COUNTRY: BRAZIL

SESSION: RUMINANT NUTRITION

Daily methane emission at different seasons of the year by Nelore cattle in Brazil grazing Brachiaria brizantha cv. Marandu. Preliminary results.

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ABSTRACT

Methane emissions by Nelore cattle grazing Brachiaria brizantha were monitored during winter (August), spring (December) and summer (February) season. Sixteen Nelore steers with live weight (LW) varying from 206 to 525 kg, 196 to 538 kg and 258 to 598 kg during winter, spring and summer, respectively. Methane emissions were measured with the sulfur hexafluoride (SF6) technique. Mean methane emissions were 102,3, 136,5 and 209,9 g animal/day and 0,343, 0,420 and 0,530 g/kg LW/day in winter, spring and summer, respectively. Variations in observed methane production among seasons were related to forage quality that affects digestibility and consumption. These results indicate high associative effects of methane production with live weight due to digestible dry matter intake

KEYWORDS

Methane, Brachiaria brizantha, Nellore.

INTRODUCTION

Methane (CH4) is considered a greenhouse gas, and is the second in global importance. CH4 is naturally produced during rumen digestive fermentation process of structural carbohydrates contained in forage based diets. The total CH4 emission by cattle in the world is estimated to be 58 millions/year, or 73% of all livestock species (US Environmental Protection Agency, 1994). At least half of world cattle population occurs in tropical regions, mainly based on grazing systems. Brazil has the world largest commercial beef cattle population (130 millions), mostly zebu breeds, with 98% of animals on pastures, mainly cultivated with Brachiaria spp. Methane emission by ruminants represents an energy loss of 4 to 12% of gross energy intake. Diet intake and digestibility are factors that influence CH4 production. However, there is a lack of data of zebu cattle on grazing conditions under tropical climate, and the IPCC's estimates are based on Bos taurus and temperate grass evaluations. Thus, the purpose of this work was to evaluate the methane emissions by Nellore cattle grazing B. brizantha in different seasons of the year to corroborate to the IPCC´s agriculture greenhouse gases inventory.

MATERIAL AND METHODS

Methane emissions by Nelore cattle grazing Brachiaria brizantha cv. Marandu were monitored during winter (August), spring (December) and summer (February) season at the Instituto de Zootecnia in Nova Odessa-SP, Brazil. The evaluation was carried out in an area of 48 ha divided in paddocks of 1 ha each. There were 16 experimental units, formed by [illegible] paddocks where the animals rotated. . Sixteen Nellore steers with live weight (LW) varying from 206 to 525, 196 to 538 and 258 to 598 kg were used during winter, spring and summer season, respectively. These animals were distributed to each experimental unit with 10 other animals of the

normal herd.
Methane emissions were measured using with the sulfur hexafluoride (SF_6) technique (Johnson & Johnson, 1995) adapted by Primavesi et al. (2002). Such technique consisted in the infusion of a capsule with a known SF_6 release rate inside the rumen, and methane and SF_6 gases were collected in a canister with vacuum, provided with a system of valves and capillaries, connected to a halter. The measurements were made during 5 consecutive days, and the canisters were changed every 24 hours. The concentration of gases in the canister was measured with a gas chromatograph.
Forage mass allowances of each paddock were measured the first day of measurements. Forage samples were dried to determine their water content, chemical composition (CP. NDF, ADF, lignin, EE and ash) and in vitro dry matter digestibility (IVDMD). The forage dry matter intake (DMI) was estimated by CNPCS (5.0) for each animal. It was considered that IVDMD were equal to TDN, then 1 kg of digestible DMI were considered to be equal 4,44 Mcal of digestible energy (DE) (NRC 199). The energy loss was estimated by dividing CH_4 energy-equivalent by estimated digestible energy intake.
The co-relations were determinate with Proc Corr. The effects of season were evaluates with Proc GLM, and if differences were detected the least square means were determinate. The statistical program used was Statistical Analysis Systems (SAS, 1998).

RESULT AND DISCUSSION

Winter forage had the lowest CP and digestibility, and the highest NDF, ADF and lignin content (table 1) than spring and summer forage. CP was lower and NDF, and lignin were higher than in spring, but other forage quality parameters were very similar. The analyses of variance showed a significant effect of season ($P<0,05$) for all variables (table 2). The mean CH_4 emissions were significantly different among all seasons, with summer > spring > winter (209,9, 136,5, and 102,3 g/day; $P<0,05$), as the CH_4/LW (0,530, 0,420, 0,343; $P<0,05$). The chemical variation of forages was the first cause of methane emission differences among seasons, which affected digestibility and consequently feed intake. Differences on methane emission related to forage quality are well described by Kurihara et al (1999) working with Brahman heifers receiving tropical forages. Animals eating low quality forage (Angleton grass) had lower intake (3,58 kg DM/day) and methane emissions (113 g/day), but when the animals had access to a better quality forage (Rhodes grass), the intake was higher (7,07 kgDM/day) and consequently the CH_4 emission (235 g/day) too.
During summer CH_4/DDMI (46.7g/kg) was higher ($P<0,05$), than in other seasons, and in spring (35.3 g/kg) there was a statistical tendency ($P= 0,058$) of lower values compared to winter (39.7 g/kg). The lower fiber contents (NDF and ADF) during spring, were the main causes of lower CH_4/DDMI, as reported by Kurihara et al (1999). During summer the highest value was due to the high fiber components and digestibility. The m[illegible] conversion rate (MC[illegible]) or the digestible energy loss as methane, was high[illegible] 0,05) in summer (14,0%), and spring (10,6%) showing a tendency (P. = 0.057) [illegible]r values in winter (11,9%). Those values are higher than 5.5-6,5 % proposed [illegible] USEPA (1994) for use in greenhouse gas inventories of cattle fed on temperate forage diets. Kurihara et al (1999) did bring values in the same range as of this work for low quality grass (10,4 %) and high quality grass (11,4 %)
CH_4 daily emissions did have a high associative effect ($P<0,05$) with LW for all evaluations (r = 0,88, 0,97, 0,78, for summer, spring and winter, respectively; Figure 1), as a consequence of the increased DDMI intake ($P<0,05$) (r= 0,92, 0,96, 0,73 for summer, spring and winter, respectively; Figure 2). Although, CH_4/LW were

inversely correlated ($P<0,05$) with LW ($r= -0,67, -0,87, -0,75$ for summer, spring and winter, respectively; Figure 3). This is probably because of that growing animals have a relative higher intake (%LW) than animals on maintenance. Figure 4 shows the positive correlation ($r= 0,64, 0,84, 0,63$ for summer, spring and winter, respectively; $P<0,05$) of CH_4 emissions with relative DM intake (%LW).

CONCLUSIONS

These results indicate differences of methane emissions because of forage quality, and a high associative effect of methane production with live weight due to digestible dry matter intake. Using these preliminary data it could be estimated that the mean methane emission is 51,79 kg/head/year, and that the total beef cattle annual production is 4.915,51 Gg. It also could be estimated that the decrease of mean slaughter age from 4,5 to 2 years would promote a 10 % reduction on total methane emission by Brazilian beef herd. This was the first step to understand and determinate the methane emissions of Zebu cattle grazing B. brizantha, which are very representative of Brazilian cattle and grasslands, and it may be helpful to improve the IPCC (Intergovernmental Panel on Climate Change) database.

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Table 1: Forage mass, In vitro dry matter digestibility and chemical composition of *B. brizantha grass in different season of the year.*

	Winter	Spring	Summer
DM (%)[1]	61.86	25.98	24.18
IVDMD (%DM)[2]	41.37	60.38	62.45
CP (%DM)[3]	3.33	7.72	5.35
NDF(%DM)[4]	82.1	71.43	77.18
ADF(%DM)[5]	51.38	41.23	44.08
Lignin(%DM)	7.79	4.35	6.26
EE(%DM)[6]	0.64	1.64	1.08
Ash(%DM)	6.21	8.13	4.83

[1]dry matter; [2]in vitro dry matter digestibilty; [3]crude protein; [4]neutral detergent fiber; [5]acid detergent fiber; [6]ether extract.

Table 2: **Mean live weight and methane emissions by Nelore cattle in winter, spring and summer.**

	Winter	Spring	Summer	P.
LW (kg)[1]	317,6	332,7	410,7	-
DDMI (kg/day)[2]	2,69	3,85	4.48	-
CH4 (g/day)	102,3[a]	136,5[b]	209,9[c]	0,0001
CH4/LW[3] (g/kg)	0.343[a]	0.420[b]	0.530[c]	0,0001
CH4/DDMI[4] (g/kg)	39.7[a]	35.3[a]	46.7[b]	0,0001
CH4 Energy Loss (%)[5]	11.90[a]	10.6[a]	14.0[b]	0,0001

[1]Live weight; [2]methane emission per kg of LW; [3]methane emission per kg of digestible dry matter intake; [4]digestible energy loss as methane

[a,b,c] means in the same line with different letter are statistically significant ($P<0,05$).

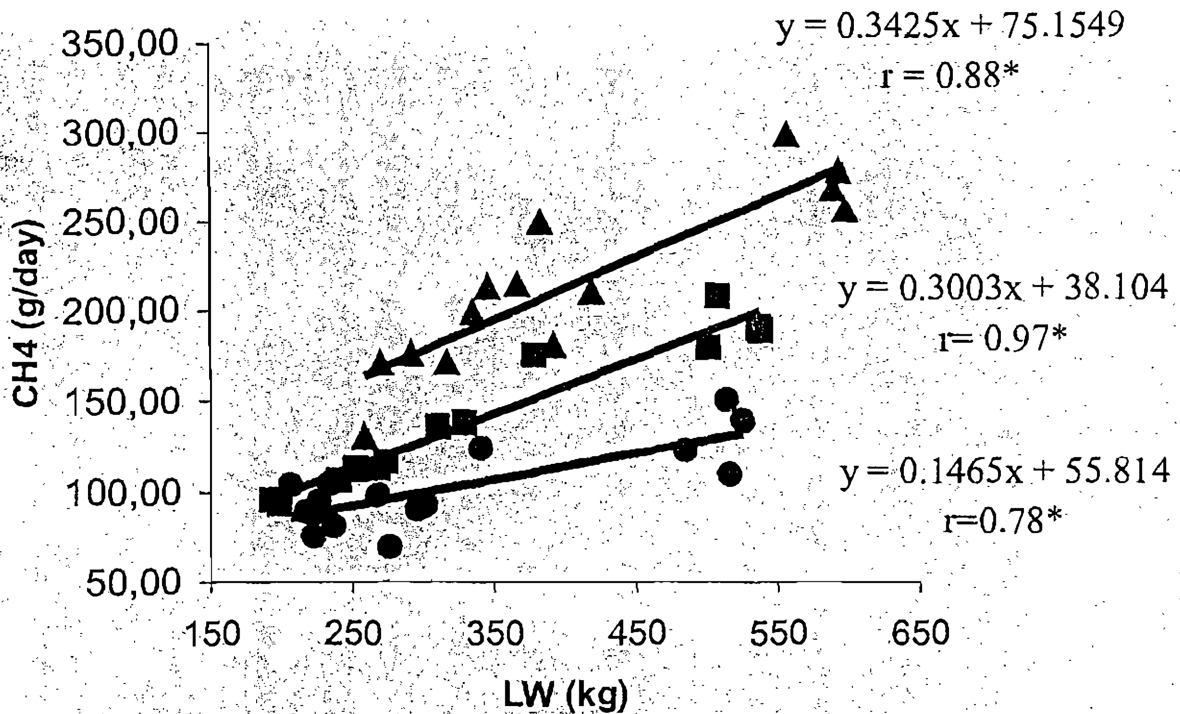

Figure 1: Correlation and linear regression fit of daily CH_4 (g/day) emissions and live weight during winter (?) spring (?) summer (?). *(P<0,05)

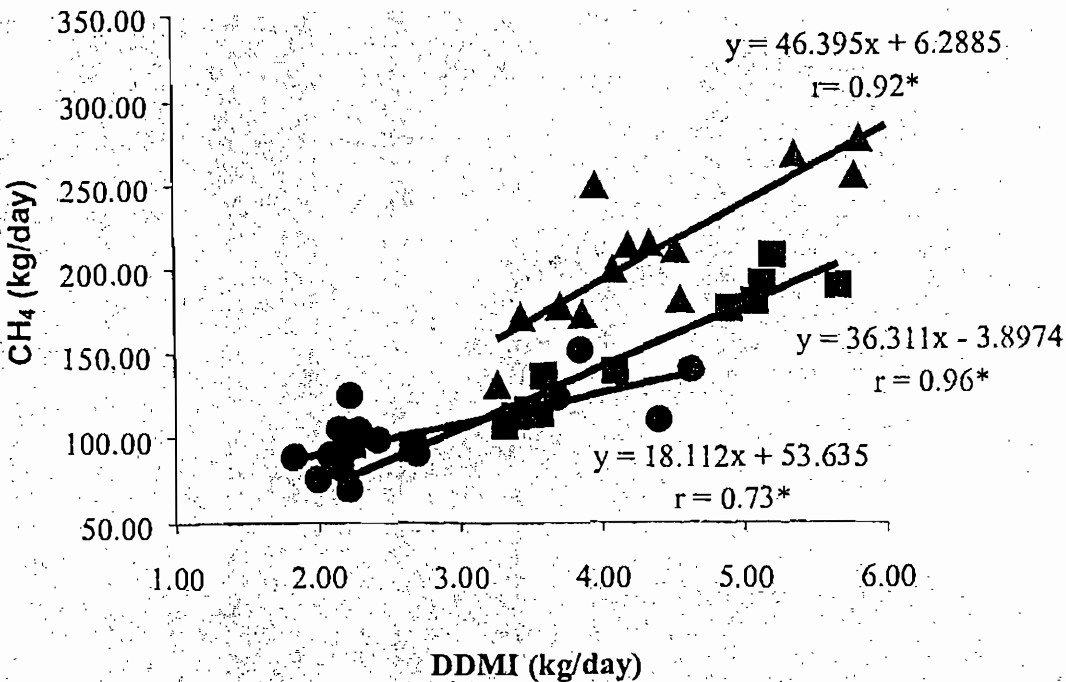

Figure 2: Correlation and linear regression fit of daily CH_4 (g/day) and digestible dry matter intake during winter (?) spring (?) suminer (?). *(P<0,05)

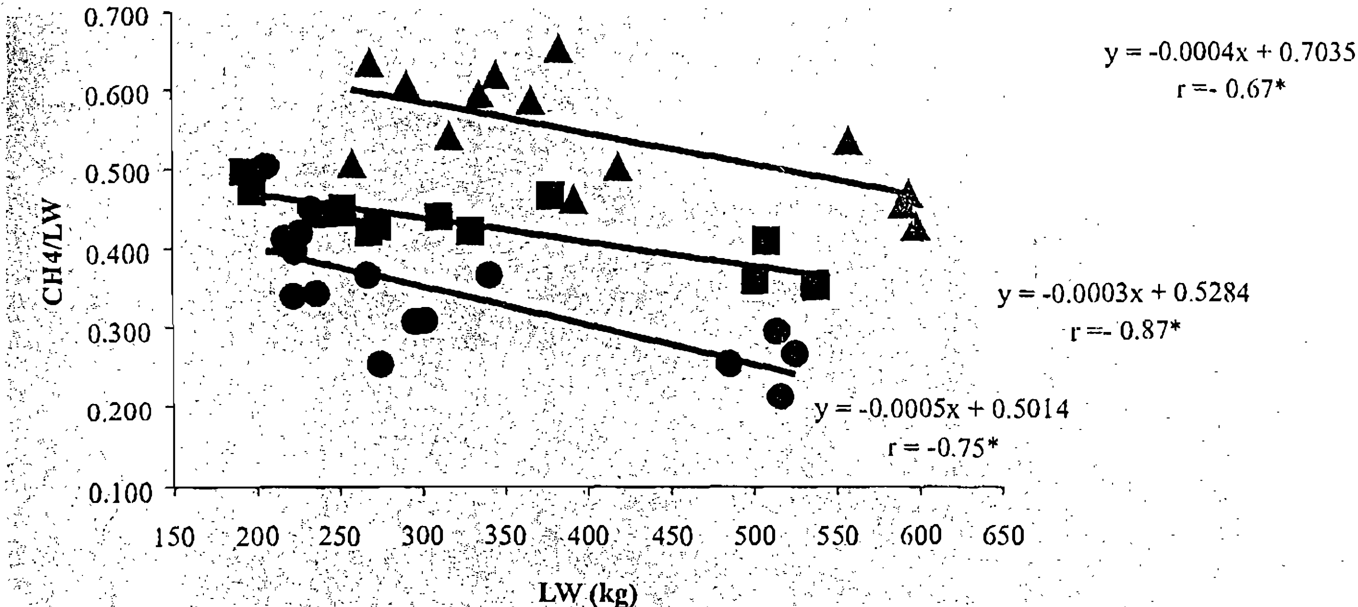

Figure 3: Correlation and linear regression fit of daily CH_4/LW(g/kg) emissions (g/day) and live weight during winter (?) spring (?) summer (?). *($P<0,05$).

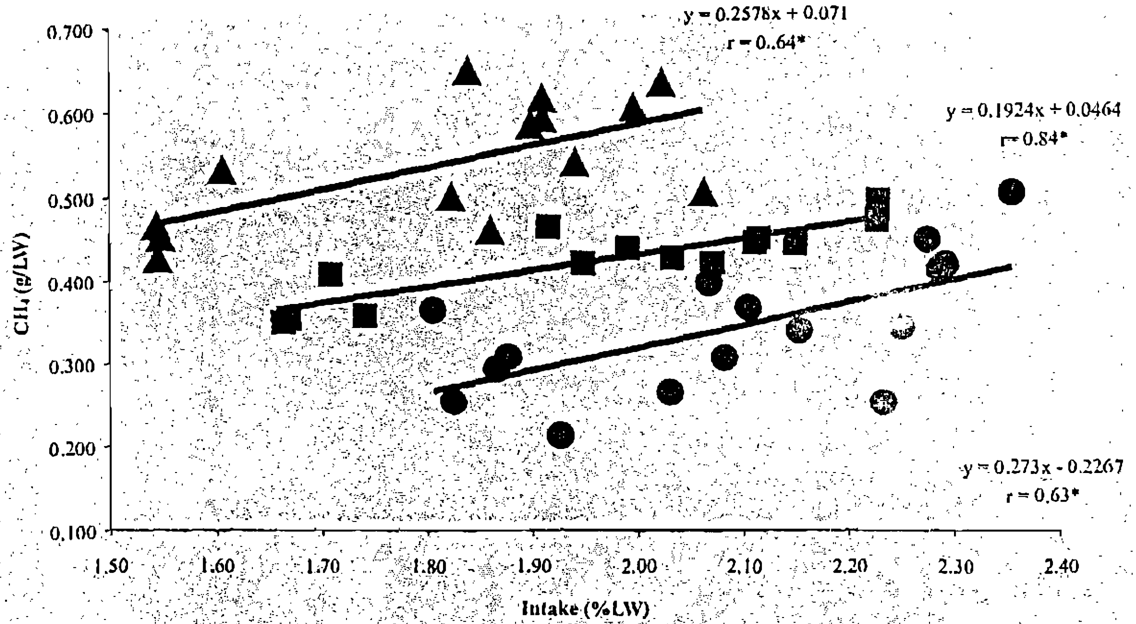

Figure 4: Correlation and linear regression fit of daily CH_4/LW(g/kg) emissions (g/day) and relative dry matter intake (%LW) during winter (?) spring (?) summer (?). *(P<0,05).