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RESEARCH PAPER

Ingestive behavior of steers on pastures of *Brachiaria brizantha* and *Cynodon dactylon*

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Abstract

A.M. Zanine, B.R. Vieira, D.J. Ferreira, A.J.M. Vieira, M.C.T. Silveira, W.L. Silva, and P.R. Cecon. 2016. Ingestive behavior of steers on pastures of *Brachiaria brizantha* and *Cynodon dactylon.* Cien. Inv. Agr. 43(2):295-304. An experiment was carried out to assess the performance of steers on *Brachiaria brizantha* and *Cynodon dactylon* cv. Coast cross pastures by the continuous stocking method with a variable stocking rate. A completely randomized experimental design was used with two pastures representing the treatments, each containing 10 replicates. The results of t-tests demonstrated that the steers grazed for less time (7:19 h) on the *B. brizantha* grass pasture than the on Coast-cross grass pasture (8:13 h). There was no difference in rumination time from 6:46 and 6:89 h for the *B. brizantha* and Coast-cross pastures, respectively. There was a significant difference for the values regarding the time that the steers remained idle, and the animals were more frequently idle on the *B. brizantha* pasture, which was associated with less grazing time because there was no significant difference in the total rumination time. The lowest bite rates were observed in the Coast-cross pasture compared with *B. brizantha* during the daytime and nighttime. Nonetheless, the total number of bites were significantly higher in the Coast cross pasture; however, the lowest bite rate overall was recorded in the *B. brizantha* pasture. These results suggested that there was a compensation mechanism between the grazing times and the bite rates so that the animals could regulate the quantity of forage ingested.

Key words: cattle, ethology, grazing, idleness.

Introduction

The knowledge of animal behavior patterns of choice, location and ingestion of pasture are extremely important when establishing management practices. Ingestive behavior is a tool that can help the understanding of animal performance because grazing time is one of the factors related to forage intake and subsequent energy expenditure (Boval *et al.,* 2007. Dry matter content affects the proportion of forage that can be ingested by the animal, the degree of sensitivity and the intake that will

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later affect the animal's performance (Hodgson, 1996; Dias *et al*., 2014). Therefore, it is important to understand the ingestive behavior to explain the mechanisms that govern cattle feeding behavior (Putfarken *et al.,* 2008).

The ingestive behavior of ruminants can be characterized by an uneven distribution of a succession of three defined and discrete activity periods, commonly classified as ingestion, rumination and rest or idleness (Illius and Hodgson, 1996; Boval *et al.,* 2007. The time spent on each of these activities depends on the pasture characteristics, environmental conditions (temperature, rainfall, etc.) and the nutritional requirements of the animal (Penning *et al.,* 2006; Wéverton *et al.,* 2014). Grazing time can compensate for variations in bite weight, which is greater when the bite is smaller or greater in the contrary situation (Baumont *et al*., 2004; Putfarken *et al*., 2008).

Pastures with low quality and quantity of forage, especially with limited availability of green blades and a high amount of stems, are minimally consumed. The selection of pastured particles can result in increased total grazing time and a change in feeding behavior that inhibits weight gain of the animals (Carvalho *et al.,* 2000; Müller *et al.,* 2014).

Detailed knowledge of grazing behavior is important for understanding the factors that affect pasture intake of grazing steers (Zanine *et al.,* 2007ab; Boval *et al.,* 2007). Therefore, studying the feeding behavior based on the more traditional management in Brazil, which is the continuous stocking method with the genus *Brachiaria* and *Cynodon*, is of great importance.

The objective of the present experiment was to assess the ingestive behavior of steers grazing *Brachiaria brizantha* and *Cynodon dactylon* cv. Coast cross grasses.

Materials and methods

The experiment was carried out at the Itamira Farm, located 20 km from the town of Itanhém, Bahia, Brazil, during the wet season. Itanhém is located at coordinates 15 °18'13'' S and 41° 17›32›› W at a 657 m altitude and has a mean annual rainfall of 767.4 mm, 86% of which falls from October to March, and an average annual temperature of 26.4 °C.

Pasture conditions

Established *B. brizantha* cv. Marandu and Coast cross (*C. dactylon* cv. Coast cross) pastures were used and previously fertilized with 50 kg nitrogen (urea form) per hectare. Analyses of the soil fertility and chemical composition of the pastures were conducted. For the soil analysis, 25 samples were removed randomly at zero and 20 cm in depth, forming a composite sample that was sent to the soil analysis laboratory (Executive Committee of Agriculture).

To analyze the chemical composition of the pastures, 20 samples were selected randomly from each pasture, forming a composite sample from which 100 g were removed for subsequent chemical analyses, according to the methodology reported by Silva (1999). Table 1 shows the mean values of the soil analyses of *B. brizantha* and Coast-cross pastures.

To estimate forage availability, ten 1.0 m^2 sub-areas were cut close to the soil level. Forage availability was 4.24 t to 1.72 t of dry matter per hectare for the *B. brizantha* and Coast cross grass pastures, respectively. The forage availability estimate was performed at the beginning and end of the experiment. The leaf to stem ratios, determined in the same subsamples used to estimate the forage availability, were 2.21:1.00 and 0.49:1.004 for *B. brizantha* and Coast cross grass, respectively. Table 2 describes the chemical composition analyses of *B. brizantha* and Coast-cross grass pastures.

Table 1. Mean values of the soil analyses of *Brachiaria brizantha* and Coast-cross grass pastures.

Chemical characteristics	Result	
	Brachiaria brizantha	Coast-cross
pH ($CaCl_2$)	5.8	5.4
Ca + Mg (meq 100 g^{-1})	1.86	2.58
H + Al	2.50	2.8
P (ppm)	21	30
K (ppm)	74.29	80.22
CTC ($cmol_c$ dm^{-3})	4.56	5.36
Saturation by bases (%)	45.18	58.02
Organic matter	2.78	3.02

Table 2. Mean values of the chemical composition of the *Brachiaria brizantha* and Coast-cross grass pastures.

Grass	DM[1]	NDF[2]	ADF[3]	HEM[4]	CP[5]
Brachiaria brizantha	22.10	65.09	30.22	34.87	9.78
Coast-cross	33.82	72.05	35.69	36.36	8.93

[1]Dry matter; [2]Neutral detergent fiber; [3]Acid detergent fiber; [4]Hemicellulose; [5]Crude protein.

Grazing and management

Ten Girolando (Holstein × Zebu) 18 months old steers were used, with a mean live weight of 280 ±16 kg. The grazing system involved continuous stocking with variable stocking rates, and the objective was to maintain the pasture height at approximately 35 cm. Regulation animals were used while considering mind that each pasture covered an area of 4.0 ha. Protein-enriched salt was offered to the steers throughout the experimental period. Table 3 shows the nutritional composition of the protein-enriched salt.

Experimental period

The experimental period was 60 days, including 45 days of animal adaptation to the pasture and protein-enriched salt and 15 days of assessment. Three 24 h long assessments were performed every five days, and the mean of the three assessments was used in the statistical analysis. The animals were differentiated by different colored tape ties around their necks. Horses were used for quick transportation and long-range lanterns were used at night.

The assessments were carried out on the 14th, 19th and 24th of December, 2009. The average temperature was 20 °C during the night and 31 °C during the day, with a maximum-minimum thermometer placed in the shade to measure the temperatures every 30 minutes, which was in a shelter set up exclusively for measurement.

Animal and treatments

A completely randomized experimental design was used, and the treatment was pasture (*B. brizantha* and *C. dactylon* cv. Coast cross) with 10 replicates (10 animals per pasture treatment).

The times of grazing, rumination, idleness and access to the protein- enriched salt were obtained by observing the animals every 10 min, and the total time was the sum of the total number of times the animals were observed in a given behavioral condition. The daytime (D) period was from 7:00 to 18:50, and the nighttime (N) period was from 19:00 to 18:50, within which the following variables were recorded: grazing time (DGT, NGT), total grazing time (TGT), rumination

Table 3. Nutritional composition of the protein-enriched salt.

Nutrients	Composition
Non-protein nitrogen, g	94.50
Sodium, g	86.48
Calcium, g	48.42
Phosphorus, g	40.00
Sulphur, g	14.00
Zinc, mg	2000
Copper, mg	500
Manganese, mg	500
Iron, mg	500
Iodine, mg	80
Cobalt, mg	60
Selenium, mg	20
Fluor (maximum), mg	379
Corn	Close

time (DRT, NRT), total rumination time (TRT), idleness time (DI, NI), total idleness time (TIT), bite rate (DBR, NBR), total daytime bite (TDB) and total nighttime bite (TNB).

The bite rate was obtained by counting the total bites observed in a one-minute period, and the result was the mean of observations for each half h the animals were grazing. The bite total was calculated from the product of the bite rate and the grazing time in minutes.

Statistical analysis

The data regarding the times for grazing, rumination, idleness and total bytes in the observed two pastures was subjected to analysis of variance and compared by t-test analysis at the 5% probability level using SAS software (2001, Version 8.2. SAS Institute, Campus Drive, Cary North Carolina, USA).

Results

Figures 1 describes the daily variations in the behavior of the steers on *B. brizantha* and *C. dactylon* cv. Coast cross pastures. The steers grazed for longer durations early in the morning and at the end of the afternoon, with a greater grazing peak on the two grasses between 4:00 and 19:00.

Between 10:00 and 13:00, the animals exhibited a drastic decrease in grazing and, consequently, the greatest rumination and idleness peaks were observed at this time.

Regarding protein-enriched salt intake, the steers visited the feeder constantly and quickly; however, the group or hierarchical intakes were not measured in this study. The individual mean intake was 200 g per day.

Table 4 shows the grazing times of the steers on the two pastures. There were significant differences between the two pastures during the day ($P = 0.0099$), night ($P = 0.0059$) and total grazing times ($P = 0.0028$).

It was observed that the time spent ruminating during the day ($P = 0.0024$) was shorter on the Coast cross pasture. However, no significant differences were observed between the two pastures during the night ($P = 0.0543$) and total rumination time ($P = 0.0677$) (Table 4).

Regarding the time the steers spent idle, there was a significant difference in the period evaluated during the nighttime ($P = 0.0027$) (Table 4).

Table 4 shows the daytime and nighttime bite rates, as well as the total number of bites for animals in the two pastures. Bite rates were significantly lower in Coast-cross with the *B. brizantha* dur-

ing the daytime (P = 0.0013) and nighttime (P = 0.0039). Nonetheless, the total number of bites were significantly higher for the Coast cross pasture (P = 0.0076).

Discussion

Behavior similar to that observed in Figure 1 was reported by Van rees and Hutson (1983), who observed intensive grazing in the first four h of the day but also observed this at the end of the afternoon, while in the early afternoon the animals grazed intermittently.

According to Huber (1990), heat is energy in transition, a life source necessary for living beings. However, when heat surpasses the so-called thermal comfort zone, which in the case of Zebu cattle is between 4 °C and 26 °C, it becomes harmful because excess heat causes chemical and physical alterations in the animal. According to Van Soest (1994), animals graze intensely between 18:00 and 20:00, when temperatures are below 25 °C.

This reality was close to that of the present experiment; when the temperature peaked over 35 °C, as shown in Figure 1, the animals drastically reduced their grazing and rumination time and sheltered in the shade. It is worth noting that the heat stress resulting from the high environmental temperatures drastically reduces food intake partly due to the decreased metabolic rate, which results in feedback signals, indicating decreased energy expenditure requirements; the animals ceasing eating; and the animals seeking shade and remaining sheltered (Church, 1993).

Note that in this study, the animals exhibited a drastic decrease in grazing and, consequently, the greatest highest rumination and idleness peaks between 10:00 and 13:00 h; this can be explained by the high temperatures at this time of the day, which that were over greater than 36 °C and, which exceedsded the thermal comfort zone for the Zebu breed animals (Mota, 2001).

The steers spent more time idle during the nighttime period, with the longest rumination times occurring at the start and end of the nighttime period. These results agree with the observations by Zanine *et al.* (2007b) and Wéverton *et al.* (2014) that cattle graze longer early in the morning and at the end of the day.

In addition to the environmental temperature, another factor that can influence cattle feeding behavior is the vegetative structure and composition of the pasture. Zanine *et al.* (2009) reported in a literature review that cattle grazing, rumination, idleness and bite rate are closely related to the forage canopy structure, with pasture height, leaf to stem ratio and senescence factors determining longer or shorter grazing times because they facilitate potential forage ingestion by the cattle.

The animals grazed on Coast cross grass for a longer period, which can be explained by the smaller leaf blade to stem ratio observed in Coast cross that led to the animals grazing more selectively and thus spending a longer time grazing. Another important factor in grazing times is the neutral detergent fiber and acid detergent fiber contents, which were higher in the *Cynodon* pasture species.

Prates *et al.* (1995) studied the steers' grazing habits on an improved native pasture and reported that the grazing time during the daytime period ranged from 5.00 to 7.90 h. Ribeiro *et al.* (1997) assessed the ingestive behavior of steers grazing dwarf elephant grass cv. Mott and reported grazing time ranging from 5.20 to 9.70 h. Pinto (2003) worked in the same experimental area and reported grazing time values ranging from 7.00 to 10.00 h. In general, taking into consideration the structural differences of the pastures studied, the prior results were close to those observed in the present experiment.

Brâncio *et al.* (2003) reported grazing times ranging from 8.30 to 11.30 h when assessing the ingestive behavior of steers with a 150 kg mean live weight on Tanzania grass pasture with and without fertil-

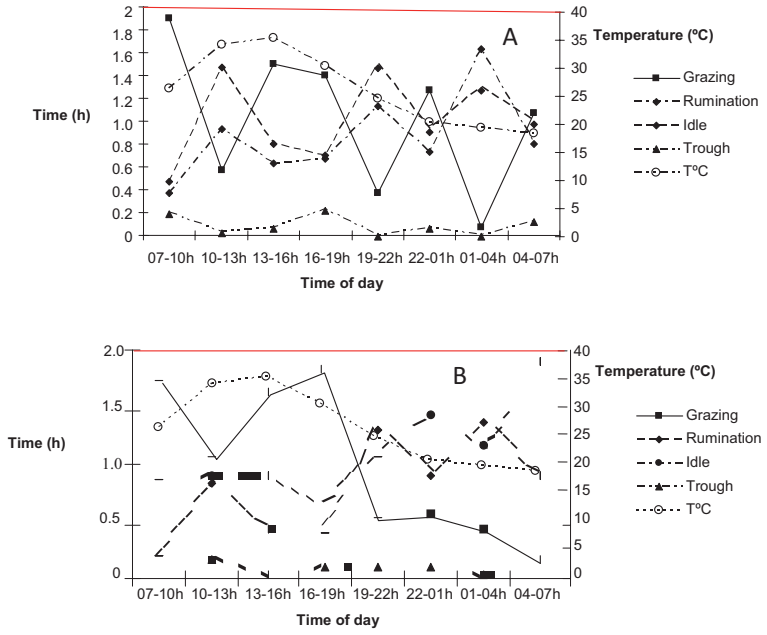

Figure 1. Daily variation in temperature and grazing behavior of the steers on *Brachiaria brizantha* (A) and Coast-cross (B) grass pasture.

Table 4. Mean values of grazing, ruminating, idle times, bite rate and total bites during the daytime, nighttime and total time spent by the steers on the *Brachiaria brizantha* and Coast-cross grass pastures.

		Pastures		
Variable	Period	*Brachiaria brizantha*	Coast-cross	Standard error of the mean
Grazing time (h)	Daytime	5.66 a	6.29 b	0.065
	Nighttime	2.46 a	3.79 b	0.018
	Total	8.12 a	10.05 b	
Ruminating time (h)	Daytime	2.95 a	2.25 b	0.017
	Nighttime	4.56 a	4.54 a	0.086
	Total	7.51 a	6.79 a	
Idling time (h)	Daytime	3.33 a	3.43 a	0.029
	Nighttime	4.93 a	3.63 b	0.019
	Total	8.26 a	7.06 a	
Bite rate (per min)	Daytime	39.00 a	36.22 b	1.352
	Nighttime	40.03 a	37.22 b	1.149
	Mean	39.51 a	36.72 b	
Total bites (per day)	Daytime	13244 b	13669 a	5.429
	Nighttime	5908 b	8463 a	8.711
	Total	19152 b	22132 a	

Means with the same letter in each row are not significantly different according to the t-test at the level of 5% probability.

ization. Sarmento (2003) observed higher values, ranging from 10.20 to 12.15 h, in Canchin × Nelore bulls on *B. brizantha* pasture. Santos *et al.* (2006) observed the ingestive behavior of steers on *B. brizantha* and *B. decumbens* pastures and reported grazing times of 9.74 and 11.30 h, respectively.

The authors reported more selective behavior in animals on the second pasture, mainly because of the higher concentration of senescent leaves and stem, thus increasing the grazing time. Zanine *et al.* (2007b) studied the steers' grazing habit with the same grass species and did not observe significant differences for the grazing time, with values of 7.45 and 6.81 h, respectively, results closer to those of the present experiment.

The results presented in Table 2 show that despite the higher neutral detergent fiber, acid detergent fiber and lower crude protein contents of 72.05, 35.69 and 8.93, respectively (Table 2), marked by the smaller leaf to stem ratio, no significant differences in total rumination time were found among the animals grazing on the two pastures species. This showed that the animals were able to select better quality plant components (green leaves) in detriment to the stem, associated with protein-enriched salt supplementation.

This proved that a longer grazing time on Coast cross grass allowed the animals to ingest a sufficient quantity of forage, specifically because there was no interference in its total rumination time.

Another striking aspect observed, also reported by Damasceno *et al.* (1999), was that the animals preferred to ruminate lying down, especially during the hottest h of the day. The authors reported that the greatest rumination frequencies occurred between 23:00 and 5:00, and the greatest idleness frequencies normally occurred between 11:00 and 14:00 and was stable from 22:00 to 5:00. The results were very similar to the behavior of the steers in the present experiment.

Brustolin *et al.* (2000) reported a calf rumination time of 6.05 h. Farinatti *et al.* (2004) assessed the grazing habits on natural pasture and observed that the rumination time ranged from 5.23 to 9.80 h and idleness ranged from 3.76 to 6.86 h. Santos *et al.* (2006) did not observe any significant differences in rumination rate on *B. brizantha* and *Brachiaria decumbens*, with times being of 6.76 and 6.60 h, respectively, although a longer idle time of 6.93 h was observed for steers that were on *B. brizantha* pasture, most likely because the pasture structure facilitated forage collection by the steers.

As noted in Table 4, the pasture species did not affect the total rumination time in this study and the same was observed for the total idleness time (Table 4). These results showed that the animals modified the duration of grazing, yet maintained the same total rumination time.

Trevisan *et al.* (2004) observed idleness times ranging from 7.05 to 7.50 h. The same was observed by Brustolin *et al.* (2000), with a mean idleness time of 7.25 h, similar to the values in the present study. Sarmento (2003) observed an idleness time of 6.90 h for steers on 30 cm tall *B. brizantha* pasture. Santos *et al.* (2006) reported idleness time values of 6.93 h and 5.55 h for *Brachiarias* sp. pastures (*B. brizantha* and *B. decubens*), respectively.

Expressing the results in percentages showed that, for *B. brizantha* grass, the animals spent 33.90% of the time grazing, 31.30% ruminating and 34.80% idling, while for the Coast cross grass, animals spent 41.90% of the time grazing, 28.30% ruminating and 29.80% idling.

The lowest bite rate was observed for Coast cross grass (Table 4), reflecting the more selective behavior of the steers on this pasture, which was explained by an increased grazing time. It was evident that animals adjusted their grazing time to ingest a satisfactory quantity of forage to meet requirement level.

Trevisan *et al.* (2004) observed a bite rate ranging from 54 to 58 bites per minute. Santos *et al.* (2006) did not observe any significant difference in the daily bite rate of steers managed on *B. brizantha* and *B. decumbens* pastures, with values of 24.49 and 21.11 bites per minute, respectively. This behavior was also reported by Zanine *et al*. (2007b), who observed values of 27.33 and 29.51, respectively, and Zanine *et al*. (2007a), who reported values of 23.27 and 21.61, respectively, between different *Brachiaria* sp. pastures.

In spite of the lower bite rate on the Coast cross grass pasture compared with *B. brizantha*, the total bite time was higher (Table 4), showing that the animals increased the grazing time as a result of their more selective behavior on this pasture. Because cattle are selective feeders, the longest grazing time was observed on the Coast cross pasture. Despite the lower bite rate of Coast cross grass pasture, the total bite time was greater, showing that the animals increased their grazing time because of more selective behavior in this pasture.

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Resumen

A.M. Zanine, B.R. Vieira, D.J. Ferreira, A.J.M. Vieira, M.C.T. Silveira, W.L. Silva y P.R. Cecon. 2016. Comportamiento alimenticio de novillos pastando *Brachiaria brizantha* y *Cynodon dactylon*. Cien. Inv. Agr. 43(2):295-304. Se realizó un experimento para evaluar el comportamiento de novillos en pasturas de *Brachiaria brizantha* y *Cynodon dactylon*, en pastoreo continuo con carga animal variable. El diseño experimental fue completamente al azar con las dos pasturas como tratamientos, cada uno con diez repeticiones. La prueba T demostró que los novillos pastaban en menos tiempo la pastura de *Brachiaria*, con el tiempo 7:19 horas, mientras que el tiempo en la pastura Coast-cross era 8:13 horas. No hubo diferencias en el tiempo rumia, lo cual fue 6:46 y 6:89 horas para pastos de hierba *Brachiaria* y Coast-cross, respectivamente. Para las cantidades relacionadas con el momento en que los novillos se quedaron inactivos, hubo diferencias significativas, con más tiempo para los animales que permanecieron en la pradera de *Brachiaria;* este hecho se asocia con el menor tiempo pastoreo, ya que no hubo diferencias significativas en el tiempo total de la rumia. Las tasas de mordeduras más bajos fueron significativamente inferiores en Coast-cross en comparación con *Brachiaria*, ya sea en el día o la noche. No obstante, el número total de mordeduras fueron significativamente más altos para en Coast-cross pastos, sin embargo, la tasa de picadura más bajo sobre el tiempo total se registró en *Bracharia* pastos. Los resultados sugieren que existe un mecanismo de compensación entre los tiempos de pastoreo y la tasa de mordeduras, de modo que los animales podían regular la cantidad de forraje consumido.

Palabras clave: etología, ganado, inactividad, pastoreo.

References

Boval, M., A. Fanchone, H. Archimède, and M.J. Gib. 2007. Effect of structure of a tropical pasture on ingestive behaviour, digestibility of diet and daily intake by grazing cattle. Grass and Forage Sciencie 62: 22-54.

Baumont, R., D. Cohen-Salmon, S. Prache, and D.A. Sauvant. 2004. Mechanistic model of intake and grazing behaviour in sheep integrating sward architecture and animal decisions. Animal Feeding Science and Techinology 112: 5-28.

Brâncio, P.A., V.P.B. Euclides, D. Nascimento, D.M. Fonseca, R.G. Almeida, and M.C.M. Macedo. 2003. Evaluation of three varieties of Panicum maximum Jacq. under grazing: cattle ingestive behaviour. Revista Brasileira de Zootecnia 32: 1045-1053.

Brustolin, K.D., F.L.F Quadros, J. Viégas, A.M. Gabbi, S.B. Carlotto, P.G. Fontouras, M.F. Ziech, and M.A. Piucos. 2000. Feeding behaviour of steers in oat and ryegrass supplemented with or without growth promoter. Proceedings... *In*: XLI Annual Meeting of the Brazilian Society of Animal Science, Viçosa, MG. pp. 456-460.

Farinatti, L.H., P.L. Monks, V. Fischer, A. Cella, M. Varela, and E. Sonego. 2004. Feeding behavior of Holstein cows in milk production systems on pasture in the Campanha of Rio Grande do Sul. 13 Proceedings *In*: XLI Annual Meeting of the Brazilian Society of Animal Science, Campo Grande, MS. pp. 550-554.

Carvalho, P.C.F., C.H.C. Poli, C. Nabinger and A. Moraes. 2000. Ingestive behaviour of grazing cattle and its relation to the structure of the pasture. p. 350-354. Proceedings... *In*: Ferraz, J.B.S. (ed.). Pecuária 2000: The beef cattle. Pirassununga, SP, Brazil.

Church, D. C. 1993. The ruminant animal digestive physiology and nutrition. Waveland Press, New Jersey. 289 pp.

Damasceno, J.C., L.A. Junior, and A. Targa. 1999. Behaviour responses of Holstein dairy cows with constant or limited access to shade. Brazilian Agriculture Research 34: 709-715.

Dias, D.L.S. R.R. Silva, F. Silva, G.G.P. Carvalho, D.S. Barroso, and V.M. Carvalho. 2014. Correlation between performance and ingestive behavior of steers post-weaned on pastures. Acta Scientiarum. Animal Sciences 36: 93-99.

Hogdson, J. 1996. The control of herbage intake in the grazing ruminant. Prod. Nut. Soc. 44: 339.

Huber, J.T. 1990. Feeding high producing cows under heat stress conditions. *In*: Dairy Cattle, FEALQ, Piracicaba, SP, Brazil. p. 180-240.

Mota, F.S. 2001. Animal climatology. Ed. 1. Pelotas, RS, Brazil. 402 pp.

Müller, K., L. Dickhoefer, T. Lin, C. Glindemann, P. WanG, H.W. Schönbach, A. Wan, B.M. Schiborra, M. Tas, F. Gierus Taube, and A. Susenbeth. 2014. Impact of grazing intensity on herbage quality, feed intake and live weight gain of sheep grazing on the steppe of Inner Mongolia. The Journal of Agricultural Science 152: 451-153.

Penning, P.D., A.J. Parsons, R.J. Orr, and G.E. Hooper. 2006. Intake and behaviour responses by sheep to changes in sward characteristics under rotational grazing. Grass and Forage Sci. 49: 476-486.

Pinto, C.E. 2003. Primary and secondary production and ingestive behaviour of steers under different offers total biomass of a natural pasture of the central depression of Rio Grande do Sul. Ph.D, Federal University of Rio Grande do Sul, Porto Alegre, Brazil. 287 pp.

Putfarken, D., J. Dengler, S. Lehmann, and W. Härdtle. 2008. Site use of grazing cattle and sheep in a large-scale pasture landscape: a GPS/GIS assessment. Applied Animal Behaviour Sciencie 111: 54–67.

Prates, E.R., I.B. Boneli, L.M. Piaggio, and J.F.P. Lobato. 1995. Time and cycles of grazing steers on pasture with improved conditions. Brazilian Journal. Animal Science 24: 128-137.

Ribeiro, H.M.N., E.X. Almeida, O.E.L. Harthmann, and G.E. Maraschin. 1997. Time and daily cycles of grazing cattle under different herbage allowance of dwarf elephant grass cv. Mott. Proceedings... *In*: XIV 15 Annual Meeting of the Brazilian Society of Animal Science, Juiz de Fora, MG, Brazil. p. 282-286.

Santos, E.M., A.M. Zanine, H.N Parente, D.J. Ferreira, P.R. Cecon, and J.C. Almeida. 2006. Inges-

tive behaviour of calves on pastures of *Brachiaria brizantha* and *Brachiaria decumbens*. Braziliam Anim.al Sciencie 7: 142-151.

Sarmento, D.O.L. 2003. Ingestive behaviour of cattle on Marandu pasture subjected to continuous stocking regimes. Ph.D. University of São Paulo. Piracicaba, SP, Brazil. 187 pp.

Silva, F.C. 1999. Manual of chemical analysis of soils, plants and fertilizers: 1st edition. CNPS, Rio de Janeiro, Brazil. 278 pp.

Trevisan, N.B., F.L.F. Quadros, F.S. Coradini, D.G. Bandinelli, and C.E.N. Martins. 2004. Ingestive behaviour of beef steers grazing oat and Italian ryegrass pasture with different levels of green leaves. Rural Science 34: 1543-1548.

Van Soest, P.J. 1994. Nutritional ecology of the ruminant: Second edition, Cornell University. 475 pp.

Van Rees, H, and G.D. Hutson. 1983. The behaviour of free-ranging cattle on an alpine range in Australia. Journal of Range management 36: 740-743,Wéverton, J.L., W.L. Fonseca, P.H. Fonseca, A.S. Amaral, and C.S. Guerra. 2014. Ingestive behavior of cows in pastures *Andropogon gayanus* and *Brachiaria decumbens* in Southern State of Piauí. Journal of Agricultural Science 6: 144-150.

Zanine, AM, E.M. Santos, H.N. Parente, D.J. Ferreira, and P.R. Cecon. 2007a. Grazing behaviour of Holstein x Zebu lactating cows in pastures of *Brachiaria brizantha* and *Brachiaria decumbens*. Brazilian Archives Veterinary Medicine and Animal Sciencie 59: 175-180.

Zanine, AM, E.M. Santos, H.N. Parente, D.J. Ferreira, and P.R. Cecon. 2007b. Grazing habits of heifers on pastures of *Brachiaria*. Acta Scientiarum Animal Sciencie 29: 365-369.

Zanine, AM, E.M. Santos, H.N. Parente, D.J. Ferreira, P.R. Cecon, and R.P Lana. 2009. Ingestive behaviour of Gyr x Holstein 26 cows grazing *Brachiaria* and *Cynodon* pastures. Brazilian Journal Animal Health and Production 10: 85-95.