Effects of Different Feed Additives on Methane Emissions from Beef Cattle

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Introduction

The rate of accumulation of methane in the atmosphere from enteric fermentation in cattle has an important impact on the greenhouse effect and contributing to global warming. Additionally, methane emission reduces the energy efficiency of substrate fermention in the rumen. Understanding the effect of the diet on enteric methane emissions could help to identify strategies to reduce emissions of this greenhouse gas. Therefore, the main objective of the present investigation was to determine the effect of nutritional additives such as monensin, fumaric acid, tannins of *Acacia decurrens*, and glycerol on methane production and other measures of fermentation character-istics using the *in vitro* rumen fermentation technique and ruminal fluid obtained from cattle fed with a base diet of *Pennisetum clandestinum*.

Methods

We conducted a test using the gas production technique of Theodorou *et al.* (1994) for rumen microorganisms not renewed on fermentation characteristics of different diet composition. Ruminal fluid was extracted from 4 cannulated cows fed a diet of *Pennisetum clandestinum*. Incubation was performed on a control treatment (CK) of fodder only *P. clandestinum*), and on fodder plus four additives incorporated as a percentage of the diet dry matter (DM). The treatment included: (1) monensin at 40 µg/ml of ruminal fluid (T1); (2) 10% fumaric acid of diet DM (2); tannins of *Acacia decurrens* at 3% of diet DM (T3); and (4) powdered glycerin at 14% of diet DM (T4).

The parameters measured during the ruminal fermentation test were gas production (mL), ammonium (mL/L), dry matter digestibility (%), volatile fatty acids (mmol/L), and methane (CH_4; mL/g of degraded DM or incubated DM). Gas production was measured after 24 hours using a pressure transducer to measure the pressure inside the flask and to calculate the volume of gas generated. Subsequently, a graduated syringe was used to take a sample of gas from the fermentation product of each vial, which was injected into vacutainers (with vacuum) to 10 mL, in order to determine the concentration of CH_4 by gas chromatography. After 24 hours of fermentation, the bottles were opened to sample and then to measure rumen fluid using an ammonium selective ammonia electrode and to measure a sample for AGV by gas chromatography. Finally, the contents of each flask were filtered through crucibles with a porous plate (No. 1) and DM digestibility calculated as the difference between the incubated and post-incubation fluid.

Statistical analysis of the data was undertaken using the GLM procedure of SAS ® software (SAS Institute Inc., Cary, NC, USA). A complete block randomized design was performed with four replicates where each replicate comprised ruminal fluid from the four cows. Tukey's least significant difference test was used to detect significant differences between treatment means.

Results

As can be seen in Table 1, the most affective additive in reducing methane production was monensin which also affected the other fermentation parameters compared to the control. Fumaric acid did not affect methane production and decreased the production of ammonium. The tannins

Table 1. Mean values of the *in vitro* fermentation products after 24 hours of incubation

	Treatments					
Items	Control	Monensin	Fumaric	Tannins	Glycerin	*P*-value
Gas (ml)	90.34a	57.59b	100.64a	88.60a	98.34a	<0.05
NH_3-N (ml/l)	126.18bc	139.50a	94.15d	134.35ab	123.29c	<.0001
DMD (%)	62.99a	34.22c	61.065a	61.06a	61.23a	<.0001
VFA						
Acetic (mmol/L)	10.29b	5.24c	11.69a	11.20ab	11.79a	0.0007
Propionic (mmol/L)	5.01cd	2.88e	7.30b	5.18c	7.86a	<.0001
Butiric (mmol/L)	1.30ab	0.63c	1.21b	1.25b	1.50a	0.0091
Acetic:Propionic	2.22ab	1.69bd	1.81bcd	2.20ac	1.46d	0.1120
CH_4 (ml/g MSi)	111.16bc	69.05d	107.34c	98.12c	122.38b	<.0001
CH_4 (ml/g MSd)	65.37bc	21.73d	66.04bc	59.79c	70.41ab	<.0001

NH_3-N, ammonia nitrogen; DMD, dry matter digestibility; VFA, volatile fatty acids; CH_4, methane mL/g; MSi mL of CH_4/g of incubated DM; CH4 mL/g MSd, mL of CH_4/g of digested DM. [a-d] Means with different letters within rows differ significantly at $P<0.05$.

and glycerin did not affect methane production or the other parameters evaluated compared to the control.

Conclusions

Monensin was the only additive evaluated that generated a clear reduction in methane production. Fumaric acid, tannins and glycerin at levels assessed did not affect methane production. Evaluation of the parameters of ruminal fermentation across longer time-frames warrants evaluation in order to assess if the effect persist.

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References

Theodorou MK, Williams BA, Dhanoa MS, Meallan AB, France J (1994) A simple gas production method using a pressure transducer to determine the fermentation kinetics of ruminant feeds. *Animal Feed Science and Technolology* **48**, 185-197.