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In vitro gas production parameters of high fat sunflower meal treated with formaldehyde, sodium hydroxide or exogenous enzyme

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Introduction Gas production technique is a useful procedure to assess digestible value of the ruminant feeds. The feeding value of the sunflower meal (SFM) depends on the oil extraction process, variety of sunflower and the proportion of the hulls removed during the extraction. Formaldehyde decreases protein degradability and NaOH (Chen *et al*., 2007) and exogenous enzymes (Eun and Beauchemin, 2007) increase digestibility. The objective of this study was to investigate the effect of formaldehyde, sodium hydroxide or exogenous enzymes on the gas production parameters of sunflower meal containing high fat (165 g fat /kg DM) during *in vitro* fermentation.

Materials and methods The samples were: untreated SFM (USFM), NaOH treated SFM (40 g/kg DM, NSFM), exogenous enzyme treated SFM (5 g/kg DM, ESFM; the enzyme mixture composition was Cellulase, Xylanase, Betaglucanase, Alpha amylase, Pectinase, Phytase, Protease and Lipase as 0.03, 6.6, 10, 0.7, 0.7, 0.07, 0.5 and 3 MU/kg, respectively; Bioproton Pty. Ltd. Co.) and formaldehyde treated SFM (30 g/kg DM, FSFM). Crude protein, NDF and lignin content of the samples were 278, 400 and 83 g/kg DM, respectively. About 500±10 mg of oven dried and milled sample (1.0 mm screen) was incubated with 35 ml buffered rumen fluid (Rumen fluid was collected from two fistulated Holstein steers (400±12 Kg, body weight) fed twice daily a diet containing 5.72 kg lucerne hay and 3.08 kg concentrate mixture) in 100 ml glass syringes, according to the method of Menke and Steingass (1988). All samples were incubated in triplicate (one run) with three syringes containing only incubation medium (blank) and gas production from the sample was corrected for the blank. Gas production was measured at 2, 4, 6, 8, 12, 24, 48, 72 and 96 h. Cumulative gas production data were fitted to the exponential equation $Y=B\ (1-e^{-Ct})$, where B is the gas production from the fermentable fraction (ml), C is the gas production rate constant for B, t is the incubation time (h) and Y is the gas produced at time t. Ammonia-N (NH_3-N) concentration (mg/dl) was determined in supernatant samples at the end of the incubation time by macro Kjeltec System Tecator (Büchi 1030, Sweden). *In vitro* digestibility of organic matter (OMD, g/kg OM) and metabolisable energy (ME, MJ/kg DM) of samples were calculated by the equation of Menke and Steingass (1988). Short chain fatty acid concentration (SCFA, µmol) was measured by the equation as proposed by Getachew *et al*. (1999). Data of gas production, ME, OMD, NH_3-N and SCFA were subjected to analysis as a completely randomized design using the General Linear Model (GLM) procedure of SAS (1990). Duncan's multiple range test was used to compare treatment means at P< 0.01.

Results *In vitro* gas production parameters [(*B*) and (*C)*], ME, OMD, NH_3-N and SCFA of the samples are shown in Table 1. All items were significantly influenced by the treatment. Gas production parameters of NSFM and ESFM were significantly higher than FSFM (P< 0.01). Formaldehyde resulted in decreased OMD, ME and SCFA compared with NSFM and ESFM. NH_3-N concentration was decreased when sunflower meal was treated with formaldehyde. The highest SCFA was recorded for ESFM compared with the other samples.

Table 1 *In vitro* gas production parameters, NH_3-N concentration, ME, OMD and SCFA of high fat sunflower meal treated with formaldehyde, sodium hydroxide or exogenous enzyme

	Treatments*				s.e.m	p-value
Item	USFM	NSFM	ESFM	FSFM		
B (ml)	167^c	185^b	196.9^a	116.9^d	0.8	0.01
*C (*ml/h*)*	0.08^c	0.1^b	0.18^a	0.07^d	0.002	0.01
NH3-N (mg/dl)	40.99^a	36.22^c	39.19^b	32.47^d	0.4	0.01
ME (MJ/kg DM)	29.38^c	35.75^b	39.2^a	29.37^c	0.1	0.01
OMD (g/kg OM)	185.9^d	207.5^b	210.2^a	189.7^c	0.1	0.01
SCFA (µmol)	1.20^c	1.53^b	1.63^a	0.62^d	0.001	0.01

*USFM (untreated sunflower meal); NSFM (40 g/kg DM NaOH treated sunflower meal); ESFM (5 g/kg DM exogenous enzyme treated sunflower meal); FSFM (30 g/kg DM formaldehyde treated sunflower meal); *B*: Gas production from the fermentable fraction; *C*: Rate constant of gas production; OMD: Organic matter digestibility; ME: Metabolizable energy; SCFA: Short chain fatty acids; s.e.m: Standard error of mean, Means with different letters within samples differed (P< 0.01)

Conclusions It was concluded that *in vitro* gas production parameters, OMD, ME and SCFA of NaOH and enzyme treated SFM were improved compared with USFM and FSFM. In contrast, formaldehyde treated SFM caused a decrease in gas production parameters, NH_3-N and SCFA concentrations. Therefore, based on the present data, formaldehyde is not recommended to treat SFM, when much fermentation is a goal of the feeding strategy.

References

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