Enteric methane emissions of zebu steers fed with tropical forages of contrasting nutritional value

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Introduction

Methane (CH_4) emissions from livestock contribute significantly to climate change and diet plays a fundamental role in the emissions generated. Research in animal nutrition should aim at identifying ways to increase production efficiency with the least possible environmental impact and manipulation of diet quality becomes one of the most viable options to both mitigate emissions and increase animal productivity.

Objective

The present study intends to contribute to the knowledge in this area by means of the evaluation of the methane emissions of some tropical forages commonly used in the Colombian low tropic of different nutritional value and level of voluntary intake in zebu steers.

Methodology

Treatments: Treatments evaluated corresponded to five different diets:

T1: low quality *Brachiaria* hybrid cv. Cayman
T2: high quality *Brachiaria* hybrid cv. Cayman
T3: *Brachiaria* hybrid cv. Cayman + *Leucaena leucocephala*
T4: *Brachiaria* hybrid cv. Cayman + *L. diversifolia*
T5: *Dichantium aristatum* hay

Methane emissions measurements: Methane emissions were measured in four zebu animals using the polytunnel technique. Two polytunnels with a volume of 134 m^3 were used; Each polytunnel was sub-divided into two independent chambers with an area of 67 m^3, making it possible to simultaneously evaluate four animals. The measurements of gas samples were collected every 80 minutes from inside and outside each polytunnel over a 24-hour period.

CH_4 concentration in gas samples: The CH_4 concentration in gas samples collected directly from the air ejected from the extraction hood were analyzed using Gasmet DX4040 (in real-time).

Dry matter intake: The voluntary intake of forage of each animal was calculated by the difference of forage offered and rejected.

Data analyses: Data were analyzed using randomized complete block design with GLM procedure of SAS (SAS Institute Inc., Cary, NC). Animal was considered as the block and the animal weight was used as a covariate.

Results

Table 1. Average intake of dry matter and nutrients in zebu steers fed with tropical forages of different nutritional value

Factor	T1	T2	T3	T4	T5	*P*-value	*SEM*
Dry matter (kg/animal)	1.93^{c}	3.46^{b}	5.77^{a}	6.71^{a}	2.36^{bc}	<.0001	0.48
Dry matter (% of body weight)	0.77^{c}	1.64^{b}	2.69^{a}	2.94^{a}	1.10^{c}	<.0001	0.22
Crude protein (kg)	0.10^{d}	0.28^{c}	0.56^{b}	0.89^{a}	0.14^{d}	<.0001	0.03
Neutral detergent Fiber (kg)	1.35^{c}	2.36^{b}	3.67^{a}	3.82^{a}	1.45^{c}	<.0001	0.31
Acid detergent Fiber (kg)	0.76^{b}	1.20^{b}	2.07^{a}	1.97^{a}	0.91^{b}	<.0001	0.18
Gross energy (Mj)	31.87^{d}	59.35^{c}	96.96^{b}	118.2^{a}	33.66^{d}	<.0001	7.56

SEM= Standard error of mean, $^{(a,b,c,d)}$ means within each rows without a common superscript are significant different *(P< 0.05)*

Figure 1. Methane emissions accumulated (g/day) in zebu steers fed with tropical forages of different nutritional value

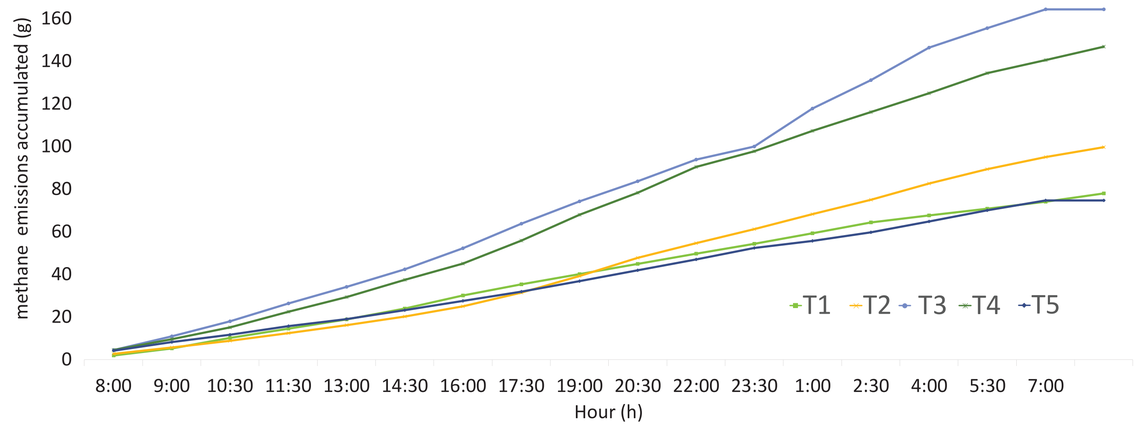

Table 2. Daily production of methane in zebu steers fed with tropical forages of different nutritional value

Factor	T1	T2	T3	T4	T5	*P*-value	*SEM*
Methane (g/kg of DMI)	60.39^{a}	30.15^{b}	27.57^{b}	19.79^{b}	35.98^{b}	<.0001	7.25
Methane (g/kg OMI)	68.52^{a}	34.33^{b}	31.46^{b}	22.76^{b}	45.16^{a}	<.0001	8.62
Methane (g/metabolic weight)	1.71^{b}	1.87^{b}	2.83^{a}	2.21^{a}	1.42^{b}	<.0001	0.28
Methane (g/kg DM digested)	118.38^{a}	48.81^{b}	45.17^{b}	32.45^{b}	75.17^{a}	<.0001	14.6
Energy (E) lost as CH_4 % of gross E intake	20.73^{a}	9.76b	9.10^{b}	6.22^{b}	14.23^{a}	<.0001	2.66

SEM= Standard error of mean, $^{(a,b,c,d)}$ means within each rows without a common superscript are significant different *(P< 0.05)*

Conclusions

» The nutritional quality of the diet that is offered to the animals directly influences the voluntary intake and methane emissions generated.

» In the present study, the diets with the highest nutritional value were those in which Leucaena was included; and it was the diets that presented the highest dry matter intake and the lowest methane emissions per unit of product.

» Animals fed with the same grass showed better efficiency in the use of nutrients when the grass has better quality due to adequate harvest times.

» The quality and quantity of forages is directly related to grazing management practices. Optimal forage harvesting time increases nutrient availability and voluntary intake and therefore influences the reduction of methane emissions.

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