and performance of pasture.

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