Some Quantitative Aspects of Ruminal Nitrogen Fractions in Goats Infused Casein and Starch into Their Rumen and Abomasum

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Concentration of nitrogen fractions in the rumen is affected by the magnitude of microbial contribution, and the magnitude of microbial contribution is affected by the kind and the quantity of dietary nutrients introduced into the rumen. In order to determine the influence of dietary nutrients on the concentration of ruminal nitrogen fractions, this experiment was carried out using goats receiving casein and starch into the rumen and the abomasum.

Experimental

Animals and diets were the same as reported previously. Feeding systems employed here were as follows: A; casein, starch and other nutrients were simultaneously given into the rumen, B; casein was given into the rumen, and starch and other nutrients were infused into the abomasum, C; casein was infused into the abomasum, and starch and other nutrients were given into the rumen, and D; all nutrients were simultaneously infused into the abomasum.

After feeding the goats for 12 days, about 100 ml of rumen contents were sampled through the ruminal cannula using a glass tube attached with a large rubber suction bulb, just before the morning feeding and at 2, 4, 6 and 8 hours after the first sampling. A few drops of saturated HgCl₂ solution were added to the sample to stop further fermentation. Then the rumen fluid was strained through four folds of gauze and centrifuged at 20,000 × g for 60 minutes to remove protozoal and bacterial fractions. The centrifuged supernatant was used for measuring pH, ammonia, total soluble nitrogen. For the determination of ammonia and non-protein nitrogen the centrifuged rumen fluid was deproteinized with 20% trichloroacetic acid solution. Micro-Kjeldahl method was employed to determine total soluble nitrogen and non-protein nitrogen, and ammonia was determined by aeration method.

Results and discussion

The results obtained in this experiment are summerized in Fig. 1. There were no large differences in values between the two goats, so that averages of two readings are indicated in the figure. According to Waldo and Lewis, a considerable amount of ammonia is directly absorbed from the rumen wall when ammonia concentration becomes high in the rumen. Bloomfield et al. reported that ammonia absorption from the rumen wall was decreased by

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Fig. 1. Time course changes in pH and concentrations of total soluble N, non-protein N and ammonia N in the rumen fluid of goats. A: casein and starch are given in the rumen, B: casein is given in the rumen and starch is infused into the abomasum, C: casein is infused into the abomasum and starch in the rumen, D: casein and starch are infused into the abomasum.

HOGAN7) also reported that no ammonia absorption through the rumen wall was observed at the ruminal pH of 4.5. In the present experiment, ruminal pH in the feeding system A was 4.7 and that in the feeding system B was 5.8 at 2 hours after feeding. These pH values obtained in this experiment suggest that ammonia absorption from the rumen may be lower in the feeding system A than in the feeding system B, and it would be explained by the reports mentioned above. Nevertheless, ruminal ammonia concentration was almost the same in the both feeding systems at 2 hours after feeding. This result seems
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to be suggestive that rumen microbes of the goats in the feeding system A utilization of ammonia is more effective than those in the feeding system B.

According to WALDO3), when large amount of ammonia is absorbed from the rumen, absorbed ammonia is converted into urea in the liver, and consequently urinary urea excretion increases. In the previous experiment11, more nitrogen was excreted into urine in the feeding system B than in the feeding system A, and subsequent negative nitrogen balance was resulted in the former feeding system. This fact also suggests that more ammonia was absorbed from the rumen in the feeding system B.

In the feeding system B, the concentration of total soluble nitrogen in the rumen fluid was nearly 1.5 times as high as the concentration ruminal non-protein nitrogen. Whereas, the concentration of total soluble nitrogen in the feeding system A was almost the same as that of non-protein nitrogen, and they were both higher than those in the feeding system B. These results suggest that in the goats receiving casein into the rumen a considerable amount of soluble protein remains in the rumen when no starch is infused into the rumen.

In the present experiment, the concentration of non-protein nitrogen was almost equal to that of ammonia nitrogen in the feeding system B, whereas, in the feeding system A the concentration of non-protein nitrogen was twice as high as ammonia nitrogen concentration. Therefore, when casein and starch were simultaneously infused into the rumen, casein was decomposed to non-protein nitrogenous substances (ammonia and other non-protein nitrogenous substances). In this experiment, however, such non-protein nitrogenous substances were not analyzed. The similar tendency was observed by McDonald and Hall8) with sheep. McDonald9) reported that ammonia was the main component of non-protein nitrogen fraction in the rumen fluid.

According to Egan10,11), the concentration of ruminal ammonia was increased by the infusion of casein or urea into the abomasum of sheep fed low protein cereal hay. In the present experiment, however, ammonia concentration in the feeding systems C and D, in which casein was infused into the abomasum directly, was very low compared to that in the feeding systems A and B, and the concentration was not changed with the lapse of time after feeding. Weston and Hogan12) also reported that in sheep fed wheat chaff the concentration of ruminal ammonia was not affected by the infusion of urea into the abomasum. This result was also reported by Tasaki et al.13). In the feeding systems C and D, the concentrations of total soluble nitrogen and non-protein nitrogen were also low and not changed with the lapse of time after feeding. It may be suggested from these results that when no casein is infused into the rumen ammonia is rarely produced even if starch is given into the rumen.

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References

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