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Article

Nutritional management of steers raised in graze and in feedlot: intake, digestibility, performance and economic viability

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Abstract:

This study aimed to evaluate nutrient intake and digestibility, performance and economic viability of steers during the rearing phase in *Brachiaria brizantha* cultivar Marandu graze and in feedlot. Were used fifty crossbred steers in the rearing phase, with a mean weight of 275 ± 8.18 kg, distributed in a completely randomized design with ten replications per treatments: Mineral supplementation, nitrogen supplementation, Concentrate supplementation in the order of 1 and 2 g/kg body weight and total feedlot. The total dry matter intake and body weight showed a difference (*P*<0.05) for animals in feedlot. Crude protein, ether extract, neutral detergent fiber corrected for ashes and protein, non-fibrous carbohydrates, total digestible nutrients showed differences for the animals that received mineral supplementation in comparison to the other managements adopted. The same performance was observed for animals in feedlot. The digestibility coefficients of dry matter, crude protein, ether extract, non-fibrous carbohydrates and total digestible nutrients showed a difference (*P*<0.05) for the animals that received mineral supplementation, in comparison to the other managements adopted. (*P*<0.05). The mean daily gain was lower (*P*<0.05) for animals receiving mineral supplementation. The gross margin was higher (*P*<0.05) for animals handled in feedlot. Considering the obtained results, it was possible to observe that the animals kept in graze with good availability of dry matter presented satisfactory performance. It is feasible to confine the animals in rearing, since it shortens the production cycle, generating favorable economic results.

Key words: Cattle, Ingestion, Management, Nutrients.

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Introduction

In tropical regions, graze is the main nutritional resource for the production of beef cattle. Tropical grasses are the basis of the cattle grazing system and provide low-cost energy substrates, mainly fibrous carbohydrates[1]. However, when used exclusively, without supplements, they rarely meet the nutritional requirements of the animals for adequate productivity, presenting some nutritional restrictions, mainly in protein and energy, which vary throughout the year[1], resulting in unsatisfactory animal performance.

Dry matter intake is undoubtedly one of the most important factors for animal performance and maintenance, since it is the starting point responsible for the entry of nutritional sources, mainly energy and protein, necessary to meet the requirements of maintenance and animal production. Therefore, animal supplementation aims to result in additional gains that depend on the objective of the producer, which can only be achieved with the intake of forage and mineral supplementation, allowing the animal to increase nutrient intake and improve their digestibility.

Thus, a program of continuous meat production that aims to be efficient and competitive, should seek to eliminate the negative phases of the production process, providing the animal conditions for adequate development throughout the year, in order to reach the conditions of early slaughter. An alternative for animals to be slaughtered younger is to keep the animals in graze during the rainy season, where there is high availability of forage with good nutritional value, aiming to reduce production costs and, during food restriction periods, an interesting strategy is to confine the animals. In addition to improving the final product, it accelerates capital turnover, reduces stocking in graze, increases the production scale of the property. The objective of this study was to evaluate the nutrient intake and digestibility, performance and economic viability of crossbred steers managed in *Brachiaria brizantha* cultivar Marandu graze and in feedlot during the rearing phase.

Material and methods

Field work was conducted on the Princesa do Mateiro Farm, located in the municipality of Ribeirão do Largo, state of Bahia, Brazil, with coordinates of 15° 26′ 46″ S and 40° 44′ 24″ W. In an area of 14 ha, divided into 12 paddocks with approximately 1.17 ha each, formed of ‘*Brachiaria brizantha* cultivar Marandu. The experiment started in February/2017 and ended on June/2017.

Fifty (50) crossbred Holstein x Zebu male steers with average initial weight of 275 ± 8.18 kg and 12 mo of age were used. The animals were distributed in a completely randomized design with 10 replicates per treatment: Mineral supplementation *ad libitum* (MS)*;* nitrogen supplementation *ad libitum* (NS); concentrate supplementation in the order of 0.1% body weight (SC 1); concentrate supplementation in the order of 0.2% body weight (SC 2); total feedlot (C 3). The proportion of each ingredient in diets is described in Table 1.

Table 1: Composition, in $g.kg^{-1}$, of the supplements, based on natural matter

Ingredient	Mineral salt	Nitrogen salt	Concentrate	Feedlot
Corn grain	-	-	-	850
[2] Engordim pellet	-	-	-	150
Ground sorghum grain	-	-	560	-
Soybean meal	-	-	200	-
Urea	-	250	150	-
[1]Mineral salt	1000	750	90	-
Total	1000	1000	1000	1000

[1] Calcium 175 g; Phosphorus 60 g; Sodium 107; Sulfur 12 g; Magnesium 5000 mg; Cobalt 107 mg; Copper 1,300 mg; Iodine 70 mg; Manganese 1,000 mg; Selenium 18 mg; Zinc 4,000 mg; Iron 1,400 mg; Fluorine (maximum) 600 mg.

[2]Vitamin A (min) 35,000 IU/kg, Vitamin D3 (min) 7,000 IU/kg, Vitamin E (min) 50 IU/kg, Copper (min) 50 mg/kg, Manganese (min) 200 mg kg, Cobalt (min) 0.6 mg/kg, Iodine (min) 3 mg/kg, Selenium (min) 1.2 mg/kg, Chromium 20-50 g/kg, Phosphorus (min) 8,000 mg/kg, Potassium (min) 20 g/kg, Sodium (min) 10 g/kg, Sulfur (min) 5,000 mg/kg, crude protein (min) 360 mg/kg, NNP 180 g/kg, Ethereal extract (max) 25 g/kg, Mineral matter (max) 350 g/kg, Crude fiber (max) 100 g/kg, Detergent fiber acid (max) 200 g kg, Monensin sodium 120 mg/kg, Virginiamycin 125 mg/kg.

Forage evaluation

The grazing method adopted was that of rotational stocking with 7 grazing days and 28 d of rest for each paddock. Graze was evaluated every 28 d. To reduce the influence of biomass variation between paddocks, the steers remained in each paddock for 7 d and, after that period, they were transferred to another, in a pre-established direction, at random. To estimate dry matter availability, the methodology described by McMeniman[2]. Residual dry matter biomass (RDB) was estimated in the four pickets, according to the double sampling method[3]. Before cutting, sample dry matter biomass was visually estimated, using the cut values, when 60 times the square were thrown and the forage biomass was then expressed in kg/ha[4]..

The triple pairing technique, methodology[5], was used to evaluate biomass accumulation over time, with the four pickets that remained fenced for 28 d, functioning as exclusion cages. The accumulation of DM in the experimental period was calculated by multiplying the value of the daily accumulation rate by the number of days in the period. The daily DM accumulation rate was estimated through the equation proposed by Campbell[6].

Digestibility assays

Fecal excretion estimates for grazing animals were obtained with the use of chromium oxide in the amount of 10 g/animal/d, packed in paper cartridges, supplied by hand and orally, at 0600 for 12 d; the initial 7 d were for regulating the excretion flow of the indicator, and the final 5 d were for feces collection. Fecal production was estimated, based on the ratio between the amount of the supplied indicator and its concentration in the feces[7]. The concentration of chromium oxide in the feces was estimated at the Animal Nutrition Laboratory of the DZO/UFV, by atomic absorption[8].

To determine the dry matter intake of the supplement (DM), the external marker titanium dioxide (TiO_2) was used, and the amount of 15 g/animal/d was supplied, mixed with the supplement at 1000 h[9]. Titanium concentration was estimated according to the methodology described by Detmann *et al*[10].

For feedlot animals, apparent digestibility and dry matter intake (TDM) were estimated from fecal production. Indigestible neutral detergent fiber (iNFD) was used to estimate animal fecal production. For the animals in feedlot, only the intake of individual dry matter (TDM) was estimated, from the daily fecal production and the knowledge of the content of the indigestible component iNFD in the total diet.

The forage and the collected material of each animal were placed in properly identified plastic bags and frozen at -10 °C for further analysis. They were then thawed, pre-dried separately per day of collection in a forced ventilation oven at 55 ºC for 72 h.

Subsequently, they were milled in a Willey mill with of 1 and 2 mm mesh sieves. The voluntary intake of dry matter from the forage (FDMI) was determine using the internal marker indigestible NDF (iNDF), obtained after 288 h of *in situ* incubation(10).

Chemical analysis

The samples of the supplement, forage and feces, after being pre-dried in a forced ventilation oven at 55 ºC for 72 h, milled in a Willey mill at 1 mm, were analyzed for the contents of dry matter (DM), mineral matter (MM), protein (CP), neutral detergent fiber corrected for ash and protein (NDFap), acid detergent fiber (ADF), according to AOAC(11). The ether extract (EE) content was analyzed using an Ankom® machine (XT15)(12).

The content of non-fibrous carbohydrates (NFCap) was obtained by the equation(13):

NFCap = 100 – [(CP% − (CP%from urea + %urea) + %NDFap + %EE + %ash]; where CP, crude protein content in the concentrate supplement; CP% from urea, protein equivalent of urea; urea%, urea content in the concentrate supplement; EE, ether extract content; NDFap, neutral detergent fiber corrected for ash and protein. All terms are expressed as % of DM.

Total digestible nutrients (TDN) were calculated(14):

NDF and NFCap corrected for ash and protein, by the following equation: TND (%)= DCP + DNDFap + DNFCap + 2.25DEE where, DCP= digestible CP; DNFDap= non-fibrous carbohydrates. The chemical composition of the feedstuffs used in the experimental diets is described in Table 2.

Table 1: Dry-matter-based chemical composition of fodder and concentrate(g/kg)

	Brachiaria brizantha	**Concentrate**	**Feedlot**
Dry matter	222	893	900
Mineral matter	97.6	107	80
Crude protein	95	45	180
Ether extract	17.5	36.6	1.35
NDFap	652	16	170
NFCap	139	243.7	600
ADF	315.9	57.6	48.2
TDN	569.3	569.2	600

1Simulated grazing, NDFap = Neutral detergent fiber corrected for ash and protein, NFCap = Non-fibrous carbohydrates, ADF = Acid detergent fiber, TDN = Total digestible nutrients.

Animal performance

The animals were weighed at the beginning and at the end of the experiment, and intermediate weightings were performed every 28 d for adjustment mean daily gain (ADG) and of supplementation. Weighing was preceded by a 12-h fasting. Supplementation was provided daily in uncovered plastic pads. The supplement was offered once a day, always at the same time (1000 h). The feedlot animals were weighed every 14 d without previous fasting. Supplementation was provided daily in a covered trough. The supplement was offered twice a day, in the morning and afternoon. Animal performance was determined by the difference between the initial live weight (IBW) and final live weight (FBW), divided by the experimental period in days. Feed conversion (FC) was determined according to intake and performance.

Economic evaluation

The study of economic viability was determined considering that the producer already had the entire system of animal rearing implanted. It is necessary to take into account that the groups received mineral salt, nitrogenous salt, of 1 and 2 g/kg of body weight in supplement containing 60 % crude protein in their high-grain diet composition.
The formulas used to determine the costs of the system were:
TC = Total cost = operating costs + opportunity + land
Gross margin = revenue (sale value of the animal) – effective operating cost
Net margin = (revenue) - total operating cost;
Net profit = revenue – total cost
Profitability = (net profit / total cost * 100)
RMA = monthly income of the activity = (net revenue per animal / cost per animal × 100) / experimental period) × 30 d of the month.
Supplement prices/kg= were US$ 0.39 for mineral salt; 0.34 nitrogenous salt; 0.24 semi-feedlot. 1 and 2 g/kg of body weight, US$ 0.28 for feedlot.
Data on intake, digestibility, performance and economic viability were submitted to analysis of variance, adopting 0.05 as a critical level of probability. The comparison between treatments was performed by the decomposition of the sum of squares, related to this source by means of orthogonal contrasts, except economic viability.

Results

Forage characteristics

Grazing showed mean availability of 3,904.59 kg DM per hectare (Table 3).

Table 3: Availability of dry matter and morphological components of *Brachiaria Brizantha* cultivar Marandu

Components	Mean
Total dry matter (DM) availability, kg/ha	3,904.59
Potentially digestible (pd) dry matter, kg/ha	2319
Forage supply, DM kg (BW)	12.80
Forage supply, DM pd kg (BW)	8.00
Green dry matter	3,232

The dry matter intake of forage was similar (P>0.05) among grazing animals, independent of the adopted management. Total dry matter intake (Total DM), as well as intake as a function of body weight (BW), did not show differences (P>0.05) for the animals that received mineral supplementation, in comparison to the other treatments (Table 4).

Table 4: Forage characteristics as a function of the management: mineral supplementation, concentrate protein/energy supplementation in *Brachiaria brizantha* cultivar Marandu grazed and in feedlot

	Nutritional management						Contrasts			
	MS	**NS**	**SC1**	**SC2**	**C3**	CV %	**MS x TD**	**NS x (1;2)**	**SC1 x SC2**	**C3 x (1;2)**
Forage DM	6.31	6.42	6.19	5.94	-----	18.77	0.188	0.4770	0.6654	------
Total DM	6.31	6.42	6.45	6.59	9.1	13.71	0.539	0.1210	0.8485	<.001
DM (%BW)	2.04	2.07	2.02	2.12	2.43	9.7	0.207	0.3419	0.8482	<.001
CP	0.65	0.69	0.74	0.95	1.82	18.61	<.001	0.3002	0.1290	<.001
NDFap	4.15	4.18	4.08	3.98	1.54	12.6	<.001	<.0001	0.3220	<.001
EE	0.10	0.10	0.11	0.12	0.18	17.6	0.001	0.2124	0.3220	<.001
NFCap	0.92	0.98	1.02	1.05	5.06	24.25	<.001	0.5623	0.7589	<.001
TDN	3.67	3.93	3.97	4.06	6.91	17.88	0.014	0.4464	0.4103	<.001

SM x TD= Mineral salt *versus* other nutritional managements; SN x (SC1; SC2): nitrogenized salt *vs* concentrate supplementation; SC1 x SC2: concentrate supplementation at 1 g/kg BW *vs* concentrate supplementation at 2 g/kg BW; C3 x (1;2): feedlot *vs* concentrate supplementation.
Total dry matter intake Total DM (kg/d), dry matter intake based in body weight (Total DM %BW), crude protein (CP), ether extract (EE), neutral detergent fiber corrected for ash and protein (NDFap), non-fibrous carbohydrates (NFC), total digestible nutrient (TDN) for grazed animals.

CP, NDFap, EE, NFC and TDN showed a difference (P<0.05) for the animals that received mineral supplementation, in comparison to the other managements adopted. There was a difference (P<0.05) in CP, NDFap, for grazed animals that received nitrogen supplementation, when compared to grazed animals that received concentrate protein / energy supplementation in the order of 1 and 2 g/kg of body weight. Total DM, BW, as well as CP, NDFcp, EE, NFC and TDN, showed a difference (*P*<0.05) for feedlot animals, when compared to grazing animals receiving Concentrate protein/energy supplementation in the order of 1 and 2 g/kg of body weight. DM, EE, NDFap, NFCap and TDN showed a difference (*P*<0.05), for grazed animals supplemented with mineral mixture, in comparison to the other management adopted (Table 5).

Table 5: Apparent dry matter digestibility (DM), crude protein (CP), neutral detergent fiber corrected for ash and protein (NDFap), ether extract (EE), non-fibrous carbohydrates (NFC) and total digestible nutrient (TDN), in (%) dry matter

	Nutritional management						**Contrasts**			
	MS	**NS**	**SC1**	**SC2**	**C3**	**CV %**	**SM x TD**	**SN x (1;2)**	**SC1 x SC2**	**C3 x (1;2)**
DM	57.07	57.20	58.80	61.60	76.1	3.27	<.001	<.0001	0.0020	<.001
CP	44.70	51.60	52.50	66.50	80.0	13.16	0.375	<.0001	0.0008	<.001
NDFap	61.60	64.40	61.40	63.70	76.3	4.44	<.001	0.0393	0.0286	<.001
EE	66.40	64.10	67.80	68.80	82.2	8.96	<.001	0.0282	0.6334	<.001
NFC	66.91	65.96	70.41	71.47	81.80	9.55	<.001	0.0174	0.6881	<.001
TDN	56.86	57.71	56.30	58.86	68.02	3.77	<.001	0.8548	0.0019	<.001

Descriptive probability levels for type I error associated with orthogonal tests for the comparisons between the adopted managements. SM x TD: Mineral salt *vs* other nutritional managements; SN x (1;2): Nitrogenized salt *versus* Concentrate supplementation; SC1 x SC2: Concentrate supplementation at 1 g/kg BW *vs* Concentrate supplementation at 2 g/kg BW; C3 x (1;2): Feedlot *vs* Concentrate supplementation

There were differences (*P*<0.05) for DM, CP, EE, NDFap and NFC between grazed animals supplemented with nitrogenized salt, compared to animals supplemented with concentrate in the order of 1 and 2 g/kg of body weight. The same performance was observed for DM, CP, NDFap, TDN, for grazing animals supplemented with the concentrate in the order of 1 and 2 g/kg of body weight, when compared to each other (Table 6).

The coefficients of DM, CP, NDFap, EE, NFC and TDN showed a presented difference (*P*<0.05) for confined animals when compared to grazing animals receiving Concentrate protein / energy supplementation in the order of 1 and 2 g/kg of body weight.

Table 6: Initial body weight (IBW, kg), final body weight (FBW), mean daily gain (ADG), feed conversion (FC) of steers in several rearing systems

	Nutritional management						Contrasts			
	SM	SN	SC1	SC2	C3	CV %	SM x TD	SN x (1;2)	SC1 x SC2	C3 x (1;2)
IBW	275	274	275	274	288	17.59	0.849	0.4587	0.9455	0.963
FBW	344	346	361	348	370	14.88	0.375	0.5247	0.3565	0.679
ADG	0.50	0.52	0.62	0.53	1.52	24.11	<.001	0.4796	0.2780	<.001
FC	13.90	12.47	12.36	10.48	5.28	33.09	0.130	0.9070	0.0399	<.001

SM x TD: Mineral salt *vs* other nutritional managements; SN x (SC1; SC2): Nitrogenized salt *vs* Concentrate supplementation; SC1 x SC2: Concentrate supplementation at 1 g/kg BW *vs* Concentrate supplementation at 2 g/kg WB; C3 x (SC1; SC2): Feedlot *vs* Concentrate supplementation

For animal performance, there was no difference (*P*>0.05) for initial body weight (IBW) and final body weight (FBW), regardless of the ADG for grazed animals supplemented with mineral mixture, in comparison to the other management practices adopted. The ADG was similar (*P*>0.05) between grazed animals supplemented with nitrogen salt, compared to animals supplemented with concentrate in the order of 1 and 2 g/kg of body weight. FC was similar (*P*>0.05) among the animals that received mineral supplementation, in comparison to the other treatments. The same results were observed for grazing animals that received nitrogen supplementation, when compared to animals receiving protein/energy concentrate supplementation in the order of 1 and 2 g/kg of body weight (Table 7).

Table 7: Economic evaluation of the production systems of crossbred steers supplemented in *Brachiaria brizantha* grazing and in feedlot (US$)

Variables	SM	SN	SC1	SC2	C3	Mean	CV(%)
Total cost	411.16a	410.45a	412.91a	411.67a	402.47a	409.83	16.00
Gross margin	46.50b	49.82b	66.48ab	56.15b	86.77a	61.14	31.63
Net margin	46.50b	49.82b	66.48ab	56.15b	86.77a	61.01	14.49
Net profit	11.65b	15.06b	31.52b	15.81b	52.03a	25.21	17.38
Profitability	0.77b	0.48b	2.11a	1.15b	3.42a	1.50	25.17
MIA	0.46b	0.37b	0.25b	0.46b	2.56a	0.48	13.20

Mineral supplementation (SM); Nitrogen supplementation (SN): Concentrate supplementation in the order of 1 g/kg of body weight (SC1); Concentrate supplementation in the order of 2 g/kg of body weight (SC2); = Feedlot, C3. MIA = monthly income of the activity.
ab Means followed by the same letter in the row do not differ (*P*>0.05).

The total cost in the experimental period was similar (*P*>0.05), regardless of the adopted management. Gross and net margins were similar (*P*>0.05) for grazing systems, being different (*P*<0.05) only for the feedlot system. The monthly income was higher (*P*<0.05) for animals in feedlot, compared to animals supplemented in grazing that received mineral mixture, nitrogenous salt and concentrate in the order of 2 g/kg (BW). The same behavior was observed for the monthly rate.

Discussion

The supply and the quality of the forage are determining factors for animal development and performance. The availability of potentially digestible dry matter found in this study was 2,000 kg ha^{-1}. The higher the content of potentially digestible dry matter, the better the biological performance and, consequently, the economic performance will be favored, since the cheapest basic nutritional resource available for livestock is grazing and, the better it is used, the greater the financial return(15). When carrying out an extensive literature review(16) recommend a minimum supply of potentially digestible dry matter of 6 % or (6 kg of MSpd per 100 kg of body weight). In this study, 8 kg was found, an MSpd value higher than those recommended by these authors.

The average forage supply observed in this study was 12.8 %. This is in agreement with that recommended by others(16); they also recommend forage supply of 10 to 12 % for tropical grasses, evidencing that the value found is above the minimum recommended by the authors to assure forage availability with quality and quantity to the animals. The similarity for forage dry matter intake can be attributed to its expressive quality, which demonstrated crude protein levels of 9.5% MS of the forage, within the minimum limits of 7 to 11 % of DM in the diet.

The similarity in the total dry matter intake and in relation to the body weight for grazing animals was possibly due to the dry matter availability of good quality forage being the same for grazing animals and for being groups of homogeneous animals with the same age group. The similarity of these variables shows that grazed animals did not find quantitative and qualitative limitations during the experimental period regarding forage availability and possibly reached the maximum physical limit of intake.

According to Lazzarini *et al*(17) the response to nitrogen supplementation in forage intake becomes less evident when the CP content of the basal diet is greater than 7 to 8 % in MS, as observed in this study: a crude protein of 9.5 %. This high protein content of the forage possibly contributed to the fact that there was no difference in dry matter intake among grazed animals.

Total dry matter intake and body weight gain were higher for animals in feedlot. This result can be justified by the fact that the animals were supplied with 100 % concentrate *ad libitum*; consequently, they had a greater weight gain due to the higher dry matter intake. Dry matter intake is undoubtedly one of the fundamental factors that influences animal performance, and it is the starting point for nutrient input, mainly protein and energy, necessary to meet the requirement of animal maintenance and production. This difference in intake may have occurred due to the higher dry matter intake of the group of confined animals, contributing to the increase in their body weight.

The values found for mean CP intake among rearing systems allowed to infer that the CP requirement of the animals in the BRCorte described by Valadares *et al*(18) was satisfied by the diet available to the animals. The ingestion of protein by animals is of fundamental importance, since this nutrient is part of the synthesis of all body tissues, besides participating in the growth and microbial synthesis in the ruminal environment, a microbiota that has the function of degrading the compounds of the diet to release nutrients for absorption, in addition to producing microbial protein available for absorption in the small intestine.

The difference in crude protein intake for grazed animals receiving a mineral mixture may be justified by the higher non-protein nitrogen intake via supplementation provided to the other groups of animals. The similarity in the crude protein intake for grazing animals supplemented with nitrogen salt and protein / energy concentrate supplement evidences that this result may be associated to the dry matter intake, since it was similar, contributing to the fact that there was no difference in the intake of this nutrient. Crude protein intake was higher for animals in feedlot, compared to those supplemented with protein / energy concentrate. The crude protein content of the diet met the requirements of the animals and consequently contributed to a better performance, when compared to the other rearing systems.

It is presumed that part of the difference found for the intake of NDFap is due to the composition of the diet, in which its content was lower, respectively, in the diet of confined animals. These results demonstrate that the animals fed with one hundred percent of concentrate ingested fiber in less quantity, in relation to grazed animals.

The difference in the intake of EE, NFC, TDN, for grazed animals supplemented with mineral salt can be justified by the additional contribution of these nutrients from the supplementation, when compared to animals supplemented with concentrate. When the concentrate is offered to animals, it increases the concentration of the non-fibrous constituents in the diets, increasing the availability and nutrients in the gastrointestinal tract of the animals. Carbohydrates are a source of energy for ruminants, when converted to volatile fatty acids (acetic, butyric and propionic), are directed towards the deposition of muscle tissue.

The absence of differences in intake of EE, as well as NFC, TDN for animals supplemented with nitrogenous salt, compared to those supplemented with protein / energy concentrate, can be justified by the low level of concentrate supplementation (1 and 2 g/kg BW), not enough to influence the ingestion of these nutrients.

The intake of EE, NDFap and NFC, TDN, were higher for animals in feedlot. These results can be attributed to the fact that these animals receive a diet containing 100 %

concentrate non-fibrous carbohydrate, contributing to an increase in the intake of these fractions due to the higher concentration of these nutrients in the diet, mainly due to the higher intake of NFC and other more digestible nutrients. Thus, the increase in the intake of these dietary components is unique and exclusively due to its greater contribution, provided by the diet. The reduction in fiber intake in neutral detergent corrected for ash and protein (FDNcp), was due to the lower participation in the diet. The dry matter intake is directly associated with performance, since it contributes to the determination of the amount of nutrients ingested, being sufficient to meet the energy and nutritional requirements of the animals and, consequently, the greater efficiency in animal production.

The difference in DM, EE, NDFap and NFC were different compared for grazed animals supplemented with mineral mixture, in relation to the other managements adopted. These results may be associated to the benefits generated in the digestibility of the fibrous fraction of the diet, when the concentrate supplement is added to the ruminant diet.

Thus, the digestibility of a given diet is a result of the interactive and associative effects of all the nutrients in the diet and not only of the isolated effect of a particular constituent of the food. Even with 100 % concentrate offered to the confined animals, digestibility was not impaired, probably due to the balance between the rumen degradable dietary protein and the energy content of the diet, since this association helps maintain fiber digestion, even in situations where starch-rich supplements are supplied to animals.

The difference in the DM, CP, NDFap, EE, and NFC for animals receiving nitrogen supplementation in grazing compared to grazed animals that received concentrate supplementation in the order of (1 and 2 g/kg) of body weight. The same behavior was observed in DM, CP, NDFap, for grazed animals supplemented with protein / energy concentrate, when compared to each other. This result demonstrates the benefits that the addition of the concentrate in the ruminant diet provides for the grazing animal production system. This difference in crude protein digestibility and in the other nutrients may be associated to the higher nitrogen supplementation in the ruminal environment, making it more favorable to the growth and development of the microorganisms present in the rumen, favoring the growth of the microbial population by balancing protein and energy in the diet.

There was a similarity in the total nutrient digestibility coefficient (TDN) for animals receiving nitrogen supplementation in grazing, compared to grazed animals receiving protein/energy concentrate supplementation in the order of 1 and 2 g/kg of body weight. The same performance for EE and NFC was observed for grazed animals that received protein/energy concentrate supplementation in the order of (1 and 2 g/kg) body weight, when compared. Possibly due to the nutritional requirements of the microbial population, it is possible that there was no limitation of these nutrients, leaving the ruminal environment under favorable conditions for microbial growth.

The best DM of CP, neutral detergent fiber corrected for ashes and NDFap, EE, and NFC for animals in feedlot in comparison to other management practices can be justified by the greater participation of these dietary nutrients in the diet. Since the association of structural and non-structural carbohydrates in the diet allows improvements in nutrient digestibility as a function of the synchrony of energy and protein availability, providing substrates to the microorganisms, resulting in improvements in the absorption efficiency of the ingested nutrients. It is worth mentioning that, when consuming diets with a lower proportion of fiber due to the increase in concentrate, ruminants can show a faster rate of passage and when the intake of diets containing high proportion of fiber occurs, the rate of passage occurs more slowly, therefore allowing greater nutrient digestibility. The difference in the digestibility coefficient of NDFap, EE, and NFC for the feedlot. system, in comparison to other rearing systems, probably occurred due to the greater contribution of nutrients from the concentrate supplement, improving the ruminal environment and increasing the digestibility of the fibrous fraction of the digestion.

The difference in the mean daily gain for grazing animals supplemented with mineral mixture, in comparison to the other managements adopted and for the animals in feedlot. when compared to grazing animals that received concentrate protein/energetic supplementation, may be associated with a higher intake of non-fibrous carbohydrate, contributing to a greater contribution of nutrients, leading to an improvement in animal performance. Non-fibrous carbohydrates are fast-degradation compounds consisting of starch, pectin and glucans of easy fermentation, providing a greater contribution of energy to the growth of the ruminal microorganisms, favoring nutrient digestion. The mean daily gain is an important index in beef cattle, and the profitability of the system depends on this gain.

The productive performance of grazed animals is directly related to the quality and quantity of forage available for grazing. These characteristics influence the intake of nutrients and nutritional attributes by grazing animals, and ingestion is the main determinant of animal performance.

The similarity in mean daily gain among grazed animals supplemented with nitrogen salt compared to animals supplemented with concentrate on the order of 1 and 2 g/kg of body weight is observed, since there was no difference in total dry matter intake, it contributes to the fact that there was no difference in animal performance. The mean daily gain, respectively, was a numerator to obtain an important variable of feed conversion (FC), in which it was not observed a difference in feed conversion between grazing managements. The similarity in the performance of the animals between grazing production systems demonstrates that, when there is a great quantity of forage and quality cattle raised in grazing can meet their requirements and achieve satisfactory gains in the period of high food availability, making the system economically viable.

Animals in feedlot perform better in comparison to those kept in grazing, since they spend less energy in search of food[19], since the food is supplied directly in the trough and in a superior quality to that of grazing.

Rearing was economically viable for grazing and feedlot systems, a fact evidenced by the positive net income, characterized for the profit, since the gross income was able to cover the total cost of the rearing system.

The animals in feedlot obtained the highest gross margin in the activity, net margin and net profit observed, justified by its best performance. Therefore, grazed animals receiving concentrate supplementation in the order of 1 g/kg and in feedlot, allowed a greater return on invested capital (US$ invest / US$ ret) in the activity. The monthly rate of return was higher for animals in feedlot, which optimized animal performance. It is interesting to always seek a balance between productivity, which in this case is expressed by economic viability and performance.

Conclusions and implications

Considering the obtained results, it was possible to observe that the animals kept in graze with good availability of dry matter showed satisfactory performance. It is feasible to confine the animals in rearing, since it shortens the production cycle, generating favorable economic results.

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