Intake and digestibility of nutrients in steers fed sugarcane ensiled with calcium oxide

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Introduction

The sugarcane is a feed source traditionally used as fresh-chopped sugarcane in feedlot diets. However, the sugarcane is relatively difficult to harvest mechanically. Therefore, to solve this daily labor of harvest and chop sugarcane, the use of sugarcane silage has been increased. On the other hand, the quality of sugarcane silage is usually poor due to the sugar which is readily fermented to ethanol by yeast, an inefficient fermentation pathway. Additives, like calcium oxide, in sugarcane silage have been studied to try decrease or stop sugar fermentation by yeast and preserve silage nutritive value. The effects of calcium oxide in sugarcane silage are decreasing the ethanol production by inhibition of yeasts activity through the pH and osmotic pressure increase.

Objectives

The objective of this study was to evaluate the effect of calcium oxide levels as additive of sugarcane silage on intake and digestibility of nutrients in crossbred steers.

Material & Methods

✓ ***Animals***

Four Nellore steers (184 ± 10.2 kg of BW), fitted with abomasal and ruminal cannulas

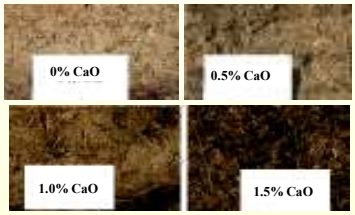
✓ ***Experimental design***

4 × 4 Latin square design

✓ ***Diets***

Diets consisted of 50% roughage and 50% concentrate, formulated to be isonitrogenous (12% CP, DM basis).

The four treatments consisted of sugarcane ensiled with four calcium oxide levels (0, 0.5, 1.0, and 1.5%, as fed).



✓***Intake and Digestibility***

The experiment was conducted for 72 d (4 periods of 18 d each: 10 d for diet adaptation, 6 d to collect fecal and abomasal samples, 1 d for ruminal pH measurements and collection of ruminal fluid).

For each animal, the DMI was measured daily. Indigestible ADF (iADF) was used as an internal marker to estimate apparent nutrient digestibility and fecal output.

Table 1. Proportion of ingredients in diets composition (% DM)

Item	Calcium oxide in sugarcane silage, %			
	0	0.5	1.0	1.5
Sugarcane silage	50.00	50.00	50.00	50.00
Corn ground	39.46	40.02	40.02	40.02
Soybean meal	8.02	8.02	8.02	8.02
Urea/AS (9:1)	1.50	1.50	1.50	1.50
Calcite limestone	0.56	-	-	-
Dicalcium phosphate	0.25	0.25	0.25	0.25
Sodium chloride	0.19	0.19	0.19	0.19
Mineral premix[1]	0.02	0.02	0.02	0.02
	Analyzed content , % DM			
DM, %	57.61	58.11	58.11	58.66
OM, %	95.20	93.80	92.40	91.15
CP, %	12.08	12.01	11.96	12.01
EE, %	2.52	2.44	2.44	2.64
NDF, %	40.51	38.44	37.06	35.35
iADF, %	10.80	9.57	8.00	7.06
NFC, %	40.09	40.91	40.94	41.15
Ca, %	0.401	0.889	1.584	2.193
P, %	0.206	0.207	0.207	0.207
Ca:P	1.95	4.29	7.65	10.59

[1]*Composition (%): copper (22.50), cobalt sulfate (1.40), zinc sulfate (75.40), potassium iodate (0.50), sodium selenite (0.20).*

Feces and abomasal digesta samples (approximately 200 g and 500 mL, respectively) were collected between d 11 and 16 of each period, with intervals of 26 h between the samplings.

Composite samples of feeds, orts, feces, and abomasal digesta were analyzed for total N, DM, ash, OM, EE, NDF, and iADF. The ruminal fluid was preserved by addition of 1 mL of 9 M H_2SO_4, and stored at −20°C for analysis of NH3. Ruminal fluid NH_3 was analyzed by distilling with 2 *M* KOH in a micro-Kjeldahl system, after previous centrifugation at 1,000 × g for 15 min.

✓ ***Statistical Analyses***

The data were analyzed as a 4 × 4 Latin Square design using the MIXED procedure of SAS. The ruminal characteristics data collected over time were analyzed as repeated measures. Linear, quadratic, and cubic effects of calcium oxide levels in sugarcane silage were tested using orthogonal contrasts. Differences were considered to be significant when $P \leq 0.05$.

Results

Table 2. Effect of calcium oxide in sugarcane silage on nutrient intake

Item	Calcium oxide in sugarcane silage, %				SEM	*P*-value[1]		
	0	0.5	1.0	1.5		L	Q	C
	Intake							
DM, kg	3.73	3.75	3.53	3.60	0.37	0.459	0.867	0.487
DM, %BW	1.95	2.01	1.86	1.91	0.15	0.464	0.978	0.291
OM, kg	3.54	3.53	3.27	3.30	0.35	0.211	0.897	0.457
CP, kg	0.47	0.45	0.44	0.44	0.05	0.395	0.709	0.937
EE, kg	0.09	0.09	0.09	0.10	0.01	0.612	0.125	0.104
NDF, kg	1.34	1.29	1.15	1.11	0.12	0.032	0.961	0.528
NFC, kg	1.62	1.68	1.56	1.63	0.16	0.762	0.885	0.186
TDN, kg	2.29	2.41	2.29	2.36	0.30	0.897	0.847	0.500

[1]Probability of linear, quadratic or cubic effect of calcium oxide in sugarcane silage

Except to NDF intake, there were no effects (P>0.05) of CaO levels in sugarcane on intake of all nutrients evaluated (Table 2). The NDF intake decreased linearly (P=0.032) when CaO levels were increased, what probably occur due to lower NDF concentration in diets with CaO.

Effects (P<0.05) of CaO levels were observed on apparent total digestibility of DM, OM, CP, and NDF (Table 3). The increase in the sugarcane silage digestibility of NDF fraction with CaO addition is likely due to the effect of the alkali treatment on cell wall constituents. There were no effects of CaO levels in sugarcane silage on ruminal digestibility of all nutrients evaluated (Table 3).

Table 3. Effect of calcium oxide in sugarcane silage on total and partial digestibility of nutrients and TDN percentage of diets

Item	Calcium oxide in sugarcane silage, %				SEM	*P*-value[1]		
	0	0.5	1.0	1.5		L	Q	C
DM, %	59.77	62.15	63.25	65.24	3.35	0.036	0.901	0.748
OM,%	62.18	65.20	67.71	68.41	3.10	0.007	0.368	0.817
CP,%	55.89	58.84	63.24	63.42	5.49	0.042	0.579	0.609
EE,%	74.15	74.14	76.68	77.71	2.72	0.102	0.747	0.575
NDF,%	29.29	34.59	37.89	41.27	4.83	0.025	0.756	0.882
NFC,%	90.98	89.60	89.58	87.21	2.71	0.106	0.725	0.556
TDN, %	61.49	63.51	64.68	65.09	2.96	0.079	0.549	0.989
Ruminal digestibity, % of total digestion								
DM, %	62.47	64.77	67.89	66.90	2.58	0.290	0.622	0.741
OM,%	65.47	69.19	71.65	71.42	2.45	0.188	0.543	0.920
CP,%	27.63	41.45	39.72	48.89	7.76	0.114	0.767	0.460
EE,%	0.61	-0.37	-5.27	0.72	3.82	0.774	0.345	0.369
NDF,%	75.87	66.39	66.52	67.40	8.67	0.503	0.539	0.811
NFC,%	75.33	82.34	85.89	85.52	4.19	0.171	0.481	0.984

[1]Probability of linear, quadratic or cubic effect of calcium oxide in sugarcane silage

Ruminal pH values were not affected by CaO levels, what means that the increase in pH silage with CaO levels had no effect on ruminal pH ruminal and environment was adequate for microbial growth. Overall, the mean ruminal pH value observed was 6.68. In the same way, NH3-N concentration also was not affected (P>0.05) by treatments and averaged 9.86 *mM*.

Conclusions

The addition of up to 1.5% of calcium oxide in sugarcane ensilage improves sugarcane silage digestibility.

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