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# PROTEIN FRACTIONATION AND DIGESTIBILITY OF MILLET GENOTYPES FOR GRAZING MANAGED AT DIFFERENT CUTTING HEIGHTS[1]

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**Abstract:** This study was developed with the purpose of evaluating the protein fractionation and in vitro digestibility of the dry matter (IVDMD) of millet genotypes for grazing, managed at different heights and subjected to several cuts. The experiment had a randomized complete block design, with repeated measures over time, four replications in a 3x3 factorial arrangement, with three cultivars of millet (ADR 500, LAB 1542 and LAB 1838) and three average cutting heights (60; 80 and 100 cm). Evaluations were undertaken through cuts in the same plots during four months. Results showed that millet genotypes were similar as for the values of protein fractionation and IVDMD. The forage quality is affected by the management of cutting height, thereby it is not recommended to manage millet genotypes at 100 cm height for providing lower fraction A, B1, B2 and digestibility and higher fraction B3 and C of the forage.

**Keywords:** Ruminal Degradation. Pasture Management. Forage Quality. *Pennisetum Glaucum.*

## FRACIONAMENTO DE PROTEÍNAS E DIGESTIBILIDADE DE GENÓTIPOS DE MILHETO PARA PASTEJO MANEJADOS EM DIFERENTES ALTURAS DE CORTE

**Resumo:** Desenvolveu-se esse estudo com o objetivo de avaliar o fracionamento de proteínas e digestibilidade *in vitro* da matéria seca (DIVMS)de genótipos de milheto para pastejo, manejados em diferentes alturas e submetidos a vários cortes. O delineamento experimental utilizado foi o de blocos completos ao acaso, com medidas repetidas no tempo, com quatro repetições, em esquema fatorial 3 x 3, sendo três cultivares de milheto (ADR 500, LAB 1542 e LAB 1838) e três alturas média de cortes (60; 80 e 100 cm). As avaliações foram realizadas durante quatro meses, consistindo de avaliações por cortes nas mesmas parcelas. Os resultados demonstraram que os genótipos de milheto apresentaram semelhanças entre os materiais utilizados nos valores de fracionamento de proteína e DIVMS. A qualidade da forragem é afetada pelo manejo da altura de corte, sendo assim não se recomenda que os genótipos de milheto sejam manejados na altura de 100 cm, por proporcionar menor fração A, B1, B2 e digestibilidade e maiores fração B3 e C da forragem.

**Palavras-Chave:** Degradação Ruminal. Manejo da Pastagem. Qualidade da Forragem. *Pennisetum Glaucum.*

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## INTRODUCTION

Millet (*Pennisetum glaucum* (L.) R. Br) is an annual forage, and has been prominent by its high production and good nutritional value. It is an excellent option for feeding ruminants, once it grows well in acid soils with low fertility (GUIMARÃES JR. et al., 2008). In this way, millet has gained attention in recent years, in cerrados, especially with the advent of early genotypes with high yield potential, coming from breeding. This made this plant to cease being a simple species for coverage or straw production for tillage, starting to be considered a culture of economic value for forage production (DAN et al., 2009).

Nevertheless, the use of millet for grazing is a great challenge, since it is not easy to find a suitable point of pasture management of these genotypes, by associating production and quality of the forage, due its rapid growth, with increased participation of stems.

Although the literature presents several studies on the chemical composition of millet for grazing information regarding its fractionation is still lacking. In this context, determinations of protein fractions and digestibility are essential because are being used with a view to maximizing the use of nutrients by animals. The *Cornell Net Carbohydrate and Protein System* considers the dynamics of ruminal fermentation and potential loss of nitrogen as ammonia, in the evaluation of food (SNIFFEN et al., 1992) and aims to adapt ruminal digestion of carbohydrates and proteins in order to subdivide them due to their chemical and physical characteristics, as well as differences in ruminal degradation and post-ruminal digestibility (BALSALOBRE et al., 2003).

In this system, the protein is divided into fractions A, B1, B2, B3 and C. The fraction A represents the protein fraction that is immediately solubilized in the rumen, and consists of non-protein nitrogen (NPN). The fraction B is the potentially degradable true protein, split into three subfractions, based on the speed of rumen degradation. The fraction B1 is rapidly degraded in the rumen, B2 has an intermediate degradation rate, B3 has a slow degradation, and finally the fraction C is composed of acid detergent insoluble proteins, that is, is not digestible in the rumen and intestine (SNIFFEN et al., 1992). This research aimed evaluate the protein fractionation and in vitro digestibility of millet genotypes for grazing, managed at different heights and subjected to several cuts.

## MATERIAL AND METHODS

The experiment was conducted at the Campus of the Faculty of Agronomy of the University of Rio Verde, located in the Farm Fontes do Saber, municipality of Rio Verde, Goiás State, at 748 m altitude, 17° 48' south latitude and 50° 55' west longitude.

The soil of the experimental area was classified as Typic Hapludox, with 580 g $kg^{-1}$ clay, 50 g $kg^{-1}$ silt and 370 g $kg^{-1}$ sand. Chemical characteristics of the soil in the 0-20 cm layer, before planting were: pH in water: 4.5; Ca: 1.12 $cmol_c$ $dm^{-3}$; Mg: 0.08 $cmol_c$ $dm^{-3}$; Al: 0.65 $cmol_c$ $dm^{-3}$; Al+H: 4.0 $cmol_c$ $dm^{-3}$; CTC: 5.82 $cmol_c$ $dm^{-3}$; K: 30 mg $dm^{-3}$; P: 0.70 mg $dm^{-3}$; Cu: 3.9 mg $dm^{-3}$; Zn: 1.5 mg $dm^{-3}$; Fe: 56.4 $mg^{-3}$; OM: 31.26 g $dm^{-3}$.

The area was prepared by elimination of weeds, by applying glyphosate at a dose of 1.458 kg $ha^{-1}$. Fifteen days after desiccation, it was applied 1.3 tons filler limestone with 100% PRNT and thereafter harrowing was performed followed by leveling.

The experimental design used was the randomized complete block design, with four replications in a 3x3 factorial arrangement, with three genotypes of millet (ADR 500, LAB 1542 and LAB 1838) and three average cutting heights (60; 80 and 100 cm). Evaluations were undertaken during four months through evaluation by cuts in the same plots. The ADR is a commercial variety, and genotypes LAB 1542 and 1838 are experimental hybrids.

The millet genotypes were planted on November 6$^{th}$, 2009, when they were manually seeded on furrowed ground and fertilized with 150 kg $ha^{-1}$ $P_2O_5$, using triple superphosphate. It was used 5 rows of 3 m for each genotype, spaced 0.35 between rows. The amount of seeds was 12 kg $ha^{-1}$, aiming to reach a population of 250,000 plants $ha^{-1}$.

For evaluating productivity, millet genotypes were harvested with cleaver at 20 cm from the ground level. Cuts were made when plots reached their respective heights, and four cuts were made. Nitrogen fertilization (15 kg $ha^{-1}$ N) was performed after each evaluation cut.

Afterwards, these materials were weighed and taken to forced ventilation oven at 55ºC for 76 hours to determine the pre-dried material. Samples were ground in a Willey mill with a 1 mm sieve, stored in plastic bags and labeled for being analyzed.

Determinations of non-protein nitrogen (NPN), neutral detergent insoluble nitrogen (NDIN) and acid detergent insoluble nitrogen (ADIN) followed the methodology of Licitra et al. (1996), and soluble nitrogen (SN) according to Krishnamoorthy et al. (1982).

Protein fractions were calculated by the CNCPS (SNIFFEN et al., 1992). Protein was analyzed and calculated for the five fractions, A, B1, B2, B3 and C and in percentage of CP. The fraction A was determined by the difference between total N and trichloroacetic acid insoluble N (TCA) according to the equation: A (%Nt) = Nt - N1 / Nt x 100, where Nt = total nitrogen of the sample and N1 = content of trichloroacetic acid insoluble N.

The fraction B1 was obtained by the difference between nitrogen soluble in borate phosphate

buffer (TBF) minus the NPN, calculated as follows: B1 (%Nt) = N1 - N2 / Nt x 100, where N2 = nitrogen insoluble in borate phosphate buffer. Fractions B2 and B3 were determined by the difference between the fraction insoluble in TBF and the fraction of NDIN, the NDIN minus the ADIN, respectively. The value of B2 is given by: B2 (% Nt) = N2 - NDIN / Nt x 100 and the fraction B3, by: B3 (% Nt) = NDIN - ADIN / Nt x 100.

The fraction C was determined by the residual nitrogen content of the sample after treated with acid detergent (ADIN) and expressed in percentage of Nt of the sample. The in vitro digestibility of dry matter (IVDMD) was determined by the procedure of Tilley and Terry (1963), with two stages of incubation of 48 hours.

Data were subjected to analysis of variance and mean values were compared by the Tukey's test, with significance level at 5% probability. Analyses were run by the model of split plot in time, according to linear models of Gauss-Markov, using the software SISVAR (FERREIRA, 2011).

## RESULTS AND DISCUSSION

No significant effect (P>0.05) was detected for protein fractions between millet genotypes. However, the cutting height, cuts, and interaction of these factors were influenced (Table 1, 2 and 3).

When analyzed the cutting heights within each genotype, it is observed in Table 2 that for all genotypes studied, the greatest fractions A were obtained at the height of 60 cm. This result is important because the fraction A is soluble with rapid ruminal degradation, enhancing thus the degradation rate. As increased the cutting height, there is reduction in the fraction A, due to the high percentage of stems and low percentage of leaves, mainly when genotypes are managed at the height of 100 cm. Russell et al. (1992) reported that high proportions of non-protein nitrogen (NPN) can result in nitrogen loss, if there is a lack of readily available carbon skeleton for microbial protein synthesis.

**Table 1**. Fractions A, B1, B2, B3 and C and in vitro digestibility of dry matter of millet genotypes managed at different cutting heights.

| Millet genotypes | Cutting height | | |
|---|---|---|---|
| | 60 cm | 80 cm | 100 cm |
| | Fraction A (%) | | |
| ADR 500 | 50.73 Aa | 37.18 Ab | 28.34 Ac |
| LAB 1542 | 47.51 Aa | 35.84 Ab | 28.49 Ac |
| LAB 1838 | 48.31 Aa | 35.05 Ab | 28.50 Ac |
| CV (%) | ..... 14.47 ..... | | |
| | Fraction B1 (%) | | |
| ADR 500 | 12.11 Aa | 12.96 Aa | 12.07 Aa |
| LAB 1542 | 11.72 Aa | 12.39 Aa | 11.11 Aa |
| LAB 1838 | 12.53 Aa | 12.34 Aa | 12.25 Aa |
| CV (%) | ..... 11.21 ..... | | |
| | Fraction B2 (%) | | |
| ADR 500 | 10.49 Ab | 11.30 Bab | 12.79 Aa |
| LAB 1542 | 10.73 Aa | 11.03 Ba | 12.15 Aa |
| LAB 1838 | 10.06 Ab | 14.04 Aa | 12.31 Aa |
| CV (%) | ..... 17.52 ..... | | |
| | Fraction B3 (%) | | |
| ADR 500 | 9.82 Aa | 11.49 Aa | 10.80 Aa |
| LAB 1542 | 9.54 Ab | 11.19 Aab | 11.98 Aa |
| LAB 1838 | 9.25 Ab | 11.50 Aa | 11.21 Aa |
| CV (%) | ..... 19.43 ..... | | |
| | Fraction C (%) | | |
| ADR 500 | 17.04 Ac | 27.06 Ab | 35.86 Aa |
| LAB 1542 | 20.48 Ac | 29.77 Ab | 36.50 Aa |
| LAB 1838 | 19.84 Ac | 27.05 Ab | 35.77 Aa |
| CV (%) | ..... 17.96 ..... | | |
| | In vitro digestibility of dry matter (%) | | |
| ADR 500 | 64.50 Aa | 61.73 Ab | 53.48 Ac |
| LAB 1542 | 63.75 Aa | 59.87 Ab | 52.62 Ac |
| LAB 1838 | 64.00 Aa | 59.18 Ab | 52.93 Ac |
| CV (%) | ..... 2.72 ..... | | |

Mean values followed by different letters, uppercases in the column (genotypes) and lower cases in the row (cutting heights) are significantly different by Tukey's test (P < 0.05).

Comparing the genotypes within each cut (Table 2), only in the first cut a significant difference could be observed (P>0.05) between genotypes. Highest fractions A were registered in genotypes ADR 500 and LAB 1542, which were different from LAB 1838 that had the lowest fraction A.

As for cuts within each genotype, Table 2 shows that for ADR 500 only the fraction A of the first cut had been different from the other cuts with lower values. For LAB 1542, the fraction A of the first cut was different from the third and fourth cut. And for genotype LAB 1838 there was a significant effect between cuts with a reduction of 23.8% in the fraction A comparing the first and the fourth cut.

For all genotypes it was observed a reduction of the fraction A according to cuts. This can be associated with the higher leaf senescence rate and lower tiller turnover rate, reducing thus the content of crude protein (LEÃO et al., 2012) owing the smaller proportion of leaves.

Sá et al. (2010) examined forage grasses at three cutting ages and found mean values of the fraction A of tifton grass, Marandu palisadegrass and Tanzania guineagrass of 26.2; 24.4 and 21.6%, when cutted at heights of 28, 35 and 54 days, respectively.

**Table 2**. Fractions A, B1, B2, B3 and C and in vitro digestibility of dry matter of millet genotypes subjected to several cuts.

| Millet genotypes | Cuts | | | |
|---|---|---|---|---|
| | 1st cut | 2nd cut | 3rd cut | 4th cut |
| | Fraction A (%) | | | |
| ADR 500 | 45.27 Aa | 37.59 Ab | 38.24 Ab | 33.88 Ab |
| LAB 1542 | 43.17 Aa | 37.71 Aab | 35.26 Ab | 32.98 Ab |
| LAB 1838 | 41.88 Ba | 37.22 Aab | 36.24 Aab | 33.81 Ab |
| CV (%) | ..... 15.58 ..... | | | |
| | Fraction B1 (%) | | | |
| ADR 500 | 11.44 Aa | 11.78 Aa | 12.98 Aa | 13.32 Aa |
| LAB 1542 | 10.99 Aa | 11.00 Aa | 12.39 Aa | 12.58 Aa |
| LAB 1838 | 11.95 Aa | 11.75 Aa | 13.25 Aa | 12.54 Aa |
| CV (%) | ..... 12.69 ..... | | | |
| | Fraction B2 (%) | | | |
| ADR 500 | 10.67 Bb | 11.20 Ab | 10.74 Ab | 13.48 Aa |
| LAB 1542 | 9.81 Bc | 10.15 Abc | 12.28 Aab | 12.98 Aa |
| LAB 1838 | 13.00 Aab | 10.52 Ac | 11.19 Abc | 13.83 Aa |
| CV (%) | ..... 10.25 ..... | | | |
| | Fraction B3 (%) | | | |
| ADR 500 | 11.44 Aa | 11.03 Aa | 10.64 Aa | 9.71 Aa |
| LAB 1542 | 10.85 Aa | 10.53 Aa | 11.64 Aa | 10.61 Aa |
| LAB 1838 | 10.93 Aab | 11.59 Aa | 11.04 Aab | 9.06 Ab |
| CV (%) | ..... 26.49 ..... | | | |
| | Fraction C (%) | | | |
| ADR 500 | 21.41 Bb | 28.39 Aa | 27.22 Aa | 29.58 Aa |
| LAB 1542 | 25.49 Ab | 30.59 Aab | 28.75 Aab | 30.83 Aa |
| LAB 1838 | 22.22 Bb | 28.91 Aa | 28.34 Aa | 30.75 Aa |
| CV (%) | ..... 15.33 ..... | | | |
| | In vitro digestibility of dry matter (%) | | | |
| ADR 500 | 65.30 Aa | 63.20 Aa | 56.61 Ab | 54.50 Ab |
| LAB 1542 | 64.08 Aa | 62.50 Aa | 55.33 Ab | 53.08 Ab |
| LAB 1838 | 63.41 Aa | 61.66 Aa | 54.83 Ab | 54.91 Ab |
| CV (%) | ..... 4.23 ..... | | | |

Mean values followed by different letters, uppercases in the column (cuts) and lower cases in the row (cultivars) are significantly different by Tukey's test ($P < 0.05$).

By analyzing the fraction A of cuts within each height (Table 3), higher fractions were obtained at the height of 60 for all cuts. And only in the third cut the fraction A was similar in heights of 80 and 100 cm. Given this, it is important to underline the importance of managing the cut to preserve the nutritional value of the forage, where the height of 60 cm provided the highest fraction B1, which favor a better ruminal degradation, because it ensures a better synchronization between fermentation of carbohydrates and protein in rumen and consequently promote a better microbial growth, resulting in better use of nutrients (PEREIRA et al., 2010).

In relation to cutting heights subjected to several cuts (Table 3), at 60 and 100 cm there was a significant reduction in the fraction A from the first to the third and fourth cut. For the height of 80 cm, only the first cut was different from the others, with higher fractions A.

**Table 3**. Fractions A, B1, B2, B3 and C and in vitro digestibility of dry matter of millet genotypes subjected to several cuts and managed at different heights.

| Cutting height | 1st cut | 2nd cut | 3rd cut | 4th cut |
|---|---|---|---|---|
| | Fraction A (%) | | | |
| 60 cm | 53.69 Aa | 48.42 Aab | 47.84 Ab | 45.44 Ab |
| 80 cm | 45.71 Ba | 35.27 Bb | 31.92 Bb | 31.19 Bb |
| 100 cm | 30.93 Ca | 28.83 Cab | 29.98 Bb | 24.04 Cb |
| CV (%) | ..... 13.65 ..... | | | |
| | Fraction B1 (%) | | | |
| 60 cm | 11.37 Aab | 10.67 Ab | 13.06 ABab | 13.36 ABa |
| 80 cm | 10.79 Ac | 11.36 Abc | 14.49 Aa | 13.62 Aab |
| 100 cm | 12.22 Aa | 12.49 Aa | 11.08 Ba | 11.45 Ba |
| CV (%) | ..... 17.05..... | | | |
| | Fraction B2 (%) | | | |
| 60 cm | 10.69 Ba | 9.56 Aa | 10.69 Aa | 10.76 Ca |
| 80 cm | 10.69 Bb | 9.86 Ab | 11.95 Ab | 15.99 Aa |
| 100 cm | 12.09 Aa | 12.45 Aa | 11.58 Aa | 13.55 Ba |
| CV (%) | ..... 18.67 ..... | | | |
| | Fraction B3 (%) | | | |
| 60 cm | 9.18 Bab | 10.89 Aa | 9.38 Bab | 8.70 Ab |
| 80 cm | 12.34 Aa | 10.89 Aa | 12.04 Aa | 10.32 Aa |
| 100 cm | 11.70 Aa | 11.37 Aa | 11.90 Aa | 10.35 Aa |
| CV (%) | ..... 14.93 ..... | | | |
| | Fraction C (%) | | | |
| 60 cm | 15.30 Cb | 20.44 Ba | 19.03 Ca | 21.71 Ca |
| 80 cm | 20.45 Bb | 32.60 Aa | 29.92 Ba | 28.86 Ba |
| 100 cm | 33.37 Ab | 34.85 Ab | 35.36 Ab | 40.59 Aa |
| CV (%) | ..... 15.28 ..... | | | |
| | In vitro digestibility of dry matter (%) | | | |
| 60 cm | 69.15 Aa | 66.85 Ab | 60.58 Ac | 59.75 Ac |
| 80 cm | 66.58 Aa | 64.75 Ab | 55.02 Bc | 54.70 Ac |
| 100 cm | 57.07 Ca | 55.76 Ca | 51.17 Bb | 48.04 Bc |
| CV (%) | ..... 3.51 ..... | | | |

Mean values followed by different letters, uppercases in the column (cuts) and lower cases in the row (cutting heights) are significantly different by Tukey's test ($P < 0.05$).

The fraction B1 is characterized as part of true protein, with rapid ruminal degradation (SNIFFEN et al., 1992). No significant effect ($P< 0.05$) was recorded between genotypes and cutting heights (Table 1). But when analyzing the genotypes within each cut (Table 2), the fraction B1 was similar between genotypes in the second, third and fourth cut, being different only from the first cut, where the LAB 1833 had the lowest fraction B1.

Comparing the cuts within each genotype, for the ADR 500 the fraction B1 was similar between the second, third and fourth cut, differing only from the first cut, with highest fraction B1 (Table 2). These results are correlated with the highest proportion of leaves in relation to stems, in the first cut.

Regarding the fraction B1 of millet genotypes managed at different heights within each cut (Table 3), in the first and second cut this fraction was similar for studied heights. In the third and fourth cut, the smallest fraction B1 was verified in the height of 100 cm, due to the great proportion of stems when genotypes were managed at this height, and once millet is an annual plant, there is a loss of vigor as cuts are performed. In relation to cuts within each height, Table 3 shows that at the height of 60 cm the fraction B1 of the first and second cut was similar, being distinct from the third and fourth cut. In the height of 80 cm, there was a significant effect only between the first and third cut.

Some authors reported a deficiency of fraction B1 in protein of tropical forages (RUSSELL et al., 1992; SNIFFEN et al., 1992), with values below 10% total crude protein (BALSALOBRE et al., 2003). Nevertheless, in the present study, for all heights and cuts performed, values of the fraction B1 were above 10%, reaching up to 14.49%, evidencing improvement in the fraction B1.

Moreover, as for millet genotypes within each cutting height (Table 1), the fraction B2 in the heights of 60 and 100 cm was similar between genotypes. However for the height of 80 cm, LAB 1838 was different from other genotypes with greater fraction B2.

In relation to cutting heights within each genotype, for ADR 500 we observed an increase of fraction B2 by 21.4% when increased the cutting height from 60 to 100 cm. For the LAB 1542 and 1838, the fraction B2 was similar for the three heights examined.

The fraction B1 + B2 presents rapid ruminal degradation rate compared with fraction B3, and tends to be extensively degraded in the rumen, con-

tributing to meet the requirements of nitrogen by ruminal microorganisms, but the rapid ruminal proteolysis of these fractions can lead to the accumulation of peptides and allow their escape into the intestine, since the use of peptides is considered limiting to protein degradation (SNIFFEN et al., 1992).

Also, considering the millet genotypes within each cut (Table 2), only in the first cut a significant difference (P>0.05) was observed between genotypes, where LAB 1838 showed the smallest fraction B2. For the other cuts, values of the fraction B2 were similar between genotypes. When compared cuts within each genotype, it is verified that for ADR 500 the greatest fraction B2 was obtained in the first cut, differing from other cuts, which showed similar values. For LAB 1542 and 1838 the fraction B2 of the first cut was distinct from the third and fourth cut, with smaller fractions. These results are also associated with the lowest proportion of leaves over the cuts, decreasing the amount of new tillers.

Faria Júnior et al. (2013) investigated the fractionation of forage millet ADR 300 and verified that without any fertilization the fraction B2 was greater in the first cut (16.34%), distinguishing from the second and third cut, with values of 7.35 and 2.57% respectively.

According to Balsalobre et al. (2003), the fraction B2 is characterized by an intermediate degradation rate, being the protein fraction that is not soluble and is not part cell wall and is not NPN, but it is very importante to the animal because it provides proteins degradable in rumen.

When comparing the fraction B2 of genotypes managed at different heights within each cut (Table 3) there was no significant effect (P<0.05) of the fraction in the second and third cut for all studied heights. Nevertheless, in the first and fourth cut, we detected influence of heights. Relative to the cuts within each height, the Table 3 indicates that at cutting heights of 60 and 100 cm no significant effect was verified for the fraction B2 between cuts. In the height of 80 cm, only the fourth cut was different from the others, with greater fraction B2, pointing out an increase of 49.5% comparing the first and fourth cut.

Besides, the fraction B3 is represented by the protein contained in NDF that presents a very slow degradation rate in the rumen (SNIFFEN et al., 1992). Considering the fraction B3 of cutting heights within each genotype, it is seen in Table 1 that values were similar between all heights. However when compared the genotypes within each height, the height of 60 cm had the smallest fractions B3 for all genotypes, being distinct from heights of 80 and 100 cm, which had similar fractions. These results are due to the larger proportion of fibers when genotypes were managed at the heights of 80 and 100 cm, and with this present a very slow degradation rate, as it is associated with the plant cell wall.

Comparing the genotypes within each cut (Table 2), the fraction B3 was similar between genotypes for all cuts. But when comparing the cuts within each genotype, only the fraction B3 of LAB 1838 was different between the second and fourth cut.

In this context, Faria Júnior et al. (2013) also obtained values higher than found in the present study, when evaluated the genotype ADR 500, and observed that without any fertilization the fraction B3 was 23.73% for the first cut, increasing to 28.64% in the second cut.

Considering the fraction B3 of the cuts within each height (Table 3), it was found a significant effect (P<0.05) only for the first and third cut, where the smallest fractions B3 were shown by the height of 60 cm. By analyzing the cutting heights subjected to several cuts (Table 3), in the height of 80 and 100 cm the values of fraction B3 were similar for all cuts performed. A significant effect occurred only at the height of 60 cm, between the second and fourth cut.

Furthermore, the fraction C corresponds to the unavailable nitrogen and is formed by protein and nitrogen compounds associated with lignin, tannin protein complex and with Maillard products, which are highly resistant to the attack of enzymes from microbial sources and from the host (SNIFFEN et al., 1992; VAN SOEST, 1994). Millet genotypes presented similar fractions C at heights of 60, 80 and 100 cm (Table 1). Meanwhile, when compared the cutting heights within each genotype, the height of 100 cm had the greatest fraction C relative to other heights for all genotypes studied. This result is due to the major components of the fiber fraction in the cell wall, especially lignin at this height, due to the rapid elongation of stems and leaves (LEÃO et al. 2012), preventing the breakdown of protein by microorganisms, because the C fraction is formed by insoluble proteins non-digestible in the rumen and intestine.

In the comparison of genotypes within each cut (Table 2), only in the first cut a significant difference (P>0.05) was detected between genotypes. Greater fractions C were observed for ADR 500 and LAB 1838, which were different from the LAB 1542 that presented the highest fraction C. For the other cuts, fractions C were similar between genotypes. However, by comparing the cuts within each genotype, for the ADR 500 and LAB 1838 the smallest fractions C were obtained in the first cut. Between the second and fourth cut, fractions were similar (P>0.05). For LAB 1542 there was an increase of 20.9% from the first to the fourth cut. Faria Junior et al. (2013) studied the protein fractionation of millet under different nitrogen levels and cutting ages, and observed values of fraction C ranging from 1.3% to 7.57% for ADR 300 and from 1.5% to 7.6% for BN1.

As for the fraction C of genotypes managed at different heights and subjected to several cuts (Table 3), there was an increase in the fraction as increased the cutting height from 60 to 100 cm for the first,

third and fourth cut. Only in the second cut the fraction C was similar between the heights of 80 and 100 cm. This behavior is explained by the higher number of leaves that millet genotypes show in the first cuts, and also at the height of 60 cm. Leão et al. (2012) reported that when millet genotypes were managed at the height of 100 cm, occurs a reduction of 49.7% in the CP content, due to the lower quality of the stem in relation to the leaf, which also undermines the pasture structure, especially given the lower density of leaves. Moreover, at this height, millet genotypes have already started to produce the panicle, where there is translocation of nutrients to the seeds.

About the cuts within each height (Table 3), in the heights of 60 and 80 cm, only the first cut differed from the others, which presented similar fractions C. The height of 100 cm presented the greatest fraction at the fourth cut.

In all cuts, the fraction C obtained at the height of 100 cm was greater than at 60 and 80 cm. This fraction refers to the unavailable protein, i.e., is the part of the protein contained in the ADF, which are highly resistant to microbial and enzymatic degradation. This evidences that the better heights to manage millet genotypes, without compromising the forage quality, are 60 and 80 cm.

Silva et al. (2009) studied protein fractions of Mombaça guineagrass subjected to nitrogen doses at two cutting heights, and found mean values for the fraction C in the rainy period varying from 8.4 to 10.5% in the residue of 20 cm, and from 9.4 to 11.4% for 0.40 cm.

In relation to the in vitro digestibility of dry matter (IVDMD) of cutting heights within each genotype, it is observed that for all genotypes the IVDMD was similar between heights. And when comparing genotypes at different heights, greater values of IVDMD were obtained at the height of 60 cm for all genotypes. At this height, it was also verified greater fraction A, indicating a better digestibility with rapid ruminal degradation, enhancing thus the degradation rate.

Considering the genotypes within each cut (Table 2), the IVDMD was similar in all cuts ($P>0.05$) between studied genotypes. However, the IVDMD was affected by cuts (Table 2). For all genotypes there was no significant difference ($P>0.05$) between the first and second cut, the same occurring between the third and fourth cut. Nonetheless, with the increase of cuts there was a reduction in IVDMD in the average of the first/second by 15.66; 16.77 and 13.96% compared with the mean of the third/fourth cut, of genotypes ADR 500, LAB 1542 and LAB 1838, respectively.

Similar results were obtained by Guideli et al. (2000) who studied the millet subjected to four nitrogen levels (0; 75; 150 and 225 kg $ha^{-1}$) and four cuts, and observed a drop in IVDMD from the third cut, due to the decrease in production of leaves in the growth period, and due to the presence of higher number of tillers with inflorescences.

With regard to IVDMD of cuts within each height (Table 3), for the first, second and fourth cut, higher IVDMD were achieved at heights of 60 and 80 cm, differing from the height of 100 cm. This result is important to define the best management of the cutting height for new millet genotypes.

With the results of genotypes managed at different heights subjected to several cuts (Table 3), it is registered that as the cuts were performed, a reduction in IVDMD occurred. Between the first and second cut, the digestibility was similar, differing ($P<0.05$) from the first and fourth cut. It is worth stressing that as the genotypes are subjected to frequent cuts, there is a reduction of new tillers, compromising the proportion of leaves, because millet is an annual plant, whose forage production decreases through the shortening of daytime, which induces the flowering and appearance of new tillers (LEÃO et al., 2012).

Jochims et al. (2010) examined the ingestive behavior and forage intake by lambs on millet pasture, and verified that this pasture had 54.67% of IVDMD. Similar values were also mentioned by Restle et al. (2002) that registered average IVDMD of 54.84% with common millet in pasture system.

## CONCLUSIONS

Millet genotypes presented similarities between used materials in terms of protein fractionation and IVDMD. The forage quality is affected by the management of the cutting height, thus it is not recommended to manage millet genotypes at 100 cm for providing smaller fractions A, B1 and B2 and digestibility and greater fractions B3 and C of forage.

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