LOW-FIBER SUGARCANE TO IMPROVE MEAT PRODUCTION WITH LESS METHANE EMISSION IN TROPICAL DRY SEASON

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ABSTRACT

One of the main strategies to improve animal production and to reduce methane emissions in tropical animal production systems is to provide feed supplement to beef cattle in the dry season, when pasture forage production and forage quality are low. Without feed supplementation, beef cattle take three to six years to get the minimum accepted 450-kg slaughter weight. High-saccharose chopped sugarcane with 1% urea may be used to reduce weight losses, or plus grain-concentrate it may improve weight gain in the dry season, mainly with low NDF:saccharose ratio varieties. The main goal of this work was to improve knowledge on methane emission rates from varieties with extreme NDF:saccharose ratios. Experiments were performed with Holstein x Zebu crossbred dairy heifers, under controlled feeding, in a randomized block design, with 4 treatments: two sugarcane varieties, low- (cane1) and high-fiber (cane2), treated with either 1% urea (U), or substituting 40% of DM with a 18% crude protein concentrate (C), and three replications repeated twice. The experiment was carried out in late winter, in August 2001, the driest month. Methane emission was measured using the hexafluoride tracer method. Methane emission rates, per day and per kg LW were 113-166-122-140 g/d and 0.33-0.47-0.34-0.37 g/d/kg LW, respectively, for cane1U-cane1C-cane2U-cane2C. For pure sugarcane, values were 101 g/d and 0.27 g/d/kg LW. Results suggest that the use of lower NDF:saccharose ratio sugarcane variety plus concentrate will improve meat production with a lower methane emission per unit of product, in tropical dry season.

INTRODUCTION

One of the main strategies to improve animal production rates and to reduce methane emissions in animal production systems under tropical conditions is to provide feed supplement to beef cattle in the dry season, when pasture forage production and forage quality are low. Without feed supplementation, beef cattle stay a long period on pasture, taking three to six years to get the minimum accepted 450-kg slaughter weight. Nowadays, many farmers in Brazil feed, in the dry season, high-saccharose sugarcane varieties (screened for sugar and alcohol industry purposes), chopped, with 1% urea, to avoid weight losses, or with concentrate to allow weight gain.

A recent study (Rodrigues et al., 2002), using four sugarcane varieties, chosen due to their extreme neutral detergent fiber (NDF):saccharose ratio (2.9 to 3.9), fed to growing heifers receiving high protein supplementation (1.3 kg/animal/day, around 17% of dry matter intake), showed a greater live weight (LW) gain of up to 37%, in the 90-days growing phase, with the same dry matter (DM) intake, for the variety with the lowest fiber content (cane1, IAC86-2480) when compared to the high-fiber variety (cane2, IAC87-3184).

These results stimulated the present study, whose main goal was to improve knowledge on methane emission rates of varieties with extreme NDF:saccharose ratios. Although saccharose is not so efficient to improve weight gain as corn starch, chopped sugarcane supplemented with concentrate, in Brazil, for a daily weight gain of 0.85 or 1.25 kg, resulted in 3.5 or 2.9 times greater profit per hectare than a corn-based diet, respectively (Nussio et al., 2003), mainly due to greater yield of total digestible nutrients per hectare, which was of 15 to 20 t/ha for sugarcane against 8 t/ha for corn, sorghum or cassava (Lima & Mattos, 1993).

MATERIAL AND METHODS

Experiments were carried out in August (winter) 2002, at Sao Carlos, Sao Paulo State, Brazil, under altitude tropical climate, at 860 m above sea level, at latitude 22^{o}01´ S and longitude 47^{o}54´ W. They were performed with Holstein x Zebu crossbred dairy heifers, under controlled feeding, in a randomized block design, with 4 treatment: two sugarcane varieties treated with either 1% urea (U), or substituting 40% of DM with a 18% crude protein concentrate (C), and three replications repeated twice. Low- and high-fiber sugarcane varieties were, respectively, IAC86-2480 (cane1) and IAC87-3184 (cane2), with an average of 44,2% and 54,7% NDF, and 15,6% and 14,2% saccharose. An additional test was run with pure chopped high-fiber sugarcane, to measure methane emission with restricted intake. The work was carried out in late winter, in the driest month, August 2001. Sugarcane was harvested daily, chopped and mixed with urea or concentrate and mineral salt. Dry matter intake was measured and quality of offered and residual feed, as well as composition of the feces, was determined. Methane emission measurements followed the method described by Johnson and Johnson (1995), using the hexafluoride tracer.

Calculations of different feed characteristics were done following the methods used by Holter and Young (1992) and Kurihara et al. (1999).

Data were analyzed by GLM procedure (SAS, 1998), and means were compared with F test (cane with urea or concentrate), and when including pure sugarcane treatment with Tukey test.

RESULTS AND DISCUSSION

Table 1 shows intake data and Table 2, methane emission rates (mean of 60 measurements each). No difference in dry matter intake was observed between sugarcane varieties (P>0.05), but a difference between treatments with and without 40% of concentrate, with corrected nitrogen level was found (P<0.05), which will increase DM intake in 50%, and methane emission in 20%.

Table 1. Live weight, NDF and dry mater intake.

Cane	Treatment	LW	------------- DMI ------------		NDFI
		kg	kg/d	%LW	%LW
1	1	357	6.9	1.9 b	0.75 c
1	2	372	10.9	2.9 a	1.04 ab
2	0	370	5.3	1.4	0.66
2	1	370	7.3	2.0 b	0.96 b
2	2	399	11.2	2.8 a	1.15 a
Mean	0	370	5.3	1.43 c	0.66 c
	1	364	7.1	1.95 b	0.86 b
	2	385	11.0	2.87 a	1.10 a

Treatment: 0 = pure chopped sugarcane, 1 = with 1% urea, 2 = 40% DM as concentrate with 18% CP. Cane: with a NDF:saccharose ratio of 3 = 1 and 4 = 2; I=intake; DM = dry mater, NDF = neutral detergent fiber. Mean values in column not sharing a common letter were significantly different, P<0.05 (F test for cane x treatments, Tukey for treatments).

Table 2. Methane emission by dairy Zebu crossbreed heifers due to intake of different sugarcane diets.

Cane	Treat	---------------------------- CH_4 emission -------------------------------				
		g/d	kg/y	g/d.kgLW	g/d.kgMLW	%GEI
1	1	113 c	41	0.32 b	1.38 b	5.39 a
1	2	166 a	61	0.45 a	1.96 a	4.91 a
2	0	101	37	0.27	1.20	6.38
2	1	122 bc	45	0.33 b	1.46 b	5.30 a
2	2	140 b	51	0.36 b	1.58 b	4.43 a
Mean	0	101 b	37	0.27 c	1.20 c	6.38 a
	1	118 b	43	0.33 b	1.42 b	5.35 b
	2	153 a	56	0.40 a	1.77 a	4.67 b

Treatment: 0 = pure chopped sugarcane, 1 = with 1% urea, 2 = 40% DM as concentrate with 18% CP. Cane: with a NDF:saccharose ratio of 3 = 1 and 4 = 2; I=intake; GE = gross energy; MLW = metabolic live weight. Mean values in column not sharing a common letter were significantly different, P<0.05 (F test for cane x treatments, Tukey for treatments).

No differences between sugarcane varieties were observed (P>0.05, F test) for none of the methane emission factors. However, there was difference for treatments containing urea or concentrate (P<0.05, F test), except for gross energy intake (GEI). Sugarcane x treatment interaction for all emission factors was significant (P<0.05, F test), except for GEI. The interactions indicated that low-fiber sugarcane will produce more methane than high-fiber sugarcane when intake is stimulated by supplementation with 40% of DM as concentrate.

Considering that the methane emission curve will reach its maximum peak at around 40% DM as grain-concentrate, as observed with sorghum silage (unpublished data), and considering the results of weight gain of about 37% greater with the low-fiber sugarcane, but with only 17% of DM as concentrate (Rodrigues et al., 2002), it can be estimated that methane emission in that case would not be significantly greater. Further studies on sugarcane diets supplement with different grain levels will evaluate it.

Results suggest that lower NDF:saccharose ratio sugarcane plus concentrate will improve meat production with lower methane emission per unit of product, in tropical dry season, although methane emission per animal or kg LW will increase. Since availability of good quality tropical grass forage will reduce from late fall to early spring, which is up to 58% of the grazing period, supplementation with concentrate-corrected chopped sugarcane to get a continuous weight gain of beef heifers may be used, mainly in winter.

Considering the mean values of all treatments, significant differences (P<0.05, Tukey) were found for all emission factors. However, methane emission related to gross energy intake (GEI) was the same for supplemented treatments (urea and concentrate). Methane emission results per kilogram of live weight did match with data of Kurihara and al. (1999) and with field observations on sugarcane feeding, where pure sugarcane results in weight loss due to intake restriction, chopped sugarcane with 1% urea maintains animal weight, and sugarcane with concentrate improves weight gain. Further data obtained with similar cattle fed sorghum silage and up to 60% of dry matter as concentrate (methane peak emission occurs at 40% concentrate), suggest that sugarcane with greater levels of concentrate may further reduce methane emission per animal and per unit of product.

Little loss of ingested gross energy (GEI) as methane will probably be a result of high energy availability of saccharose and concentrate sources, since sugarcane fiber is of very low digestibility (Preston & Leng, 1980). Further evsaluations, including digestible energy intake, and further research with sugarcane and increasing doses of concentrate will point out the concentrate amount that will result in less methane emission per digestible energy intake.

CONCLUSION

1. Without concentrate, methane emission during digestion of low-fiber and saccharose-rich sugarcane is similar to that of high-fiber and saccharose-rich variety.

2. Supplementation of sugarcane with concentrate will increase both dry matter intake and methane emission, and it will increase methane emission faster for low-fiber cane.

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