Acta Scientiarum. Animal Sciences
ISSN: 1806-2636
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Universidade Estadual de Maringá
Brasil

Rodrigues, Marcônio Martins; Oliveira, Maria Elizabete de; Moura, Raniel Lustosa de; Rufino, Marcelo de Oliveira Alves; Silva, Wellington Kelson Alvarenga; Nascimento, Maria do Perpétuo Socorro Cortez Bona

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Acta Scientiarum. Animal Sciences, vol. 35, núm. 1, enero-marzo, 2013, pp. 37-41
Universidade Estadual de Maringá
.png, Brasil

Acta Scientiarum

http://www.uem.br/acta
ISSN printed: 1806-2636
ISSN on-line: 1807-8672
Doi: 10.4025/actascianimsci.v35i1.16035

Forage intake and behavior of goats on Tanzania-grass pasture at two regrowth ages

Marcônio Martins Rodrigues[1*], Maria Elizabete de Oliveira[2], Raniel Lustosa de Moura[2], Marcelo de Oliveira Alves Rufino[2], Wellington Kelson Alvarenga Silva[3] and Maria do Perpétuo Socorro Cortez Bona Nascimento[2]

*[1]Universidade Federal do Piauí, Campus Universitário Ministro Petrônio Portel, Ininga, 64049-550, Teresina, Piauí, Brazil. [2]Programa de Pós-graduação em Ciência Animal, Universidade Federal do Piauí, Teresina, Piauí, Brazil. [3]Programa de Pós-graduação em Zootecnia, Universidade Federal do Ceará, Benfica, Fortaleza, Ceará. *Author for correspondence. E-mail: marnunes07@yahoo.com.br*

ABSTRACT. The forage mass, sward structure, the ingestive and grazing behavior and forage intake by goats grazing on Tanzania-grass at 22 and 37 days of regrowth were evaluated. A completely randomized experimental design was used, with eight replications for evaluating the pasture and bite depth, and six replications for evaluating intake, feeding and grazing behavior. The forage canopy height ranged from 64.1 to 92.7 cm. Higher forage mass was observed at 37 days, and the best leaf/stem ratio, at 22 regrowth days. The bite depth did not differ between regrowth ages. The biting rate for the 22 regrowth days (23.07 bites $min.^{-1}$) was higher than at 37 days (19.06 bites $min.^{-1}$). The grazing time was longer at the regrowth age of 22 days (5.58h) than at 37 days (4.51h). The average feed intake was 2.75% of the body weight and was not different between regrowth ages.

Keywords: grazing, bite depth, leaf/stem ratio, biting rate.

Consumo de forragem e comportamento de caprinos em pasto de capim-tanzânia em duas idades de rebrotação

RESUMO. Avaliou-se a massa de forragem e estrutura do pasto, comportamento ingestivo e de pastejo e o consumo de forragem por caprinos em pasto de capim-tanzânia aos 22 e 37 dias de rebrotação. Foi adotado o delineamento experimental inteiramente casualizado com oito repetições para a avaliação do pasto e da profundidade do bocado, e com seis repetições para a avaliação do consumo e do comportamento ingestivo e de pastejo. As alturas do dossel variaram de 64,1 a 92,7 cm. Maior massa de forragem foi verificada aos 37 dias e a maior relação folha/colmo aos 22 dias de rebrotação. A profundidade de bocado não diferiu nas idades avaliadas. A taxa de bocado aos 22 dias (23,07 bocados $minuto^{-1}$) foi maior que aos 37 dias (19,06 bocados $minuto^{-1}$). Os animais despenderam maior parte do tempo em pastejo, aos 22 dias (5,58h) do que aos 37 dias (4,51h). O consumo médio de forragem foi 2,75% do peso vivo e não diferiu entre dias de rebrotação.

Palavras-chave: pastejo, profundidade de bocado, relação folha/colmo, taxa de bocado.

Introduction

In the Brazilian Mid-North region, the native pasture still is the major source of forage for goats (SIDRA, 2006). Nevertheless, the use of cultivated pasture is increasing in order to replace or complement the native pasture. This change in the productive system demands information on the management that results in efficient collection of the pasture by the goats. In this way, one should know the interaction animal-pasture to identify management practices that result in productivity and stability of the goat production system.

The goat grazing behavior reflects the way the pasture is presented to the animals. The height, leaf/stem ratio, mass of leaves and senescent material, i.e., the sward structure is influenced by the management practices, which influence the forage intake and the patterns of animal behavior, reflecting on their performance (MAIXNER et al., 2007).

The grazing and idle times in goats may be associated with the forage mass in the pasture. A longer grazing time and shorter idle time are observed in goats under reduced availability of forage (AICH et al., 2007; BARROS et al., 2007). Regarding the ingestive behavior, it is observed that an increased biting rate is a response to decreased forage availability (AICH et al., 2007). Another component of sward structure influencing goat

behavior is the canopy height, since it is observed that the biting rate in cultivated pasture ranged from 21.12 to 33.47 bites minute^{-1}, with a canopy height between 8.91 and 50.39 cm (BARROS et al., 2007; BRATTI et al., 2009; PARENTE et al., 2005). The grazing time, biting rate, and bite weight define the forage intake.

This study evaluated the sward structure, the ingestive and grazing behavior and forage intake by goats grazing on Tanzania-grass managed under rotational stocking at two regrowth ages.

Material and methods

The experiment was performed in February and March (rainy period) in an area of the Department of Zootechny of the Center for Agricultural Sciences of the Federal University of Piauí, Teresina city (latitude 05º05'21" S and longitude 42º48'07" W; altitude 74.4 m), Piauí State. According to Köeppen classification, the climate of Teresina is Aw, tropical and rainy climate (megathermic), with dry winter and rainy summer. During the experimental period, the maximum, minimum and mean temperatures were 31.5; 27.3 and 29.9ºC, respectively. The rainfall was 458 mm.

It was used 0.33 ha of Tanzania-grass (*Panicum maximum* cv. Tanzânia), set in 2000, and divided into ten paddocks of equal size. The experimental area was fertilized in the amounts of 100 kg urea, 80 kg P_2O_5 and 50 kg K_2O.

Six adult goats were used during service period, with average body weight of 44.5 kg. The fixed forage supply was set at 10% of body weight in dry matter, with the use of equilibrium animals to adjust the supply. The animals remained on the pasture from 7:00 to 17:00 hours, where they had access to water and artificial shade. At the end of the day they were driven to the fold where they had free access to mineral salt.

The treatments consisted of two regrowth ages (22 and 37 days), considered from the mechanical mowing performed at 15 cm above the ground. It was used five paddocks for each treatment, three for adaptation and two for data collection, using occupation period of three days.

To characterize the sward, we measured the height, forage mass, and in vitro digestibility. The sward height was measured at 20 points inside each paddock with the aid of a graduated ruler in places representative of the average height of the canopy. The measures were performed before the entry of animals and during the next three days of occupation.

In order to determine the forage mass before the entry of animals into the experimental paddocks, pasture samples were taken using a frame with 0.5 m^2 (1 x 0.5 m). The forage inside the frame was cut at 15 cm, a height set as post-grazing residual stubble. After collection and identification, the samples were weighed and divided into two subsamples, one for bromatological analysis and one for separation into leaf, stem, pseudostem and senescent material.

For the determination of in vitro digestibility, crude protein, neutral and acid detergent fiber, forage samples were collected, simulating the grazing, on the occasion of the observations of grazing and ingestive behavior of the animals.

All the samples were placed in paper bags, weighed, pre-dried at 65ºC for 72h, milled using a Willey-type mill and subjected to determination of the contents of dry matter (DM). The crude protein was determined according to Silva and Queiroz (2002). The analyses of neutral (NDF) and acid detergent fiber (ADF) were performed as proposed by Van Soest and Wine (1967), modified by Souza et al. (1999). The in vitro digestibility of dry matter (IVDDM) was obtained according to Tilley and Terry (1963), using artificial rumen, developed by ANKOM®.

The grazing behavior (grazing time, idle, rumination and displacement) was observed every 15 minutes. The evaluations took place between 7:00 and 17:00 hours, by observing six animals for six consecutive days (in two paddocks) for each regrowth age, according to Barros et al. (2007).

The biting rate was determined by visualization of each animal, using a stopwatch to measure the time spent to perform 20 bites (FORBES; HODGSON, 1985). The observations were made during six consecutive days, for each treatment, at 7:00, 9:00, 11:00, 13:00, 15:00 and 17:00 hours.

The methodology of Bratti et al. (2009) was applied to assess the bite depth. For each treatment, 80 tillers were marked, spaced 50 cm from each other in a straight line, using eight transects in two paddocks. Each transect represented a replication, totaling eight replications per treatment, with random position of these lines in the experimental area. The marked tillers were extended and measured using a ruler before and after the presence of the animals, on the first day of occupation. The bite depth was calculated by the mean difference in the height of extended tillers before and after grazing.

The intake of forage dry matter by the goats was determined using chromium oxide (Cr_2O_3) as external marker. The animals received two grams of the indicator per day, one in the morning and another in the late afternoon. The animals received Cr_2O_3 for 15 days, ten days for adaptation and five

days for feces collection, which were sent to the Laboratory of Animal Nutrition of the Federal University of Viçosa for determining the Cr_2O_3 concentration by means of atomic absorption spectrophotometry, according to Williams et al. (1962). The dry matter intake was obtained by the formula: DMI = fecal production/(1- IVDDM), where the fecal production (FP), in kg DM day^{-1}, was calculated as: FP = chromium administered in feces (g day^{-1})/chromium in feces (g kg^{-1} in DM).

To evaluate the pasture and bite depth, it was adopted a completely randomized experimental design with two regrowth ages and eight replications. To assess the intake, the grazing and ingestive behavior, it was also used a completely randomized experimental design with six replications. The data were submitted to analysis of variance and F test, and when it was detected differences between the mean values, a SNK test was employed, at 5% significance. The analysis were performed using the software SAS Institute (2000).

Results and discussion

The sward structure has changed with increased regrowth age, except for the number of leaves/tiller (Table 1). The forage mass in the interval of 15 days of regrowth doubled, but decreased the participation of leaf and increased the participation of stem, pseudostem and dead material. At 37 days of regrowth age, the mass of green leaf corresponded to 75.91% of the forage, a production of 3.3 ton. leaf ha^{-1} and a leaf stem^{-1} ratio of 3.3, which characterizes a good quality pasture. Gontijo Neto et al. (2006) observed that Tanzania-grass pastures with 1.637,1 kg of dry matter of leaf ha^{-1} and leaf stem^{-1} ratio of 1.15 led to the maximum intake of dry matter by cattle in 2.42% of body weight.

Table1. Forage mass (FM), sward height (H), leaf/tiller (L T^{-1}), leaf mass (LM), leaf/stem ratio (L S^{-1}), percentage of green leaf (GL), stems and pseudostems (SPS) and dead material (DeM) at 22 and 37 regrowth days of the Tanzania-grass pasture.

Ages	FM (ton. ha^{-1})	H (cm)	L T^{-1}	LM (ton. ha^{-1})	L S^{-1}	GL %	SPS %	DeM %
22	2.0^{b*}	64.1^{b}	3.2^{a}	1.7^{b}	5.9^{a}	84.82^{a}	13.18^{a}	2.0^{b}
37	4.4^{a}	92.7^{a}	3.3^{a}	3.3^{a}	3.3^{b}	75.91^{b}	16.59^{b}	5.5^{a}

*Means followed by the same letter in the column are not different (p > 0.05) by the SNK test.

The mean number of leaves per tiller was not different between treatments (Table 1). If the pasture management only use this variable, it could be indicated the grazing on Tanzania-grass at 22 or 37 regrowth days. The number of leaves per tiller observed in the present study is out of the range suggested by Cândido et al. (2006) for the use of Tanzania-grass pasture with the best quality. These authors recommended that the resting time should not exceed the expansion of 2.5 new leaves per tiller. However, this condition in the study of Cândido et al. (2006) occurred at 28 regrowth days, in the present study at 22 days the grass had already 3.2 new leaves per tiller.

The increased supply of forage reduced the grazing time (Table 2). On the pasture at 22 regrowth days, the goats spent 5.52 hours on grazing, one hour longer than on 37 days-pasture. In percentage, the grazing time corresponded to 52.6% and 45.1% of the total time the animals remained on the pasture, for the first and second regrowth ages, respectively. Other authors also observed a longer grazing time in goats with reduced mass of available forage (AICH et al., 2007; BARROS et al., 2007).

Table 2. Percentage of the grazing behavior (hours) of goats on Tanzania-grass pasture at two regrowth ages, 22 and 37 days.

Activities	22 days	37 days
Grazing	52,6^{a*}	45,1^{b}
Idleness	38,5^{a}	41,9^{a}
Rumination	8,2^{a}	11,3^{a}
Displacement	0,5^{b}	1,5^{a}

*Means followed by the same letter in the row are not different (p > 0.05) by the SNK test.

The idleness, the second activity with longer time, was not different between two regrowth ages of the pastures (Table 2), and varied from 38 to 41% of the total time of stay of the animals on the pasture. There seems to be an association between the idle time and forage availability, since values much lower than those recorded in the present study were observed for goats under low availability of forage, when the idle time was only 6.0% of the total time of stay of the animals on the pasture (AICH et al., 2007).

The time spent on rumination and displacement corresponded to 9.7 and 1% of the period of stay of the animals on the pasture, but the rumination was the third major activity performed by the animals. The time spent on rumination was 5 to 4 hours less than on grazing and idleness. The short rumination time in the two assessed ages may be because this activity is mostly performed at night, not evaluated herein.

The displacement was short and different between treatments, with 0.5 and 1.5% at 22 and 37 regrowth days, respectively, indicating short displacements between feeding stations. The experimental area was small and the forage availability in the evaluated periods was not a problem, since the grazing pressure was 10%. The longest time on displacement at 37 regrowth days resulted from increased investment in search of feeding stations with higher availability of leaves.

The bite depth was not different between regrowth ages, with a mean value of 42.6 cm, corresponding to 46% of the extended tiller height (Table 3). Nevertheless, the biting rate was higher in the pasture at 22 regrowth days, being inversely proportional to the mass of leaves in the pasture, considering that in both pastures, the forage supply was 10% of body weight. The biting rate observed at 22 regrowth days is within the range observed by other studies with goats on cultivated pastures, i.e., between 21.12 and 33.47 bites minute^{-1} (BARROS et al., 2007; BRATTI et al, 2009; PARENTE et al., 2005). At 37 regrowth days, the lower biting rate may be associated with the high availability of leaves in the forage, once an increased biting rate of goats is a response to decreased forage availability (AICH et al., 2007). Some authors observed a reduction in the biting rate of cattle on Mombaça-grass pasture at higher heights, because the animals spent longer time on capturing the leaves as their blades grew in length (PALHANO et al., 2007).

Table 3. Ingestive behavior of goats and extended tiller height of the Tanzania-grass pasture at 22 and 37 regrowth days.

Regrowth age	Bite depth (cm)	Biting rate (Bites minute^{-1})	Height/tiller
22	37.87^{a*}	23.07^{a}	72.5
37	47.50^{a}	19.06^{b}	120.0

*Means followed by the same letter in the column are not different ($p > 0.05$) by the SNK test.

Considering that the canopy height is related to sward structure that influences the animal behavior, it was observed that a canopy height above 100 cm in the pasture at 37 days did not limit the access of the animals to the pasture. In the literature, data of biting rate of goats have been reported in pastures with canopy height between 14.4 and 40.5 cm (BARROS et al., 2007; BRATTI et al., 2009; PARENTE et al., 2005).

When evaluating the bromatological composition of the pasture cut at 15 cm above the ground, the values of CP and NDF were 11.24 and 7.53%, and 69.03 and 73.24% at 22 and 37 regrowth days, respectively, evidencing a downward trend in the levels of crude protein and upward trend in the levels of fiber according to the regrowth age and canopy height, as also observed by Rego et al. (2003). Nevertheless, in the samples collected simulating the grazing, the CP levels were similar between the two regrowth ages. This was also observed for NDF, ADF, and IVDDM (Table 4), stressing the information that the animals select predominantly the forage with the best value, rich in leaves. The values recorded for bromatological composition and IVDDM of the forage are within the range cited in literature for Tanzania-grass leaves (REGO et al., 2003).

Table 4. Mean values of crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), in % DM, in vitro digestibility of dry matter (IVDDM) of the material from simulated grazing, and dry matter intake in relation to body weight of Tanzania-grass at 22 and 37 regrowth days.

Regrowth age	CP(%)	NDF(%)	ADF(%)	IVDDM (%)	DMI (% BW)
22	14.73^{a}	69.60^{a}	40.00^{a}	71.18^{a}	2.8^{a}
37	13.22^{a}	66.47^{a}	36.93^{a}	68.37^{a}	2.7^{a}

*Means followed by the same letter in the column are not different ($p > 0.05$) by the SNK test.

The mean intake of DM for the two treatments was 2.75 per 100 kg body weight. The intake achieved in the present study at the regrowth ages evaluated is a little above the recommended by NRC (2007) for this animal category, which recommends an intake of 2.49% body weight. The sward structure probably had no effect on the intake by the animal, since the leaf/stem ratio was 4.6 and the percentage of dead material did not exceed 4%, values that indicate that the pasture had a great amount of leaves. Roman et al. (2007) affirmed that to not affect the sheep intake it is needed a pasture with at least 1,000 kg ha^{-1} forage mass, in the present study, the this condition was met, since only considering the leaf mass the two treatments presented on average 2,500 kg ha^{-1} leaf mass.

Taking into account the difference in the grazing time and biting rate and the similarity in the forage intake between the two pastures, it appears that the animals have compensated for the lower leaf mass in the pasture at 22 regrowth days by increasing the biting rate and the grazing time. In this way, it is emphasized that the mass of green leaves in the pasture is a factor with high influence on the behavior of goats on grazing, corroborating Prache et al. (1998) that worked with sheep.

Conclusion

The forage intake by goats was not different between the two regrowth ages, but at 37 days the highest forage mass and leaf mass produced qualify this age as the best for goat farming on Tanzania-grass pasture.

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Received on February 13, 2011.
Accepted on April 11, 2012.