

FERMENTATION PRODUCTS AND PROTEIN CONCENTRATIONS IN DIGESTIVE TRACTS IN *MICROTUS MONTEBELLI* FED WITH DIFFERENT RATIONS

M. Sugawara, T. Arai and Y. Oki

Department of Veterinary Biochemistry, Nippon Veterinary
and Zootechnical College, Musashino-shi, Tokyo 180, Japan

Introduction

The field voles, *Microtus* species, have large complex stomachs consisted of forestomach (first), fundic region (second), and pyloric region (third) of glandular stomach. The voles have their own characteristic that fermentation products in the digestive tracts are used as energy source and bacterial flora in the forestomach is changed easily by feeding with various rations (Kudo and Oki, 1981). In the present paper, fermentation products, protein concentration and proteolytic activities were investigated in voles fed with different rations.

Materials and Methods

Mature voles, *Microtus montebelli*, (B.W. 38.7 ± 9.9 g) bred in our laboratory were divided into two groups, A and B. In group A, voles were fed with hay-cubes (CF 23.7%, CP 17.2%) and pellets for herbivore (CF 12.5%, CP 18.4%) which contained high fiber and high protein. Voles in group B were fed with potatoes alone (CF 0.6%, CP 1.9%) containing low fiber and low protein but high starch. Fermentation products were analyzed with gas chromatography. The protein concentrations of contents were determined by the method of Bradford (1976). Activities of pepsin in the fundic region at pH 1.2 and trypsin in the duodenum at pH 6.0 were measured using hemoglobin and casein as substrates, respectively.

Results and Discussion

In the forestomach (first) of the voles (group A) fed with high fiber and high protein ration, pH value was 5.6 to 6.0 and acetic acid was major fermentation products, over 90% of total VFAs. In the forestomach of the voles (group B) fed with potatoes alone, pH value, total VFAs and acetic

acid decreased significantly, but lactic acid concentration was considerably high in comparison with that of the voles (group A) fed with hay-cubes and pellets (table 1). In the fundic region (second) of glandular stomach, hydrochloric acid and pepsin were secreted, and pH value and fermentation decreased considerably in the pyloric region (third). In the caecum of voles in both groups, pH value was stable, 6.5 to 6.7, and total VFAs concentration was almost twice higher than that in the forestomach, and ratios of propionic and butyric acids greatly increased, respectively. However, lactic acid was not detected. Fermentation in caecum was influenced very little by changing of rations.

The voles in group B were fed with low protein ration, but protein concentrations in the forestomach were as high as those in group A (table 1). The increases of the protein concentrations were considered to be derived from microorganisms which increased with fermentation of the feeds in the forestomach. The proteins in the forestomach appeared to be degraded by high activities of the pepsin detected in the fundic region, and the protein concentrations greatly decreased in the pyloric region of voles of the both groups. Further, high proteolytic activities of trypsin were observed in the duodenum. It was considered that the proteins degraded by pepsin were changed into amino acids by trypsin and absorbed in the duodenum. Significantly high concentrations of proteins were detected in caecum of the voles in group B. Obara and Goto (1988) reported that endogenous urea was utilized predominantly in the caecum of voles in condition of low protein feeding. Low proteolytic activities were found in caecum, and a part of the proteins seemed to be changed into amino acids to be absorbed. There are many obscure points in utilization of proteins in caecum, but it is considered that the proteins are possible to be used by the copro-phagy under certain conditions.

TABLE 1. CONCENTRATIONS OF FERMENTATION PRODUCTS AND PROTEIN IN CONTENTS OF THE DIGESTIVE TRACTS OF VOLES FED WITH DIFFERENT TYPES OF RATIONS (MEAN±SEM)

Region	Group	pH	Total V.F.A. ¹ (mM)	Acetic acid (mM)	Propionic acid (mM)	Butyric acid (mM)	Lactic acid (mM)	Protein (mg/g contents)
Fore-stomach	A ² (22) ³	5.8	46.5 ^a ±1.0	41.6 ^a ±0.6	3.0 ±0.3	1.8 ±0.4	12.8 ±2.1	4.8 ±0.8
	B (20)	4.1	33.1 ±0.5	20.9 ±0.5	2.6 ±0.2	6.9 ^b ±0.3	37.8 ^b ±2.5	5.8 ±0.8
Glandular stomach (Pyloric region)	A (22)	1.8	1.8 ±0.6	1.7 ±0.6	0.03 ±0.05	0.03 ±0.03	0.16 ±0.27	1.7 ±0.2
	B (17)	1.9	1.2 ±0.49	0.8 ±0.5	0.09 ±0.05	0.21 ±0.23	0.93 ±0.26	1.0 ±0.2
Caecum	A (22)	6.7	100.7 ±3.4	76.4 ±2.2	8.7 ±0.4	15.3 ±1.4	—	5.3 ±0.2
	B (20)	6.5	97.2 ±3.5	63.9 ±1.4	13.5 ±1.1	19.5 ±1.3	—	10.7 ^b ±1.3

¹Volatile fatty acid.

²Group A: fed with hay-cubes and pellets for herbivore. Group B: fed with potatoes alone.

³Number of voles examined is in parentheses.

^aSignificantly high ($p < 0.001$) against group B.

^bSignificantly high ($p < 0.001$) against group A.

It was suggested that the fermentation products and the microorganism proteins in forestomach and caecum were used efficiently as energy and nitrogen sources in the voles. It was considered that *Microtus* species was a useful animal model to study nutrient metabolism in herbivora including ruminants.

(Key Words: Vole; Fermentation, Proteolytic Activity)

Literature Cited

- Bradford, M.M. 1976. A rapid and sensitive method for the quantitation of protein utilizing the principle of protein-dye binding. *Anal. Biochem.* 72:248-254.
- Kudo, H. and Y. Oki. 1981. Fermentation and VFA production in the esophageal sac of *Microtus montebelli* fed different rations. *Jpn. J. Vet. Sci.* 43:299-305.
- Obara, Y. and N. Goto. 1988. Utilization of endogenous nitrogen in Japanese field vole (*Microtus montebelli*). *Jpn. J. Zootech. Sci.* 59:733-739.