Original Article

INGESTIVE BEHAVIOR AND FORAGE INTAKE OF HEIFERS RECEIVING CORN GRAIN WITH OR WITHOUT CRUDE GLYCERIN ON ITALIAN RYEGRASS PASTURE

COMPORTAMENTO INGESTIVO E INGESTÃO DE FORRAGEM POR BEZERRAS RECEBENDO GRÃO DE MILHO COM OU SEM GLICERINA BRUTA EM PASTAGEM DE AZEVÉM

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ABSTRACT: The objective was to analyze the ingestive behavior, forage intake and pasture characteristics when beef heifers are kept exclusively on ryegrass pasture (*Lolium multiflorum* Lam.) or receiving ground corn grain as supplement (0.9% of body weight (BW)) with or without addition of crude glycerin (0.2% BW). Experimental animals were Angus heifers with initial age and body weight of eight months and 166.2 ± 9.5 kg, respectively. The grazing method was continuous with variable number of animals. The experimental design was completely randomized with repeated measures. Dry matter intake was estimated using chromium oxide as an indicator of fecal output. Heifers ingested a similar amount of dry matter and neutral detergent fiber. Forage intake was 19.0% lower when heifers receiving ground corn grain as supplement with or without addition of crude glycerin and these reduction in dry matter intake of forage provided increase of 38.2% in the stocking rate. Heifers that received crude glycerin as a supplement spent more time in the trough than heifers that received only ground corn grain.

KEYWORDS: Angus. *Lolium multiflorum* Lam. energy supplement. nutrients intake

INTRODUCTION

Grazing is a complex process performed by herbivorous to obtain forage to meet their nutritional requirements. Voluntary forage intake is the major factor influencing the productivity of pasture production systems and is influenced by characteristics related to the animal, the plant, the supplement, the environment and the pasture management (MERTENS, 1994).

Several factors determine the relationship between defoliation and characteristics of the grazing environment. The forage plant structure can have a striking influence on the decisions taken by the grazing animal as to searching and handling forage and the bite size throughout the day (PALHANO et al., 2002).

Some of the main effects of using supplements combined with high quality pasture, like ryegrass, are observed mainly in forage intake and ingestive behavior of grazing animals. Rosa et al. (2013) reported reduction in forage intake of 0.27 kg DM pasture for each kg DM corn grain ingested. The reduction in forage intake by animals receiving supplement enables a greater selectivity of pasture and therefore intake of better quality forage (ADAMS, 1985).

Corn is a cereal standing out among the most used energy concentrates for cattle grazing in the State of Rio Grande do Sul, providing 0.968kg day^{-1} gain (SANTOS et al., 2005). The gain on marketable product may not always be accompanied by increases in the profitability of the activity based on the additional costs (ROSA et al., 2010). Thus, various types of byproducts are being tested in animal feed to replace or be combined with supplement ingredients to reduce the production cost.

Increasing biodiesel production increases the availability of glycerin, a byproduct that can be used in cattle feed. Crude glycerin can be included in the diet for ruminants as an energy ingredient. As any byproduct, however, it presents variations in quality, and may contain varying levels of glycerol in its composition (SANTANA JUNIOR et al., 2013).

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Dry matter intake plays an important role in the response of grazing ruminants, because it is influenced by diverse factors associated with the animal, the pasture, the environment and their interactions (CARVALHO et al., 2007). Ryegrass is the most widely cultivated winter grass in the State of Rio Grande do Sul, but there is still little known about the use of crude glycerin as a supplement in this pasture (PELLEGRIN et al., 2012), which justifies further studies on this topic. In this context, this study was undertaken to provided information on the ingestive behavior, forage intake and pasture and grazing characteristics when beef heifers are kept exclusively on ryegrass pasture (*Lolium multiflorum* Lam.) or receiving ground corn grain as a supplement (0.9% body weight (BW)) with or without addition of crude glycerin (0.2% BW).

MATERIAL AND METHODS

This experiment was approved by the Ethics Committee for animal experimentation of Universidade Federal de Santa Maria (protocol 035/2013). This study was carried out at the Federal University of Santa Maria (UFSM), located in the Central Depression of the State of Rio Grande do Sul, Brazil. The climate in the region is humid subtropical, according to the Köppen classification. A total of 27 Angus heifers, eight months old and average body weight 166.2 ± 9.5 kg were used. Feeding systems consisted of heifers exclusively on Italian ryegrass pasture (*Lolium multiflorum* Lam.) or receiving 0.9% of body weight (BW) of ground corn grain with or without addition of 0.2% BW crude glycerin.

Ryegrass pasture was sown in May 2012 in an experimental area of 7.2 hectares with nine paddocks of similar size. We used 45 kg ha^{-1} seeds and 250 kg ha^{-1} NPK fertilizer (5-20-20). Top dressing fertilization was performed with 84.4 kg ha^{-1} nitrogen (N) as urea, in three applications. The first application was made after the emergence of the second tiller of ryegrass and the others at intervals of 30 days. Corn grain was composed of 88.9% dry matter (DM), 1.4% mineral matter (MM), 98.7% organic matter (OM), 21.8% neutral detergent fiber (NDF), 4.3% ether extract (EE), 8.5% crude protein (CP) and 80.8% DM *in situ* digestibility (DMISD). Crude glycerin was composed of 82.1% DM, 4.3% MM, 95.7% OM, 0.13% EE, 0.0% CP and 3833.8 Kcal kg^{-1} crude energy. The supplements were provided daily at 2:00 p.m.

The grazing method was put-and-take stocking to maintain 2.0 t/ha DM forage mass and minimum canopy height of 10 cm. Forage mass (FM; kg DM/ha) was evaluated every 14 days by direct visual estimation method with double sampling. Canopy height (cm) was measured at the same time with a ruler, with 20 readings in each paddock. The forage was cut at the grounded level and the samples collected were split into two sub-samples for determination of DM content and for manual separation of structural components of ryegrass. After botanical separation and drying of structural components in a forced air circulation oven at 55°C for 72 hours, we determined the percentage participation of leaf blades, stems, inflorescences and dead material. Next, we calculated the leaf: stem ratio (L:S). Tiller density was determined by counting the number of ryegrass tillers in three predetermined areas of the paddock with 0.0625 m^2 each.

Animals were weighed every 28 days, following a 12-hour fast from solids and liquids. The stocking rate (SR; kg/ ha body weight) was calculated by measuring the sum of the mean body weight of test animals plus the average weight of animals used for adjustments in the stocking rate, multiplied by the number of days in the experimental unit, and divided by the number of days in the trial period. The forage accumulation rate (FAR; kg/ha/day DM) was determined by using three exclusion cages in each paddock. Forage allowance (FA; kg DM forage/kg body weight/day) was calculated by the equation: ((FM/number of days of the period) + FAR)/SR of the period*100.

Grazing was simulated according to the methodology described by Euclides et al. (1992). Forage samples from the grazing simulation were pre-dried at 55 °C for 72 hours and ground in a Wiley mill for later laboratory analysis. Ash content was determined by combustion at 600 °C for four hours and the organic matter (OM) by mass difference. Total nitrogen (N) was determined by the Kjeldahl method (Method 984.13, AOAC, 1997). Analysis of neutral detergent fiber (NDF) was performed according to Senger et al. (2008). Ether extract (EE) was determined in ether refluxing system (Soxtherm Gerhardt, Germany) at 180 °C for two hours. The organic matter *in situ* digestibility (OMISD) was determined by incubation for 48 hours in the rumen.

Forage intake was evaluated in the periods: 06/08 to 02/09/2013, 03/09 to 30/09/2013, 01/10 to 10/28/2013 to coincide with other assessments for pasture and animal. Chromium oxide (Cr_2O_3) was used as an indicator of fecal output, with supply period of eleven days and collection of feces from the eighth day (12:00 p.m. and 12:00 a.m., 3:00 p.m.

and 03:00 a.m., 6:00 p.m. and 06:00 a.m., 9:00 p.m. and 09:00 a.m.). Chromium levels in dried feces were determined by atomic absorption spectrophotometry for technique adapted by Kozloski et al. (1998). Fecal output was estimated by the formula: FO = chromium supplied (g day^{-1})/chromium in the feces (g kg^{-1} DM) (Pond et al., 1989). Forage intake was evaluated (FI, kg day^{-1} DM) by the formula: FI = fecal output - (IDM supplement *(1 -supplement digestibility)) (1-forage digestibility) -1. From these data, the total intake, forage intake, NDF intake and CP intake were calculated, as % BW. The substitution coefficient (reduction in DM forage intake per kg DM supplement intake) was estimated according to Hodgson (1990).

For ingestive behavior evaluation, test animals were observed for 24 uninterrupted hours in each experimental period. In 10-minute intervals, the grazing, rumination and other activities total time were evaluated (Jamieson and Hodgson, 1979). Also, the daily bites rate data were recorded, measured by the time spent by the animal to make 20 bites (FORBES; HODGSON, 1985). By dividing the estimated forage intake in the days of evaluation of feeding behavior (g DM) by the number of bites, the estimated mass was obtained for each bite in g DM/bite (FORBES, 1988).

A completely randomized design with repeated measurement arrangement was used, three feeding systems and three replications of area for treatments. For evaluation of ingestive behavior and forage intake, animals were considered replicates.

Statistical analyses were performed using the ‘Mixed’ procedure of SAS software for variables that showed normality of residuals. We performed a structure selection test using the Bayesian information criterion (BIC) to determine the model that best represented the data. We used a mixed model with fixed effects (feeding systems, periods of assessment and their interactions) and random effects (the residual and the nested paddocks in each feeding system). The interaction between feeding systems and evaluation periods was significant at 5% probability. Whenever significant differences were detected, mean values were compared using the *lsmeans* test. We used a stepwise procedure in multiple regression analysis to identify the most influential independent variables. From the equations obtained, we selected the one with the lowest P-value, residual variance and number of independent variables, and the highest coefficient of determination. The variables canopy height, CP intake, CP forage intake were transformed by rannor.

RESULTS AND DISCUSSION

There was no interaction (P>0.05) between feeding systems × evaluation periods for the variables related to pasture. Heifers, in the different feeding systems, were kept on similar forage mass (FM; 2260.0 ± 149.5 kg ha^{-1} DM), canopy height (CH; 13.6 ± 0.7 cm), tiller population density (TPD, 4527.5 ± 554.2 tillers m^{21}), leaf:stem ratio (LSR, 1.6 ± 0.2), forage allowance (FA; 12.7 ± 0.5% BW), leaf blades allowance (LBA, 4.0 ± 0.5% BW), neutral detergent fiber (NDF; 51.9 ± 1.2%), crude protein (CP; 20.8 ± 0.8%) and dry matter in situ digestibility (DMID; 79.3 ± 1.9%). These variables showed differences between the periods of evaluation of ryegrass (P<0.05; Table 1).

The forage mass range required for the adequate performance of animals on ryegrass pasture is between 1100 and 1800 kg ha^{-1} DM (Roman et al., 2007) and canopy height must be between 10 and 15 cm to optimize the biomass flow (Pontes et al., 2004). Due to the high tiller population density, which led to a greater forage mass (Table 1) than that reported by Roman et al. (2007), it was recommend to keep the canopy height in the range 10-15 cm, for no limitation on forage intake by animals.

The forage and leaf blades allowance were close to values obtained by Eloy et al. (2014) of 9.7% BW and 4.3% BW, respectively, on ryegrass pasture, not limiting forage intake by heifers. Forage allowance was 3.2 times higher than the value estimated by the National Research Council (NRC, 2000; 3.0%) characterizing no limitation of intake (GIBB; TREACHER, 1976). The crude protein content in the apparently consumed forage showed a value 39% higher than recommended by the National Research Council (NRC, 2000), providing an average daily weight gain of 971.0 g day^{-1} for heifers exclusively on ryegrass pasture and 1243.0 g day^{-1} for supplemented heifers. Even at the final third of usage, after 84 grazing days, heifers harvested forage with non-limiting CP content (15.0%) for the category.

Heifers harvested forage with similar DMID in all feeding systems, with values similar to those obtained by Eloy et al. (2014) who reported average value of 79.2%. Along the evaluation period, there was a reduction in DMID of the apparently consumed forage by heifers, with reductions of 10.5 and 29.2% in the second and third periods, respectively. The DMID was associated with the leaf:stem ratio of the ryegrass forage mass (r=0.71; P<0.0001) and the leaf blades allowance (r=0.82; P<0.0001) reflecting the harvest of plant structures with higher amount of structural components along the ryegrass cycle.

Table 1.Pasture characteristics and nutritive value of forage as grazed in the evaluation periods of Italian Ryegrass

Variables	Periods			P[1]	CV[2]
	08/06-09/02	09/03-09/30	10/01-10/28		
Forage mass[3]	1725.2c	2257.2b	2797.8a	<0.0001	4.4
Canopy height[4]	10.1	12.3	18.5	0.0618	5.8
Tiller population density[5]	4096.6b	5414.5a	4071.4c	<0.0001	9.0
Leaf:stem ratio	3.1a	1.3b	0.5c	<0.0001	18.9
Forage allowance[6]	11.8	12.9	13.4	0.4226	6.8
Leaf blades allowance[7]	5.5a	5.0a	1.3b	<0.0001	15.8
Dry matter[8]	18.1c	20.5b	28.1a	<0.0001	2.4
Neutral detergent fiber[8]	44.9c	50.4b	60.3a	<0.0001	2.2
Crude protein[8]	24.9a	22.5b	15.0c	<0.0001	3.6
DMID[8,9]	91.3a	82.6b	63.9c	<0.0001	2.5

[1]Probability of evaluation periods; [2]Coefficient of variation (%); [3]kg ha^{-1} of DM; [4]cm; [5]Tillers m^{-2}; [6]kg of DM 100 kg^{-1} of BW; [7]kg of leaf blades 100 kg^{-1} of BW; [8]%; [9]DMID= dry matter in situ digestibility. Values followed by different letters in the same line differs by *lsmeans* procedure

Moreover, there was no interaction (P>0.05) between feeding systems × evaluation periods for the variables related to intake. Heifers, in the different feeding systems, showed similar total consumption (3.2 ± 0.1% BW), total NDF intake (1.3 ± 0.1% BW), forage CP intake (0.5 ± 0.04% BW) and total CP intake (0.6 ± 0.04% BW). These variables showed differences between the periods of evaluation of ryegrass (P<0.05; Table 2).

Forage intake by heifers differed between feeding systems (P<0.05). Animals exclusively on pasture ingested 19.0% more forage compared to heifers fed corn grain with or without addition of crude glycerin (Table 2). Thus, the reduction in forage intake by supplemented animals was compensated by the intake of supplement, so that the total intake of DM was similar. The rate of replacement of DM of the forage with DM from the supplement was 0.58 for corn grain with or without addition of crude glycerin. Given the reduction in forage intake to maintain the same forage mass in all feeding systems, there was a 38.2% increase in stocking rate in relation to the exclusive use of pasture (847.2 ± 0.1 kg ha^{-1} BW; P<0.05).

The forage NDF intake by heifers also differed between feeding systems (P<0.05). The higher intake of forage NDF was found for heifers exclusively on pasture without difference from heifers fed corn, which, in turn, showed no differences from heifers fed corn with added glycerin (Table 2). As heifers consume greater amount of forage when exclusively on pasture and NDF content of the apparently consumed forage is similar in all feeding systems, the heifers exclusively on ryegrass consumed greater amounts of neutral detergent fiber.

Heifers that received corn grain have showed lower forage intake than animals exclusively on pasture. Corn grain presented NDF content of 21.8%, which provided a NDF intake similar to those of heifers on ryegrass pasture, receiving or not corn grain. In turn, heifers fed corn grain with added crude glycerin, besides having lower intake of forage, received a supplement able to provide temporary satiation and thus consumed less forage and consequently less NDF.

Additionally, there was interaction (P<0.05) between feeding systems × evaluation periods for grazing time (Table 3). In the first period, the heifers exclusively grazing on ryegrass remained 207.4 minutes (65.7%) more than heifers receiving corn grain with added glycerin, which spent 315.8 minutes grazing. Animals that received corn grain remained grazing an intermediate time compared to heifers in the other feeding systems. This reduction in the grazing time shows that the supplemented animals require less time to ingest the same amount of DM than the heifers of the feeding system exclusively on pasture (Table 3).

Table 2. Forage intake, total intake, neutral detergent fiber intake of forage and total neutral detergent fiber intake by beef heifers exclusively in Italian Ryegrass or receiving grain with or without crude glycerin

Feeding systems	Periods			Average	P*
	08/06-09/02	09/03-09/30	10/01-10/28		
Forage intake (% of BW)					
Ryegrass	3.3	3.1	2.4	2.9 ± 0.1a	0.0095
Corn	3.0	2.4	2.0	2.5 ± 0.1b	
Glycerin	2.8	2.0	2.0	2.2 ± 0.1b	
Average	3.0 ± 0.1a	2.5 ± 0.1b	2.1 ± 0.1c		0.0001
Total intake (% of BW)					
Ryegrass	3.3	3.1	2.4	2.9 ± 0.1	0.0858
Corn	3.9	3.3	2.9	3.4 ± 0.1	
Glycerin	3.9	3.1	3.1	3.3 ± 0.1	
Average	3.7 ± 0.1a	3.2 ± 0.1b	2.8 ± 0.1c		0.0001
Neutral detergent fiber intake of forage (% of BW)					
Ryegrass	1.2	1.41	1.3	1.3 ± 0.1a	0.0398
Corn	1.1	1.1	1.3	1.1 ± 0.1ab	
Glycerin	0.9	0.9	1.2	1.0 ± 0.1b	
Average	1.0 ± 0.1	1.1 ± 0.1	1.3 ± 0.1		0.0616
Total neutral detergent fiber intake (% of BW)					
Ryegrass	1.2	1.4	1.3	1.3 ± 0.1	0.4629
Corn	1.2	1.2	1.5	1.3 ± 0.1	
Glycerin	1.1	1.1	1.4	1.2 ± 0.1	
Average	1.1 ± 0.1b	1.2 ± 0.1ab	1.4 ± 0.1a		0.0325

Values followed by different letters in the same line or column differs by *lsmeans* procedure; *Probability; Ryegrass=heifers on Italian Ryegrass; Corn=heifers on Italian Ryegrass + 0.9% of BW of ground corn grain; Glycerin= heifers on Italian Ryegrass + 0.9% of BW of ground corn grain with addition of crude glycerin

Table 3. Components of ingestive behavior of beef heifers exclusively on Italian Ryegrass pasture or receiving grain with or without crude glycerin as supplement

Feeding systems	Periods			Average	P*
	08/06-09/02	09/03-09/30	10/01-10/28		
Grazing time (min.)					
Ryegrass	523.3a	443.0a	444.7a	470.3 ± 16	0.0003
Corn	419.0b	390.1a	389.9a	399.7 ± 16	
Glycerin	315.8c	380.9a	430.9a	375.9 ± 16	
Average	419.4 ± 16	404.7 ± 16	421.8 ± 16		0.7179
Rumination time (min.)					
Azevém	281.1	320.1	434.3	345.2 ± 18	0.2497
Milho	277.7	272.2	359.0	334.1 ± 18	
Glicerina	285.1	320.5	396.8	303.0 ± 18	
Média	281.3 ± 18c	304.3 ± 18b	396.7 ± 18a		<0.0001
Other activities time (min.)					
Ryegrass	635.7	679.1	560.9	625.2 ± 22b	0.0350
Corn	710.9	750.9	654.5	705.4 ± 22a	
Glycerin	787.2	694.9	579.6	687.2 ± 22ab	
Average	711.3 ± 22a	708.3 ± 22a	598.3 ± 22b		0.0006
Trough time (min.)					
Ryegrass	.	.	.	.	0.0065
Corn	33.4	22.3	34.4	30.0 ± 3b	
Glycerin	51.3	43.4	32.3	42.3 ± 3a	
Average	42.3 ± 3	32.9 ± 3	33.3 ± 3		0.1408

Values followed by different letters in the same line or column differs by *lsmeans* procedure; *Probability; Ryegrass=heifers on Italian Ryegrass; Corn=heifers on Italian Ryegrass + 0.9% of BW of ground corn grain; Glycerin= heifers on Italian Ryegrass + 0.9% of BW of ground corn grain with addition of crude glycerin

Heifers presented a similar grazing time in the second (404.7 min.) and third (421.8 min.) evaluation periods, independent of the feeding system. In these periods, there was a reduction in the leaf:stem ratio and DMID (Table 1) according to the ryegrass cycle, which probably were accounted for the reduction in the amount of forage consumed by the animals.

The grazing time of heifers exclusively on pasture depends on the forage allowance, according to the equation: $\hat{Y}$ = 789.8 – 94.3FA (P=0.0718; r^2=0.51), demonstrating that the heifers exclusively on pasture reduced grazing in 94.3 minutes when the FA increased 1%. The grazing time of heifers fed corn grain with added crude glycerin was explained by the leaf:stem ratio, according to the equation: $\hat{Y}$ = 439.3 – 47.6LSR (P=0.0002; r^2=0.89), in which heifers decreased 47.6 minutes of grazing when the LSR increased by 1 point. The addition of crude glycerin in the diets for heifers may probably have caused satiety, because, when ingested, glycerol (main component of crude glycerin) is converted into propionate in the rumen (TRABUE et al., 2007). The dynamics of satiety leads the animals to show reduction in instantaneous intake rate during grazing by means of a higher selectivity (GREGORINI et al., 2007), in other words, the greatest satiety leads the animals to be more selective during the grazing, seeking pastures with higher proportion of leaves. The grazing time of heifers on ryegrass pasture receiving corn grain as a supplement did not fit to any regression model.

There was no interaction (P>0.05) between feeding systems × evaluation periods for the variables rumination, other activities and trough time. Heifers in the different feeding systems showed a similar rumination time (327.4 ± 16.1 minutes; P>0.05). This value is according to that verified by Bremm et al. (2005), when heifers ruminated 393.0 minutes on oat and ryegrass pastures. This result is explained by the similarity in total NDF intake by heifers, regardless of the feeding system, despite the differences in forage NDF content between evaluation periods (Table 1).

During the first and second evaluation periods, animals showed a shorter rumination time (292.8 ± 18.4 min.) compared to the third period (396.7 ± 18.4 min.). The rumination time was positively correlated with the NDF content in the apparently consumed forage (r=0.51; P=0.007). The NDF content increased along the ryegrass cycle (Table 1), and the fiber fraction is the main factor stimulating chewing (GRANT; ALBRIGHT, 1995).

The different feeding systems interfered with the other activities and trough time (P<0.05). Heifers that received corn grain remained more 80.2 minutes in other activities when compared to heifers exclusively on pasture. The heifers receiving corn grain with added glycerin remained a similar time in other activities than the other animals (Table 3). This behavior can be explained by the excluding nature of each of the activities. The animal cannot perform more than one activity at the same time, which could lead to competition between feeding activities in the distribution of time (FISCHER et al., 1998).

The time spent in other activities differed between evaluation periods (P<0.05). In the first and second periods, animals spent time in other activities 18.7% longer than in the third period (598.3 ± 22.4 min.). This result may be related to the LBA, which was higher in the first and second periods (5.3% BW) and lower in the third period (1.3% BW), allowing a greater grazing selectivity and thus the harvest of a higher proportion of leaf blades, more rapidly. In this way, the stimulation to interrupt the meal associated with the possible increase in satiety signals is faster (BAGGIO et al., 2008).

Heifers supplemented with crude glycerin exhibited a longer time in the trough (min.) than those fed only corn grain as supplement (P<0.05). This is because the animals receiving crude glycerin did not have prior experience with this supplement (NEWMAN et al., 1992) and because the crude glycerin is viscous, which differs from corn grain, making it difficult the consumption of the supplement by heifers.

There was interaction between feeding systems × evaluation periods for bite rate (P<0.05; Table 4). In the first and third (41.9 bites min^{-1}) evaluation periods, the animals performed a similar bite rate, regardless of the feeding system. In the second period, the heifers exclusively on pasture and those that received corn grain performed more 7.6 bites per minute than those fed corn grain with added glycerin. Probably, the greater satiety caused by crude glycerin intake led the animals to perform fewer bites per minute during grazing.

Table 4. Rate and bite mass of beef heifers kept exclusively on Italian Ryegrass or receiving corn grain with or without crude glycerin as supplement

	Periods				
Feeding systems	08/06-09/02	09/03-09/30	10/01-10/28	Average	P*
Bite rate (bite min.$^{-1}$)					
Ryegrass	45.7a	50.2ª	38.0a	44.7 ± 1.1	0.0115
Corn	50.6a	45.9ª	36.5a	44.4 ± 1.1	
Glycerin	47.2a	40.5b	33.7a	40.5 ± 1.1	
Average	47.8 ± 1.1	45.5 ± 1.1	36.1 ± 1.1		<0.0001
Bite mass (g bite^{-1})					
Ryegrass	0.4	0.4	0.4	0.4 ± 0.04	0.9522
Corn	0.4	0.4	0.5	0.4 ± 0.04	
Glycerin	0.4	0.4	0.4	0.4 ± 0.04	
Average	0.4 ± 0.03	0.4 ± 0.03	0.4 ± 0.03		0.5371

Values followed by different letters in the same line or column differs by *lsmeans* procedure; *Probability; Ryegrass=heifers on Italian Ryegrass; Corn=heifers on Italian Ryegrass + 0.9% of BW of ground corn grain; Glycerin= heifers on Italian Ryegrass + 0.9% of BW of ground corn grain with addition of crude glycerin

The bite rate of heifers kept on ryegrass pasture and supplemented with corn grain was explained by in situ dry matter digestibility, according to the equation: $\hat{Y}$ = 0.4 + 0.5 DMID (P=0.0125; r^2=0.61), where the 1% reduction in DMID made the heifers to reduce 0.5 bites minute^{-1}. The bite rate of heifers receiving corn grain with addition of crude glycerin was explained by the neutral detergent fiber content, according to the equation: $\hat{Y}$ = 73.8 – 0.6NDF (P=0.0176; r^2=0.58), demonstrating that the 1% increase in the NDF content made the heifers to reduce 0.6 bites minute. Considering that the bite mass was constant throughout the evaluation period and that the heifers have reduced forage intake with advancing ryegrass cycle (Table 2), the bite rate also had to be reduced. The bite rate of heifers kept exclusively on ryegrass pasture did not fit to any regression model.

Finally, there was no interaction (P>0.05) between feeding systems × evaluation periods for the variable bite mass (g DM bite^{-1}). The bite mass was similar (0.4 ± 0.0 g DM bite^{-1}; P>0.05) for heifers in all feeding systems and evaluation periods. The bite mass is a major determinant of forage intake in grazing situation (LACA; ORTEGA, 1995). The value found herein is higher than the value considered limiting for the daily intake of 0.3g OM bite^{-1} reported by Stobbs (1973). Although the LSR, content of CP, NDF and DMISD have varied with advancing pasture cycle (Table 1), heifers were able to keep a constant bite mass throughout the utilization period of the pasture.

CONCLUSIONS

The addition of 0.2% of body weight of crude glycerin in the diet for beef heifers on Italian ryegrass pasture shows no effect on total intake or chemical composition of the apparently consumed forage.

The addition of crude glycerin to corn grain as a supplement in ryegrass pasture does not change the forage intake in relation to the exclusive use of corn grain. Forage intake is higher when the heifers remain exclusively on ryegrass.

The supply of ground corn grain, with or without addition of crude glycerin, for beef heifers on ryegrass increases the stocking rate.

The grazing time of heifers exclusively on ryegrass pasture is influenced by forage allowance, and when supplied corn with added crude glycerin, this is influenced by the leaf blades allowance.

RESUMO: Objetivou-se avalizar o comportamento ingestivo, ingestão de forragem e as características da pastagem quando bezerras de corte são mantidas exclusivamente em pastagem de azevém (*Lolium multiflorum* Lam.) ou recebendo grão de milho quebrado como suplemento (0,9% do peso corporal (PC)) com ou sem adição de glicerina bruta (0,2% PC). Os animais experimentais foram bezerras Angus com idade e peso inicial de oito meses e 166,2 ± 9,5 kg, respectivamente. O método de pastejo foi o contínuo com número variável de animais. O delineamento experimental foi o inteiramente casualizado com medidas repetidas no tempo. A ingestão de matéria seca foi estimada usando óxido de cromo como indicador de produção fecal. As bezerras ingeriram similares quantidades de matéria seca e fibra em detergente neutro. A ingestão de forragem foi 19.0% menor quando as bezerras recebem grão de milho quebrado como suplemento com ou sem adição de glicerina bruta e essa redução na ingestão de matéria seca de forragem promove aumento de 38,2%

na taxa de lotação. Bezerras que recebem glicerina bruta como suplemento permanecem mais tempo no cocho do que bezerras que recebem somente grão de milho quebrado.

PALAVRAS CHAVE: Angus. *Lolium multiflorum* Lam. Suplemento energético. Ingestão de nutrientes.

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