Rumen Metabolism of Sheep Fed Silage Containing Poultry Litter

Shahid RasooI*, S.H.Raza and Tanveer Ahmad***

*Dept. Animal Nutrition University of Agriculture Faisalabad, Pakistan.
**Dept. Livestock Management, University of Agriculture, Faisalabad, Pakistan.

1. Introduction

The use of molasses not only improves the energy content of silage but also ensures low pH and prevents proteolysis. The nitrogen (N) concentration of the cereal and grass silages, which is generally low, can however, be improved considerably, without affecting its fermentation characteristics, by the addition of poultry waste at the time of ensiling. Ensiling poultry waste with cereal forages and grasses not only considerably increases their inherent low N concentration but also provide many basic nutrients such as energy, calcium, phosphorus and unidentified nutrients. In this way the poultry waste can be recycled as feed for livestock with no undesirable effects on animal health. The objective of this study was to determine the effect of feeding silage containing broiler litter on the rumen metabolites of sheep.

2. Materials and Methods

Commercial broiler house litter was sun dried, ground and stored for silage making. A representative sample of litter was analysed for total-N, protein-N, ammonia-N, ash, fibre fractions, silica (Van Soest and Robertson 1982) and Non-fibre carbohydrates. Dried broiler litter[1] (30 % DM) and cane molasses (60% of DM) were added to chaffed Sudax fodder[1] (SPL-Silage) for silage making. Control silage without litter was also prepared. To determine chemical changes during ensiling, triplicate samples of each silage were analysed at the start and on 40th day, when opened. Samples were analysed for Dry matter (DM), total-N, protein-N, ammonia-N and lactic acid. Since the poultry litter had a high silica concentration, which dissolves in neutral detergent but not in acid detergent, adding the difference in silica between ADF and NDF to the apparent hemicellulose values made a correction. Lignin was determined as acid detergent (AD) lignin and cellulose as lignin free ADF.

Three adult rumen cannulated mature sheep were randomly allotted to one of the following rations in an experiment run according to 3×3 Latin Square Design experiment.

1) Ration A: Complete farm ration.

2) Ration B: SPL-silage.

3) Ration C: Sudax silage + 30% concentrate mixture

All rations were formulated at 14% crude protein (CP) and 70% total digestible nutrients (TDN). Each ration was fed to a rumen cannulated sheep for a period of 10 days as adjustment period. In the following three days, the rumen liquor samples were collected at 0, 3 and 6 hr post-feeding. The pH of rumen liquor was recorded immediately after collection with Beckman pH meter. The rumen liquor samples were strained through four layers

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[1] Broiler litter and Sudax fodder contain (%): dry matter at103°C: 90.16, 24.88; organic matter: 79.78, 93.97; NDF: 38.97, 61.23; ADF: 35.97, 34.02; hemicellulose: 3.00, 27.21; cellulose: 18.10, 29.32; non-fiber carbohydrates: 16.01, 22.08; lignin: 2.82, 3.58; silica: 14.56, 1.12; total-N: 3.84, 1.62; protein-N: 1.28, 1.47; ammonia-N: 0.29, 0.09; non-protein-N, 2.56, 0.15. All values are on DM basis.

of cheesecloth and the filtrate was collected in 50 ml plastic bottles, containing 2 drops of N H_2SO_4. After adding a few drops of chloroform. The samples were stored in deep freezer till analysis after thawing, for total-N, protein-N and ammonia-N.

The data on chemical analysis of rumen liquor were analysed statistically using analysis of variance technique in a factorial model (3×3 with interactions) in a Latin Square design (Steel and Torrie 1981).

3. Results

Data on average pH and different N fractions in rumen liquor of sheep fed on different rations is shown in Table 1. Significantly ($P<0.05$) higher pH was observed in rumen liquor of sheep fed the ration containing SPL-silage as compared to that having Sudax silage plus concentrate mixture. The changes in pH of rumen liquor of sheep at different times post feeding were found to be non-significant ($P>0.05$).

Sheep fed on complete farm ration had significantly ($P<0.05$) higher total-N than those on SPL-silage or Sudax silage plus concentrate mixture. The sheep on SPL-silage had the lowest total-N concentration, and was significantly higher ($P<0.05$) when Sudax silage was supplemented with concentrate mixture (Table 1). Significant differences ($P<0.05$) were also observed in total-N concentration of rumen liquor of sheep at different times post-feeding. At zero hours post-feeding the total-N concentration of ruminal fluid of sheep on complete farm ration was significantly higher ($P<0.05$) than that of the other rations. The ruminal total-N concentration of sheep on SPL-silage and Sudax silage plus concentrate mixture rations were similar at 0 hours post- feeding.

At 3 hours post-feeding the total-N concentration of rumen liquor of sheep on Sudax silage plus concentrate mixture ration increased and was higher (P<0.05) than that on SPL-silage ration.

The protein-N concentration of rumen liquor was significantly higher (P<0.01) on complete farm ration followed by regime Sudax silage plus concentrate mixture and SPL-silage. The protein-N concentration of rumen liquor of sheep on all ration at different times post-feeding followed a similar pattern as in case of total-N concentration.

Table 2. Average pH and different N fractions in rumen liquor of sheep fed different rations

Ration*	Time post feeding (hr)	pH	Total-N (mg %)	Protein-N (mg %)	Ammonia-N (mg %)
A	0	6.39^{c}	127.8^{b}	89.13	23.16
	3	6.24^{c}	120.3^{bc}	83.31	33.64
	6	6.50^{c}	148.0^{a}	105.36	30.53
	Average	*6.357^{c}*	*132.0^{a}*	*92.60^{a}*	*29.11^{b}*
B	0	6.91^{a}	89.4^{f}	46.53	40.62
	3	6.80^{a}	96.5^{def}	58.76	37.77
	6	6.76^{a}	92.1^{ef}	55.99	36.08
	Average	*6.826^{a}*	*92.66^{c}*	*53.76^{c}*	*38.16^{a}*
C	0	6.66^{b}	88.4^{f}	56.22	20.52
	3	6.58^{b}	109.2^{dc}	72.38	27.83
	6	6.59^{b}	104.5^{de}	71.33	24.75
	Average	*6.608^{b}*	*100.7^{b}*	*66.64^{b}*	*24.37^{c}*

*Ration A: complete farm concentrate, B: SPL-silage, C: Sudax silage + concentrate mixture.

[abcdef] Means within column with different superscripts differ significantly (P<0.05)

The ammonia-N of rumen fluid of sheep fed SPL-silage was significantly higher (P<0.05) as compared to complete farm ration or Sudax silage plus concentrate mixture (Table 2). An ammonia-N concentration of rumen fluid was the lowest at 0 hours but it increased significantly (P <0.05) at 3 hours post-feeding and then decreased again at 6 hours post-feeding. Following this pattern the final ammonia-N concentration of ruminal fluid was not significantly different from that determined at zero hours post-feeding.

4. Discussion

The results as shown in Table 1 indicate that the difference among rations were significant (P< 0.05). It has been observed that when 3.1 to 6.0 kg poultry litter was fed to cattle in a daily ration, ammonia concentration in rumen fluid was 3 to 5 times higher than the optimal level of 10 mg/dl for maximum fermentation and optimal microbial protein synthesis (Silanikove and Tiomkin 1992) It was stated that once the microbial requirements for N in the rumen are met, there should be no further increase in the rate of fermentation. Excessive consumption of poultry litter exposes the cow to metabolic burdens, as reflected in ammonia (> 2O mg/dl) concentration and reduces the cell life span (Visck 1984).

Ammonia concentration in rumen fluid had direct relationship with poultry litter intake and the parallel increase with pH would encourage the absorption of ammonia from the gut (Harmeyer and Martens 1980). Excessive ammonia, which is not utilised by the microbes, is absorbed in the blood circulation and converted to urea in the liver with consequent metabolic burden on liver.

Rumen pH, concentration of total-N, protein-N and ammonia-N very much depend upon the physiological status of the animal as happened in our experiment when sheep were fed on SPL-silage. When Sudax silage was fed with supplemental concentrate mixture, the concentration of total-N and protein-N increased and that of ammonia-N decreased compared with SPL-silage, yet it was less (P<0.0l) than the control. The reason being increased DM intake, reduced cell wall or structural carbohydrates with corresponding increase in cell contents and thus increased rate of digestion due to microbial stimulation with corresponding increase in microbial population and protein synthesis.

The pH of rumen fluid on three diets indicated highest value on SPL-silage, probably due to high ammonia concentration. The ammonia-N of the rumen fluid increased to a significantly (P<0.01) higher level, on all the three rations, at 3 hours post- feeding and again decreased to lower level. It was probably either utilised by microbes or crossed the rumen wall, because during this time the pH of the rumen fluid was in the range of favourable ammonia absorption. The results of this trial indicates that SPL-silage alone could not support growth because it was deficient in energy, had higher concentration of soluble N, low concentration of less soluble protein and a high proportion of structural carbohydrates with correspondingly decreased microbial stimulation and low ruminal fermentation.

5. References

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