Index

Title

Author

Country

Key words

In Situ Ruminal Degradation of Sesame (*Sesamum indicu)* Stover Treated with Sodium Hydroxide, Urea or Sulfuric Acid

M. Malekkhahi, M. D. Mesgaran, A. R. M. Heravi, A. Tahmasbi, A. Vakili, and H. Jahani-Azizabadi
Dept. Animal Science, Excellence Centre for Animal Science, Faculty of Agriculture, Ferdowsi University of Mashhad, P O Box 91775-1163, Mashhad, Iran

ABSTRACT

The objective of the present study was to compare in situ dray matter (DM) and NDF degradation coefficient of untreated or treated sesame (*Sesamum indicum*) stover (SS) with a solution containing urea, sodium hydroxide or sulfuric acid. Samples were obtained from the Iranian plant varieties adapted to grow in a semi-arid condition. The samples were manually chopped (5 cm length) and evaluated as untreated or treated with sulfuric acid (2 ml/100 g DM), urea (3 g/100 g DM), NaOH (4 g/100 g DM) or both NaOH and urea [NaOH as 4 g/100g DM was sprayed on SS and kept for 48 h, then urea (3 g /100g of initial DM) was added]. Present results indicate that the highest amount of *a* fraction of DM and NDF was observed in SS treated with sodium hydroxide (0.30 ± 0.020 and 0.08 ± 0.005, respectively). Sulfuric acid caused a significant decrease ($p<0.05$) in *b* fraction of DM (0.29 ± 0.014) and an increase in *c* fraction of NDF (0.06 ± 0.003). Urea did not alter the degradation coefficients of SS.

Key Words: Sesame stover, Rumen, Degradation, Urea

INTRODUCTION

Sesame (Sesame Indicun) is an annual plant, broadleaf that cultivated after wheat in arid and semi-arid regions of Iran for its seed oil and extensively used for medicinal and food purposes. Sesame stover is the most abundance residual of Sesame cultivation in Iran and traditionally used as a basal feed in ruminants. Treatment of straw with chemicals like ammonia and ammonia precursors as urea to increase the digestibility is used in many parts of the world. Such treatment generally increases both the rate and extent of fiber digestion in the rumen, which leads to higher energy value of the treated material as well as to a higher intake (Celik et al., 2003). There are a number of chemical reactions taking placed during alkali treatment. Saponification of ester linkages between acetic acid and phenolic acids, polysaccharides and/or lignin as well as such linkages between uronic acid residues of xylan in hemicelluloses and lignin would be expected (Ramalho, 1991).The aims of the present study were to evaluate the effect of chemical treatment of sesame stover with NaOH and urea or sulphuric acid on chemical composition and in situ ruminal degradation parameters of dry mater (DM) and Neutral detergent fiber (NDF).

MATERIALS AND METHODS

Sesame stover (SS) was obtained from the Iranian plant varieties adapted to grow in semi-arid condition. The samples were manually chopped (5 cm length) and used as untreated or treated with sulphuric acid (SSA, 2 ml/100 g DM), urea (SSU, 3 g/100 g DM), NaOH (SSN, 4 g/100 g DM) or both NaOH and urea [SSUN, NaOH as 4 g/100g DM was sprayed on the stover and

kept for 48 h, then urea (3 g /100g of initial DM) was added]. Treated SS were ensiled under unaerobic condition for 4 weeks. Feed samples were dried at 60 °C in oven dryer for 48 h and then ground to pass through a 2-mm screen. Samples were analyzed for Crude protein (CP) (Kjeltec 2300 Auto analyzer, Foss Tecator AB, Hoganas, Sweden), organic matter (OM) and ash (AOAC, 2000). Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were determined using the method of Van Soest et al. (1991). In situ degradation of DM and NDF was studied following the nylon bag technique described by Mehrez and Orskov (1977). Four sheep (49.6±2 kg) fitted with ruminal fistulae were used. The animals were fed with 1.5 kg DM alfalfa hay and 0.4 kg DM concentrates (165 g CP/kg DM) per head per day, at 8.00 and 17:00 h. Approximately, 5 g DM of each sample (10 bags per each feed) was placed in a polyester bag (9 × 17 cm; pore size of 52 ìm) and incubated in the rumen for 0.0 (bags were washed with cold tap water), 2, 4, 8, 16, 24, 36, 48, 72 and 96 h. After removal from the rumen, bags were washed with tap water and subsequently dried using oven dryer (60°C, 48 h), then weighed to determine DM disappearance. Neutral detergent fiber (NDF) concentration of un-incubated and rumen incubated samples were then determined. The data from in situ studies were fitted into an exponential model {p = a + b(1 – e-ct)} of Orskov and McDonald (1979) by using the Maximum Likelihood Programme to obtain estimates of a, b and c for each sample in each sheep. Data were statistically analyzed using GLM of SAS (1999).

RESULTS AND DISCUSSION

The chemical composition of the untreated and the chemically treated of sesame stover are shown in Table 1. Neutral detergent fiber (NDF) was significantly ($p<0.05$) decreased by sulphuric acid treatment. The main difference between untreated and treated sesame stover was observed in crude protein content as a result of the addition of urea. Urea caused a significant ($p<0.001$) increase in CP content of SS than the other treatments. Vadiveloo (2003) showed that the treatment Malaysian rice straw with 4% urea increased CP content from (6.0%) for the untreated to (9.3%) for treated rice straw. The values of in situ ruminal degradation coefficients of DM and NDF of the experimental samples are presented in Table 2. Results showed that the chemical treatments applied in the present study did alter the degradation coefficients of SS.

DM degradation rates (both a and b fractions) of SSUN was significantly ($p<0.05$) higher than those of the other treatments. These results confirmed the finding of Chaudhry (1998) who observed that the digestibility of DM of wheat straw was increased by treatment with NaOH. Results of the present study demonstrated that the slowly degradable fraction of DM was the greatest for the sample treated by sulphuric acid compared with those of the untreated or the other samples. Also, the present study the quickly degradable fraction (a) and slowly degradable fraction (b) of NDF were significantly ($p<0.05$) increased when NaOH was applied.

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Table 1 Chemical composition of sesame stover as untreated or treated treated with NaOH, urea or sulphuric acid

Item	Treatment*						
	SS	SSA	SSU	SSN	SSUN	SEM	p
NDF	75.7^{a}	66.6^{d}	71.7^{b}	69.9^{c}	73.6^{ab}	0.85	< 0.05
ADF	46.2	43.8	45.4	45.4	45.8	0.55	ns
CP	6.7^{c}	6.7^{c}	11.8^{a}	6.3^{c}	8.9^{b}	0.13	<
OM	96.4^{ab}	96.1^{b}	94.4^{d}	96.5^{a}	95.7^{c}	0.09	<

Means within a row with different superscripts differ (p<0.05)

* SS (sesame stovet), SSA (sesame stover + sulphuric acid), SSU (sesame stover + urea), SSN (sesame stover + NaOH), SSUN (sesame stover + NaOH + Urea)

Table 2 In situ luminal degradation of dry matter (DM) and crude protein (CP) of sesame stover as untreated or treated with NaOH, urea and sulphuric acid (mean ± SE)

Samples	DM			NDF			p-value
	a	b	c	a	b	c	
SS	0.22±0.0	0.36±0.01^{a}	0.07±0.010^{a}	0.017±0.1	0.389±.12	0.126±.09	< 0.05
SSA	0.28±0.0	0.29±0.01^{b}	0.06±0.008^{b}	0.032±.05	0.305±.06	0.061±.03	< 0.05
SSU	0.21±0.0	0.35±0.03^{ac}	0.05±0.016^{bc}	0.034±.08	0.337±.01^{c}	0.045±.04^{c}	< 0.05
SSN	0.30±0.0	0.38±0.02^{d}	0.05±0.008^{cd}	0.08±.051	0.427±.06	0.044±.01	< 0.05
SSUN	0.23±0.0	0.36±0.02^{ac}	0.05±0.011^{d}	0.049±.04	0.343±.05	0.043±.02^{c}	< 0.05

* SS (sesame stovet), SSA (sesame stover + sulphuric acid), SSU (sesame stover + urea), SSN (sesame stover + NaOH), SSUN (sesame stover + NaOH + Urea)