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Chemical-bromatological composition of elephant grass silage with increasing levels of acerola by-product

Composição química-bromatológica da silagem do capim-elefante com níveis crescentes de resíduos de acerola

Composición química-bromatológica del ensilaje de pasto elefante con niveles crecientes de resíduos de acerola

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Abstract
The objective of this study was to evaluate the chemical-bromatological composition of elephant grass (EG) silages with the addition of acerola by-product (ABP). The experimental design was completely randomized, with five treatments: Treatment 1 = 100% EG; Treatment 2 = 94% EG + 06% ABP; Treatment 3 = 88% EG + 12% ABP; Treatment 4 = 82% EG + 18% ABP and Treatment 5 = 76% EG + 24% ABP, with four replications (silos). EG and ABP were mixed at the time of ensiling. The silos were open at 42 days and samples were collect for chemical analysis. The addition of up to 24% of ABP in EG silage significantly (P<.05) increases the pH, dry matter (DM) and crude protein levels, thus providing fermentations within desirable standards. The estimated dry matter intake, neutral detergent fiber (NDF), ash and ethereal extract of EG silage was not influenced by ABP. Total digestible nutrients, total carbohydrates, hemicellulose and estimated DM digestibility decreased linearly. The high levels of NDF and acid detergent fiber of the ABP compromise the DM digestibility, reducing the nutritional value of the silages.
Keywords: *Malpighia punicifolia* L.; Silage quality; Fruticulture by-product.

Resumo
Objetivou-se neste estudo avaliar a composição química-bromatológica da silagem de capim-elefante (CE) com adição de níveis crescentes de resíduo da acerola (RA). O delineamento experimental foi inteiramente ao acaso, com cinco tratamentos: Tratamento 1 = 100% CE; Tratamento 2 = 94% CE + 06% de RA; Tratamento 3 = 88% CE + 12% de RA; Tratamento 4 = 82% CE + 18% de RA e Tratamento 5 = 76% CE + 24% RA, com quatro repetições (silos). O CE e o RA foram misturados no momento da ensilagem. Os silos foram abertos com 42 dias e colhidas amostras para análises químicas-bromatológicas. A adição de até 24% do RA na ensilagem de CE aumenta significativamente (P<0,05) os níveis de pH, de matéria seca (MS) e de proteína bruta, provendo assim, fermentações dentro dos padrões desejáveis. A estimativa de consumo de MS, os teores de fibra em detergente neutro (FDN), cinzas e extrato etéreo da silagem de CE não foram influenciados pela adição do RA. Os teores de nutrientes digestíveis totais, carboidratos totais, hemicelulose e a estimativa de digestibilidade da MS decresceram linearmente. Os elevados níveis de FDN e FDA do RA comprometem a digestibilidade da MS diminuindo o valor nutritivo das silagens.
Palavras-chave: *Malpighia punicifolia* L.; Qualidade da silagem; Subproduto da fruticultura.

Resumen
El objetivo de este estudio fue evaluar la composición química-bromatológica de ensilajes de pasto elefante (PE) con la adición de niveles crecientes de residuos de acerola (RA). El diseño experimental fue completamente al azar, con cinco tratamientos: Tratamiento 1 = 100% PE; Tratamiento 2 = 94 % PE + 06 % RA; Tratamiento 3 = 88% PE + 12% RA; Tratamiento 4 = 82% PE + 18% RA y Tratamiento 5 = 76% PE + 24% RA, con cuatro repeticiones (silos). PE y RA se mezclaron en el momento del ensilaje. Los silos se abrieron a los 42 días y se recogieron muestras para análisis químico. La adición de hasta un 24 % de RA en el ensilaje PE aumenta significativamente ($P<0.05$) el pH, la materia seca (MS) y los niveles de proteína cruda, proporcionando así fermentaciones dentro de los estándares deseables. El consumo estimado de MS, fibra detergente neutro (FDN), cenizas y contenido de extracto etéreo del ensilaje PE no se vieron influenciados por la adición de RA. Los contenidos de nutrientes digestibles totales, carbohidratos totales, hemicelulosa y digestibilidad estimada de MS disminuyeron linealmente. Los altos niveles de FDN y FDA de RA comprometen la digestibilidad de la MS, disminuyendo el valor nutricional de los ensilajes.
Palabras clave: *Malpighia punicifolia* L.; Calidad del ensilaje; Subproducto de la fruticultura.

1. Introduction

An important feature of Brazilian livestock, notably for meat or dairy cattle, is the maintenance of the vast majority of herds on native or cultivated pastures, which constitutes the most economical and practical forage resource for their food. However, forage production has an uneven seasonal distribution throughout the year and is closely correlate with rainfall, that is, maximum productivity during the rainy season and limiting availability for animal production during the dry season.

This scenario is more evident in the Northeast region, mainly in the Caatinga biome, which has semi-arid climate characteristics, whose frequent periods of drought demand strategies to overcome the discontinuity of forage production for animal feed. Therefore, it is essential to ensile the forage surplus produced in the rainy season, aiming at its use in times of lower availability (Cândido & Furtado, 2020; Paula, 2021). Ensiling consists of the natural fermentation of food carried out by microorganisms in the absence of air, acidifying the environment and conserving the ensiled material (Savoie & Tremblay, 1998; Molina et al., 2004; Martínez-Fernández et al., 2014).

Among the forage species recommended for the ensiling process, elephant grass (*Pennisetum purpureum*) stands out, as it is easy to implement pasture, large number of varieties, high forage yield, reasonable nutritional quality and good palatability. It should be note that the chemical-bromatological composition of elephant grass may vary according to cultivar, cultural practices and management (Carvalho, 1985; Vilela, 1997; Narciso Sobrinho, 1998; Hertentains et al., 2005; Magalhães et al., 2007; Mfoukou-Ntsakala et al., 2008; Magalhães et al., 2009; Cevallos et al., 2016; Kamaruddin et al., 2018; Rodrigues et al., 2018; Rosa et al., 2019; Martins et al., 2020).

On the other hand, fruit growing, one of the productive segments that make up the Brazilian agribusiness, has been gaining projection both in the domestic and foreign markets, positioning the country as the third largest fruit producer in the world. In a planted area of 2.3 million hectares, Brazilian production in 2017 was approximately 41 million tons of fresh fruit (Rozane et al., 2017), of which 9.33 million tons were produce in the Northeast region, resulting advances in irrigation and management technologies that allowed overcoming the limitation of the frequent water deficit. As a consequence of this regional development process, the number of installed agroindustries has increased considerably, generate an increase in the agroindustrial residues production that can be used in the diet as an alternative food for ruminants (Rogério et., 2009; Alexandre, 2010; Massaro Junior et al., 2022; Fávaro & Rech, 2022), mainly from the production of frozen fruit pulp and juices.

Currently, the use of agro-industrial residues in animal feed, in addition to being considered an economically viable alternative and of great importance in reducing the environmental impact, enables the production of noble and good quality foods, due to their nutritional characteristics (Cruz, 2009; Cabrera-Núñez et al., 2020; Kordi & Naserian, 2021; Vivas et al., 2021).

Acerola (*Malpighia punicifolia* L.) is a tree-bearing fruit species native to the America and it has high levels of ascorbic acid (vitamin C) and was introduced in 1950 in Brazil, through the Northeast region, from Puerto Rico (Assis et al., 2008; Tavares et al., 2003; Mezadri et al., 2006). The country is consider the world's largest producer, consumer and exporter of acerola, with an estimated average productivity of 150,000 tons of the fruit per year, with approximately 64% of this total produced in the Northeast region (Prakash & Baskaran, 2018; Aguilera-Arango et al., 2020). The acerola residue represents 40% of the total production volume, consisting of seed, bark and pulp, whose chemical composition, on average, presents contents of 89.25% of dry matter; 10.20% crude protein; 71.44% neutral detergent fiber; 15.64% hemicellulose; 20.11% lignin and 3.17% ethereal extract (Lousada Júnior et al., 2006; Maia et al., 2015). However, it is important to emphasize that the chemical composition of a given residue is conditioned to several factors such as the genetic variety, soil characteristics and cultivation methods, harvesting period and industrial processing that are used (Rogerio et al., 2009; Binod et al., 2010; Cabrera Rodríguez et al., 2016).

The objective of this work was to evaluate the chemical-bromatological composition of elephant grass silage processed with the addition of increasing levels of acerola residue.

2. Methodology

The research was carried out under field and laboratory conditions, using the quantitative method, where the data obtained are interpreted through statistical resources and techniques (average, regression analysis and percentage) (Pereira, 2012), avoiding distortions in the analysis of interpretation (Michel, 2009). As there are still uncertainties about the most appropriate level of acerola residue for association with elephant grass silage, the hypothetical-deductive method was choose to be used (Pereira et al., 2018).

The silages were made at the Parnaíba Research Execution Unit (REU Parnaíba), linked to the Mid-North Agricultural Research Center (Embrapa Mid-North). The experimental design was completely randomized, with five treatments: Treatment 1 = silage with 100% elephant grass (EG); Treatment 2 = 94% EG + 06% acerola residue (AR); Treatment 3 = 88% EG + 12% AR; Treatment 4 = 82% EG + 18% AR and Treatment 5 = 76% EG + 24% AR, with four replicates (silos).

The whole plant of elephant grass (*Pennisetum purpureum* Schum.) cv. BRS Capiaçu, 125 days regrowth and 3.53 m tall was use. The acerola residue used was obtain from the Rio Grande Polpa de Frutas industry, located in the Teresina County, Piauí State. The acerola residue was compound of seed, bark and pulp, was subjected to dehydration in the sun in cemented areas for seven days and then crushed in order to facilitate its homogenization with the grass.

After pre-withering for 18 hours, the elephant grass was chopped in a forage machine, and then mixed with the acerola residue, according to the proportions previously describe in each treatment. The mixtures were packed in 20 mini-silos represented by plastic buckets with a capacity of twenty liters that were sealed with adhesive tape, weighed and stored in a covered area for 42 days. Before ensiling, the raw materials had a chemical-bromatological composition as described in Table 1.

Table 1 - Chemical-bromatological composition of elephant grass and acerola residue before ensilage.

Parameters	**Elephant grass**	**Acerola by-product**
Dry matter (%)	27.68	80.64
Crude protein (%)	5.90	13.03
NDF (%)[1]	72.11	70.55
ADF (%)[1]	42.21	55.78
Hemicellulose (%)	29.90	14.77
Ash (%)	6.38	6.31
Ethereal extract (%)	2.22	2.60
TDN (%)[1]	58.29	48.79
TC[1]	85.5	78.06
DMI (% body weight)	1.66	1.70

[1]Neutral detergent fiber (NDF); acid detergent fiber (ADF); total digestible nutrients (TDN); total carbohydrates (TC) and dry matter intake (DMI). Souce: Authors.

After opening the silos, samples of the silages were collect and sent to the Laboratory of Physical and Chemical Analysis of Food at REU Parnaíba. Samples of approximately 200 g of silage were collect for pH analysis. In the laboratory, subsamples of 9 g were taken, to which 60 mL of distilled water were add. After resting for 30 minutes, the reading was performed using a digital benchtop pH meter, previously measured.

In addition, other samples of each silage were weighed and placed in an oven with forced ventilation at 65°C until constant weight. Subsequently, they were ground through a 1.0 mm mesh to determine the chemical composition. The contents of dry matter (DM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), ethereal extract (EE) and ash were estimated. Hemicellulose contents (HCEL) were calculate by the difference between NDF and ADF contents. Total digestible nutrient (TDN) values were estimated using the equation described by Undersander et al. (1993) and Linn and Kuehn (1997): % TDN = 87.84 - (0.7 x ADF), while DM digestibility was estimated by the equation: Digestibility = 88.9 - (0.779 x ADF) (Teixeira and Andrade 2001; Contreras et al., 2019). Total carbohydrates (TC) were determined according to equations devised by Sniffen et al. (1992): TC = 100 – (CP % + EE % + Ash %). In order to estimate forage intake, the DMI formula BW (% of body weight) = 120 ÷ NDF%, recommended by Thiago e Silva (2001), was applied.

All laboratory analyzes used the methodologies recommended by Silva and Queiroz (2002).

The results obtained were subjected to analysis of variance, and the means were compared by Tukey's test, at a 5% probability level, using the statistical program Infostat (Di Rienzo et al., 2012). Furthermore, only regression equations that presented determination coefficients ≥ 50% were considered.

3. Results and Discussion

The chemical-bromatological analyzes of elephant grass silage associated with different levels of acerola residue are shown in Table 2.

Table 2 - Hydrogen potential (pH), dry matter content (DM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), hemicellulose (HCEL), ethereal extract (EE), ash, total digestible nutrients (TDN), total carbohydrates (TC), dry matter digestibility (DMD) and dry matter intake (DMI) of elephant grass silages added with acerola by-product.

Variables	Acerola by-product levels in elephant grass silage (%)					Regression equation	R^2 (%)	CV (%)*
	0	6	12	18	24			
pH	3.89 c	3.87 c	3.99 b	4.06 a	4.07 a	y = 3.867 + 0.0092x	87.13	0.82
DM (%)	27.60 e	31.51 d	33.63 c	37.49 b	40.80 a	y = 27.728 + 0.5398x	97.00	2.42
CP (%)	5.37 b	6.36 c	6.89 b	7.78 a	8.02 a	y = 5.5405 + 0.1153x	97.00	3.07
NDF (%)	70.23 a	69.61 a	68.13 a	67.98 a	66.68 a	No significant effect	-	2.70
ADF (%)	44.18 d	45.15 cd	45.96 bc	47.08 ab	48.20 a	y = 44.122 + 0.661x	81.00	1.73
HCEL (%)	26.05 a	24.45 ab	22.17 abc	24.45 ab	26.05 a	y = 27.528 – 0.312x	68.00	9.42
EE (%)	2.17 a	2.15 a	2.18 a	2.25 a	2.35 a	No significant effect	-	7.37
Ash (%)	6.24 a	6.16 a	6.02 a	6.00 a	5.54 a	No significant effect	-	6.85
TDN (%)	56.91 a	56.23 ab	55.67 bc	54.88 cd	54.10 d	y = 56.955-0.1162x	81.00	1.01
CT (%)	86.2 a	85.33 ab	84.88 bc	83.85 d	84.08 cd	y = 86.025-0.0962x	83.00	0.53
DMD (%)	54.48 a	53.72 ab	53.10 bc	52.22 cd	51.36 d	y = 54.529 -0.1294x	80.37	1.17
DMI (% BW)	1.71 a	1.72 a	1.76 a	1.77 a	1.80 a	No significant effect	-	2.77

- Means followed by the same letters on the line do not differ by the Tukey test at 5% significance. * CV (%): coefficient of variation. Source: Research data.

The pH values of elephant grass silage were increase when associated with acerola residue levels (Table 2). The relationship was described by the equation y = 3.867 + 0.0092x (R^2 = 87.13), which were within the optimum range recommended for good fermentation quality and silages conservation (3.7 to 4.2) (McDonald et al. al., 1991; França et al., 2011; Ramos et al., 2021.). The ideal pH for silage conservation can be affect by the humidity of the ensiled material and the fermentation temperature. Silages with a DM content greater than 20%, a pH equivalent to 4.0 is acceptable for satisfactory conservation (Possenti et al., 2016). The pH is one of the main indicators of silage quality. It affects the growth and survival of microorganisms present in the silage, in addition to being considered an important parameter in the qualification of the ensiling process (Amaral et al., 2007; Cañaveral-Martínez et al., 2020; Sánchez-Santillán et al., 2022), as the acidification of the harvested forage mass is necessary to allow its satisfactory conservation.

The DM contents of the elephant grass silages were directly proportional to the levels of added acerola residues (y = 27.728 + 0.5398x; R^2 = 97.00) (Table 2), which favored its fermentation process. This behavior may be relate to the higher DM content of the acerola residue, 80.64%, which markedly contributed to the increase silage DM content when used in addition to elephant grass silage. For each 1% addition of acerola residue, there was an increase of 0.53% in DM content. This result was similar to those reported by Maia et al. (2015), after adding levels of 0.0 to 20% of acerola residue to elephant grass silage cut at 80 days of age, whose contents were estimate at 0.54% for each 1% of acerola by-product added in silage.

The DM is the fraction of the food remaining after removing all the water, as it is in this fraction that its nutritional constituents (carbohydrates, proteins, minerals, lipids and vitamins) are concentrated. It is an extremely relevant parameter, especially when obtained from bulky foods, which normally have variable humidity (Salman et al., 2010). Nussio et al (2001) suggest DM levels between 30% to 35% so that the silage is well preserved. Silages that have high DM contents can hinder the process of compaction and air exclusion during ensiling, factors that can reduce the fermentation process, resulting in silages with low nutritional quality (Acosta, 2002; Matta, 2005; Vanegas Ruiz & Codero-Ahiman, 2019). Silages with contents below 30% DM can increase the production and release of effluents and stimulate the growth of undesirable microorganisms, such as clostridia (Mcdonald et al. 1991; Sánchez-Ledesma, 2018). In this experiment, the desirable levels of DM can be obtained with the inclusion of ≅ 4.20 to ≅ 13.48% of acerola residue in the silage of elephant grass cv. Capiaçu, when cut at 125 days of regrowth and with a pre-withering period of 18 hours.

Silage DM contents are affected by several factors such as plant type and age, time of year, plant phenology, type of additive added, time of exposure to drying and storage conditions (Lousada Junior et al., 2006; Herrera-Velazco et al., 2010).

The CP contents of elephant grass silage were increase by adding acerola residue (Table 2). The regression equation indicated that for each 1% addition of acerola residue there was an increase of 0.1153% on the CP contents of elephant grass silage. These results are correlate with the CP contents of the acerola residue, which were estimate at 13.03% before the ensiling process. Maia et al. (2015) and Gonçalves et al. (2002) reported, respectively, increments of 0.13 and 0.22% for each 1% addition of acerola residue in elephant grass silage. Similar results were related by Bonfá et al. (2017), after adding levels of 0.0 to 50% of pineapple residues in elephant grass silage by Ferreira et al. (2004) evaluating the addition of up to 48% of cashew bagasse in elephant grass ensilage and by Borja et al. (2012) evaluating massai grass silages with contents of 0; 8; 16 and 24% of sunflower flour.

It should be note that it is pertinent to emphasize that diets with a CP content below 7% can reduce the digestibility of the cell wall fibrous constituents and restrict forage intake, as consequence of the slow passage of food through the rumen (Van Soest, 1994; Ferreira et al., 2009). Thus, it is estimate that at least 12.67% of the acerola residue is need for the elephant grass silage to reach this limit. Moreover, from the equation in Table 1, it can be deduce that during the fermentation process there was a satisfactory preservation of the proteins.

The levels of NDF are primarily composed of cellulose, hemicellulose, lignin and lignified protein (Godin et al., 2011). In this experiment, NDF levels were not affect by acerola residues (Table 2). However, the high levels of NDF obtained in exclusive elephant grass silages and with the addition of acerola by-products may induce a lower DM intake, due to the physical effect of rumen filling by the extremely fibrous material, reducing the rate of passage of food through the digestive tract (Resende et al.; 1994; Cruz-Calvo & González, 2000; Pompeu et al., 2006). Thus, DM intake is limited by NDF levels greater than 60% (Van Soest, 1994).

The ADF consists of cellulose, lignin, as well as variable amounts of ash and nitrogenous compounds (Calsamiglia et al., 1997; Godin et al., 2011). The ADF represents the amount of fiber that is not digestible and can be consider as a good nutritional indicator of the energy value of the food (Macedo Júnior et al., 2007). In this experiment, the ADF contents were directly proportional to the levels of acerola residue added to the elephant grass silage (Table 2), explained by the equation $y = 44.122 + 0.1661x$; $R^2 = 80.37$).

The increments in the ADF contents of the elephant grass silages were due to the high percentages of ADF in the acerola residue. At the time of ensiling, elephant grass had an ADF content of 42.21%, while acerola residue had a content of 55.78%. ADF levels are directly related to the lignin content of foods, which determine the level of fiber digestibility, since the higher the ADF content, the greater the lignin content and, consequently, the lower the digestibility of the food (Magalhães et al., 2015; Salama & Nawar, 2016; Merlo-Maydana, 2017). According to Lousada Junior et al. (2006), Maia et al. (2015) and Ferreira (2018), the lignin contents of the acerola residue can exceed 20%, since it is mainly composed of seeds, a naturally lignified ingredient. Thus, it would be reasonable to infer that the addition of high levels of acerola by-product reduces the nutritive value of silages as consequence of the negative correlation between ADF and DM digestibility (Van Soest, 1994).

Positive linear effects on ADF contents of elephant grass silage were also observed by Gonçalves et al. (2004) and Maia et al. (2015) by including levels from 0 to 20% of acerola residue to elephant grass silage, whose responses were explained by the respective equations: $y = 44.54 + 0.32x$; $y = 9.66 + 0.29x$. A similar behavior was observed by Pompeu et al. (2006) after adding levels from 0 to 20% of melon residue ($y = 45.92 + 0.43x$) to elephant grass silage.

Acerola residue linearly and significantly reduced the HCEL content of silages and declines of 0.312% were estimate for each 1% addition of acerola residue (Table 2). It can be infer that the reduction in hemicellulose contents can be attributed to the lower participation of elephant grass (29.90% HCEL) and the increase in acerola residues (14.77% HCEL) in ensilage.

Decreasing responses in HCEL levels (y = 21.17 - 0.29x) were also reported by Maia et al. (2015), after adding levels of 0.0 to 20% of acerola residue to elephant grass silage.

Similarly, to cellulose and pectin, hemicellulose is a structural carbohydrate linked to lignin and part of the cell wall of plants. Hemicelluloses are polymers formed by the most diverse types of sugars: hexoses (glucose, mannose and galactose), pentoses (xylose and arabinose) and uronic acid, representing important sources of energy for the diet of ruminants (Philippe et al., 2008; Segura et al., 2007). Plant species present large variations of hemicellulose (10 to 25% of DM) in forages, meal, pulps and lower values in cereal grains (2 to 12%) (Giger-Reverdin, 1995).

The levels of ash in elephant grass silage were not influenced by the levels of acerola residues evaluated (Table 2), possibly as consequence of the similarity of their contents (Table 1). According to Carvalho (1985), irrespective to the age of grass regrowth, the ash content of elephant grass can vary from 3.8 to 11.6%. The acerola residue can range from 2.25 to 6.08%, according to Maia (2015).

The determination of ash or mineral matter content provides only an indication of the richness of the forage in mineral elements. However, according to Jobim et al. (2010), can also reveal losses of organic compounds due to the contamination of the forage with sand during grass mowing, and which normally occur in the ensiling process, a management practice that can result in an increase in ash content and provide negative effects buffering power on the pH of the silage.

There were significant decreases in TDN levels (Table 2) after the addition of acerola residue to elephant grass silage, and the response pattern was explained by the equation: y = 56.955-0.1162x (R^2 = 80, 37). TDN is an indication of the energy content of foods and its determination in silages is fundamental for the adequate and desirable balance of diets. For Keplin (1992) and Stella et al. (2016), a silage with adequate energy content should have between 64 and 70% TDN and, therefore, silages made with elephant grass at 125 days of regrowth, with or without the addition of acerola residue, would not be recommend as a single source of roughage in the diet.

There were also significant decreases in TC contents (Table 2) which were explained by the equation y = 86.025-0.0962x (R^2 = 83.00). These results must have been influence by the high levels of CP in the acerola residue compared to elephant grass, since, according to Sniffen et al. (1992), the higher the CP and EE contents, the lower the proportion of carbohydrates. The CT levels presented here are close to those observed by Maia et al. (2015) in mixed elephant grass silages with levels from zero to 20% of acerola residue.

The food digestibility represents the animal's ability to use its nutrients, to a greater or lesser extent, being a characteristic of the food and not of the animal (Silva & Leão, 1979). DM digestibility estimates of elephant grass silages were significantly reduce when associated with acerola residues (Table 2), which were described by the equation: y = 54.529 - 0.1294x (R2 = 80.37). According to Van Soest (1994), there is a negative correlation between ADF levels and DM digestibility. Thus, the reduction in DM digestibility of the evaluated silages may be correlate to the high percentage of ADF presented by the acerola residue (Table 1). However, it should be note that all silages presented a digestibility coefficient greater than 50%, an index considered satisfactory for DM digestibility, according to Almeida (1997). Cândido and Furtado (2020) corroborate that data on the chemical composition, nutritional value and digestibility of waste from the acerola agroindustry, as well as its use in animal feed, are scarce in the national and international literature.

The DMI estimate was not affect by the levels of acerola residue added to the elephant grass silage (Table 2), whose values ranged from 1.71 %BW (Trat. 1) to 1.80 %BW (Trat.5). Possibly, the absence of significance may be relate to the small difference presented by the NDF levels of elephant grass and acerola residue. Similar results were reported by Rodrigues et al. (2001) and Bringel et al. (2011), who recorded, respectively, DMI of 1.63 and 1.59 %BW per sheep after providing elephant grass silage cut at 75 and 60 days of regrowth.

4. Final Considerations

- Acerola residue is a viable alternative for the production of mixed silage with elephant grass to feed ruminants during the dry season.

- The addition of up to 24% of acerola residue in elephant grass ensilage considerably increases pH, dry matter and crude protein levels, providing fermentation within desirable chemical standards.

- The high levels of NDF and ADF presented by the acerola residue can negatively compromise DM digestibility, reducing the nutritional value of its silages.

- The use of acerola residue as an additive to elephant grass silage may mitigate the environmental impacts caused by the fruit pulp agroindustry.

- It is recommend to carry out experiments to evaluate the animal productive performance intake diets silages compounds of the best proportions of elephant grass and acerola residue.

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