RELATIONSHIP BETWEEN PARTICLE SIZE REDUCTION OF RETICULO-RUMINAL CONTENTS AND CHEWING TIME

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Introduction

Reduction in particle size of forage digesta to small ones to pass through the rumen contributes to the control of voluntary intake (Welch, 1982; Martz and Belyea, 1986). Although chewing during eating and ruminating is considered to be the major factor responsible for reducing the size of particles in the rumen, limited information on the relationship between particle size reduction and time spent chewing is available. The objective of this research was to measure the time spent chewing and particle size of digesta and to discuss the relationship between them and dry matter intake.

Materials and Methods

Sixteen sheep weighing 50.4 ± 12.3 kg, were fed once daily chaffed orchardgrass hay as a sole diet. The hay was removed 2 hours after the commencement of feeding. Water was available to all sheep at all times. From the sixth day to 30 minutes before slaughter, jaw movement was measured using a balloon attached to the lower jaw and a tambour with a proximity switch connected to an event recorder for at least 24 hours. Four sheep were slaughtered prior to feeding, respectively on the 7th day. Digesta sample was collected from the reticulo-rumen, omasum, abomasum, small intestine and cecum. The particle size distribution of digesta was determined by wet sieving using three sieves with pore sizes of 1.18, 0.30 and 0.045 mm.

Results and Discussion

A sheep slaughtered at 8 hours after feeding consumed extremely low, had absesses at the pyloric region and could not ruminate normally. Therefore, data from the sheep were excluded from the analysis. Daily dry matter intake, chew-

TABLE 1. THE DAILY DRY MATTER (DM) INTAKE, THE CHEWING ACTIVITIES AND LARGE PARTICLE (LP) POOL OF RETICULO-RUMINAL DIGESTA

	Time after commencement of feeding (hour)				MSD[1]
	2	8	16	24	
DM intake (g/kgW$^{.75}$)	15.5	14.9	19.3	16.8	5.2
Eating time (min/d)	96.0	120.0	117.5	114.8	15.3
Ruminating time (min/d)	1.8^{a}	90.7^{a}	212.3^{b}	286.0^{b}	65.2
Total chewing time (min/d)	97.8^{a}	210.7^{b}	329.8^{c}	400.8^{c}	61.8
Net chewing time (min/d)[2]	97.4^{a}	193.7^{b}	281.8^{bc}	359.4^{c}	55.7
DM of digesta (g/kgW$^{.75}$)	37.2	26.1	32.7	22.6	10.6
Proportion of LP (> 1.18mm, %)	41.7^{a}	33.5^{a}	35.1^{a}	19.2^{b}	6.7
LP pool (g/kgW$^{.75}$)	15.6	9.3	11.6	4.3	5.2
DM intake – LP pool (g/kgW$^{.75}$)	0.1^{a}	5.6^{ab}	7.7^{bc}	12.5^{c}	3.5

[1] MSD, Mean standard deviation. [2] Net chewing time, See text.
a,b,c Means with uncommon superscripts differ ($P < 0.05$).

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ing activities and large particle (> 1.18 mm) pool of digesta in the reticulo-rumen are presented in table 1. Eating time was restricted to 120 minutes. However, most animals were considered to have complete active consuming within that time.

There was wide variation among individuals in dry matter intake and dry matter in the reticulo-rumen. In the four sheep slaughtered at 2 hours after feeding, the values of dry matter intake were very close to those of large particle pool. A Chi square test showed that probability of the coincidence was lower than 0.005. This suggested that large particle pool controlled the dry matter intake and that small particle (< 1.18 mm) from newly consumed hay had little effect on the dry matter intake under the present condition. Mean dry matter in the reticulo-rumen before and after the meal were 1.4 and 2.4 times of dry matter intake, respectively. This indicates that little flew out from the reticulo-rumen during the meal. About 70 percent of hay entered the reticulorumen as large particle and 30 percent as small particle. Ruminating time increased along with the increasing intervals between the meal and slaughter. Net ruminating time was obtained by subtracting time intervals spend for regurgitating and reswallowing from the ruminating time and ranged from 66.2 to 92.2 percent of the ruminating time. Net chewing time was obtained by adding net ruminating time to eating time.

Correlations between net chewing time and dry matter intake and dry matter in the reticulo-rumen were low, while net chewing time significantly correlated with the proportion of large particle and large particle pool. Dividing dry matter in the reticulo-rumen and large particle pool by dry matter intake resulted in higher correlation with net chewing time. This suggested that the effect of dry matter intake was significant. The results described above indicated that dry matter intake was close to large particle pool after the meal. Therefore, the difference between dry matter intake and large particle pool at a certain time might be the amount of breakdown of large particle and its disappearance from the reticulo-rumen. These values also highly correlate with net chewing time and net ruminating time. Linear regressions were presented in table 2.

TABLE 2. LINEAR REGRESSIONS

Dependent (Y)	Regression equation	r^2	P
DM intake (g/kgW$^{.75}$)	Y = 13.4 + 0.0139 X	.105	
DM of digesta (g/kgW$^{.75}$)	Y = 37.9 − 0.0342 X	.125	
Proportion of LP (> 1.18mm, %)	Y = 49.3 0.0718 X	.615	**
LP pool (g/kgW$^{.75}$)	Y = 17.7 − 0.0316 X	.326	*
DM of digesta/DM intake	Y = 2.69 − 0.0037 X	.794	**
LP pool/DM intake	Y = 1.20 − 0.0024 X	.766	**
DM intake − LP pool (g/kgW$^{.75}$)	Y = −4.29 + 0.0455 X	.835	**

Independent (X): *Net chewing time (min/d)*.
*: Significant P < .05; **: Significant P < .01.

Results obtained in the present study suggest that large particle pool in the reticulo-rumen controls the dry matter intake in a meal and net chewing time is the major factor of particle size reduction in the reticulo-rumen. Further investigation is required to confirm this conclusion.

(Key Words: Intake, Particle Size, Chewing)

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