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Productive performance and quantitative carcass traits of lambs fed saccharine sorghum silage

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Abstract – The objective of this work was to evaluate the productive performance and carcass traits of lambs fed silages of different types of sorghum and corn. Thirty-two uncastrated male Suffolk lambs were used. The experimental design was completely randomized, with four treatments (silages) and eight replicates (animals). Silages of the GrandSilo forage sorghum, BRS 506 saccharine sorghum, BRS 511 saccharine sorghum, and the BRS 2223 double-grain corn hybrid were tested. The lambs fed sorghum silages had a lower daily dry matter intake than those fed corn silage. The diet containing corn silage led to 27% greater weight gain, when compared with the treatments with the other silages. In vivo digestibility did not differ among the different silages. Lambs fed corn silage showed the lowest hot and cold carcass yields of 44.71 and 42.62%, respectively, whereas those that consumed BRS 506 sorghum silage showed the highest hot and cold carcass yields of 46.90 and 44.78%. The greater intake by and the better performance of the animals fed corn silage was not enough to enhance production and carcass yield. Lambs fed BRS 506 saccharine sorghum silage have higher efficiency in the conversion of silage into carcass.

Index terms: *Sorghum bicolor*, BRS 506, BRS 511, carcass yield, intake, roughage.

Desempenho produtivo e características quantitativas da carcaça de cordeiros alimentados com silagem de sorgo sacarino

Resumo – O objetivo deste trabalho foi avaliar o desempenho produtivo e as características da carcaça de cordeiros alimentados com silagens de diferentes tipos de sorgo e milho. Foram utilizados 32 cordeiros machos, da raça Suffolk. O delineamento experimental foi inteiramente casualizado, com quatro tratamentos (silagens) e oito repetições (animais). Foram testadas silagens de sorgo forrageiro GrandSilo, sorgo sacarino BRS 506, sorgo sacarino BRS 511 e milho híbrido duplo BRS 2223. Os cordeiros alimentados com silagens de sorgo apresentaram menor consumo diário de matéria seca que os alimentados com silagem de milho. A dieta contendo silagem de milho proporcionou ganho de peso 27% superior ao dos tratamentos com as demais silagens. A digestibilidade in vivo não diferiu entre as diferentes silagens. Os cordeiros alimentados com silagem de milho apresentaram os menores rendimentos de carcaça quente e fria, de 44,71 e 42,62%, respectivamente, enquanto os que consumiram silagem de sorgo BRS 506 apresentaram os maiores rendimentos de carcaça quente e fria, de 46,90 e 44,78%. O maior consumo e o melhor desempenho dos animais alimentados com silagem de milho não foi suficiente para incrementar a produção e o rendimento de carcaça. Os cordeiros alimentados com silagem de sorgo sacarino BRS 506 apresentam maior eficiência de conversão da silagem em carcaça.

Termos para indexação: *Sorghum bicolor*, BRS 506, BRS 511, rendimento de carcaça, consumo, volumosos.

Introduction

Sorghum [*Sorghum bicolor* (L.) Moench] is a plant native to Africa that adapts to various types of climate and soil. It is recommended for planting in seasons or regions where water deficit can prevent the success of other more traditional crops, such as corn (*Zea mays* L.) (Barcelos et al., 2016; Habyarimana et al., 2018). In Brazil, in recent years, special attention has been paid to sorghum varieties because they accumulate high sugar contents in the stem and are used for sugar (Willis et al., 2013; Asikin et al., 2018) and ethanol (Fernandes et al., 2014; Castro et al., 2017) production.

Despite being researched for the production of sugar and alcohol, few studies use saccharin varieties as bulky sources for feeding ruminants. Orrico Junior et al. (2015) evaluated the forage potential of four varieties of sorghum in terms of plant and silage productivity, botanical composition, and nutritional value. According to these authors, plants of this species can reach dry matter yield of 24 Mg ha^{-1}, average crude protein contents of 5%, and in vitro dry matter digestibility coefficient of up to 70%. The silages produced with these varieties also present good fermentative and nutritional quality.

When comparing the nutritional value of the silages of six sorghum hybrids for saccharine, forage, and grain production, Neto et al. (2017) and Di Marco et al. (2009) found high soluble carbohydrate contents, low indigestible neutral detergent insoluble fiber contents, and high dry matter in vitro digestibility coefficients. Although important, the researches of Orrico Junior et al. (2015), Di Marco et al. (2009), and Neto et al. (2017) only indicate the potential of saccharin varieties for silage production. Therefore, further studies are needed to assess how the traditional silages of corn and forage sorghum, compared with those of the saccharin varieties, affect the consumption, performance, and carcass characteristics of animals when offered as feed.

The objective of this work was to evaluate the productive performance and carcass traits of lambs fed silages of different types of sorghum and corn.

Materials and Methods

The study was carried out in Dourados, in the state of Mato Grosso do Sul, Brazil (22°11'55"S, 54°56'7"W, at 452 m altitude). According to Köppen's classification (Alvares et al., 2014), the climate in the region is Cwa, humid mesothermal, with average temperature and rainfall between 20 and 24°C and 1,250 and 1,500 mm, respectively. The research was approved by the animal use ethics committee of Universidade Federal da Grande Dourados, under protocol nº 33/2015.

Thirty-two uncastrated male Suffolk lambs, with 75±15 days of age and 21±7 kg initial weight, were used. The experimental design was completely randomized with four treatments (silages) and eight replicates (animals). Silages of GrandSilo forage sorghum, BRS 506 saccharine sorghum, BRS 511 saccharine sorghum, and BRS 2223 corn hybrid were tested. The ensiled material of each treatment was stored in 200-L drums for manual compaction. Mean particle sizes were 14, 10, 13, and 10 mm, with a density of 874.38, 882.81, 861.47, and 738.82 kg m^{-3}, for silages of GrandSilo forage sorghum, BRS 506 saccharine sorghum, BRS 511 saccharine sorghum, and corn, respectively.

The diets were prepared based on the requirements of National Research Council (NRC, 2007) for mean weight gain of 0.20 kg per animal per day at a 50% roughage (silages) and 50% concentrate ratio (Table 1). For the diets to have similar crude protein (CP) contents, two concentrates were prepared: one for corn silage, with a lower CP content; and the other for sorghum silages, with a higher CP content. The concentrate was made with corn, soybean meal, calcitic limestone, mineral and vitamin premixes, coccidiostat, urea, and common salt.

The animals were housed in individual stalls, with 2 m^2 area, equipped with individual mobile feeder and nipple drinker, arranged under a covered area. The shaving bed was used for stool and urine retention, and was changed every 15 days. The animals were identified, weighed, vermiculated with the active ingredient monepantel, and subjected to facilities and diets before the beginning of the experiment.

The experimental phase began in January 2016, with 10 days of adaptation and 56 days of evaluation. The diets were provided daily at 8 a.m. and 4 p.m. Feed was provided ad libitum, and the amount was recalculated every 3 days to achieve 5 to 10% leftovers. Every day, prior to the first meal, the leftovers of the previous day were collected, weighed, and sampled to obtain the intakes of dry matter (DM) and nutrients. The samples of feed and daily leftovers were frozen and grouped at 14-day periods (one compound sample per animal per period) for later nutrient analysis. Every 14 days, after solid and liquid fast for 16 hours, the animals were weighed on a digital scale to measure body weight gain and then to calculate feed conversion.

The in vivo digestibility of the diet was obtained by full collection of feces using collecting bags with no contamination and reduced nitrogen volatilization. The digestibility coefficients of DM, organic matter, total digestible nutrients (TDN), CP, neutral detergent fiber (NDF), and acid detergent fiber (ADF) in the diets, as well as the digestibility of the silages, were determined according to Silva & Leão (1979), based on the relationship between intake and fecal production. The following formula (Cappelle et al., 2001) was used to calculate TDN: $TDN = 3.71095 - 0.129014 \times NDF + 1.02278 \times DOM$, where DOM is the digestible organic matter.

Feed, leftover, and feces samples were dried in a forced-air oven at 55°C for 72 hours and then ground in a Wiley mill equipped with a 1-mm mesh screen. The contents of DM, organic matter, mineral matter, CP, NDF, ADF, and ether extract were determined according to Silva & Queiroz (2006).

The animals were weighed to determine body weight at slaughter (BWS) at the end of the experimental period, after solid fasting for 16 hours. Slaughter was carried out according to the industrial and sanitary standards for the inspection of products of animal origin (Brasil, 2017).

After skin removal, evisceration, and the removal of the head and extremities of the limbs, the carcasses were weighed to obtain hot carcass weight (HCW, kg). After cooling in a cold room at 1 to 4°C for approximately 24 hours, a new weighing was carried out to obtain cold

Table 1. Ingredients and chemical composition of the diets with different types of silage fed to male Suffolk lambs(1).

Ingredient (kg)	Silage			
	GrandSilo forage sorghum	BRS 506 saccharine sorghum	BRS 511 saccharine sorghum	BRS 2223 corn hybrid
Roughage	50.00	50.00	50.00	50.00
Corn kernel	32.30	32.30	32.30	34.80
Soybean meal 46	15.00	15.00	15.00	12.50
Mineral premix(2)	1.00	1.00	1.00	1.00
Lime	1.00	1.00	1.00	1.00
Urea	0.47	0.47	0.47	0.47
Ammonium sulfate	0.15	0.15	0.15	0.15
Vitamin premix(3)	0.05	0.05	0.05	0.05
Flower of sulfur	0.02	0.02	0.02	0.02
Lasalocid sodium 15%	0.01	0.01	0.01	0.01
Nutrient (%)	Chemical composition			
Dry matter	33.90c	35.06b	36.45a	34.60bc
Mineral matter (% DM)	6.26a	5.32b	5.01c	5.26b
Organic matter (% DM)	93.73c	94.67b	94.99a	94.73b
Crude protein (% DM)	13.15	12.82	12.66	13.77
Ether extract (% DM)	1.35	1.35	1.35	1.40
Neutral detergent fiber (% DM)	44.61a	41.05b	40.98b	36.11c
Acid detergent fiber (% DM)	20.17a	17.26b	17.56b	12.97c
Total digestible nutrients(4) (% DM)	70.32b	69.09b	70.25b	74.66a
Calcium (g kg^{-1}, % DM)	5.37	5.37	5.37	5.37
Total phosphorus (g kg^{-1}, % DM)	2.52	2.52	2.52	2.52

(1)Values followed by different letters, in the same rows, differ by Tukey's test, at 5% probability. (2)Composition: 111.00 g kg^{-1} calcium (min.), 50.00 mg kg^{-1} cobalt, 11.99 g kg^{-1} sulfur, 4.42 mg kg^{-1} iron, 72.00 g kg^{-1} phosphorus (min.), 75.00 mg kg^{-1} iodine, 9.00 g kg^{-1} magnesium, 1,550.00 mg kg^{-1} manganese, 13.50 mg kg^{-1} selenium, 174.00 g kg^{-1} sodium, 7,200.00 mg kg^{-1} zinc, and 720.00 mg kg^{-1} fluorine (max.). (3)Composition: 15,000.000 UI kg^{-1} vitamin A (min.), 2,000.000 UI kg^{-1} vitamin D3 (min.), and 5,500 UI kg^{-1} vitamin E (min.). (4)Calculated according to Cappelle et al. (2001). DM, dry matter.

carcass weight (CCW, kg). Commercial hot carcass yield (HCY, %) was calculated using the formula (HCW/BWS) x 100, and commercial cold carcass yield (CCY, %) was obtained by (CCW/BWS) x 100. Carcass losses by cooling (CLC, %) were calculated by ((HCW - CCW)/HCW) x 100.

Ribeye area and subcutaneous fat thickness (SFT) were measured in the right-side half-carcass between the twelfth and thirteenth ribs after cooling. Ribeye area was determined by tracing the outline of the *Longissimus thoracis et lumborum* muscle as described by Yáñez et al. (2006). SFT was measured at the distal third of the same muscle using digital calipers. Feed conversion into carcass was calculated by dividing the amount of feed consumed by the animals by the weight of the carcass produced in each treatment.

Data on animal performance parameters were subjected to the analysis of variance, and means were compared by Tukey's test, at 5% probability. In order to perform multivariate analyses – clustering analyses and principal components analyses (PCAs) –, the dataset was standardized so that each descriptor had an average equal to zero and a variance equal to one. In order to facilitate understanding, the data plotted in the figures were grouped using the value of the correlation coefficient (>0.7) as a cut-off parameter. All analyses were carried out using the R software, version 3.3.0, and PCA used the vegan package (R Core Team, 2016).

Results and Discussion

The animals fed corn silage showed greater intakes than the ones fed saccharine and forage sorghum silages (Table 2). Other studies confirmed the greater intake of corn silage compared with silages of other forage species, which was directly related to the quality of the diet and of fermentation (Miron et al., 2007; Dann et al., 2008).

In the present study, BRS 2223, a grain hybrid of corn that has been bred for grain production (Cardoso

Table 2. Nutrient intake by male Suffolk lambs fed different silages[1].

Variable[2]	Treatment				P-value	Coefficient of variation (%)
	GrandSilo forage sorghum	BRS 506 saccharine sorghum	BRS 511 saccharine sorghum	BRS 2223 corn hybrid		
DMI (kg per day)	0.926b	0.872b	0.906b	1.167a	<0.0001	9.10
DMI (g kg^{-1} BW)	34.630b	32.573b	35.328b	39.742a	<0.0001	6.42
DMI (g per $kg^{0.75}$)	78.657b	73.880b	79.314b	92.395a	<0.0001	7.02
OMI (kg per day)	0.764b	0.732b	0.762b	0.967a	0.0003	9.69
OMI (g kg^{-1} BW)	28.553b	27.117b	29.911ab	32.850a	<0.0001	6.92
OMI (g per $kg^{0.75}$)	64.866b	61.628b	67.039b	76.425a	0.0001	7.51
CPI (kg per day)	0.111b	0.101b	0.103b	0.140a	<0.0001	9.10
CPI (g kg^{-1} BW)	4.172b	3.749b	4.070b	4.755a	<0.0001	6.85
CPI (g per $kg^{0.75}$)	9.476b	8.157b	9.116b	11.066a	<0.0001	7.19
TDNI (kg per day)	0.577b	0.539b	0.566b	0.763a	<0.0001	10.15
TDNI (g kg^{-1} BW)	21.532b	19.828b	22.169b	25.899a	<0.0001	7.57
TDNI (g per $kg^{0.75}$)	48.930b	45.151b	49.727b	60.257a	<0.0001	8.15
NDFI (kg per day)	0.336	0.299	0.308	0.350	0.1941	12.14
NDFI (g kg^{-1} BW)	12.517	11.058	12.066	11.976	0.1644	9.89
NDFI (g per $kg^{0.75}$)	28.464	25.139	27.062	27.819	0.1709	10.43
ADFI (kg per day)	0.142	0.121	0.127	0.122	0.1061	14.75
ADFI (g kg^{-1} BW)	5.260a	4.474ab	4.958ab	4.181b	0.0218	12.23
ADFI (g per $kg^{0.75}$)	11.965a	10.162ab	11.121ab	9.698b	0.0342	12.88

[1]Values followed by different letters, in the same rows, differ by Tukey's test, at 5% probability. [2]DMI, daily dry matter intake; OMI, organic matter intake; CPI, crude protein intake; TDNI, total digestible nutrient intake; NDFI, neutral detergent fiber intake; and ADFI, acid detergent fiber intake. BW, body weight; and $kg^{0.75}$, metabolic weight.

et al., 2005), was evaluated. Using this type of hybrid in silage increases the proportion of grains in the ensiled mass, which leads to silages with lower fiber contents (Table 1) that favor higher DM intake (Riaz et al., 2014; Krämer-Schmid et al., 2016). Since saccharine and forage sorghum silages increase NDF (Table 1), the animals consumed less DM and, consequently, less TDN and CP.

The animals fed GrandSilo forage, BRS 506, or BRS 511 sorghum silages showed 24.40, 29.26, and 25.72% lower TDN intake, respectively, than those fed corn silage (Table 2). The mean CP intake by animals fed corn silage was higher than that of those fed GrandSilo forage, BRS 506, and BRS 511 sorghum silages, whose intake was 20.71, 27.85, and 26.42% lower, respectively. These results are in alignment with those obtained by Nascimento et al. (2008), who observed lower DM intake by dairy cows fed saccharine sorghum silage, compared with corn silage. These authors reported a reduction of 19.85% in the intake of DM per animal per day with saccharine sorghum diets, close to the values found in the present study. This way, Nascimento et al. (2008) concluded that the higher NDF proportion in saccharine sorghum silage contributed to rapidly filling the rumen, to a reduction in nutrient intake, and, consequently, to a lower milk production.

According to Banakar et al. (2018), the threshold for NDF intake is around 1.2% of the daily DM intake. In this experiment, NDF intake ranged from 1.1 to 1.2% of the daily intake, with no difference among treatments, i.e., the animals consumed as much NDF as possible in all experimental diets, which might have limited DM intake (Table 2).

Another factor that may have influenced the intake of sorghum silages is the final product of fermentation. The content of soluble carbohydrates in the saccharin varieties is usually greater than that necessary for the acidification process of silage to occur effectively (Santos et al., 2018). In this case, the excess of soluble carbohydrates can lead to the growth of yeasts and, consequently, to the formation of alcohol within the silos (Borreani et al., 2018). Neto et al. (2017) compared the final products of the fermentation of different types of sorghum, and found that the saccharine varieties had an average of 5.9% ethanol in DM, whereas the contents of the forage and grass varieties were below 0.6% ethanol. Excessive alcohol production leads to increased DM losses and to a significant reduction in silage consumption by animals (Santos et al., 2018), which is another factor that may explain the lower DM intakes of silage observed in the present study.

The results obtained by the fixed linear effect models showed differences among the silages tested for each nutrient intake variable among lambs. However, the PCA provides a global visualization of the dataset in two dimensions (Figure 1). The variance accumulated in the first and second principal components was 95.9% of the total initial variance. The main contributions for the first component were nearly all nutrient intake variables, except those related with the intake of NDF and ADF, which are associated with the second component, corresponding to 26.2% of total variability. When all nutrient intake components are considered, the ellipse that represents corn silage is farther from the other silages assessed in the foreground.

The nutrient intake variables associated with the first and the second components allowed identifying the silages with similar nutrient intake results. Forage sorghum and corn silages differed little regarding the properties of the nutrient intake variables related to the second component, but showed significant differences

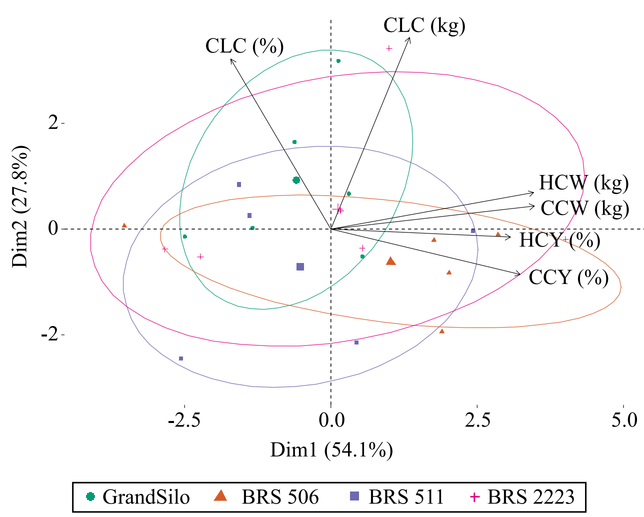

Figure 1. Biplot of the principal component analysis for the assessment of nutrient intake parameters of male Suffolk lambs fed GrandSilo forage sorghum (*Sorghum bicolor*), BRS 506 and BRS 511 saccharine sorghum, and BRS 2223 corn (*Zea mays*) hybrid silages. CLC, carcass losses by cooling; HCW, hot carcass weight; CCW, cold carcass weight; HCY, commercial hot carcass yield; and CCY, commercial cold carcass yield.

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regarding those related to the first one (Figure 1). These results reflect the estimates presented in Table 2.

The greater nutrient intake contributed to a greater weight gain of the animals fed corn silage (Table 3): 27% more than of those fed GrandSilo forage, BRS 506, or BRS 511 sorghum silages, with no significant differences among sorghum varieties. The animals fed corn silage also had a mean final weight about 13% greater than that of the animals fed sorghum silages. The fact no differences were found between the intake and performance of animals fed saccharine or forage sorghum silages stands out. The low grain production of saccharine sorghum (Orrico Junior et al., 2015) is offset by the high content of soluble sugars (Neto et al., 2017), resulting in silage with a nutritional value similar to that of the traditionally used sorghum silage. Therefore, BRS 506 and BRS 511, saccharine sorghum varieties, can be used in ruminant feed.

No differences were observed among treatments regarding feed conversion. Since feed conversion is a ratio between the amount of feed consumed and weight gain, the treatments were balanced, i.e., animals fed sorghum silage had a lower weight gain, as well as a lower DM intake, which is similar to the ratio found for the diet with corn silage.

The in vivo digestibility of DM, CP, NDF, and ADF did not differ among treatments. The results of the analyses of variance (Table 3) and of principal components (Figure 2) show that most of the analyzed characteristics also did not differ among the tested treatments. Most variables associated with performance and digestibility are related to the first principal component; the exception are weight gain (kg), feed conversion, and DM digestibility (%), correlated with the second component, which can be considered little significant since it accounts for only 17.8% of total

Table 3. Performance and in vivo digestibility of male Suffolk lambs fed different silages[(1)].

Variable[(2)]	Treatment				P-value	Coefficient of variation (%)
	GrandSilo forage sorghum	BRS 506 saccharine sorghum	BRS 511 saccharine sorghum	BRS 2223 corn hybrid		
IBW (kg)	21.78	21.80	20.97	22.66	0.7770	13.03
BWS (kg)	31.70b	31.98b	30.75b	36.30a	0.0124	6.61
FC	5.64	4.82	5.28	4.86	0.2617	17.56
MDG (kg)	0.177b	0.182b	0.175b	0.244a	0.0124	19.86
DMD (%)	72.55	72.05	71.15	72.82	0.7752	2.85
OMD (%)	70.76b	69.11b	70.23b	73.93a	0.0012	2.46
CPD (%)	68.86	65.33	65.77	70.01	0.2556	6.49
NDFD (%)	65.64	64.54	65.77	68.75	0.7406	8.73
ADFD (%)	60.38	59.95	62.62	65.08	0.8106	16.00
HCW (kg)	15.11b	16.00a	14.86b	16.55a	0.0131	2.95
CCW (kg)	14.28b	15.28a	14.18b	15.78a	0.0062	2.92
HCY (%)	45.70ab	46.90a	45.70ab	44.71b	0.0163	2.97
CCY (%)	43.18ab	44.78a	43.58ab	42.62b	0.0077	2.93
CLC (%)	5.51	4.52	4.64	4.68	0.0672	14.27
REA (cm^2)	11.87	12.49	13.00	12.08	0.8051	16.74
SFT (mm)	1.36c	2.46b	2.11ab	3.33a	0.0226	29.84
FCC (kg)	3.43ab	3.06b	3.42ab	3.96a	0.0021	10.72

[(1)]Values followed by different letters, in the same rows, differ by Tukey's test, at 5% probability. [(2)]IBW, initial body weight; BWS, body weight at slaughter; FC, feed conversion; MDG, mean daily gain; DMD, dry matter digestibility; OMD, organic matter digestibility; CPD, crude protein digestibility; NDFD, neutral detergent fiber digestibility; ADFD, acid detergent fiber digestibility; HCW, hot carcass weight; CCW, cold carcass weight; HCY, hot carcass yield; CCY, cold carcass yield; CLC, carcass loss by cooling; REA, ribeye area; SFT, subcutaneous fat thickness; and FCC, feed conversion into carcass.

variance. The ellipses plotted for each silage are very close to each other, which indicates that, on average, the different silages evaluated have the same effect on the performance and in vivo digestibility of lambs. An analysis of the behavior of the ellipses as a function of the silages shows that BRS 506 and BRS 511 act similarly, whereas corn and forage sorghum silages behave differently. This indicates there may be some differences in the studied characteristics among the tested silages, particularly of corn, which matches the results in Table 3.

SFT was higher in the carcasses of animals fed corn silage, compared with sorghum silages (Table 3). According to Irshad et al. (2012), the efficient conversion of ration into meat by animals is usually related to the level of feed intake. However, if dietary energy intake exceeds the amount needed for lean tissue growth, the excess is used for fat deposition (Ponnampalam et al., 2019). Therefore, animals that ingest greater amounts of energy generally deposit more fat (carcass and viscera) and are, consequently, less efficient in converting food into lean meat than animals fed slightly below ad libitum energy intake (Irshad et al., 2012).

The greatest weight gain observed for animals fed corn silage was not reflected in HCW or CCW, whose values were similar to those of animals fed BRS 506 saccharine sorghum silage (Table 3). This contributed to corn having the lowest HCY and CCY values of 44.71 and 42.62%, respectively, indicating that the greater weight gain of animals fed this silage was likely converted into non-carcass components. In other studies, such as those of Medeiros et al. (2008) and Moreno et al. (2011), an increase was observed in the size of visceral organs, especially the liver and the gastrointestinal tract, due to the type of roughage used. Therefore, the higher DM intake in the diet based on corn silage, associated with greater TDN concentrations, may have contributed to gut fat deposition, to the increase in the size of organs linked to nutrient digestion and metabolism, and to the increase in the gastrointestinal content volume, which hinders carcass yield.

No differences were observed regarding CLC (%) or ribeye area values, with averages of 4.83% and 12.35 cm^2, respectively. According to Osório et al. (2012), fat cover evenness, sex, weight, and cold chamber temperature and relative humidity may impact losses

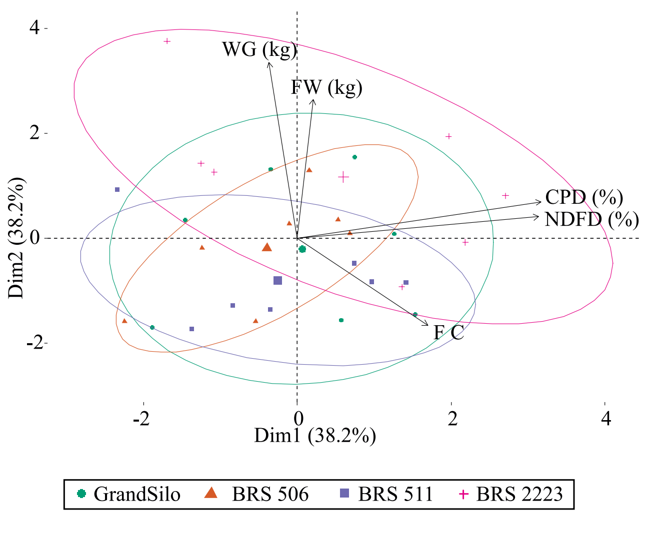

Figure 2. Biplot of the principal component analysis for the assessment of the performance and in vivo digestibility parameters of male Suffolk lambs fed GrandSilo forage sorghum (*Sorghum bicolor*), BRS 506 and BRS 511 saccharine sorghum, and BRS 2223 corn (*Zea mays*) hybrid silages. WG, mean weight gain; FW, fresh weight; CPD, crude protein digestibility; NDFD, neutral detergent fiber digestibility; and FC, feed conversion.

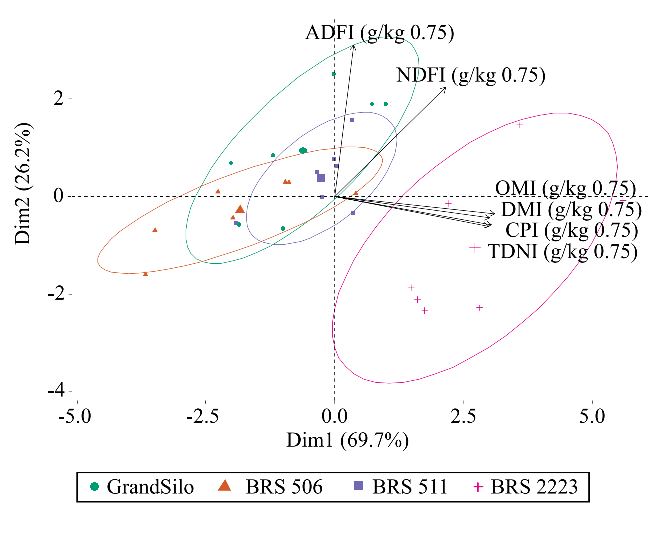

Figure 3. Biplot of the principal component analysis for the assessment of carcass component parameters of male Suffolk lambs fed GrandSilo forage sorghum (*Sorghum bicolor*), BRS 506 and BRS 511 saccharine sorghum, and BRS 2223 corn (*Zea mays*) hybrid silages. ADFI, acid detergent fiber intake; NDFI, neutral detergent fiber intake; OMI, organic matter intake; DMI, dry matter intake; CPI, crude protein intake; and TDNI, total digstible nutrient intake.

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by cooling in ovine in 1 to 7%, which makes the CLC values found in the present study favorable. Other researches have found ribeye area values between 12.2 to 13.2 cm^2 for Suffolk lambs terminated with different supplementation strategies (Turner et al., 2014); therefore, the values obtained in the present study can be considered satisfactory.

The PCA regarding carcass components (Figure 3) showed a value of 54.1% for the first component, as well as an accumulated variance of 81.9% in both components in relation to total variance. The main contributions for the first component were HCW, CCW, HCY, and CCY, whereas CLC (%) contributed to the second one. The ellipses plotted for each studied silage are close and indicate that the analyzed variables have the same effect on the carcass components of lambs; the exception was GrandSilo forage sorghum silage, whose variables were more concentrated between the first and fourth quadrants, i.e., negative for PC1 (of higher determination) and positive for PC2 (of lower determination). It should be noted that the variables of the carcass components of the animals fed BRS 506 sorghum silage were predominant in the third quadrant (PC1 of higher determination and positive vector variables), while the variables of the animals fed corn silage lay between the second and fourth quadrants, i.e., with positive characteristics between PC1 and PC2, but with a greater distribution of variables in the negative quadrant of PC1 and PC2, which means this diet showed a worse conversion of components into carcass.

The diet with BRS 506 silage led to the best ratio between feed intake and carcass production due to the lower DM intake by animals and to their greater carcass production. This probably makes this silage the most interesting from an economic standpoint, particularly when compared with the diet based on corn silage.

Conclusions

1. Although the values for the consumption and performance of male Suffolk lambs fed corn (*Zea mays*) silage are greater, they do not provide the best conversion of feed into carcass.

2. BRS 506 saccharine sorghum (*Sorghum bicolor*) is the most efficient in the conversion of feed into carcass.

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