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Performance of finishing beef cattle fed different diets containing whole-crop maize silage or sugarcane silage

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ABSTRACT - The objective of the present study was to evaluate the performance of beef cattle in feedlots fed diets containing either whole-crop maize silage or sugarcane silage, and with different formulations. Five diets were evaluated: MSF - diet containing whole-crop maize silage, with fixed formulation during feedlot period; MSV- diet containing whole-crop maize silage, with variable formulation according to feedlot phase; SCSF - diet containing sugarcane silage with fixed formulation; SCSV- diet containing sugarcane silage, with variable formulation; SCSV/MSV- SCSV diet in initial half of fedlot and MSV diet in final half of feedlot period, respectively. It was used a complete random experimental design, with five treatments and three replicates (pens). It was used 285 steers at 36 months of age, with an initial body weight of 362.4 kg. Diets with whole-crop maize silage promoted greater intake of dry matter (10.5 kg and 2.4% BW) compared with diets containing sugarcane silage (10.1 kg and 2.3% BW). There was no effect of the silages on average daily gain (1.348 kg/animal/day) and live weight at slaughter (481.2 kg BW). SCSV/MSV diet promoted the worst feed conversion (8.0 kg DM/kg BW). Animals fed diets composed of whole-crop maize silage presented greater weight of hot carcass, of carcass yield and subcutaneous fat thickness (262.1 kg, 54.1% and 6.2 mm) compared with the animals fed sugarcane silage (252.5 kg, 52.7% and 4.8 mm). The use of sugarcane silage in diets for finishing beef cattle is feasible and the adjustment of formulation during confinement period does not influence performance of the animals. Replacement of sugarcane silage by whole-crop maize silage during the feeding period affects negatively feed conversion.

Key Words: average daily gain, dressing percentage, hot carcass weight, intake

Desempenho de bovinos de corte em terminação com rações contendo silagem de milho ou de cana-de-açúcar

RESUMO - Objetivou-se com este trabalho avaliar o desempenho de bovinos de corte em confinamento alimentados com rações contendo silagem de milho ou de cana-de-açúcar, e com diferentes formulações. Foram avaliadas cinco rações: SMF – ração contendo silagem de milho, com formulação fixa durante o período de confinamento; SMV – ração contendo silagem de milho, com formulação variável conforme a fase de confinamento; SCF: ração contendo silagem de cana-de-açúcar, com formulação fixa; SCV: ração contendo silagem de cana-de-açúcar, com formulação variável; SCV/SMV: SCV na metade inicial do confinamento e SMV na metade final. O delineamento experimental foi o inteiramente casualizado, com cinco tratamentos e três repetições (baias). Foram utilizados 285 bovinos castrados, com idade de 36 meses e peso vivo inicial de 362,4 kg. As rações contendo silagem de milho promoveram maior consumo de matéria seca (10,5 kg e 2,4% PV) em comparação àquelas contendo silagem de cana-de-açúcar (10,1 kg e 2,3% PV). Não houve efeito das silagens sobre o ganho médio diário (1,348 kg/animal/dia) e peso vivo ao abate (481,2 kg PV). A ração SCV/SMV promoveu a pior conversão alimentar (8,0 kg MS/kg PV). Os animais alimentados com as rações compostas com silagem de milho apresentaram maior peso de carcaça quente, rendimento de carcaça e espessura de gordura subcutânea (262,1 kg, 54,1% e 6,2 mm) em relação àqueles que receberam a silagem de cana-de-açúcar (252,5 kg, 52,7% e 4,8 mm). A utilização de silagem de cana-de-açúcar em rações para bovinos de corte em terminação é viável e o ajuste da formulação durante o período de confinamento não influencia o desempenho dos animais. A troca de silagem de cana-de-açúcar por silagem de milho durante o período de alimentação interfere negativamente na conversão alimentar.

Palavras-chave: consumo, ganho médio diário, peso de carcaça quente, rendimento de carcaça

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Introduction

Roughage feed plays an important role in the development of diets for beef cattle, as it directly or indirectly determines the diet cost and influences animal performance. In Brazil, there are many available options for using in feedlot diets, mainly whole-crop maize silages and sugarcane.

Sugarcane is widely used for animal feeding, especially in its *in natura* form, due to its many desirable features (Resende et al. 2005), as for example: high biomass yield in a single crop, retention of the nutritious value for a prolonged period after ripeness, easy-implementation and few requirement of cultivation, its harvest coincides with low quality pasture, and the technologies used in other processes involving sugarcane (e.g. for the production of sugar and alcohol) are duly available. Using sugarcane as silage is an important strategy in situations when daily harvest is compromised or when there is a necessity to clear field cultivation swiftly (Siqueira et al., 2008).

One of the main difficulties found when preserving sugarcane as silage is the alcoholic fermentation stage, which is responsible for dry matter loss and changes in the nutritional content of forage (Pedroso et al., 2005; Schmidt et al., 2007; Mendes et al., 2008). Nevertheless, recent studies have indicated that when fermentation is controlled, the use of sugarcane in well-balanced diets provides satisfactory results in animal production (Pedroso et al., 2006; Queiroz et al., 2008; Mendes et al., 2008).

A strategy that has been recently adopted is to alternate the types of silage during feedlot period, by saving high-quality roughage source to later stages of confinement. Such strategy aims an increase in animal performance and finishing as well as a reduction in costs. However, there are not any published scientific studies that have evaluated this technique.

The objective of the present study was to analyze the intake and performance of finishing cattle fed diets containing sugarcane silage or whole-crop maize silage. Furthermore, it was also evaluated the effect of diet variations in animal performance by adjusting the nutritional composition according to feeding period or by replacing the silage source.

Material and Methods

Experiments were performed from September to December in 2007, at Fazenda Experimental da Agência Paulista de Tecnologia dos Agronegócios - Pólo Regional da Alta Mogiana (APTA Alta Mogiana), situated in Colina, São Paulo. A total of five diets for finishing beef cattle in feedlots were analyzed: MSF - diet containing whole-crop maize silage, with fixed formulation during feedlot period; MSV - diet containing whole-crop maize silage, with variable formulation during feedlot period: initial or later stages; SCSF - diet containing sugarcane silage, with a fixed formulation throughout the entire feedlot period; SCSV - diet containing sugarcane silage, with a variable formulation during feedlot period: initial or later stages; SCSV/MSV - diet with variable formulation, using sugarcane silage during initial feedlot stage (SCSV) and whole-crop maize silage in later stages (MSV). A completely randomized design, with five treatments and three replicates (pens) was used.

The total experimental period was 96 days, divided into a 14-day animal adaptation period to the diets, and two 41-day periods concerning the feedlot stages: initial and later. The feedlot periods were further divided into two periods of 20 and 21 days.

The installations constituted of 15 collective uncovered pens, with 240 m^2 (12 x 20 m) each. Each pen was capable of housing 19 animals, allowing each animal an area of 12.6m^2 and 0.63m of feeder space. A total of 285 steers were used, at 36 months of age and weighing 362.4 ± 4.6 kg. Of these animals, 230 were Nelore breeds, and 55 were crossbreds (Zebu/Zebu and Zebu/Holstein Friesian). Animals were marked and distributed according to their breed and body weight. An anthelmintic product with ivermectin 1% was administered to all animals at the beginning of the experiment.

To compose whole-crop maize silage, the IAC 8333 hybrid (Campinas Agronomic Institute, Campinas, Brasil) was used, harvested with 20 cm of cut height. At harvest time, the dry matter (DM) level of maize was 33% and the percentage of grains in the plant was 35%. The average productivity of the crop was 8,380 kg/ha of DM.

The sugarcane IAC 86-2480 cultivar (Campinas Agronomic Institute, Campinas, Brasil) used for silage was at ten months of age with 28% DM, 16.2^o brix and 20cm of height cut. Average productivity was 30,500 kg/ha of DM. The bacterial inoculant *Lactobacillus buchneri* NCIMB40788 (Lasil Cana®, Lallemand Inc., Blangnac Cedex, France) was used as a silage additive. It was administered in the dosage of 5.0 × 10^4 cfu/g of sugarcane biomass ensilaged.

For the diets formulation, besides the silages, the principal ingredients used to create the concentrate were ground sorghum grain, citric pulp and peanut meal (Table 1).

The diets (Table 2) were adjusted through the Cornell Net Carbohydrate and Protein System (CNCPS method) (Sniffen et al., 1992), to be isoproteic (14% CP) and isoenergetic (70% TDN). For the SCSF and MSF, the

Table 1 - Chemical and nutritional composition and average particle size of the main ingredients constituting the total mixed rations

Item (%DM)	Whole-crop maize silage	Sugarcane silage	Sorghum grain	Citric pulp	Peanut meal
Dry matter (% natural matter)	32.47	24.03	87.81	89.52	92.41
Crude protein	8.02	4.08	10.80	6.78	47.91
Ether extract	2.40	0.93	3.30	2.38	1.47
Neutral detergent fiber	50.00	70.92	16.88	23.09	27.09
Acid detergent fiber	29.52	47.25	3.69	16.94	16.55
Acid detergent lignin	3.87	6.97	2.25	4.14	6.93
Non-fibrous carbohydrates	37.49	21.41	70.63	63.95	21.59
Mineral matter	3.51	3.95	1.58	5.60	8.24
Starch	19.50	0.26	65.60	8.10	7.50
Average particle size (mm)	36.93	19.81	-	-	-

Table 2 - Composition of total mixed rations

Ingredient (%)	Sugarcane silage			Whole-crop maize silage		
	Fixed Formulation (SCSF)	Variable Formulation (SCSV)		Fixed Formulation (MSF)	Variable Formulation (MSV)	
		Initial	Later		Initial	Later
Sugarcane silage	35.57	34.72	37.05			
Whole-crop maize silage				43,76	43.17	44.10
Peanut meal	10.19	13.62	7.00	6.32	10.42	3.17
Citric pulp	35.12	35.77	34.36	34.64	33.60	35.22
Ground sorghum grain	15.32	11.95	18.03	11.54	8.96	13.86
Bicalcic phosphate	1.05	1.06	1.03	1.01	1.03	1.01
Urea	1.46	1.56	1.28	1.41	1.49	1.33
Ammonium sulphate	0.11	0.11	0.11	0.12	0.11	0.12
Iodized salt	0.87	0.87	0.85	0.87	0.87	0.87
Refinazil® (corn bran)	0.27	0.28	0.25	0.28	0.28	0.27
Trace minerals, nucleus	0.02	0.02	0.02	0.02	0.02	0.02
Monensin sodium	0.02	0.02	0.02	0.02	0.02	0.02
Nutritional composition (% DM)						
Dry matter (% natural matter)	45.97	45.88	45.22	51.21	51.17	50.77
Crude protein	14.36	15.70	12.82	14.26	15.76	12.80
Ether extract	1.79	1.69	1.78	2.35	2.32	2.39
Neutral detergent fiber	41.77	42.98	41.46	36.70	37.30	36.10
Acid detergent fiber	31.00	31.85	31.28	25.51	25.25	25.39
Acid detergent lignin	4.50	4.21	4.39	3.49	2.80	3.20
Non-fibrous carbohydrates	37.49	35.55	39.28	42.80	40.60	44.30
Mineral matter	6.87	6.59	6.94	6.08	6.31	6.36
Total digestible nutrients	65.40	65.62	65.53	67.70	68.33	67.60
Starch	12.62	10.56	14.84	18.28	16.84	19.90
Average particle size (mm)	9.64	9.62	10.15	15.65	19.23	18.00

SCSV/MSV - diet with variable constitution, using sugarcane silage during initial feedlot stage (SCSV) and whole-crop maize silage in later stages (MSV). Total digestible nutrients: calculated as proposed by NRC (2001). Trace mineral nucleus: sulfur - 365 g/kg; manganese - 23,890 mg/kg; zinc - 76,920 mg/kg; iron - 23,300 mg/kg; copper - 23,300 mg/kg; cobalt - 3,050 mg/kg; iodine - 2,230 mg/kg; selenium - 325 mg/kg.

formulations considered average animal body weight of 420 kg as constant throughout the entire feedlot period. For the SCSV, MSV and SCSV/MSV, the formulations were based on the estimated average body weight divided into two feedlot stages: the initial phase, from the 1st to the 41st day, at 390 kg; and the later phase, from the 42nd to the 82nd day, at 450 kg. Silage sources were changed without an adaptation period for the animals.

Feed was provided twice a day, in the morning (8:00 a.m.) and in the afternoon (16:00 a.m.), allowing a refusal of 5% of offered. For mixing and distribution of the total mixed ration (TMR) to the animals, a vertical mixer (Rotormix Express Casale®, São Carlos, SP) with electronic scales and with a capacity of 1,800 kg were used. The average mixing time adopted was two minutes. Water was supplied *ad libitum*, available in waterers with a capacity of 2,000 L.

The amounts of TMR offered per pen as well as the refusals were daily recorded. Silage, total mixed ration offered and refusal samples were collected, organized weekly and further divided into subsamples. One subsample was sent to pre-drying in a forced-air circulation incubator at 55ºC for 72 hours. The second subsample was used to determine average particle size using the Penn State Particle Size Separator (Lammers et al., 1996) method modified by Mari & Nussio (2002). Daily samples were also obtained from the concentrate and monthly samples from the ingredients present in the concentrate. Subsequently, pre-dried silage, total mixed ration and refusal samples, as well as samples obtained from the concentrate and its ingredients, were ground in a Wiley mill with 1 mm sieve mesh, packed in identified plastic recipients and sent for chemical analysis.

The chemical and nutritional analysis was performed in the Laboratório de Nutrição Animal da Universidade Estadual de Maringá (LANA/UEM). Determination of DM, mineral matter (MM), crude protein (CP), ether extract (EE), acid detergent fiber (ADF), acid detergent lignin (ADL), neutral detergent insoluble nitrogen (NDIN) and acid detergent insoluble nitrogen (ADIN) were performed according to AOAC (1995) recommendations. Acid detergent insoluble protein (ADIP) and neutral detergent insoluble protein (NDIP) final values were obtained by multiplying the ADIN and NDIN values by 6.25. Neutral detergent fiber (NDF) was analyzed according to Van Soest et al. (1991). Starch determination was performed using the enzymatic method described by Poore et al. (1989), following Pereira & Rossi (1995) adaptations.

Non-fibrous carbohydrate (NFC) levels were estimated according to the equation described by Van Soest et al. (1991): NFC = (NDF - NDIP) + CP + EE + MM. Total digestible nutrients (TDN) were estimated using the equation system proposed by the NRC (2001): TDN = dCP + dNDF + dNFC + (dFA × 2.25) -7, where: dCP = true digestible crude protein; dNDF = digestible neutral detergent fiber; dNFC = digestible non-fibrous carbohydrate; and dFA = digestible fatty acids.

Average daily gain (ADG) was assessed by weighing the steers at each sub-period (21 days), in a 16-hour liquid and solid fasting state. Weighing was performed over 3 consecutive days, weighing one replicate of each treatment per day (95 steers/day). The objective of this approach was to ensure a short time frame between the first and last weighing animals, and to avoid unnecessary stress to the animals. Average weighing time was 60 minutes per day.

After the last weighing, at the end of the experiment, the steers were sent to a slaughterhouse 15 km away. As with the weighing, the slaughtering was also divided in three days, which means that 95 steers were slaughtered every day. Determination of hot carcass weight (HCW) and dressing percentage (DP) of all animals were performed. To determine subcutaneous fat thickness (SFT), four steers of each pen were sampled, totaling 60 steers. Sampling was carried out based on the last body weight of fasted animals from each experimental unit (pen). After the slaughter, carcasses were identified, washed, divided in two and taken to cooling for 24 hours at a temperature of -2°C. Subsequently, the *Longissimus dorsi* muscle was removed from the left half of the carcass, between the 12th and 13th ribs. Subcutaneous fat thickness was measured from the incision of the *Longissimus dorsi* muscle in the 12th rib with the help of a ruler (Müller, 1987).

The obtained results were tested by using analyses of variance and all means were compared through orthogonal contrasts test among the silage source (SCSF and SCSV vs MSF and MSV); among diets with fixed and variable formulation within each silage source (SCSF vs SCSV; MSF vs MSV); and the diet that had a change in the silage source (SCSV/MSV) with all other diets. Moreover, correlation and polynomial regression analyses were performed for the different variables evaluated. The SAS (2001) statistic package was used.

Results and Discussion

Changes in diet formulation, according to the feedlot period, did not influence (P>0.22) the dry matter intake (DMI) in absolute values or when considering the body weight of the animal (Table 3). Similarly, the diet with a change in the silage source during feedlot period (SCSV/MSV) did not cause any effect (P>0.59) on these variables when compared to diets that remained with the same silage throughout the feedlot period. The silage source had an effect on DMI, both in absolute values and when considering body weight of the animal (P = 0.009 and P = 0.003, respectively).

Dry matter intake was higher (P<0.01) in the group fed whole-crop maize silage (10.51 kg and 2.43% BW) when compared to the group fed sugarcane silage (10.07 kg and 2.35% BW). Possible factors that could explain a lower DMI in the group fed with sugarcane silage are the NDF levels in the total mixed ration (TMR) and the digestibility of the fiber.

Dry matter intake adjusted to the body weight (%BW) correlated negatively to the NDF levels of TMR (r = -0.68; P = 0.004), with adjust to the linear regression model (DMI %BW = 2.95 – 0.014NDF; r^2 = 0.47; P = 0.005). The TMR composed of sugarcane silage indicated a 5.3% increase in NDF when compared to those with whole-crop maize silage (42.0% vs 36.7%, respectively; Table 2), resulted from the high levels of NDF contained in sugarcane silage (70.9% DM; Table 1). Sugarcane presented NDF a value of 52% DM during ensiling, but, because of the alcoholic fermentation in the fermentation stage, which is known to cause a decrease in soluble carbohydrates, there was an

Table 3 - Nutrient intake by feedlot cattle fed different diets

Item	SCSF	SCSV	MSF	MSV	SCSV/MSV	SEM	Contrast P>F			
	(1)	(2)	(3)	(4)	(5)		1 and 2 *vs.* 3 and 4	1 *vs.* 2	3 *vs.* 4	5 *vs.* 1, 2, 3 and 4
Dry matter intake										
kg	10.20	9.95	10.60	10.42	10.37	0.13	0.009	0.224	0.369	0.599
% LW	2.37	2.33	2.45	2.42	2.40	0.32	0.003	0.232	0.472	0.870
Neutral detergent fiber										
kg	4.21	4.17	3.85	3.85	4.07	0.10	0.06	0.789	0.990	0.681
% LW	0.98	0.98	0.89	0.90	0.94	0.02	0.001	0.904	0.809	0.731
Crude protein intake										
kg	1.47	1.42	1.49	1.46	1.46	0.02	0.270	0.214	0.480	0.909
Total digestible nutrients intake										
kg	6.69	6.58	7.35	7.34	7.06	0.10	<0.001	0.445	0.925	0.538

SCSF = diet with sugarcane silage, fixed formulation; SCSV = diet with sugarcane silage, variable formulation; MSF = diet with whole-crop maize silage, fixed formulation; MSV = diet with whole-crop maize silage, variable formulation; SCSV/MSV = diet with SCSV in the initial stage and MSV in the later stage.

increase in the relative values of NDF in the silage (Siqueira et al., 2007; Mendes et al., 2008; Evangelista et al., 2009).

The highest NDF values identified in TMR with sugarcane silage resulted in a higher NDF intake when comparing with the whole-crop maize silage groups (Table 4), both in absolute values (P = 0.006) and when considering the body weight of the animal (P = 0.001). Average NDF intake values calculated for the entire feedlot period were 4.19 kg and 0.97% BW in sugarcane silage diets, and 3.85 kg and 0.89% BW in whole-crop maize silage diets. These values are below 1.2% BW, described by Mertens (1987) as the point when physical control starts to show a regulative effect on intake. Therefore, this suggests that fiber digestibility could have been more important than the ingested amount of NDF on influencing DMI. The NDF digestibility constitutes an important forage quality parameter on account of the high variability of ruminal degradation and its impact on animal performance (Oba & Allen, 1999). When analyzing lactating cows with similar amounts of NDF present in forage, Correa et al. (2003) found that diets containing sugarcane *in natura* generated less DMI compared with diets containing whole-crop maize silage (reduction of 6.9%), and attributed that to the lower apparent digestibility of NDF found in sugarcane, 45% lower than that found in whole-crop maize silage (23.1% vs. 42.05%, respectively).

The NDF intake did not differ (P>0.79) between fixed (SCSF and MSF) and variable (SCSV and MSV) formulation diets, just as there was no statistical difference (P>0.68) between the diet with change of silage source and other diets.

There was no statistical difference (P>0.21) in crude protein (CP) intake among the diets. Variable formulation diets (SCSV and MSV) presented a variation in CP values during the feeding period, from 15.7% during the first period (days 1 - 41) decreasing to 12.8% in the second period (days 42 - 82), while those with fixed formulation maintained CP values of 14.3% (Table 2). Despite this, CP intake was similar among feeds, with a mean value of 1.46 kg, which corresponds to 0.34% BW.

Variation observed on DMI between whole-crop maize and sugarcane silage diets was not sufficiently distinct to interfere with CP intake. An important factor corresponding to this finding was the selection of food performed by animals in the feeders, which deviated amongst the studied diets, especially between the silage sources (Table 4).

In diets composed of sugarcane silage, refusal was characterized by having greater amount of roughage when comparing to refusal of whole-crop maize silage based diets. Average particle size of refusals in SCSF and SCSV feeds was found to be higher when comparing to TMR (21.06 and 25.03 mm vs 9.64 and 9.88 mm, Table 2) and sugarcane silage (19.81 mm; Table 1), which indicates rejection of larger particles in the forage, mainly constituted by parts of the stalk not processed during ensiling. Concerning the TMR, only 2.6% of the material was withheld by a sieve with mesh greater than 38 mm, and 69% by a sieve with a mesh inferior to 8 mm. When refusals were considered, 13% of the material was withheld by a sieve with mesh greater than 38 mm and 62% with a mesh inferior to 8 mm.

A different tendency was observed for MSF and MSV diets, in which the refusals presented a higher amount of the concentrate, which was consistent due to its smaller average particle size (5.57 and 5.17 mm, respectively) and to its chemical composition, with values close to those found in the TMR (Table 2). Within the TMR, 8.4% of the material was withheld by a sieve with mesh greater than 38 mm and 62.8% with a mesh inferior to 8 mm. Refusals had 1.5% withheld by a mesh larger than 38 mm and 92% with mesh sized inferior to 8 mm. The observed tendency of the

Table 4 - Chemical composition and average particle size of refusals found in feeders

Item (% DM)	SCSF	SCSV	MSF	MSV	SCSV/MSV	
					days 1-41	days 42-82
Dry matter (% natural matter)	53.85	52.03	62.04	64.3	51.94	62.64
Crude protein	9.74	10.40	12.55	12.69	10.82	10.75
Ether extract	1.22	1.40	2.32	2.39	1.29	2.35
Neutral detergent fiber	48.80	45.44	29.06	26.87	47.20	28.85
Acid detergent fiber	33.55	31.94	19.47	19.05	32.77	20.32
Acid detergent lignin	5.68	5.67	2.97	2.45	6.31	2.99
Non-fibrous carbohydrates	30.54	33.39	47.55	48.90	30.57	49.05
Mineral matter	6.76	6.57	8.09	8.58	7.21	7.85
Average particle size (mm)	25.03	21.06	5.57	5.17	25.90	6.98

SCSF = diet with sugarcane silage, fixed formulation; SCSV = diet with sugarcane silage, variable formulation;
MSF = diet with whole-crop maize silage, fixed formulation; MSV = diet with whole-crop maize silage, variable formulation; SCSV/MSV = diet with SCSV in the initial stage and MSV in the later stage

SCSV/MSV diet was the same as that observed for the sugarcane silage diet during the first period, and similar to the whole-crop maize silage diet during the second period.

Although the total feed selection done by the animals contributed to maintaining CP intake similar for both silage sources, it did not incur the same effect for NDF intake.

Total digestible nutrient (TDN) intake did not differ (P>0.42) between fixed (SCSF and MSF) and variable (SCSV and MSV) formulation diets, and between SCSV/MSV and other diets (P>0.34). An effect caused by the silage source was observed (P<0.0001). Whole-crop maize silage allowed animals to ingest a TDN daily amount equal to 0.710 kg more than animals fed sugarcane silages, determined both by DMI and levels of TDN found in TMR. Selection made by animals fed sugarcane silage allowed them to ingest higher amounts of TDN when compared to that offered in the diet, 65.9 vs 65.5%, not enough to assure a similar intake to that observed with the whole-crop maize silage, however.

Despite the difference in DMI and TDN intake found in whole-crop maize and sugarcane silages, no statistical difference (P>0.21) was observed in the average daily gain (ADG) of animals. (Table 5). No difference was identified between fixed and variable formulation diets (P>0.16) and between the SCSV/MSV and other diets (P = 0.226). The ADG was 1.348 kg/animal.

Sugarcane silage diets provided an equal ADG as whole-crop maize silage diets, despite demonstrating a lower energy content. Therefore, the TDN amount in sugarcane silage diets could have been underestimated, mainly because the equations did not account for volatile compounds formed during fermentation, e.g. ethanol and acetic acid. These compounds are characteristic of the sugarcane fermentation process, having a high energy content. Randby et al. (1999) have demonstrated that by adding ethanol in the feeds of lactating cows, an increase of total energy intake was observed, as was the increase of fat found in milk. Pedroso et al. (2006) observed an increase of ADG greater than that predicted by NRC (2001) in sugarcane silage diet, which was explained by the underestimation of TDN levels found in the silage.

Feed conversion was neither influenced by the silage source (P = 0.968) nor by diet formulation, fixed or variable (P = 0.275). Change of silage during the feedlot period resulted in a lower feed conversion (P = 0.08) when compared to diets where silage source remained constant during feeding period: 8.6 and 8.0 DM/kg of BW, respectively. This difference was identified in later stages of feedlot period, after the change of silage (42nd and 82nd days), when a lower average daily gain (P = 0.04) was found associated with a higher DMI (P = 0.06) in the SCSV/MSV when compared to

Table 5 - Performance of feedlot finishing cattle with whole-crop maize silage and sugarcane silage diets with different formulation[1]

Item	SCSF	SCSV	MSF	MSV	SCSV/MSV	SEM	Contrast P>F			
	(1)	(2)	(3)	(4)	(5)		1 and 2 *vs.* 3 and 4	1 *vs.* 2	3 *vs.* 4	5 *vs.* 1, 2, 3 and 4
Average daily gain, kg	1.391	1.290	1.430	1.338	1.293	0.05	0.389	0.168	0.203	0.226
Feed conversion, kg DM/kg LW	7.7	8.2	7.8	8.1	8.6	0.3	0.968	0.275	0.601	0.080
Initial liveweight, Kg	370.3	368.1	370.4	371.9	372.5	2.1	0.373	0.478	0.622	0.335
Liveweight at slaughtering, kg	484.3	473.9	488.0	481.6	478.5	4.1	0.198	0.103	0.298	0.478
Hot carcass weight, kg	254.8	250.2	263.4	260.8	258.0	2.2	0.001	0.159	0.413	0.797
Dressing percentage, %	52.5	52.9	54.0	54.1	53.9	0.3	0.001	0.404	0.693	0.170
Subcutaneous fat thickness, mm	4.6	5.0	6.7	5.7	5.4	0.6	0.056	0.677	0.294	0.885

SCSF = diet with sugarcane silage, fixed formulation; SCSV = diet with sugarcane silage, variable formulation; MSF = diet with whole-crop maize silage, fixed formulation; MSV = diet with whole-crop maize silage, variable formulation; SCSV/MSV = diet with SCSV in the initial stage and MSV in the later stage.

other diets (1.077 vs 1.249 kg and 2.44 vs 2.40% BW, respectively), resulting in a lower feed conversion (P = 0.05; 10.4 vs 9.1 kg DM/kg BW).

The change of sugarcane for whole-crop maize silage without an adaptation period for the animals may have interfered with the ruminal ambient, through an increase of non-fibrous carbohydrate levels and starch content in the TMR (Table 2), having a negative effect on animal performance, despite an increase in DMI, therefore hindering feed conversion efficiency. Replacing the diet of animal can cause a transition period for the ruminant population, with a variation in the proportion of different ruminant species that can better adapt to the dietary changes, a process that could last days and/or weeks (Owens & Goetsch, 1993).

Animals were slaughtered at the end of the experiment with an average body weight of 481.2 kg, with no differences (P>0.10) among the analyzed diets, resulting in a similar ADG. There was an increase of 110.6 kg in the animal body weight.

The similarity observed in body weight at slaughter was not translated to hot carcass weight (HCW) by differences (P<0.001) found among silage sources for dressing percentage (DP). Higher HCW and DP values were found for the diets containing whole-crop maize silage (262.1 kg and 54.1%, respectively) when compared to diets containing sugarcane silage (252.5 kg and 52.7%). A higher DP for diets constituted by whole-crop maize silage when compared to sugarcane *in natura* was also found by Brondani et al. (2006). On the other hand, Vaz & Restle (2005) and Fernandes et al. (2007) did not observe the influence of roughage source (whole-crop maize silage vs sugarcane) on DP. Adjusting the diet formulation according to the feedlot period for both whole-crop maize silage (MSV) and sugarcane silage (SCSV) and the change of silage source (SCSV/MSV) neither influenced (P>0.15) HCW nor DP.

The silage source also influenced subcutaneous fat thickness (SFT) on the carcass, where diets containing whole-crop maize silage allowed for higher values (P = 0.056) than those containing sugarcane silage (6.2 vs. 4.8 mm). Although lower, the SFT of animals fed sugarcane silage (4.8 mm) fell within the range considered acceptable for slaughter (3 to 6 mm), which combines carcass quality with fewer losses by cooling and a lower trimming necessity (Müller, 1987). No differences (P>0.29) were found for the SFT when comparing fixed vs. variable formulations, for both whole-crop maize and sugarcane silages, similarly for the SCSV/MSV and the other diets.

Differences found within the DP could have been related to two factors: gastrointestinal weight and carcass quality. DP was negatively correlated to NDF intake, both in absolute values (r = -0.63; P = 0.01) and when considering the BW (r = -0.67; p = 0.006), with a linear regression adjust (DP = 63.36 – 2.45 NDF intake (kg), r^2 = 0.40; P = 0.01; DP = 64.24 – 11.48 NDF intake (%BW), r^2 = 0.45; P = 0.006). Greater values of gastrointestinal weights have been discovered in feeds with a higher degree of NDF and lower digestibility (Silva et al., 2002). Macitelli et al. (2005) have found that diets containing sugarcane resulted in higher levels of ruminal material in the gastrointestinal tract when compared to whole-crop maize silage.

There was a positive correlation between DP and SFT (r = 0.54; P = 0.03) with a linear regression adjust (DP = 51.47 + 0.37 SFT, r^2 = 0.30; P = 0.03). According to Berg & Butterfield (1976), the influence which fat deposition had on dressing percentage is due to a higher quantity of fatty acids deposited in the carcass as opposed to components that were not part of the carcass.

Although the higher DMI found for the whole-crop maize silage diets did not alter quantitatively the ADG, it did affect its composition, by increasing the deposition of fat in the carcass, with positive effects in its dressing percentage. Finally, as the animals showed very similar initial average weights in all the studied diets, and presumably an equal initial dressing percentage, the supply of whole-crop maize silage may have resulted in a higher carcass gain for the animals, when compared to the sugarcane silage.

Conclusions

The changes made in the formulation according to the feedlot period do not influence finishing cattle performance. Substituting sugarcane silage for whole-crop maize silage during feedlot period affects negatively the animal feed conversion. The use of sugarcane silage in balanced diets is a viable alternative to whole-crop maize silage, permitting a satisfactory performance in finishing cattle during feedlot. Whole-crop maize silage provides superior finishing and dressing percentage than does sugarcane silage.

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