INFLUENCE OF AMMONIA TREATMENT OF RICE STRAW OFFERED TO CATTLE AS A FORAGE ON RUMINAL MICROBIAL POPULATIONS

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Introduction

It was reported that ammonia treatment increased the digestibility of barley straw by up to about 20 percentage units in feeding experiments to cattle. Moreover, it was shown that ammonia treatment of barley straw increased its susceptibility to solubilization by the predominant cellulolytic bacteria from the rumen, *Bacteroides succinogenes, Ruminococcus albus* and *Ruminococcus flavefaciens* (Kolankaya et al., 1985). The aim of the present investigation was to clarify the influence of ammonia treatment of rice straw given to cattle as a forage on the constitution of micro-organisms established in the rumen.

Materials and Methods

Two Holstein steers, 14 months of age and weighing approximately 280 kg, were used in this experiment. Each animal was fed the following three types of feeds at different feeding periods: ordinary feed(F), containing 2 kg timothy hay, 1 kg lucerne hay cubes and 3 kg concentrate (per day); untreated rice straw feed (RSF), containing 4 kg untreated rice straw and 3 kg concentrate; ammonia-treated rice straw feed (ARSF), containing 4 kg ammonia-treated rice straw and 3 kg concentrate. The rations were offered to two animals in the following sequence: for No. 1 cattle, F (28 days), ARSF (28 days), F (42 days), RSF (30 days); for No. 2 cattle, F (28 days), RSF (28 days), F (42 days), ARSF (30 days).

For anaerobic bacterial enumeration, ten fold serial dilutions of the rumen fluid were made in the anaerobic dilution solution, to which agar was added to 0.1 % (W/V). Total viable counts of bacteria in the rumen fluid were made by the techniques of Hungate (1959) with the rumen fluid-glucose-cellobiose-maltose-starch-agar merium (RGCMSA). Approximately 35 strains were isolated by picking colonies at random from roll tubes used in the total viable count containing 20 – 50 colonies per tube. Primary identification of bacterial isolates was carried out according to the VPI Manual (1977) and Bergey's Manual of Systematic Bacteriology Vol.1 and 2.

The count and identification of protozoa in the samples was done by using a plankton counter deck glass.

Results

Total VFA concentrations in the rumen of both animals at the periods of feeding ARSF were consistently higher than at the periods of feeding RSF. The molar proportion of acetic acid in the rumen of both animals at the periods of feeding ARSF decreased and that of butyric acid increased significantly, compared with the periods of feeding RSF.

The proportion of *Dasytricha* spp. and *Eremoplastron* spp. was higher at the periods of feeding RSF than at those of feeding ARSF. And, the proportion of *Entodinium* spp. in the rumen of both animals increased at the periods of feeding ARSF, compared with the periods of feeding RSF.

The viable bacterial population in the rumen of both animals at the periods of feeding ARSF was dominated by *Eubacterium* spp., *Butyrivibrio* spp. and *Bacteroides* spp. On the other hand, the bacterial population in the rumen of both animals at the periods of feeding RSF was dominated by *Bacteroides* spp. and *Butyrivibrio* spp. *Eubacterium* spp. was present at 3.1 – 7.1 % of the bacterial population in the rumen of both animals at the periods of feeding RSF or F. The cellulolytic bacteria such as *B. succinogenes* and *R. albus* was predominantly present in the rumen of both animals at the periods of feeding ARSF, but was

not detected at high dilutions of the rumen contents of both animals at the periods of feeding RSF.

Discussion

The kinds of the predominant bacteria established in the rumens of both animals at the periods of feeding the same feed, when RSF or ARSF was fed, were quite similar regard less of sampling months. And, the kinds of bacteria isolated at high dilutions from the rumen contents of both animals at the periods of feeding ARSF were more significantly abundant than at the periods of feeding RSF. The numbers of cellulolytic bacteria counted by MPN method were higher at the period of feeding ARSF than at the period of feeding RSF. And, the cellulolytic bacteria were isolated at high dilutions from the rumen contents of both animals at the period of feeding ARSF, but were not isolated at the period of feeding RSF (table 1). *R. albus* and *B. succinogenes* were isolated at high dilutions from the rumen contents of No. 1 and No. 2 cattle, respectively. It would appear therefore that *R. albus* and *B. succinogenes* must be responsible for most of the cellulolytic activity in the rumens of these animals. These results will be supported by the findings that treatment of barley straw with anhydrous ammonia increased its digestion by *B. succinogenes* and *R. albus in vitro* and increased microbial colonization on straw (Kolankaya et al., 1985).

TABLE 1. THE CONSTITUTION OF BACTERIA ISOLATED FROM THE RUMEN CONTENTS OF CATTLE AT THE PERIODS OF FEEDING THREE DIFFERENT FEEDS (NO. 1 CATTLE)

Organism	Ordinary feed (F)	Ammonia-treated rice straw feed (ARSF)	Ordinary feed (F)	Untreated rice straw feed (RSF)
Bacteroides spp.	18.5[a]	8.6	46.9	53.5
Ruminobacter amylophilus	3.7			3.6
Bacteroides succinogenes			3.1	
Butyrivibrio spp.	22.2	25.8	28.2	28.6
Ruminococcus albus		5.7		
Eubacterium spp.		45.8	3.1	7.1
Others	55.6	14.1	18.7	7.2

[a]Figures show % of total bacteria isolated.

(**Key Words**: Ammonia-treated Rice Straw, Rumen Microflora)

Literature Cited

Hungate, R.E. 1969. A roll tube method for cultivation of strict anaerobes. In "Method in Microbiology 3B" (Ed. by J.R. Norris and D.W. Ribbons) Academic Press, p.117-132.

Kolankaya, N., C.S. Stewart, S.H. Duncan, K.J. Cheng and J.W. Costerton, 1985. The effect of ammonia treatment on the solubilization of straw and the growth of cellulolytic rumen bacteria. J. Appl. Bacteriol. 58: 371-379.