Notas Científicas

Nutritional value of elephant grass genotypes

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Abstract – The objective of this work was to assess the nutritive value of four elephant grass (*Pennisetum purpureum*) genotypes. The chemical composition, intake by sheep, and digestibility of different genotypes (G1, G2, G3, and G4) were evaluated. A dry matter (DM) digestibility assay was performed with total leftovers and feces collected from 20 sheep kept in metabolic cages. G3 had lower DM intake in grams per animal per day compared with G1 and G2, and it had greater digestibility, crude protein, neutral detergent fiber, and acid detergent fiber values. G1, G2, and G4 have the best nutritive values among the evaluated genotypes.

Index terms: *Pennisetum purpureum*, digestibility, intake, ruminant.

Valor nutritivo de genótipos de capim-elefante

Resumo – O objetivo deste trabalho foi determinar o valor nutritivo de quatro genótipos de capim-elefante (*Pennisetum purpureum*). Foram avaliados a composição química, o consumo por ovinos e a digestibilidade de diferentes genótipos (G1, G2, G3 e G4). A digestibilidade da matéria seca (MS) foi avaliada por meio da coleta total de sobras e fezes de 20 ovinos mantidos em gaiolas para ensaio de metabolismo. O G3 apresentou menor consumo de MS em gramas por animal por dia comparado ao G1 e ao G2, e maiores valores de digestibilidade, proteína bruta, fibra em detergente neutro e fibra em detergente ácido. Entre os genótipos avaliados, G1, G2 e G4 apresentam os melhores valores nutritivos.

Termos para indexação: *Pennisetum purpureum*, digestibilidade, consumo, ruminante.

In Brazil, elephant grass (*Pennisetum purpureum*) is a forage that has high biomass yield and good quality, acceptability and vigor (Souza Sobrinho et al., 2005). Therefore, it has been studied with the aim to select genotypes better than those currently cultivated and adapted to the different Brazilian environments (Mello et al., 2006). In the search for forage cultivars that meet herd nutritional requirements, it is necessary to evaluate the nutritional value, chemical composition, intake and digestibility of the forage.

The objective of this work were to determine the nutritional value of four elephant grass genotypes and to identify the most promising genotypes.

The present work was assessed and approved by the ethic committee of animal use (CEUA) of the Universidade Federal Rural da Amazônia (UFRA) under protocol number 06/2012. The experiment was performed in city of Belém, in state of Pará, Brazil (latitude 01°25'59" South, longitude 48°26'29" West and altitude of 10 meters). The Köppen climate classification is the Af type. The average annual minimum and maximum temperatures are 29°C and 34°C, with a relative humidity of 90% and annual precipitation of 2,800 mm.

The elephant grass genotypes were obtained from the forage genetic enhancement program from Embrapa Gado de Leite (Embrapa Dairy Cattle) and included: G1: CNPGL 91-11-2 with a tetraploid genotype and normal size; G2: CNPGL 96-27-3 with a tetraploid genotype and normal size; G3: CNPGL 96-24-1 with a tetraploid genotype and normal size; G4: CNPGL 00-1-3 with a tetraploid genotype and intermediate size. The genotypes were cultivated in a dystrophic yellow latosol and were corrected and fertilized according to Cravo et al. (2010). On the 55th day after standardization cut, the genotypes were cut daily at 20 cm in height and crushed to about 10 mm in size, weighed and offered to animals. The plant

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heights were measured and samples were collected to determine the leaf:culm ratio (L:C). Samples were dried at 55°C for 72 h in a stove with forced ventilation to determine the air-dried sample, and then the L:C ratio was corrected (Table 1).

The intake and digestibility of four genotypes were evaluated using a completely randomized design with five repetitions of each treatment. The study evaluated 20 sheared sheep of the Santa Inês breed with an average body weight (BW) of 20.84±3.65 kg, housed in cages for individual metabolic assays. The elephant grass genotypes were provided to animals at 8:00 am and 4:00 pm over a period of 19 days, with 14 days of acclimation to management, diet and environment and five days of collection of the provided, leftovers and feces.

Intake was measured daily by the weight difference between the provided and leftover diet. Elephant grass samples, leftovers and feces were pre-dried in a stove with forced ventilation at 55°C for 72 h. Then, the samples were crushed in a "Willey" type mill (Fortinox®, FT-50, Piracicaba, Brazil) containing a sieve with 1 mm screens. In the elephant grass samples, leftovers and feces, the following characteristics were determined: the dry matter (DM) contents by INCT-CA G-003/1; crude protein (CP) by INCT-CA N-001/1; mineral matter (MM) by INCT-CA M-001/1; organic matter (OM) by INCT-CA M-001/1; ether extract (EE) by INCT-CA G-004/1 method; neutral detergent fiber (NDF) by INCT-CA F-001/1; neutral detergent fiber corrected for ashes and protein (apNDF) by INCT-CA F-001/1; acid detergent fiber (ADF) by INCT-CA F-003/1; and lignin (LIG) by INCT-CA F-005/1 according to the methodology of Detmann et al. (2012). The DM, CP, EE, NDF, ADF and non-fiber carbohydrates (NFC) intakes and percentage of body weight (%BW) were calculated. The NFC contents were calculated as the difference between total carbohydrates (tCHO) and apNDF. The tCHO were determined by: 100 - (%CP + %EE + %MM). The DM, CP, EE, NDF, ADF and NFC digestibility coefficients were evaluated.

The normality of errors and homogeneity of variance were tested by the Cramer-von Mises and Brown & Forsyth tests, respectively. The data were submitted to Anova, and the averages were compared using a T-test at 5% probability using the SAS statistical program (SAS Institute Inc., Cary, NC, USA).

The G1 and G2 genotypes had higher DM intakes (Table 2). The G4 genotype had intermediate intake, and the G3 genotype had a lower intake than the G1 and G2 genotypes. The lower DM intake observed in the G3 genotype is probably linked with the lower leaf:culm ratio and the high dead matter content in relation to the G1 and G2 genotypes (Table 1). The CP intake was different between the G2 and G4 genotypes (Table 2). The daily CP intake in all genotypes was below the minimum requirements for sheep with a BW of approximately 20 kg, which is 69 g day^{-1} for a weight gain of 100 g day^{-1} (NRC, 2007). This may be explained by the low DM intake observed in this study when compared to 780 g of DM per animal per day, which was predicted by the NRC (2007). However, the CP intake variable in relation to the %BW did not differ between the genotypes. The EE intake in g per animal per day varied between the genotypes, with the G1 and G4 genotypes having the highest intakes. When intake in %BW was evaluated, G3 had the lowest intake among the evaluated genotypes.

There were no observed differences in NDF intake in g per animal per day and %BW between the four genotypes. The average NDF intake observed was 336 g day^{-1} and 1.64 %BW. The NDF intake average values in %BW were higher than the results with elephant grass silage obtained by Ferreira et al. (2010). In the present work, no differences (p=0.1182; p=0.1112) were observed in the ADF intake expressed in g per animal per day or %BW. The NFC intake varied between the genotypes. The G2 genotype had the highest intake, with a relevant DM intake and high NFC content in composition (15.43%), while G3 had the lowest NFC intake due to a lower DM intake when compared to the G1 and G2 genotypes. There were differences between the genotypes for NFC intake in %BW, with the highest intake for the G2 genotype. Rêgo et al. (2010) and Teles et al. (2010) evaluated elephant grass silages collected on the 70th day and observed lower NFC intakes than those of the present study, probably due to the use of these carbohydrates by microorganisms during the silage processes and because the age of regrowth was higher, a fact that increases the grass fiber fraction.

The apparent dry matter digestibility coefficient (DMDC) was higher in G3 (Table 2). However, this result was not enough to compensate for the lower DM intake, because the digestive dry matter intake (DMC

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Table 1. Morphological characteristics and chemical composition of different elephant grass genotypes (*Pennisetum purpureum*) at approximately 55 days of age.

Variable[(1)]	Genotype			
	G1	G2	G3	G4
Leaf (% of whole plant)	42.33	39.10	29.50	45.80
Culm (% of whole plant)	49.34	48.06	40.83	53.60
Dead matter (% of whole plant)	8.33	12.84	29.67	0.60
Leaf:culm ratio	0.86	0.81	0.72	0.86
Height (cm)	151	159	141	120
Dry matter (DM, % of FM)	16.72	15.41	14.34	11.77
OM (% of DM)	90.86	94.74	94.87	94.98
CP (% of DM)	8.85	8.53	11.52	11.86
EE (% of DM)	1.79	1.58	1.66	2.04
NDF (% of DM)	75.01	73.65	76.15	70.17
ADF (% of DM)	44.58	43.30	44.43	40.81
NFC (% of DM)	11.11	15.43	11.27	14.35
INND (% of DM)	1.40	1.36	1.65	1.84
INAD (% of DM)	0.34	0.32	0.33	0.39
LIGNIN (% of DM)	4.89	6.26	6.29	7.93

[(1)]FM, fresh matter; DM, dry matter; OM, organic matter; CP, crude protein; EE, ether extract; NDF, neutral detergent fiber; ADF, acid detergent fiber; NFC, non-fibrous carbohydrates; INND, insoluble nitrogen in neutral detergent; INAD, insoluble nitrogen in acid detergent.

Table 2. Nutrient intake in g per animal per day, % body weight (%BW) and average digestibility values according to the four elephant grass genotypes (*Pennisetum purpureum*) in sheep[(1)].

Variable[(2)]	Genotype				Coefficient of variation (%)	p-value
	G1	G2	G3	G4		
	Intake (g per animal per day)					
DM	505a	504a	394b	465ab	13.77	0.0473
CP	49bc	47c	54ab	57a	9.09	0.0182
EE	11a	8b	7b	10a	13.35	0.0006
NDF	368	361	292	323	15.46	0.1105
ADF	213	209	167	186	16.36	0.1182
NFC	60b	85a	49c	67b	10.68	0.0001
	Intake (% of body weight)					
DM	2.45	2.48	1.92	2.29	17.05	0.1333
CP	0.240	0.234	0.266	0.280	19.07	0.4203
EE	0.054a	0.040bc	0.038c	0.048ab	18.26	0.0256
NDF	1.78	1.78	1.42	1.59	16.42	0.1546
ADF	1.03	1.03	0.81	0.91	16.08	0.1112
NFC	0.294bc	0.422a	0.240c	0.330b	20.51	0.0038
	Digestibility (%)					
DMDC	56.88b	56.92b	64.35a	58.66b	6.71	0.0276
CPDC	79.40bc	78.25c	86.77a	82.63b	3.31	0.0006
EEDC	72.82a	48.57b	72.14a	84.07a	15.08	0.0005
NDFDC	54.46b	53.69b	64.41a	55.13b	7.77	0.0045
ADFDC	25.24b	29.23b	45.83a	25.06b	25.81	0.0025
NFCDC	74.57	82.86	78.24	75.23	6.91	0.0989
DDMC	287.24a	286.87a	253.54b	272.75a	7.78	0.0459

[(1)]Means followed by different letters in same row differ by T-test at 5% probability. [(2)]DM, dry matter; CP, crude protein; EE, ether extract; NDF, neutral detergent fibers; ADF, acid detergent fibers; NFC, non-fibrous carbohydrates; DMDC, dry matter digestibility coefficient; CPDC crude protein digestibility coefficient; EEDC, ether extract digestibility coefficient; NDFDC, neutral detergent fiber digestibility coefficient; ADFDC, acid detergent fiber digestibility coefficient; NFCDC, non-fibrous carbohydrate digestibility coefficient; DDMI, digestible dry matter intake.

x DMDC) was lower (253.5 g) in relation to the other genotypes. The digestibility is related to the kinetics and passage rate of digest through the digestive tract, while the intake is influenced by the characteristics of food, animals and environments. Thus, according to Pancoti et al. (2011), food digestibility is related to the substrate:enzyme ratio and to the time of exposure of this substrate to microorganisms in the rumen, that is, the longer the time in which the food remains in the rumen – for example, in low-consumption food – probably the higher its digestibility will be.

The DMDC values observed in the different genotypes varied from 56.88 to 64.35%, which corroborates Lima et al. (2008), who observed values between 50.43 and 64.78% for different elephant grass genotypes cut at 56 days of age. In the present work, the average value for DMDC was 59.2%, which was lower than those found by Chaves et al. (2016) for the BRS Kurumi and CNPGL 00-1-3 genotypes (elephant grass) in natura, with had DM digestibility values of 66.8 and 67.5%, respectively. However, when compared with tropical grass silages, the values obtained were within the normal range, as observed by Rêgo et al. (2010), who obtained lower DMDC for elephant grass silages.

There were differences between the genotypes in the crude protein digestibility coefficients (CPDC), with the highest value for the G3 genotype. Differences in the ether extract digestibility coefficients (EEDC) were also observed, and the G2 genotype had the lowest value (48.57%). For the digestibility coefficients of fiber fractions, the G3 genotype had the highest neutral detergent fiber digestibility coefficient (NDFDC) and acid detergent fiber digestibility coefficient (ADFDC). The NDFDC can be influenced by slowly digestive or indigestive cell wall components, in addition to the structure and organization of the tissues (Branco et al., 2010). No differences were observed for the non-fibrous carbohydrate digestibility coefficients (NFCDC).

The G1, G2, and G4 genotypes had the best nutritive values, which are more promising. New studies are suggested for the G3 genotype, due to its lower intake, which may be related to an unidentified limiting factor of this study.

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