

**Key words:** fiber digestion, butyrate, propionate

**W380 The combination of garlic oil and cinnamaldehyde modify rumen fermentation profile reducing methane production.**

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The objective of this study was to analyze the effects of 3 doses (200, 300 and 400 mg/L of product) of NEXT Enhance 300 (NE300; containing cinnamaldehyde and diallyl disulfide) on in vitro ruminal fermentation. Batch cultures (120 mL serum bottles) of mixed ruminal microorganisms (BCRM) were used to test the effects of the additive. Three hundred mg of 60:40 alfalfa hay:concentrate diet was used as a basal substrate. The rumen fluid inoculum was obtained from 4 rumen-cannulated Merino sheep fed the same diet incubated in BCRM, mixed and strained through 4 layers of cheesecloth into an Erlenmeyer flask with an O<sub>2</sub>-free headspace. Particle-free fluid was mixed with the buffer solution (no trypticase added) in a proportion 1:4 (vol/vol) at 39°C under continuous flushing with CO<sub>2</sub>. Thirty mL of buffered rumen fluid were added into each bottle under CO<sub>2</sub> flushing and were sealed with rubber stoppers and aluminum caps, and incubated at 39°C for 24 h. After incubation total gas production was measured, and a gas sample was removed for methane production. Bottles were then uncapped, the pH was measured immediately, and samples for volatile fatty acid (VFA) and ammonia-N analyses were taken. Incubations were repeated on 4 different days to allow statistical analysis of results. Differences were declared at  $P < 0.05$ . Doses of 400 mg/L of NE300 decreased total VFA production and apparently fermented organic matter compared with control (CTR, no additive), thus indicating some inhibition of ruminal fermentation. NE300 at 200 mg/L reduced acetate:propionate ratio, methane production and methane/VFA ratio compared with CTR. NE300 at 300 mg/L reduced ammonia-N concentrations, methane production, acetate proportion, and acetate:propionate ratio, and increased propionate proportion compared with CTR. In conclusion, NE300 at 300 mg/L decreased methane production and increased propionate proportion without affecting total VFA production, and this would indicate a higher supply of energy for the host animal.

**Key words:** cinnamaldehyde, garlic oil, methane

**W381 Ruminant kinetics of the diets with increasing levels of crude propane-1,2,3-triol.**

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The objective was to assess the effect of different levels of propane-1,2,3-triol in the diets on rumen fermentation kinetics. Treatments were 0, 3, 6, 9, 12, 15, 18, 21 and 24% addition levels of crude propane-1,2,3-triol, co-product derived from the production of biodiesel fuels with palm oil (*Attalea maripa*), replacing corn on dry matter of the diets. A randomized block experimental design with 9 treatments and 3 replications was used, considering the incubation as blocking criterion. The ruminal kinetics was analyzed by in vitro gas production technique. Substrates were incubated with ruminal fluid buffered in triplicate. Gas production was followed over time (72h) in an automated system by radiofrequency (Ankom). Data were fitted by

dual-pool logistic model and parameters estimated through the Gauss-Newton algorithm implemented in the NLIN procedure of SAS® software. The increase of propane-1,2,3-triol resulted in longest lag time: Lag (h) = 0.220+0.203x;  $r^2 = 0.91$ ; i.e., a delay of 12 min in the latency period to each 1% of propane-1,2,3-triol. The maximum volume of gas produced (mL per gram of incubated organic matter) by degradation of soluble fraction ( $V_1 = 84.71 - 2.415x$ ;  $r^2 = 0.88$ ) and insoluble potentially degradable fraction ( $V_2 = 78.62 - 2.264x$ ;  $r^2 = 0.87$ ) reduced, while the specific rates of gas production by degradation of soluble fraction ( $k_1 = 0.106$ ) and insoluble potentially degradable fraction ( $k_2 = 0.031$ ) were constant as the propane-1,2,3-triol level raised in the diets. Total volume of gas produced also reduced, can be represented by equation:  $VT (V_1 + V_2) = 163.34 - 4.680x$  ( $r^2 = 0.99$ ). This suggests that propane-1,2,3-triol has an effect in vivo glycogen to be absorbed directly (intact) or indirectly (as propionate) by the ruminal epithelium. Volume of methane produced (mL/g OM) also decreased with increase of propane-1,2,3-triol in the diets ( $CH_4 = 43.8633 - 0.3514x$ ;  $r^2 = 0.56$ ). Thereby, addition of propane-1,2,3-triol can help in mitigation enteric methane and improve energy supply. Thus, the inclusion of propane-1,2,3-triol in ruminant diets may be an important alternative to mitigate greenhouse gas emissions.

**Key words:** 1,2,3-propanetriol, glycerol, glycerin

**W382 Effect of various semi-arid medicinal plant essential oils on in vitro ruminal methane emission and feed fermentation efficiency.**

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The objective of the present study was to investigate the in vitro effect of some semi-arid medicinal plant essential oils on ruminal methane emission and feed fermentation efficiency (FFE). A mixed diet of alfalfa hay: concentrate (50:50, based on DM) was provided. It was then ground to pass through a 1-mm screen. Approximately, 500 mg of the diet alone (as control) or plus essential oil of cinnamon, dill, oregano or peppermint (100 µL/g DM) were placed into a 125 mL serum bottle (n = 6) containing 50 mL of buffered-rumen fluid (2:1). Rumen fluid was obtained from 3 ruminally fistulated sheep (49.5 ± 2.5 kg, body weight), before the morning feeding. Bottles were placed in shaking water bath for 24 h at 38.5°C. Gas produced of each bottle was recorded using a pressure transducer and then sampled. Gas pressure was converted into volume using an experimentally calibrated curve. Then, bottle content was filtered (42 µm) and residual was dried (60°C, 48 h) to determine dry matter disappearance (DMD). Data were statistically analyzed using SAS (V. 9/1) and Dunnett's test was used to compare the means ( $P < 0.05$ ). Feed fermentation efficiency was estimated as  $FFE = DMD (g/kg)/cumulative\ gas (ml) produced at 24 h$ . Methane content of the produced gas was determined using gas chromatography procedure. Results indicated that these essential oils caused a significant ( $P < 0.05$ ) decrease in methane and total gas produced over 24 incubation compared with those of the control (Table 1). The essential oil of Dill enhanced FFE ( $P < 0.05$ ) compared with that of the control. Present results demonstrated a positive effect of the essential oils on ruminal fermentation pattern.

**Table 1.** In vitro effect of medicinal plant essential oils on total gas produced, methane emission and feed fermentation efficiency

Item	Control	Cinnamon	Dill	Oregano	Peppermint	SEM
Total gas (ml/ g DMD)	276.1	115.4 *	253.1 *	186.5 *	187.8 *	0.61
Methane (ml/ g DMD)	41.28	13.97 *	36.89 *	24.28 *	23.61 *	4.8
FFE	6.1	10.6 *	5.9	6.0	6.5	0.5

\*Within a row, means with an asterisk differ significantly from the control ( $P < 0.05$ ).

**Key words:** methane, essential oil, fermentation efficiency

**W383 Rumen parameters and digestibility of diets with different levels of crude propane-1,2,3-triol.** R. Mello<sup>\*1</sup>, C. M. M. Bittar<sup>2</sup>, L. A. M. A. da Costa<sup>3</sup>, P. B. Costa<sup>4</sup>, J. K. Kirinus<sup>1</sup>, and J. L. Nörnberg<sup>1</sup>, <sup>1</sup>Universidade Federal de Santa Maria, Santa Maria, Rio Grande do Sul, Brazil, <sup>2</sup>Universidade de São Paulo - Escola Superior de Agricultura 'Luiz de Queiroz', Piracicaba, São Paulo, Brazil, <sup>3</sup>Universidade Federal de Roraima, Boa Vista, Roraima, Brazil, <sup>4</sup>Universidade Estadual do Oeste do Paraná, Marechal Cândido Rondon, Paraná, Brazil.

The objective was to assess the effect of increasing levels of propane-1,2,3-triol in the diets on rumen fermentation parameters and digestibility. Treatments were 0, 3, 6, 9, 12, 15, 18, 21 and 24% addition levels of crude propane-1,2,3-triol, co-product derived from biodiesel production with palm oil (*Attalea maripa*), replacing corn on DM of the diets. A randomized block experimental design with 9 treatments and 3 replications was used, considering the incubation as blocking criterion. Substrates were incubated with ruminal fluid buffered in triplicate. The digestibility was evaluated after 48 h and ruminal parameters were measured after 72 h of in vitro incubation. Data were analyzed in the SAS software. The table below shows the least squares means of dependent variables. The acetate and butyrate concentrations, acetate: propionate ratio, in vitro true digestibility (IVTD) of DM, organic matter (OM) and NDF coefficients decreased ( $P < 0.05$ ); and the pH values increased ( $P < 0.05$ ) as the propane-1,2,3-triol level raised in the diets. Thus, the inclusion of propane-1,2,3-triol with 35.6% purity in substitution of non-fibrous carbohydrates on DM of ruminant diets negatively affect the ruminal fermentation parameters and digestibility, but can be an important alternative of destination to the surplus generated from biodiesel chain.

**Table 1.** Least squares means

Variables	P-value	Equation	r <sup>2</sup>
pH	0.0016	5.7953+0.0144x	0.92
NH <sub>3</sub> -N, mg/dL	0.7898	17.7	-
Microbial protein, mg/L	0.0859	273.0	-
C <sub>2</sub> , mM/mL	0.0106	37.6280-0.5702x	0.51
C <sub>3</sub> , mM/mL	0.9017	24.0	-
C <sub>4</sub> , mM/mL	0.0288	7.9102-0.0893x	0.93
VFA, mM/mL	0.0699	64.8	-
C <sub>2</sub> :C <sub>3</sub>	0.0003	1.6237-0.0272x	0.66
IVTD-DM, %	0.0001	77.7867-0.2322x	0.91
IVTD-OM, %	0.0001	75.3363-0.3033x	0.93
IVTD-NDF, %	0.0001	22.0815-0.6083x	0.80

**Key words:** 1,2,3-propanetriol, glycerol, glycerin

**W384 Dose response effects of a garlic oil chemical compound propyl-propyl thiosulfate (PTSO) on rumen microbial fermentation in a dual flow continuous culture system.** A. Foskolos<sup>\*1</sup>, A. F. De Souza<sup>1</sup>, M. Rodriguez-Prado<sup>1</sup>, A. Ferret<sup>1</sup>, D. Bravo<sup>2</sup>, and S. Calsamiglia<sup>1</sup>, <sup>1</sup>Animal Nutrition, Management and Welfare Research Group, Universitat Autònoma de Barcelona, Bellaterra, Spain, <sup>2</sup>Pan-cosma, Geneva, Switzerland.

Oxy-propyl-thiosulphate (PTSO) is an active molecule purified from garlic bulb. The objective of this experiment was to investigate the effects of increasing doses of PTSO on ruminal fermentation in vitro. Eight dual flow continuous culture fermentors inoculated with rumen liquid from a dairy cow were used in 2 replicated periods (blocks). Temperature (39 °C), pH (6.4), and liquid (0.10/h) and solid (0.05/h) dilution rates were maintained constant. Fermenters were fed 95 g DM of a diet (21.6% corn silage, 43.6% dehydrated alfalfa, 11.4% soybean meal, 31.6% corn grain and 0.83% vitamin-mineral mix, DM basis) in 3 equal portions daily and treatments were no additive (CTR) and 50, 100 and 150 mg/L of PTSO. Each experimental period consisted of 5 d for adaptation and 3 d for sampling. Samples were collected 2 h after the morning feeding and from the 24-h effluent of the 3 sampling days. Results were analyzed with PROC MIXED and significance was declared at  $P < 0.05$ . Contrasts were used to analyze for linear, quadratic and cubic responses. Total VFA and molar proportions of acetic and propionic acids concentrations and the acetate to propionic acid ratio responded quadratically with higher total VFA and propionic acid and lower acetic acid concentrations and acetic to propionic ratio in the intermediate doses. Branch-chained VFA decreased linearly by increasing doses of PTSO and ammonia-N concentration was not affected by treatments. In the samples from the 24-h incubations, only the total VFA and BCVFA concentrations responded quadratically and linearly by increasing dose of PTSO, respectively. Results suggest the potential of PTSO to modify rumen fermentation in a direction consistent with better energy utilization.

**Key words:** essential oils, garlic, fermenters

**W385 Estimation of protein fractions of tropical grasses by near infrared reflectance spectroscopy.** R. G. Basurto<sup>1</sup>, G. Buendia-Rodriguez<sup>1</sup>, E. R. Ramirez<sup>1</sup>, M. A. Barron<sup>2</sup>, J. J. G. Bustamante<sup>3</sup>, R. E. Santos<sup>4</sup>, J. J. M. Maldonado<sup>5</sup>, and S. S. Gonzalez-Muñoz<sup>\*6</sup>, <sup>1</sup>CENID Fisiología Animal-INIFAP, Queretaro, Mexico, <sup>2</sup>CE Huimanguillo-INIFAP, Tabasco, Mexico, <sup>3</sup>CE Santiago Ixcuintla-INIFAP, Nayarit, Mexico, <sup>4</sup>CE Iguala-INIFAP, Guerrero, Mexico, <sup>5</sup>CE Rosario Izapa-INIFAP, Chiapas, Mexico, <sup>6</sup>Colegio de Postgraduados, Montecillo, Estado de Mexico, Mexico.

The aim of the study was to investigate the use of near infrared reflectance spectroscopy (NIRS) as an alternative method to estimate crude protein (CP), degradable (DIP) and undegradable (UIP) intake protein of tropical grasses. A total of 945 samples of 13 species were collected by clipping at different ages of re-growth (28, 42, 56, 70 and 84 d) in plots in 4 states (Chiapas, Guerrero, Nayarit and Tabasco) in Mexico. The grass species included were *D. aristatum*, *C. dactylon*, *H. altissima*, *U. brizantha*, *D. swazilandensis*, *C. plectostachyus*, *U. maximum*, *B. humidicola*, *C. echinatus*, *A. gayanus*, *B. brizantha* x *ruziziensis*, *D. eriantha* and. DIP was estimated as the protein fraction that disappeared after incubation with a protease ofand UIP was the remaining protein in the sample. Samples were scanned using a spectrophotometer Nicolet FT-IR 6700 (Thermo Fisher Scientific, Inc.) over a wavelength range of 1000 to 2500 nm in reflectance. Data were stored as log (1/R) at intervals of 4 nm. Calibration equations were developed using modified partial least squares with the TQ Analyst