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STRUCTURAL AND CHEMICAL TRAITS OF TANZANIA GRASS UNDER ISOLATED, SIMULTANEOUS AND ALTERNATED GRAZING BY SHEEP AND CATTLE

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ABSTRACT

The aim of this study was to evaluate the effect of three types of rotational pasture – isolated (I – grazing only by sheep), simultaneous (S – simultaneous grazing by cattle and sheep) and alternated (A – granzing by cattle and then by sheep) – on the structural and chemical traits of Tanzania grass. Twelve crossbreed heifers, weighing initially 207 kg, 30 Santa Inês lambs, weighing 23 kg, and 16 adult ewes weighing 47 kg were used. The following parameters were determined on the pasture: forage mass available per grazing cycle (FMG); leaf (LP); stem (SP); dead material proportion (DMP), leaf:stem ratio (L/S); levels of dry matter (DM); mineral matter (MM); crude protein (CP); ether extract (EE); neutral detergent fiber (NDF); acid detergent fiber (ADF); inorganic phosphorus (Pi) and total digestible nutrients (TDN). The S and I systems presented the smallest values for SP and NDF, while their values for L/S, CP, EE and TDN were higher than in A system. Therefore, the results showed that the grass offered to sheep in S and I systems had better quality than in the A system. There was no effect of systems and cycles of pasture on the other parameters evaluated. Tanzania grass available to sheep showed best structural and chemical traits in S and I systems while it presented worse quality in A system. The S system may be an alternative to traditional sheep rearing systems in the Brazilian savannah region.

KEYWORDS: grass; pasture; ruminant.

CARACTERÍSTICAS ESTRUTURAIS E BROMATOLÓGICAS DO CAPIM TANZÂNIA SOB PASTEJO ISOLADO, SIMULTÂNEO E ALTERNADO DE OVINOS COM BOVINOS

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RESUMO

Objetivou-se avaliar o efeito dos três sistemas de pastejo rotacionado: isolado (O – pastejo isolado de ovinos), simultâneo (BO – pastejo simultâneo de bovinos com ovinos no mesmo piquete) e alternado (BDO – pastejo alternado: primeiro pelos bovinos, depois pelos ovinos), sobre características estruturais e bromatológicas do capim Tanzânia. O delineamento foi inteiramente casualizado, em fatorial 3x3 (sistemas de pastejo x ciclos de pastejo). Utilizaram-se 12 bovinos (mestiços), com peso médio de 207 kg, 16 ovelhas adultas com 47 kg e 30 cordeiros com peso médio de 23 kg da raça Santa Inês. As seguintes variáveis foram avaliadas: massa de forragem disponível por ciclo de pastejo (MFP); proporções de folhas (PF), colmo (PC) e material morto (PMM); relação folha:colmo (F/C); teores de matéria seca (MS), matéria mineral (MM), proteína bruta (PB), extrato etéreo (EE), fibra em detergente neutro (FDN), fibra em detergente ácido (FDA), fósforo inorgânico (Pi) e nutrientes digestíveis totais (NDT). Os tratamentos BO e O apresentaram menores valores para as variáveis PC e FDN, ao mesmo tempo em que foram superiores em F/C, PB, EE e NDT em relação ao tratamento BDO, denotando melhor qualidade do capim oferecido aos ovinos nesses dois tratamentos. Nas demais variáveis não houve efeito dos sistemas e nem dos ciclos de pastejo. O sistema de pastejo simultâneo pode ser considerado uma alternativa de manejo ao sistema isolado de ovinos na região de cerrado brasileiro.

PALAVRAS-CHAVE: gramínea; pastagem; ruminantes.

INTRODUCTION

Pastures are the main source of food for domestic ruminant herds in Brazil, which has increased competitiveness of the country in the international meat and milk market, due to low production costs, regarding, mainly, feeding. In livestock production on grazing, besides the nutritive value of pasture, its structure also affects the animal's response in terms of consumption and performance (CARVALHO et al., 2001; POMPEU et al., 2008), it also influences the use efficiency of abiotic resources, interfering with the competition among plants (LEMAIRE, 2001, CARVALHO et al., 2005).

Forage quality is determined by chemical and physical characteristics of plants, and their interactions with the mechanisms of digestion, metabolism and voluntary intake control determine the level of digestible energy intake and the animal´s performance. In this sense, knowing the chemical composition of forage plants allows to quantify the presence of compounds such as protein, structural carbohydrates, soluble carbohydrates, toxic substances, organic acids, and essential vitamins and minerals for animals. Thus, it is possible to formulate diets that meet nutritional needs of animals (REIS & RODRIGUES, 1993).

The potential of Tanzania cultivar can be verified by the results obtained during the access evaluation on CNPGC, in which this grass produced 33 t/ha.year of DM and presented, on average, 80% leaves, 12.7% crude protein in the leaves and 9% in the stem (SAVIDAN et al., 1990; JANK et al., 1994; SANTOS et al., 1999).

This study was conducted to verify the effect of three rotational grazing systems - isolated, simultaneous and alternated between sheep and cattle - on structural and chemical characteristics of Tanzania grass.

MATERIAL AND METHODS

The study was carried out at the Center for Sheep Management, Água Limpa Farm, Universidade de Brasília, Federal District (15º 57' latitude and 47º 56' west longitude), where the climate is Seasonal Tropical (Aw), Koeppen classification, with rainfall seasonality, dry winters and rainy summers. The annual rainfall varies between 1,500 and 1,900 mm. The experiment lasted 84 days in the rainy season, between January and April 2008.

The experimental area was formed at the end of 2007, after soil analysis, correction and fertilization. Tanzania grass pastures were established in 5.2 ha and divided into 13 paddocks of approximately 0.4 ha each, in which three management systems were installed: S - bovine and sheep simultaneous grazing in the same paddock; A - alternated grazing - first by the bovine followed by sheep; I - isolated sheep grazing. Four pasture sites were used for S and I and five for A systems, in order to carry out the rotational grazing, with seven days of occupation and 21 days of rest. There were always two paddocks in simultaneous use in A system, one with bovines and another with sheep. Soil preparation, correction and fertilization were performed in the pasture area, according to MARTHA et al. (2007), as well as the quantity of viable seeds per hectare was determined, according to recommendations by Embrapa. The paddocks subdivision was made by means of an electric fence with two electric and two ground wires.

After the sheep left the paddocks, in the first grazing cycle, nitrogen fertilization was performed using urea as a fertilizer, equivalent to a dose of 100 kg N / ha applied as a single dose.

The experiment was conducted in a completely randomized design, in a 3x3 factorial arrangement, and the sources of variation were grazing systems and grazing cycles, with four replications for each treatment, being each paddock, with an average area of 0.4 ha, used as experimental unit.

The statistical model used was:

$$Y_{ij} = \mu + S_i + C_j + SC_{ijk} + E_{ijk}$$

In which:

Y_{ij} = observed value for Y in the i-th grazing system, the j-th grazing cycle;

μ = general mean

S_i = effect of grazing system (i = S, A, I);

C_j = effect of grazing cycle (j = 1, 2, 3)

SC_{ijk} = effect of interaction between (S_i x $C_{j)}$

E_{ijk} = experimental error associated with Y_{ijk}

The initial stocking rate was approximately two AU / ha, when 30 male intact Santa Ines sheep, with initial average weight of 22.70 ± 2.23 kg, were equaly distributed into the different grazing systems. To complete the prescribed stocking rate, 16 Santa Ines ewes, weighing 47.38 ± 7.67 kg, were used in I treatment, as well as 12 crossbred bovines, with an average weight of 206.70 ± 20.79 kg, being six in S treatment and six in A treatment. The animals were kept in the experimental area from the beginning to the end of this study without the introduction of other animals. Regarding intake, it was considered that five adult sheep with a live weight of approximately 50 kg are equivalent to 1 AU (450 kg). This 5:1 ratio considers the metabolic weight of the animal and not the live weight, since smaller animals produce more heat and consume more food per body weight unit than larger size animals (CARVALHO et al., 2005). The metabolic weight of a 450 kg cow is equivalent to 97.7 kg, while the metabolic weight of a 50 kg sheep is equivalent to 18.8 kg, i.e. a ratio of approximately 1:5 (cow: sheep).

Sheep were fed 200 g/animal/day of concentrate mixture composed of 55% ground corn, 30% soybean meal, 10% cotton seed meal and 5% wheat bran with 88% dry matter, 22% crude protein, 72% total digestible nutrients and 2.613 Mcal/kg metabolizable energy, aiming to obtain an average gain of approximately 110 g/animal/day, as recommended by NRC (2007). Bovines received 2 kg/ animal/day of concentrate mixture containing 60% corn + 40% soybean meal, with levels of 88% dry matter, 23% crude protein, 78% total digestible nutrients and 2.839 Mcal/kg metabolizable energy. In addition, specific minerals were provided at will to each species; however, preventing the access to the salt of one species by the other: by means of the height of the bovine trough, and by collecting the ovine trough to the overnight bay. Water was also provided *ad libitum.*

The forage was collected weekly in the animals´ entry and exit paddocks in order to estimate the forage mass availability per grazing cycle. Four representative samples were obtained from each paddock, collected at a height of approximately 5 cm from the ground, in 0.5 x 1.0 m rectangles, which were packed in a plastic bag, and together formed a composite sample. This sample was weighed, and thus dry matter weight per grazing cycle, available in 2 m², was obtained, proportionally estimating the availability in one hectare.

After weighing the composite sample collected at the moment of entry of the animals, the material was placed on tarpaulin, to be mixed and then two sub-samples were withdrawn, one for dry matter determination and the other for leaves, stem and dead material separation. These sub-samples were placed in plastic bags, sealed and properly identified. Afterwards, they were taken to analyses to the laboratory of animal nutrition of Água Limpa Farm, of Universidade de Brasília.

In A system, forage samples were collected at two occasions, at the moment of bovine entry to each paddock and at bovine exit/sheep entry, in order to evaluate the forage characteristics in these two moments in this system, as well as to evaluate the effect of the three systems on the forage characteristics available to sheep.

The absolute and relative determinations of leaves, stems and dead material components in the forage samples were done by separating them, placing them in paper bags and then moving them to a forced air circulation hothouse at 55-60°C for 72 hours for drying. Later, the samples were weighed and had their dry matter proportions determined.

Grass samples were collected from each paddock, immediately before the entry of animals, simulating grazing, in which the contents of neutral detergent fiber and acid detergent fiber were analyzed, using the methodology proposed by VAN SOEST et al. (1991), as well as the contents of dry matter, crude protein, ether extract, inorganic phosphorus and mineral matter, according to descriptions given by SILVA & QEUIROZ (2002).

The content of total digestible nutrients (TDN) was calculated according to methodology proposed by CAPPELLE et al. (2001), by the Equation 1:

TDN = 9.6086 to 0.669233 NDF + 0.437932 CP (R^2 = 0.71) [Eq. 1]

The SAS statistical package (1999) was used to perform all testing procedures, adopting the GLM procedure (analysis of variance). The test adopted for comparisons between means of the other variables was the Tukey test, at 10% significance level.

RESULTS AND DISCUSSION

Rainfall during the experimental period was 924.7 mm and the average temperature was approximately 21.6°C (Table 1).

Table 1- Precipitation and temperature in the experimental area during the months of the experiment

Month	Precipitation (mm)		Temperature (°C)		
	Mean	Total	Mean	Max	Min
January	9.6	297.4	21.8	27.4	16.1
February	9.5	266.7	21.8	27.4	16.2
March	8.3	257.6	21.4	27.1	15.7
April	6.4	191.8	21.5	28.1	14.9

All variables were influenced by grazing cycles and there was interaction between grazing systems and grazing cycles for the variables: stem proportion, crude protein, ether extract and total digestible nutrients (Table 2).

Forage available for grazing cycle (FMG) was similar for the three grazing systems. Some factors, such as grazing frequency and nitrogen fertilization, had a direct influence on this variable. In this experiment, the animals returned to the same paddock for forage intake after 21 days, and the nitrogen dose (100 kg/ha) was applied once after the departure of the sheep from paddocks in the first grazing cycle. SANTOS et al. (1999), studying Tanzania grass pastures grazed by Holstein heifers, found a positive correlation between the grazing frequency and forage mass availability per grazing cycle. These authors established a cycle of 28 days of rest, three days of occupation and nitrogen fertilization of 400 kg / ha divided into six applications, which may explain higher availability of dry matter per grazing cycle (4486 kg / ha) than in this experiment.

Table 2 - Summary of analysis of variance for structural features: FMG - dry matter per grazing cycle; LP - leaf proportion; SP - stem proportion; DMP - dead material proportion, L/S - leaf:stem ratio; and chemical characteristics of Tanzania grass (DM - Dry Matter; MM - Mineral Matter; CP - crude protein, EE - ether extract, NDF - neutral detergent fiber, ADF - acid detergent fiber; Pi - inorganic phosphorus and TDN - total digestible nutrients)

	Grazing system	Grazing cycle	Grazing system* Grazing cycle	CV (%)
FMG (kg / ha)	ns	***	ns	15,26
LP [1]	ns	**	ns	13,83
SP [1]	ns	**	p<0.10	12,64
DMP [1]	ns	*	ns	32,35
L / S	p<0.10	**	ns	19.68
DM [1]	ns	**	ns	6.89
MM [1]	ns	*	ns	8.32
CP [1]	ns	***	*	9.80
EE [1]	ns	***	*	6.88
NDF [a]	p<0.10	p<0.10	ns	3.10
ADF	ns	***	ns	3.80
Pi [1]	ns	**	ns	27.57
TDN [1]	*	***	**	4.66

[1] % in DM; CV: coefficient of variation * p <0.05, ** p <0.01, *** p <0.001, ns: non-significant.

Leaf proportion represents the most important part of the plant destined to ruminant feeding and, regarding this variable, pasture system submitted to S system was superior than A, without, however, any difference from the I system (Table 3). This demonstrates better forage utilization in S and I systems, considering the forage available for animals´ intake was richer in leaves, where most of digestible nutrients are concentrated, although dry matter production was the same. This difference can be explained by the fact that instantaneous stocking rate was higher during the occupation in both simultaneous and isolated grazing systems, because all the animals allocated in these grazing systems consumed the available forage within a week, while in alternated grazing the same paddock was occupied for 14 consecutive days, seven days by bovines and seven by sheep. We should take into account that in the A system, much of the leaves had been consumed by the time sheep entered into the paddock, leaving these animals lower quality forage, because bovine had already passed through the paddock.

Table 3 - Means of structural features: FMG - dry matter per grazing cycle; LP - leaf proportion; SP - stem proportion; DMP - dead material proportion, L/S - leaf:stem ratio; and chemical characteristics of Tanzania grass (DM - Dry Matter; CP - crude protein; NDF - neutral detergent fiber, ADF - acid detergent fiber; EE - ether extract; MM - Mineral Matter; Pi - inorganic phosphorus and TDN - total digestible nutrients)

	GRAZING SYSTEMS			CV(%)
VARIABLES	S	A*	I	
FMG (kg / ha)	3200.48	3176.16	3672.19	15.26
LP [1]	61.69 [a]	51.62 [b]	57.20 [ab]	13.83
SP [1]	25.52	29.88	28.59	12.64
DMP [1]	12.80	18.50	14.21	32.35
L / S	2.75 [a]	1.90 [b]	2.23 [ab]	19.68
DM [1]	22.96	24.93	23.09	6.89
CP [1]	15.80 [a]	12.05 [b]	15.14 [a]	8.32
NDF [1]	67.03 [b]	70.34 [a]	67.13 [b]	9.80
ADF [1]	37.26 [ab]	39.22 [a]	36.84 [b]	6.88
EE [1]	2.59	2.45	2.54	3.10
MM [1]	8.91	8.74	8.52	3.80
Pi [1]	0.27	0.25	0.25	27.57
TDN [1]	53.67 [a]	49.81 [b]	53.31 [a]	4.66

[1] % in DM, CV - coefficient of variation; means followed by different letters in the same line differ (P <0.10) from each other, according to the Tukey test. S - bovine and sheep; A - first bovine followed by sheep; I - sheep.

In contrast, stem proportion, which is more fibrous and less digestible, should be avoided on the pasture. This variable showed no significant difference among grazing systems. PARSONS et al. (1988) emphasize the importance of controlling the production of stems on pasture. The presence of large number of stems can compromise the efficiency of the system in two ways: limiting the harvesting capacity of the animal or reducing the grass food value.

Following the behavior observed in the leaves proportion, leaf:stem ratio on pasture submitted to the S system showed better results in relation to A, with no difference between I and the others. The higher this ratio, the better is the dry matter digestibility in different genotypes of *P. maximum*, as observed by SINGH (1995). Furthermore, the high proportion of stems may limit the intake by the animals (FLORES et al., 1993). According to PINTO et al. (1994), ratio values lower than 1 interfere negatively on the intake by ruminants. In all systems studied, this ratio was above 1, a situation that is reflected in the intake data for sheep, which showed no significant difference. The excellent ability of Tanzania grass to develop more leaves than stems which is a characteristic of great interest for the nutrition of ruminants should be emphasized.

In the evaluation of forage quality, the data for crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF) and total digestible nutrients (TDN) corroborate the results observed in the best leaf:stem ratio of S system compared to A. Although the I system was not significantly higher than the A for leaf:stem ratio, the isolated system proved to be superior to the alternated one in the bromatological evaluation, with larger amounts of protein and total digestible nutrients and lower fiber content, providing better forage mass quality available to the animals.

According to NOLAN &CONNOLY (1977), a mixed sheep-cattle farm produces variable effects on the plant-animal interface. The authors concluded that this type of rearing increases production per area and per animal compared to the use of forage for only one species. This effect is related to three consequences of this production system: increased pasture production, improved forage quality and efficiency of use (NOLAN & CONNONLY, 1989). According to BAKER (1985) and NOLAN & CONNONLY (1989), the origin of this positive effect would be on the complementarity of grazing patterns associated with the different preferences of each species for different plants, parts of plants or geographic locations. In this experiment, the preference for the plant and geographical location was observed, because the pasture rejected by the bovine, around the feces plates deposited by them, was consumed by the sheep.

In addition, we highlight the excellent quality of forage produced around the area of cattle excretion. NOLAN & CONNOLY (1989) found the percentage of 5% area under the stools and 15% of rejected area (high plants around the excretion plates) in isolated bovine grazing areas. This small area comprised up to 44% of the total available forage and concentrated 40% of total phosphorus and potassium, due to the fact that a bovine fece plate amounts to an application of 1040 kg N/ha, 400 kg K/ha and 280 kg P/ha (WILLIANS & HAYNES, 1995).The authors found that bovines reject tall plants for at least three weeks after the excretion, the preference of sheep for these plants is approximately two times higher compared to bovines, and tall plants have about four should be emphasized percentage units of digestibility in mixed grazing.

Andropogon and Bracharia are the taditional forages in sheep and bovine mixed production and in bovine isolated production, respectively, in the Midwest of Brazil. Andropogon protein levels in water are around 7%, and Brachiaria presents 8% CP. The values obtained here for Tanzania were superior, indicating that, in addition to mass production, the protein level in this mass was very satisfactory. It should be emphasized that this data refers to newly-established pasture during first grazing.

The NDF and ADF rates are in accordance with both tropical pasture rates and those values obtained by CANO et al. (2004) and BALSALOBRE (2002) for Tanzania grass, whose NDF values were between 63.6 and 69.0%. According to VAN SOEST (1982), fibers are constituted by the less digestible fraction of forage, thus impairing the quality of the material, and they are the main source of energy for ruminants, which, in a synergistic action with the protein, must ensure animal performance.

Minerals, along with vitamins, also have essential functions in ruminants' nutrition. Mineral matter content did not differ and are within the parameters presented by BALSALOBRE (2002) from 7.87 to 10.47% in dry matter. According to the author, there is a tendency for high levels of mineral matter in fertilized tropical forages. Phosphorus concentration in the three grazing systems showed values above the normally found in tropical pastures. CARVALHO et al. (2005), reviewing different studies in Brazilian literature, showed that phosphorus concentration in dry matter of tropical grasses shoot ranged from 0.07 to 0.20%, with only 14% of them presenting levels exceeding 0.18%, being 86% of the grass deficient to meet animals´ requirements. However, well-managed pastures showed levels above 0.18% of P in the summer. These authors stated that the content of this mineral decreases with the age increase of the grass, which can be aggravated by the time of year and part of the plant, emphasizing that leaves present more P than the stems. As mentioned before, there was nitrogen and phosphorous fertilization in the experimental area, which could have ensured the high quality of the pasture used.

At least two grazing systems differ as to the stem proportion in the third grazing cycle to the CP concentration in the second and third cycles, EE in the second and fourth cycles and TDN in the first and second cycles (Table 4).

Table 4 - Summary of analysis of variance for the following variables: stem proportion (SP), crude protein (CP), ether extract (EE) and total digestible nutrients (TDN), studied and compared by Tukey test at 10%, according to the grazing cycle

GRAZING CYCLE	VARIABLES			
	SP (% in DM)	CP (% in DM)	EE (% in DM)	TDN (% in DM)
1	ns	ns	ns	*
2	ns	***	p<0.10	**
3	*	*	ns	ns

*p<0.05; **p<0.01; ***p<0.001; ns – non-significant. S – bovine and sheep; A – first bovines followed by sheep; I – sheep.

The details of the analysis of variance per grazing cycles (Table 5) shows that, as it was seen previously, A grazing system had a higher stem proportion, but only in the third cycle, affecting mainly the nutritional characteristics, with a reduction of CP and increase of fiber, indicating that the pasture in this system had lower quality than in the others.

The average of TDN throughout the experimental period for S and I systems were similar and higher than the average in A system, contributing to a better nutritional quality of grass offered to the animals in isolated and simultaneous grazing systems instead of alternated grazing system. According to CAPPELLE et al. (2001), the increase in CP positively affects the content of total digestible nutrients, while the levels of neutral and acid detergent fibers are inversely proportional to the TDN. In addition to these chemical components of forage plant, the largest proportion of leaves, which concentrates most of the digestible nutrients, also contributes to the increase in TDN content and digestibility of the forage offered.

Table 5 – Means of stem proportion (SP), crude protein (CP), ether extract (EE) and total digestible nutrients (TDN) in the diferente grazing systems and grazing cycles. Compared by Tukey test at 10%

Variable	GRAZING CYCLE	GRAZING SYSTEM			CV (%)
		S	A	I	
SP [1]	3	20.46 [b]	30.48 [a]	21.29 [b]	5.77
CP [1]	2	17.84 [a]	13.22 [b]	21.13 [a]	6.08
	3	18.76 [a]	13.58 [b]	17.08 [a]	6.18
EE [1]	2	2.70 [ab]	2.52 [b]	3.16 [a]	5.90
TDN [1]	1	51.09 [a]	45.02 [b]	48.29 [ab]	5.77
	2	54.52 [b]	50.65 [c]	58.78 [a]	3.92

[1] % in DM, CV - coefficient of variation; means followed by different letters in the same line differ (P <0.10) from each other, according to the Tukey test. S - bovine and sheep; A - first bovine followed by sheep; I - sheep.

The contents of acid detergent fiber were similar to the results found in samples of simulated grazing by BALSALOBRE (2002) and CANO et al (2004). According to these authors, the levels of the ADF in Tanzania grass can reach levels above 40% only in plants at advanced physiological age.

We compared the structural and chemical variables of the grass, referring to two moments of paddock use of A group - entry of bovines (E) and entry of sheep / exit of bovines (E /Ex) - in order to verify whether there were differences amongst the parameters evaluated in these two moments, as well as whether there was interaction between time and period of grazing.

The summary of analysis of variance (Table 6) shows a significant difference between the two moments of use, in at least one of the grazing periods, for the following variables: forage mass available per grazing cycle and crude protein content. These two variables are crucial for the performance of animals on pasture, also affecting their immunological capacity.

The variables leaf proportion, stem proportion, leaf:stem ratio and content of acid detergent fiber were influenced by moment of use and grazing cycle, showing that the management system adopted in the A grazing resulted in changes in the structure of the grass offered firstly to bovines and then sheep.

Table 6 - Summary of analysis of variance for structural features: FMG - dry matter per grazing cycle; LP - leaf proportion; SP - stem proportion; DMP - dead material proportion; L/S - leaf: stem ratio; and bromatological features (DM - Dry Matter; MM - Mineral Matter; CP - crude protein; EE - ether extract; NDF - neutral detergent fiber; ADF - acid detergent fiber; Pi - inorganic phosphorus and TDN - total digestible nutrients)

	Moments of use	Grazing cycle	Moments* Grazin cycles	CV(%)
FMG (kg/ha)	ns	***	P<0.10	25.82
LP [1]	p<0.10	*	ns	18.15
SP [1]	**	p<0.10	ns	22.09
DMP [1]	ns	p<0.10	ns	45.70
L/S	*	*	ns	39.47
DM [1]	ns	**	ns	12.44
MM [1]	ns	ns	ns	71.82
CP [1]	p<0.10	***	**	13.54
EE [1]	ns	*	ns	16.67
NDF [1]	ns	*	ns	3.99
ADF [1]	p<0.10	**	ns	9.69
Pi [1]	ns	ns	ns	46.08
TDN [1]	ns	***	ns	4.58

[1] % in DM; *p<0.05; **p<0.01; ***p<0.001; ns – non-significant.

The two moments of use showed significant differences for the forage mass available only in the first grazing cycle and for the crude protein content in the second and third grazing cycles (Table 7).

Table 7 - Summary of analysis of variance for the variables dry matter per grazing cycle (FMG) and crude protein (CP) in the various grazing cycles

GRAZING CYCLE	VARIABLES	
	FMG (Kg/ha)	CP (% of DM)
1	**	ns
2	ns	**
3	ns	*

*p<0.05; **p<0.01; ns: non-significant.

Table 8 - Means of dry matter per grazing cycle and crude protein (CP) at different times of use of grazing in BDO system in different grazing periods, compared by Tukey test at 10%

VARIABLE	GRAZING CYCLE	MOMENTS OF USE		CV (%)
		E	E/Ex	
FMG (kg/ha)	1	5177.35 a	4043.16 b	6.86
CP [1]	2	18.22 a	13.22 b	11.18
	3	17.55 a	13.58 b	9.89

[1]% in DM, CV - coefficient of variation; Means followed by different letters in the same line differ (P <0.10) from each other, according to the Tukey test. E - entry of bovines; E / Ex - entry of sheep / exit of bovines.

The rate of CP was on average 34% higher at the moments of bovine entry into the paddock (E), compared to the moment of entry of sheep / exit of bovines (E / Ex) (Table 8). This difference placed the sheep submitted to A system in disadvantage compared to those submitted to other systems, which had average crude protein similar to the time of use (E) in A system. Furthermore, TORRES et al. (2009) found that grazing increased the parasite burden in sheep on pasture and submitted to A system, which requires a greater amount of protein to repair functions of the gastrointestinal tract and functions related to immunity, as antibody production, besides higher endogenous losses of nitrogen. However, even with lower levels of protein on pasture, the performance of animals in A was not affected.

Dry matter production did not differ amongst grazing cycles except the first one, in which the average was higher at the moment of entry of bovines. This indicates that, overall, the fact that bovines accessed the paddocks before the sheep did not result in quantity loss. This may have been due to the seven days occupation period, having an appropriate mass production of grass during the time interval, therefore presenting no difference in the amount of available dry matter at the moments of entry and exit of bovines.

Table 9 presents the mean proportions of leaf and stem, the leaf:stem ratio and content of acid detergent fiber in the two instances of paddock use in the BDO system.

Table 9 - Means of leaf and stem proportions (LP and SP, respectively), leaf:stem ratio (L/S) and content of acid detergent fiber in the two instances of forage use in the A system, in% of DM

VARIABLE	MOMENTS OF USE		CV (%)
	E	E/Ex	
LP	60.11 a	51.19 b	18.15
SP	23.02 b	30.14 a	22.09
L / S	2.97 a	1.88 b	39.47
ADF (%)	37.27 b	39.73 a	9.69

Means followed by different letters in the same line differ (P <0.10) from each other, according to Tukey test at 10%. E - time of entry of bovines; E / Ex - time of entry of sheep and exit of bovine
.

The structural arrangement of the plant with a lower leaf:stem ratio hinders the intake by animals. Moreover, with a higher ADF and lower CP content, diet digestibility is impaired, which may interfere with animal performance. CARVALHO & MORAES (2005) argue that the characteristics of feeding and the magnitude of consumption obtained are direct reflections of the quality, quantity and structure of the pasture which is offered to the animal.

CONCLUSION

The S and I treatments and presented lower values for SP and NDF, while they were higher in L/S, CP, and TDN compared with A treatment, indicating better quality of grass offered to sheep in those two treatments. Therefore, the simultaneous grazing system can be considered a management alternative to the isolated system for sheep in the Brazilian Savanna region.

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