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Enteric Methane Emission of Female Buffaloes Supplemented with Palm Kernel Cake in the Amazon Biome

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Introduction

The relation between environmental impacts caused by different anthropic activities, particularly in the agricultural and livestock sector, have been reported as a source of greenhouse gas emissions, which are strongly related to global climate change. Ruminants, due to enteric fermentation, are known important sources of methane (CH_4) emissions into the atmosphere. The carbohydrate digestion process by these animals generates, physiologically, CH_4 as a metabolic by-product (CUNNINGHAM; KLEIN, 2008).

Several alternatives to reduce methane emissions by ruminant digestion are studied, mainly linked to changes in diet.

The increase in the worldwide demand for palm oil and its application in biodiesel production have generated waste in agro-industries and allowed greater availability of co- products for animal feed (BRINGEL et al., 2011). Palm kernel cake's chemical composition features protein, energy, and fiber contents that may supply ruminants with part of their nutrient needs. In the Brazilian state of Pará, palm kernel cake is available throughout the year at low cost for rural

producers compared to other supplements employed in diet (corn, soybean, and wheat). The introduction of cakes with high fat content into ruminant diets may aid in mitigating enteric methane emissions (ABDALLA et al., 2007).

Thus, in face of the concern about global warming and the efficiency of diets, this study aimed to assess the levels of inclusion of palm kernel cake on enteric methane production among female buffaloes in the Amazon.

Material and Methods

The trial was carried out at the animal research unit "Senador Álvaro Adolfo," belonging to Embrapa Eastern Amazon, in the city of Belém-PA, Brazil. The study area features Af2 climate (MARTORANO et al., 1993) with mean rainfall above 60 mm in the least rainy month and annual rainfall around 2,900 mm. The study was certified by the Animal Ethics Committee - CEUA under protocol 007/2015. 24 crossbred Murrah and Mediterranean female buffaloes with initial age and weight of 34 months and 514 ± 69.88 kg, respectively, belonging to Embrapa Eastern Amazon's experimental herd were used. The female buffaloes were supplemented during September and October 2015. The experimental treatments consisted of supplementing the female buffaloes with palm kernel cake at the following inclusion levels in relation to their body weight (BW): 0% (T_1) (control), 0.25% (T_2), 0.50% (T_3) and 1.00% (T_4). The research adopted a completely randomized design with four treatments and six repetitions considering each animal as an experimental unit. The diets at every inclusion level were added with 0.15% (BW) wheat bran, which acted as a palatability agent. The chemical composition of the ingredients is presented in Table 1. Corn silage (CS) was used as roughage. The animals were managed in confinement in individual pens and underwent 21 days of adaptation to the experimental diets with free access to water and mineral mix. The diet was provided to the animals twice a day (8 AM and 5 PM). The amounts of CS

offered were weighed daily and adjusted according to the animals' intake to result in daily leftovers of 10%.

Methane emission was assessed using the sulfur hexafluoride (SF_6) tracing gas technique according to the methodology described by Johnson et al. (1994). Samples were collected every 24 h for five consecutive days. The animals were removed from the pens at 7:30 AM and taken to the management corral, where the samples were collected. The collecting yokes were taken to the laboratory, where the samples were diluted with pure nitrogen gas prior to the analyses. CH_4 and SF_6 concentrations were determined in a 7890A gas chromatograph. The data were analyzed using the statistical package R Core Team (2015) and the means were compared by Tukey's test at 5% significance.

Table 1. Chemical composition of the ingredients at dietary of female buffaloes supplemented with palm kernel cake.

	Ingredients		
Nutrient composition (% dry matter basis)	Palm kernel cake	Wheat bran	Corn silage
Dry matter	90.44	85.85	29.40
Organic matter	95.82	93.51	94.92
Crude protein	14.27	16.77	7.73
Neutral detergent fiber	66.30	49.1	56.07
Acid detergent fiber	41.49	12.8	31.48
Ash	4.18	6.49	5.08
Ether extract	12.53	3.64	3.17

Results and Conclusions

The amounts ingested ($kg.day^{-1}$) of crude protein and Ether extract were higher in the treatment with maximum inclusion of palm kernel cake (T_4) compared to the control group (Table 2).

Daily enteric methane emission was lower in the treatment with palm kernel cake inclusion of 1.00% BW (27.65 $kg.year^{-1}$), showing values lower than those observed in the IPCC (2006), which estimated the emission in buffaloes at 55 $kg.year^{-1}$. The animals

that were not fed palm kernel cake emitted greater amounts of CH_4 (214.12 $g.day^{-1}$).

Including palm kernel cake in the diet of female buffaloes at over 0.50% BW was negatively correlated ($r = -0.51$; $P<0.01$) with enteric methane production, i.e., the level of lipid offered in the experiment led to the lowest enteric methane emission.

Table 2. Dietary intake and enteric methane emission of female buffaloes supplemented with palm kernel cake.

	Treatment				
Nutrient intake ($kg.day^{-1}$)	**T_1**	**T_2**	**T_3**	**T_4**	***P***
Dry matter	6.08	6.18	6.64	6.20	0.5892
Organic matter	5.77	5.87	6.32	5.90	0.5674
Crude protein	0.52b	0.59ab	0.68a	0.70a	0.0015
Neutral detergent fiber	3.37	3.53	3.87	3.74	0.2231
Acid detergent fiber	1.80	1.94	2.18	2.16	0.0367
Ether extract	0.19d	0.29c	0.39b	0.47a	<0.0001
Ash	0.31	0.31	0.32	0.29	0.5074
Enteric methane					
CH_4 (g/day)	214.12a	171.11ab	173.12ab	75.75b	0.0151
CH_4 (kg/year)	78.15a	63.19ab	62.45ab	27.65b	0.0151

[a, b] Different letters in the same row differ ($p<0.05$) by Tukey's test.

Including palm kernel cake at levels above 0.50% BW decreases enteric methane emissions in female buffaloes under the same experimental conditions.

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