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Características fermentativas e composição química das silagens produzidas a partir de variedades de sorgo sacarino[1]

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Resumo: O sorgo sacarino é muito estudado para a produção de etanol mas poucas são as pesquisas que avaliam sua utilização na ensilagem. O objetivo do trabalho foi comparar as variedades de sorgo sacarino no que diz respeito à qualidade do processo fermentativo e composição química. Foi utilizado um delineamento inteiramente casualisado utilizando-se como tratamentos as variedades de sorgo sacarino BRS 506, 508, 509 e 511. Foram avaliadas as perdas de matéria seca, perdas de efluentes, perdas de gases, pH, teores de proteína bruta, frações fibrosas e coeficiente de digestibilidade "*in vitro*" da matéria seca das silagens. Não foram observadas diferenças no pH das variedades tanto no inicio quanto no final do processo. As variedades BRS 511 e 506 apresentaram as maiores perdas de matéria seca que foram de 16,67 e 10,67%, respectivamente. Já a menor perda de MS foi observada para a variedade 509 com apenas 8,87%. As perdas de gás não diferiram entre as variedades, sendo observada uma média de 5,98%. As maiores produções de efluentes foram observadas para as variedades 506 e 508, com uma produção de 521,87 e 393,16 kg/ton de MS ensilada, respectivamente. Essas variedades também apresentaram os maiores teores de fibra e os menores valores de proteína bruta e coeficiente de digestibilidade "*in vitro*" da MS. A variedade BRS 509 apresentou os melhores resultados tanto na qualidade do processo fermentativo, quanto na qualidade do produto final.

Palavras–chave: ensilagem, ruminantes, valor nutritivo, volumoso

Fermentation characteristics and chemical composition of the silage produced from varieties of saccharine sorghum

Abstract: Saccharine sorghum is widely studied for ethanol production but there are few studies that evaluate its use in silage production. The objective of this study was to compare the varieties of saccharine sorghum according to the quality of the fermentation process and chemical composition. A completely randomized design was adopted, using as treatments the varieties of saccharine sorghum BRS 506, 508, 509 and 511. Evaluated parameters were: dry matter losses, effluent losses, gas losses, pH, crude protein, fibrous fractions and in vitro dry matter digestibility. There was no difference in pH values of the varieties at the beginning as well as at the end of the process. Varieties BRS 511 and 506 had the highest dry matter losses that were 16.67 and 10.67%, respectively while the smallest loss of DM was observed for variety 509 with only 8.87%. Gas losses did not differ among varieties with an average of 5.98%. The highest yields of effluents were observed for varieties 506 and 508, with a production of 521.87 and 393.16 kg / ton ensiled DM, respectively. These varieties also showed the highest fiber content and the lowest values of crude protein and in vitro DM digestibility. Cultivar BRS 509 showed the best results for the qualities of fermentation process and final product.

Keywords: ensiling process, ruminant, nutritional value, forage

Introduction

In Brazil, silage is a feed commonly offered as a form of roughage supplementation during the off-season (fall and winter) in which sorghum is one of the most used forages. Thus, the use of sorghum bicolor (L.) Moench for silage production is growing every year, mainly due to increased resistance to water stress when compared to corn (Souza et al., 2003). According to these same authors, varieties of sorghum must provide not only good dry matter yield, but also high nutritional value. Saccharine sorghum varieties, presenting increased stem yield with high content of soluble carbohydrates, were developed to serve as raw material for ethanol production in the off-season of sugarcane (DURÃES, 2012). However, the larger amount of sugars present in these varieties may favor the silage process, reducing losses and ensuring a final product with superior quality (França et al., 2011). Therefore

the objective of this study was to compare the varieties BRS 506, 508, 509 and 511 with regard to the quality of fermentation, chemical composition and silage digestibility.

Material and Methods

The study was conducted at the Experimental Field of Embrapa Western Agriculture and chemical analysis was performed at the College of Agricultural Sciences - UFGD both located in Dourados-MS. The experiment was carried out in a completely randomized design with four treatments and three replicates (silos), using as treatments varieties of saccharine sorghum BRS 506, 508, 509 and 511. PVC pipes were used as experimental silos with 50 cm height and 10 cm in diameter and sealed at the bottom end with a cap. At the bottom of the silos, it was placed dry sand (0.3 kg) separated from the forage by a screen and a cotton fabric to quantify the effluent produced. Compaction of the chopped material was performed manually with wooden bats. After compaction of the forage, the silos were sealed with plastic sheet and duct tape, weighed and stored. At 100 days of fermentation, silos were weighed again to determine the gas losses and then were opened. After removal of the silage, the whole set, silo, sand, screen and cotton fabric were weighed to quantify the produced effluent. The determination of gas loss, effluent production and dry matter loss were calculated according to equations proposed by (Jobim et al., 2007). Each sample was broken down into two sub-samples: one was used for determination of pH, according to Silva & Queiroz (2002); and the other was weighed and taken to forced air circulation drying oven at 55 °C for 72 hours. Samples collected after opening of the silos and kept in oven were re-weighed and ground in a knife mill to produce particles of less than 1 mm in diameter. These dried and ground samples were submitted to analysis of dry matter (DM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), hemicellulose, cellulose, lignin and in vitro dry matter digestibility (Silva & Queiroz, 2002). The results were evaluated by analysis of variance and mean comparison by Tukey test (P <0.05), using the software R.

Results and Discussion

There was no difference (P> 0.05) in pH among the varieties at the beginning as well as at the end of the process (Table 1). The average pH value was 3.64, which can be considered as ideal since, as stated by Van Soest (1994) pH values lower than 4 characterize lactic acid fermentation which inhibits the growth of undesirable microorganisms, ensuring the quality of the final product. Rodrigues et al. (2002) who evaluated the hybrid AG 2005 cut at 97 days reported a pH of 3.7, a similar value to those obtained in this work. But França et al. (2011) found higher values of pH from silage of sorghum cultivars 1F 305, 0369 267, 0369 255 and EN 700 with pH ranging from 3.9 to 4.3.

Tablel 1. pH, fermentation losses and chemical composition of silages produced from four varieties of saccharine sorghum.

Parameters	Variety				P	CV (%)
	506	508	509	511		
pH ensiling	5.35	5.53	5.28	5.25	0.056	16.90
pH opening	3.60	3.68	3.64	3.67	0.158	0.47
DM losses (%)	10.57 ab	11.12 ab	8.87 b	16.67 a	0.021	34.88
Gas losses (%)	6.16	5.94	3.74	8.10	0.240	59.24
Effuent losses (kg/ton DM)	521.87 a	393.16 b	310.89 d	374.62 c	<0.001	9.09
Mineral Content (% DM)	5.26 a	4.93 ab	4.48 c	4.82 bc	<0.001	7.91
Crude Protein (% DM)	4.14 b	4.10b	4.98 a	4.96 a	0.009	5.81
Neutral Detergent Fiber (% DM)	47.30 ab	48.32 a	43.63 c	45.70 b	0.010	7.45
Acid Detergent fiber (% DM)	27.60 ab	27.69 a	24.01 c	24.45 bc	0.002	11.31
Hemicellulose (% DM)	19.70	20.63	19.61	21.24	0.237	11.00
Cellulose (% DM)	21.52 ab	22.49 a	18.24 c	18.88 bc	<0.001	12.47
Lignin (% DM)	5.31	4.51	5.33	5.07	0.113	18.1
Digestibility % DM)	57.29 b	57.02 b	61.35 a	61.16 a	<0.001	5.70

Means within rows (varieties) with different letters differ from each other according to Tukey's test P<0,05. P = p-value; CV% = coefficient of variation.

Varieties BRS 511 and 506 had the highest (P <0.05) DM losses which were 16.67 and 10.67%, respectively. While the smallest DM loss was observed for variety 509 with only 8.87%. These data losses are similar to those observed by Rodrigues et al. (2002) who found values ranging between 8 and 14% DM losses. Gas

losses did not differ (P> 0.05) among varieties with an average of 5.98% which was 2% higher than gas losses found by França et al. (2011). Saccharine varieties have a very succulent stem and consequently, presented great production of effluent, varying from 310.89 to 521.87 kg / ton of ensiled DM for BRS 509 and 506, respectively. These values are considered high when compared to 133 kg / ton reported by França et al. (2011). This excessive effluent can promote the development of anaerobic bacteria genus Clostridium, which produce butyric acid, resulting in the degradation of protein and lactic acid. Furthermore, a significant portion of plant nutrients is eliminated from the effluent, reducing the quality of the material and inducing concentration of insoluble material (fiber fraction). This can easily be seen in Table 1, since varieties BRS 506 and 508 that produced the largest amount of effluent were also the ones that showed the highest fibers values (P <0.05), with the exception of lignin, which did not differ (P> 0.05) among the tested varieties. The highest effluent production of varieties 506 and 508 may have also influenced the CP content and the coefficients of in vitro DM digestibility, which were also lower (P <0.05) than the varieties 509 and 511. The low concentration of NDF found in silage of saccharine varieties is an interesting feature as it provides increase in voluntary intake, digestibility and animal performance (Van Soest, 1994). Average levels of 46.30% NDF and 59.20% in vitro DM digestibility were greater than those obtained by Rodrigues et al. (2002) with 58.79% NDF and 52.87% in vitro DM digestibility by using a non-saccharine varieties. Variety 509 presented superior performance compared to the other varieties; but according to literature data, all cultivars showed satisfactory performance in the studied parameters. The only exception is in the production of effluents, which must be reduced to ensure a better use of nutrients of silage in saccharine varieties.

Conclusions

Cultivar BRS 509 showed the best results for the qualities of the fermentation process and final product. However, further studies are necessary in order to reduce effluent production from saccharine varieties, which may significantly influence the quality of silage.

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