EFFECT OF CHEWING TIME OF DIETS ON RUMEN FERMENTATION AND MILK PRODUCTION IN DAIRY COWS

K. Sakurai[1], S. Fujishiro[2], K. Shinjoh[2], N. Honzawa[3], F. Yamamoto[4], T. Tomabechi[5], M. Yoshida[6], A. Takahashi[7], H. Itabashi[8], and A. Abe[8]

[1] Yamanashi Dairy Experiment Station, Yamanashi 408; and
[2] Chiba Livestock Experimental Station, Chiba 289-11; and
[3] Tochigi Dairy Experimental Station, Tochigi 329-27; and
[4] Tokyo Livestock Experiment Station, Tokyo 198; and
[5] Gunma Livestock Experiment Station, Gunma 371-01; and
[6] Nagano Livestock Experiment Station, Nagano 399-07;
[7] Aichi Agricultural Research Center, 480-11;
[8] National Institute of Animal Industry, Ibaraki 305 Japan

Introduction

In dairy cows, feeding of high energy, restricted roughage diets is associated with many physiological disorders, depressed rumen pH and reduced milk fat percentage (Van Soest, 1963). Therefore many feeding standards recommend a minimum of 15-17% crude fiber in the diet of lactating dairy cows (e.g. National Research Council of Agriculture, Forestry and Fisheries, 1987). However, this suggested fiber does not consider absolute amount, quality or physical form. Many attempts have been made to account for the "roughage effect". Balch et al. (1971) reported that chewing time could be used as an indicator of physical property of roughages. Some roughage indexes for different diets have been reported (Balch et al., 1971, Ørskov et al., 1974, Sudweeks et al., 1981). In this report, we studied the effect of chewing time (CT, both eating and cud chewing) of diet on rumen fermentation and milk production.

Materials and Methods

Fifty nine multiparlus Holstein cows were assigned randomly to the three diets: (1) short CT, (2) medium CT, (3) long CT. Varying amounts of Timothy hay and soybean hulls were used to prepare three different diets. Timothy hay was chopped at 1 cm theoretical length of cut. The concentrate consisted of corn, soybean meal, barley, defatted rice bran, wheat bran, and others. The amounts of these materials were essentially the same for three diets. All diet ingredients were combined as a total mixed ration. Three diets were formulated at 75% TDN, 16% CP and 35% NDF on a DM basis.

Prepartum cows were fed diets consisting of 60% the experimental diet and 40% hay on a DM basis for 2 weeks. Five days postpartum, all cows were fed only the experimental diet ad libitum, which lasted for 15 weeks. Residual feed was collected and weighed daily. Rumen fluid was taken by stomach tube about 4-5 h after feeding. Sampling intervals were 1, 5, 9 and 13 weeks postpartum. Milk was sampled weekly. Total chewing, eating, and ruminating times were determined at 16 weeks postpartum by recording the action of 8 cows for each diet during 48 h. The results were analyzed by analysis of variance.

Results and Discussion

Effects of chewing time on rumen fermentation and milk production are shown in table 1. Total chewing times in minutes per kg of DM intake were 23.0, 26.1 and 32.0 for CT-S, CT-M and CT L diet, respectively.

There were no differences in dry matter intake among three diets. The concentrations of total volatile fatty acids (VFA) and ammonia N in the rumen fluid were not affected by the diets. However, molar percentages of each acid were affected by the diet. Acetic acid and butyric acid increased with an increase in total chewing time. On the other hand, propionic acid and other acids decreased with an increase in chewing time. These changes would be due to the increased saliva secretion in longer CT diets: the buffering action of the saliva altered rumen condition favoring the

TABLE 1. MEAN DAILY DRY MATTER INTAKE (DMI), MOLAR PROPORTIONS OF RUMEN VFA, RUMEN AMMONIA-N (NH_3-N), DAILY MILK YIELD, PERCENTAGES OF MILK CONSTITUENTS AND CHEWING ACTIVITIES

	Chewing time of diet		
	S	M	L
DMI (kg)	22.8	23.8	23.6
Acetic (%)	56.4^{b}	57.7^{ab}	60.2^{a}
Propionic (%)	29.4^{a}	28.0^{ab}	25.0^{b}
Butyric (%)	10.7^{b}	11.4^{ab}	12.3^{a}
NH_3-N (mg/dl)	2.9	3.2	3.7
Milk yield (kg)	37.1	35.5	34.3
Fat (%)	2.86^{b}	3.26^{a}	3.45^{a}
SNF (%)	8.67	8.65	8.67
Chewing activities (min/kg DMI)			
Eating	9.9	10.6	12.4
Ruminating	13.1^{b}	15.5^{ab}	19.6^{a}
Chewing	23.0^{b}	26.1^{ab}	32.0^{a}

^{a,b,c}Values in the same row with different letters differ significantly ($p < 0.01$).

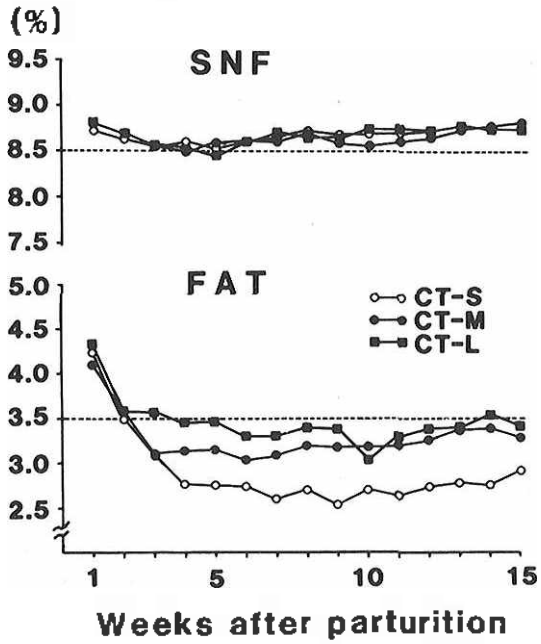

Figure 1. The changes of milk composition after parturition.

production of acetate and butyrate over propionate.

Milk production averaged 35.6 kg/day throughout the experimental period and was not affected by the diets. In figure 1, changes with lactation period in percentages of fat and solids-not-fat (SNF) in milk are shown. Percentages of milk fat in CT-L and CT-M diets were higher than in CT-S diet. However, percentages of milk SNF were not affected by diets.

These data indicate that the chewing time of diet affects milk quality through the change in rumen fermentation, especially VFA production. Sudweeks et al. (1981) reported that the required roughage value index (chewing time, min/kg DM) for milk of 3.5% fat was 31.1. Our data were in accordance with the results of Sudweeks et al. (1981), indicating that the chewing time is an adequate measure of roughage evaluation. More study is needed to establish roughage index.

(Key Words: Chewing Time, Rumen Fermentation, Milk Production)

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