Assessment of Methane Production by Goats under Intermittent Grazing

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Presenter Information

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Introduction

There are 875 million goats worldwide (FAO 2012) and the majority are in developing countries where they are typically raised on pasture. Ruminants release gross energy as methane, which is a greenhouse gas. Mthane mitigation startegies require prior knowledge about emission of methane by animals under different management systems. Intake, quality and type of feed are factors that influence methane emissions, therefore the objective of this study was to investigate how grazing intensity, measured by the residual leaf area index (RLAI), influences methane emission by goats under rotational grazing on Tanzania grass pasture.

Methods

The experiment was conducted at Jaboticabal, Sao Paulo, Brazil. The climate is tropical with a defined dry winter season between April and September and rainfall concentrated during the summer months (October to March). The experimental period started in November 2010, at the beginning of the rainy season. The 1.2 ha pasture area, formed 14 years ago with *Panicum maximum* Jacq cv. Tanzania grass, was divided into paddocks of 243 m^2 each. The criterion adopted for animal input into the paddock was 95% light interception (LI) and the cessation of grazing criterion were RLAI targets of 0.8, 1.6 and 2.4, when methane emissions and forage morphology were determined. LI and RLAI were measured using the canopy analyzer – AccuPAR Model LP – 80 PAR/LAI (Decagon Devices®). A rotational grazing system with three days of occupation was adopted. The animals remained in the paddocks for 11 hours during the day with free access to water and mineral salt. The morphological variables were evaluated within a randomized block design with six replicates. Canopy heights were determined pre- and post-grazing using a graduated ruler. The Tanzania grass morphological components of leaf, stem (stem + sheath) and dead material as well as forage dry matter (DM) were determined for a 0.5 m^2 area in the paddock defined using a metal quadrat. The morphological components were dried in a forced air oven at 55ºC, for 72 h. Methane (CH_4) production was determined for 15 adult Anglo Nubian goats weighing average 56.8 kg that were neither pregnant nor lactating and randomly distributed among the three RLAI treatments. Methane collection were conducted during April 2011, in two consecutive paddocks using the tracer gas sulfur hexafluoride (SF_6) technique, described by Jonhson *et al.* (1994). The concentrations of CH_4 and SF_6 were analyzed by gas chromatography (Agilent® model 6890). Feed consumption was estimated for 5 goats using two markers: LIPE® - purified lignin extracted from Eucaliptus grandis, which is modified and enriched hydroxyphenyl propane (Saliba e Araujo 2005) and indigestible neutral detergent fiber (NDFi). The chemical composition of Tanzania grass was determined from a sample of the grazable extract. The statistical analyses were performed by the software SAS (version 9.2, SAS Institute, Cary, NC, USA) using the PROC MIXED.

Results

LI average values were 97, 98 and 97% while RLAI were 0.8, 1.7 and 2.4, respectively, for the target treatments of 0.8; 1.6 and 2.4. The RLAI were considered close to the target for animal input and output within the experimental paddocks. The high values for total dry matter mass (TDMM) and stem DM mass (SDMM) shown in Table 1, were expected and are compatible with the tropical forage production of the genus *Panicum* (Quadros *et al.* 2002). The variables TDMM and SDMM were affected by RLAI and increased linearly (P<0.10) in the pre-grazing. However, the variables, leaf DM (LDM), dead material DM (DMDM) and leaf/stem ratio (L/S) were not influenced by increasing RLAI (Table 1). The linear increase of TDMM and SDMM was possibly caused by tiller accumulation due to higher RLAI, which became old and increased in mass with time (Martha Junior *et al.* 2002). Another hypothesis is that post-grazing, the remaining leaves shaded the lower layers thus inducing stem elongation.

The linear increase of intake with increasing RLAI (Table 2) results from increased forage supply provided by the RLAI of 2.4, which was confirmed by greater leaf leftover in the pre-grazing (Table 1) and the lower number of animals in this treatment.

The 17% increase in intake between RLAI of 0.8 and 2.4 did not influence the variables related to methane production (Table 2). The methane emission value of 5.1

Table 1. Mean values (kg/ha) and corresponding contrast comparisons of morphological components of Tanzania grass as a function of residual leaf area index

Morphological Components		RLAI			Effect[1]	*P*-value [2]
		0.8	1.6	2.4		
Pre grazing	LDMM	3,494	3,656	4,496	-	>0.10
	SDMM	5,106	5,601	6,380	L	0.035
	DMDMM	163	2,240	1,541	-	>0.10
	TDMM	10,237	11,498	12,418	L	0.010
	L/S	0.71	0.67	0.71	-	>0.10
Post Grazing	LDMM	933	1,502	1,658	L	0.021
	SDMM	3,637	3,607	3,916	-	>0.10
	DMDMM	929	861	962	-	>0.10
	TDMM	5,500	5,971	6,537	-	>0.10

[1] L (linear effect, considering $P<0,10$); [2] Probability associated with the F-test for contrasts. RLAI, residual leaf area index; LDMM, leaf dry matter mass; SDMM, stem dry matter mass; DMDMM, dead material dry matter mass; TDMM, total dry matter mass.

Table 2. Intake, average methane emission per metabolic weight, dry matter intake and energy loss in goats as a function of RLAI of Tanzania grasslands.

	RLAI			Effect[1]	*P*-value [2]
	0.8	1.6	2.4		
Dry matter intake(g/day)	505 ± 15	514 ± 15	591 ± 15	L	<0.0001
CH_4/metabolic weight (g/body weightl$^{0.75}$)	0.91 ± 0.05	0.88 ± 0.05	0.84 ± 0.05	-	>0.10
CH_4/MS intake (g/kg)	35.7 ± 2.7	37.3 ± 2.7	31.8 ± 2.7	-	>0.10
Loss of gross energy (%)	12 ± 0.9	12 ± 0.9	10 ± 0.9	-	>0.10

[1]L (linear effect, considering $P<0.10$); [2] Probability associated to F-test, for contrast; CH_4 = methane; RLAI = residual leaf area index; DM = dry matter; Metabolic weight = body weight$^{0.75}$; Loss of gross energy as methane was calculated using forage average energy of the two paddocks where methane was measured.

kg/year for a 40 kg animal in this study agrees with the IPCC (2006) of 5.0 kg/year. The similar methane emission for all three treatments can be explained by the similar chemical composition found for all three treatments, which displayed average 14% crude protein, 70 % NDF, 29% acid detergent fiber, 9% ash and 16.5 MJ/kg DM gross energy (GE). If the emission measurements had been made at different times during the rainy season, methane emission by goats grazing on Tanzania grass pasture may have differed among treatments.

Conclusion

The RLAI changed the features of Tanzania grass, without changing methane production. The methane emitted by goats under rotational grazing on Tanzania grassland was 0.88 g/kg metabolic weight (body weight^{0,75}) or 5.1 kg/year for a 40 kg animal.

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