

Studies on the technique and its usefulness for the early establishment of adult rumen microorganisms in new born calves

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It was assumed that the early establishment of rumen microorganisms in calves would be important for both the improvement of growth and the inhibition of the colonization of pathogenic bacteria in the intestinal tract. Therefore, to develop techniques for the early establishment of adult rumen microorganisms in calves, several experiments were carried out.

Experiment I. Effect of oral administration to calves of fresh rumen fluid from healthy adult cattle on both the early establishment of rumen microorganisms and the improvement of growth

In this experiment, calves were divided into four groups; calves administered fresh rumen fluid from healthy adult cattle within 2 to 3 hours after birth (group 1), calves administered fresh rumen fluid and autoclaved rumen fluid (AT-R) (group 2), calves administered AT-R (group 3), and non-administered control calves (group C). Oral administration of fresh rumen fluid from healthy adult cattle was effective in the early establishment of rumen microorganisms in the rumen of calves, as compared with non-administered calves. On the colonization of aerobic and facultative anaerobic bacteria in the rumen, the numbers of *Lactobacillus* spp. were much higher in calves in groups 1, 2, and 3 during the experimental period, as compared with the non-administered calves. The numbers of *Streptococcus* spp. were higher in calves in groups 2 and 3, as compared with calves in groups 1 and C. The number of *Escherichia coli* was lower in calves in groups 1, 2, and 3, as compared with the non-administered calves. On the development of anaerobic bacteria in the rumen, the numbers of lactate-utilizers were same in calves in both the rumen fluid administered groups and the non-administered group during the experimental period. Pectin-fermenters and xylan-fermenters, cellulolytic bacteria, and methanogenic bacteria developed early in the rumen of calves in groups 1, 2, and 3, as compared with the non-administered calves. Oral administration of fresh rumen fluid also promoted the colonization of protozoa in the rumen of calves. On the other hand, oral administration of AT-R did not promote the colonization of protozoa in calves, as compared with non-administered calves. Total volatile fatty acids (VFA) concentrations in the rumen were higher in the rumen fluid

administered calves until 50 days of age, as compared with the non-administered calves. After 70 days of age, total VFA concentrations remained level at 40 ~ 50 mM in the administered calves. The total VFA concentration in the non-administered calves after 50 days of age was the same as that in the administered calves. The molar proportion of VFA in the rumen of the administered calves (groups 1, 2, and 3) was lower for acetic acid and inversely higher for propionic acid until 50 days of age, as compared with the non-administered calves. There was no difference in the molar proportion of VFA between the administered calves and the non-administered calves at 90 days of age. The intake of feed was higher in the administered calves until 90 days of age, as compared with the non-administered calves. The daily gain was significantly higher in the calves of group 1 than in the calves of the other groups.

From these results, it is suggested that the oral administration of 100 ml of fresh rumen fluid for three consecutive days to new born calves was effective in both the early establishment of adult rumen microorganisms in calves and the improvement of animal growth.

Experiment II. Influence of oral administration of representative rumen bacteria to a germ-free goat

An experiment to investigate the influence of oral administration of major representative rumen bacteria isolated from bovine rumen to a germ-free goat was carried out. Nine species of rumen bacteria were orally administered to a germ-free goat during 35 to 39 days of age after birth. The goat administered rumen bacteria was euthanized at 60 days of age. The pH and total VFA concentration of the rumen contents of the goat were 6.98 and 25.9 mM, respectively. The numbers of *Veillonella parvula* and *Streptococcus bovis* were about 1,000 times higher in the rumen of the goat than in the lower digestive tract. Among the 9 species orally administered, *S. bovis*, *Prevotella (Bacteroides) ruminicola* ss. *brevis*, *Ruminobacter (Bacteroides) amylophilus*, and *Butyrivibrio fibrisolvens* abundantly colonized the rumen.

The oral administration of major representative rumen bacteria isolated from the rumen to a germ-free goat demonstrated that rumen bacteria, except cellulolytic bacteria, colonized not only the rumen of the goat but also the intestinal tracts.

Experiment III. Effect of oral administration of fresh rumen fluid from healthy adult cattle on the ability of pathogenic *Escherichia coli* to colonize the digestive tract of newborn calves

To confirm the usefulness of the early establishment of adult rumen

microorganisms in calves, experiments were carried out to inhibit the colonization of pathogenic *Escherichia coli* in the digestive tract by oral administration of rumen fluid from healthy adult cattle to new born calves within 2 to 3 hours after birth. The new born calves which were not administered rumen fluid died of watery diarrhea following the administration of *E. coli* NAS-10 (09: K99: Sta+: LT-). On the other hand, no occurrence of diarrhea was observed in the newborn calves which were administered rumen fluid prior to the administration of *E. coli* NAS-10. The numbers of *E. coli* NAS-10 in the duodenum were markedly lower in the new born calves administered rumen fluid followed by *E. coli* NAS-10, as compared with the calves administered *E. coli* NAS-10 without rumen fluid. Morphologically, a greater variety of bacteria were observed in the rumen, duodenum and rectum of newborn calves that were administered rumen fluid as compared with non-administered calves. Furthermore, the total VFA concentration of the intestinal contents of newborn calves administered rumen fluid were much higher as compared with non-administered calves.

The results obtained in this investigation showed that administration of rumen fluid to newborn calves has inhibitory effects on the colonization of pathogenic *Escherichia coli* in the intestinal tract.