EFFICIENCY OF BACTERIAL PROTEIN SYNTHESIS IN THE RUMEN OF SHEEP RECEIVED A STRAW-MANURE SILAGE AND BARLEY

Nam-Hyung Lee and Chil-Surk Yoon

Korea Food Research Institute, P.O. Box 131 Seoul, Korea

Introduction

Straw-manure silage is recently given to a large number of Korean cattles and dairy cow but it is not clearly reported on the effect of straw-manure silage feeding on nitrogen metabolism. This experiment was conducted to investigate the ruminal synthesis of bacterial protein and its influence on the abomasal flow of N in sheep given diets varing in the ratio of silage and barley.

Materials and Methods

Three Corriedale rams (43 kg) fitted with rumen cannula and T type abomasal cannula were housed in a temperature controlled room (15°C ± 3). Experimental diets were consisted of straw-manure silage and barley mixture in the ratios of 75:25, 50:50, and 25:75, and sheep was fed the diets at 1.75% of body weight at 2 hrs intervals by continuously feeding system.

A dual-phase marker system was used to measure abomasal digesta flow. Chromic oxide as the solid marker was mixed with diets and Co-EDTA (Uden et al., 1980) as the liquid marker was infused into rumen continuously. DAPA was determined according to the procedures of streamlined method with performic acid oxidation (Mason et al., 1980) and flow of abomasal digesta was calculated by the matrix equation (Armentano and Russell, 1985). Bacterial N content in abomasal digesta was calculated from the N: DAPA ratio in rumen bacteria and DAPA concentration of abomasal digesta.

Results and Discussion

The flow rate and digestion of organic matter in sheep received diets containing three different ratios of straw-manure silage to barley is shown in table 1.

As the proportion of barley in the diet increased there was an increase in OM intake. Apparently digested OM in the rumen and whole tract in high barley diets was significantly increased as to compare OM digestion in low barley diet ($p < 0.01$).

TABLE 1. THE FLOW RATE AND DIGESTION OF ORGANIC MATTER IN SHEEP RECEIVED DIETS CONTAINING THREE DIFFERENT RATIOS OF STRAW-MANURE SILAGE TO BARLEY

	Silage:Concentrate			
	75:25	50:50	25:75	SE
Organic matter				
Intake, g/day	607.64	647.65	713.64	–
Abomasum	299.20^{b}	245.57^{a}	231.92^{a}	8.19
Faeces	176.30	163.41	158.20	7.93
Bacterial OM at the abomasum	113.02^{b}	109.62^{b}	73.77^{a}	3.84
Digested amount in:				
Rumen(apparently)	308.44	402.08	481.72	29.34
Rumen(truly)	421.47^{a}	511.70^{b}	555.49^{c}	6.92
Whole tract	431.35^{a}	484.24^{b}	555.44^{c}	4.35
Proportion digested in:				
Rumen(apparently)	50.53^{a}	62.10^{b}	67.86^{c}	1.03
Rumen(truly)	69.50^{a}	79.02^{b}	78.14^{b}	0.98
Whole tract	70.52^{a}	74.72^{ab}	78.33^{b}	1.34

Values with the different superscripts in the same line are significantly different (a,b,c: ($p < 0.01$).

Mean values for rumen pH and the concentrations of VFA are given in table 2. As the proportion of barley in the diet increased there was a reduction in rumen pH and total VFA concentration. For the molar percentage of individual VFA, there was significantly increased values of isobutyric, butyric and isovarleric acid with the increased proportion of barley in the diets. There were great differences in NH_3-N concentrations between diets. Mean ammonia content of the rumen fluid in the high barley diet showed the highest level of 12.79 mg/100 ml as compared

TABLE 2. THE RUMEN FERMENTATION PARAMETERS AND DILUTION RATE IN SHEEP RECEIVED DIETS CONTAINING THREE DIFFERENT RATIOS OF STRAW-MANURE SILAGE AND BARLEY

	Silage:Concentrate			
	75:25	50:50	25:75	SE
pH	6.27	6.31	6.10	0.06
NH_3-N mg/dl	4.06[a]	6.07[a]	12.79[b]	0.86
Total VFA, mM/l	80.58	74.56	45.91	10.17
Individual VFA, m%				
Acetic acid	65.78	61.00	59.03	1.62
Propionic acid	19.76	20.18	23.27	1.70
Iso-butyric acid	0.59[a]	1.23[b]	1.34[b]	0.07
Butyric acid	11.96[a]	15.15[b]	12.49[a]	0.41
Iso-valeric acid	0.38[a]	0.80[a]	2.69[b]	0.09
Valeric acid	1.53	1.64	1.17	0.23
Rumen volume, l	3.33	2.94	2.43	0.27
Dilution rate/hr	0.1157[b]	0.0908[a]	0.0881[a]	0.0017
Rumen liquid outflow ml/hr	357[b]	290[b]	126[a]	2.71

Values with the different superscripts in the same line are significantly different ($p < 0.01$).

TABLE 3. THE FLOW RATE AND DIGESTION OF NITROGEN, AND BACTERIAL N SYNTHESIS IN SHEEP RECEIVED DIETS CONTAINING THE DIFFERENT LEVEL OF STRAW-MANURE SILAGE AND BARLEY

	Silage:Barley			
	75:25	50:50	25:75	SEM
Nitrogen				
Intake, g/day	14.48	15.24	16.58	
Abomasum	12.89	12.82	11.54	0.43
Faeces	4.51	4.71	4.54	0.21
Urine	5.79	6.97	5.69	0.82
Absorption	9.97[b]	10.53[a]	12.05[b]	0.16
Retention	4.18	3.56	6.36	0.84
Apparent digestion %	68.33	68.98	73.03	1.48
Abomasum flow/ intake	90.47[b]	85.37[ab]	69.39[a]	3.29
NH_3 at abomasum	0.35[a]	0.31[a]	0.52[b]	0.03
NAN flow	12.55	12.51	11.02	0.43
Bacterial	9.18[b]	9.60[b]	7.28[a]	0.25
Non bacterial	3.37	2.91	3.74	0.30
Bacterial/NAN	73.15[b]	77.03[b]	65.71[a]	1.82
Bacterial N synthesis				
g N/kg OMADR	30.47[b]	24.05[b]	14.93[a]	1.24
g N/kg OMTDR	20.05[b]	18.90[b]	12.95[a]	0.71

with 4.06-6.07 mg/100 ml for the other diets. Dietary silage level did affect rumen volume and dilution rate. Dilution rate and ruminal liquid outflow decreased significantly ($p < 0.01$) with decreasing silage level.

As far as VFA is concerning, diets of high energy and low fiber content are generally associated with greater concentration of VFA as compared to more fibrous feedstuffs. The large amounts of readily degradable starch provided by the low fiber diet may have promoted the growth of lactic acid producing bacteria in the rumen. Hence, an increased incorporation of carbon into lactate may account for the unusual differences in VFA concentration (Schwartz and Gilchrist, 1975). These reasons may also be responsible for the decreased rumen pH and higher ammonia content at high barley diet.

There were no significant differences between diets in abomsal NAN flow. However, bacterial N flow for low silage and high barley diet was significantly lower than the other diets ($p < 0.01$). The efficiency of microbial N synthesis for the 75:25, 50:50, and 25:75 diets were estimated as 22.05, 18.90, and 12.95 g N per kg OM truly digested in the rumen, respectively. A low efficiency of bacterial N synthesis for high barley diet may be due to low pH, low dilution ratio, and high NH_3-N concentration in the rumen. This experiment was carried out to investigate the ruminal synthesis of bacterial protein and its influence on the abomasal N flow in sheep given diets varing in the ratio of silage and barley. There were no significant differences between diets in abomsal NAN flow. But significant differences between diets was observed in the efficiency of microbial protein synthesis ($p < 0.01$). Bacterial N was synthesized as 30.5, 24.1, and 14.9 g per kg OM apparently digested in the rumen for the 75:25, 50:50, and 25:75 diets, respectively.

(Key Words: Straw-manure Silage, Barley, Bacterial N Synthesis)

Literature Cited

Armentano, L.E. and R.W. Russell. 1985. Method

for calculating digesta flow and apparent absorption of nutrients from nonrepresentative samples of digesta. J. Dairy Sci. 68:3067-3070.

Uden, P., P.E. Colucci and P.J. Van Soest. 1980. Investigation of chromium, cerium, and cobalt as markers in digesta rate of passage studies. J. Sci. Fd. Agri. 31:625-632.