Bacterial flora, protozoal fauna and volatile fatty acids in the rumen of the water buffalo *(Bubalus bubalis)* in tropical Asia

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The composition of the ruminal flora and the VFA concentration were surveyed in the water buffalo found in tropical Asia. The results showed that the average concentration of VFA in rumen contents was 57 mM and the number of bacteria and protozoa was 10^{10} and 10^6 per ml, respectively. Acetic acid comprised the major portion of the individual VFA followed by propionic acid. Among the rumen bacteria Gram-negative rods were most predominant followed by Gram-positive cocci. Four new species of rumen protozoa have been found in the water buffalo in tropical Asia i.e. *Entodinium ogimotoi, E. bubalum, E. fujitai* and *E. tsunodai.* The rumen ciliate composition was compared among water buffalo found in different regions of the world.

Die samestelling van die flora van die grootpens en die vlugtige vetsuurkonsentrasie is ondersoek in die waterbuffel wat in tropiese Asië voorkom. Volgens die resultate was die gemiddelde konsentrasie van vlugtige vetsure in die grootpensinhoud 57 mM en die aantal bakterieë en protosoë was 10^{10} en 10^6 per ml onderskeidelik. Die grootste gedeelte van die individuele vetsure was asynsuur, gevolg deur propionsuur. Gram-negatiewe stawe het die oorheersende gedeelte van die rumen bakterieë uitgemaak, gevolg deur Gram-positiewe kokke. Vier nuwe spesies rumen protosoë is in die waterbuffel in tropiese Asië gevind, nl. *Entodinium ogimotoi, E. bubalum, E. fujitai* en *E. tsunodai.* Die samestelling van die siliate van die grootpens is vergelyk met dié van waterbuffels wat in verskillende streke van die wêreld voorkom.

Keywords: Rumen, water buffalo, bacterial flora, protozoal fauna, ciliate, *Entodinium, Entodinium ogimotoi,* ruminant, volatile fatty acids (VFA)

Introduction

The water buffalo is one of the most common domestic and herbivorous animals in tropical Asia, Okinawa, Taiwan, Thailand, Philippines, Malaysia, Indonesia and other countries. However, the microbial features in the rumen of water buffalo found in tropical Asia have not been reported. The present studies were carried out to provide information on the bacterial flora, protozoal fauna, especially the ciliates, and volatile fatty acids in the rumen of water buffaloes.

Materials and Methods

Rumen contents were collected from adult water buffaloes in Okinawa, Taiwan, Philippines, Thailand, Indonesia and Malaysia. The preserved rumen contents were cooled and transported to the laboratory in tightly closed screw-cap polyethylene bottles. The rumen contents were stored at −20°C until required for chemical and microbial analysis.

The methods used for culture, counts, identification and description of microbes in the rumen of water buffalo were described in the *Atlas of Rumen Microbiology* (Ogimoto & Imai, 1981). The volatile fatty acids were determined by a gas chromatograph equipped with a flame-ionization detector (Ogimoto & Imai, 1981).

Results and Discussion

The average concentration of VFA in the rumen was 57 mM (Table 1). Acetic acid formed the largest part (66,4%) and propionic acid formed 20,1%. The composition of VFA in the rumen of water buffalo in tropical Asia closely resembles the composition found in cattle fed roughage in Japan, but the concentration of total VFA in the rumen was lower than that found in cattle or sheep in Japan (Ogimoto, 1980; Ogimoto & Imai, 1981).

Table 1 Concentrations and proportions of volatile fatty acids (VFA) of the rumen contents of water buffalo in tropical Asia

VFA	Concentration (mM)	Molar proportion (%)
Total	57,1 ± 31,7	–
Acetic	37,9 ± 22,0	66,4
Propionic	11,5 ± 5,0	20,1
Butyric	5,0 ± 5,2	8,8
Higher acids	1,7 ± 0,7	3,0

Numbers of total bacteria and ciliate protozoa in the rumen were 10^{10} and 10^{6} per ml, respectively. These values were similar to those reported for cattle fed primarily on roughage (Ogimoto, 1980; Ogimoto & Imai, 1981). Among the rumen bacteria, Gram-negative rods were most predominant followed by Gram-positive cocci. The protozoal fauna, especially the *Entodinium* spp., found in the rumen of the water buffalo in tropical Asia, differed from those of cattle in Japan.

The water buffalo *(Bubalus bubalis)* is divided into two types, the river-type and the swamp-type. The river-type buffalo is distributed from India to north Africa, and the swamp-type buffalo in tropical Asia. The microbial features in the rumen of river-type buffalo, especially the rumen ciliate fauna has been reported in the Turkestan region (Dogiel, 1928), in India (Banerjee, 1955) and in Brazil (Dehority, 1979).

The protozoal flora in the rumen of swamp-type water buffalo found in tropical Asia have been reported by our research group (Fujita, Imai & Ogimoto, 1979; Imai, 1981).

Table 2 shows the number of ciliate species in the protozoal families found in the rumen of the water buffalo in tropical Asia, in the African water buffalo *(Syncerus caffer)* in Africa, of the zebu *(Bos indicus)* in India and Sri Lanka, and of cattle *(Bos taurus)* in Japan. They were composed of a mixture of three types of the fauna each typical of water buffalo in tropical Asia, of cattle in Japan and of zebu in India or Sri Lanka.

Four new species of rumen ciliates *Entodinium ogimotoi, E. bubalum, E. fujital* and *E. tunodai,* have been reported from water buffaloes in Taiwan (Imai, 1981). *E. ogimotoi* is rectangular to nearly square in body contour with two flattened triangular lobes at the posterior end of the body. The cytoproct (anus) is situated right on the median line. The body is 30 to 47 μm long (Figure 1). *E. bubalum* is ovoid or elliptical with two caudal spines, which are close to each other and situated near the middle of the posterior end of the body. The upper-right spine is shorter than the lower-left one. The body is 25 to 45 μm long. *E. fujitai* is asymmetrical in shape. Its body surface is strongly convex on the right side and concave in the anterior half of the left side. Its tail is composed of two heavy spines. The body is 23 to 32 μm long. *E. tunodai* is ovoid, with four caudal spines. The body is 28 to 40 μm long.

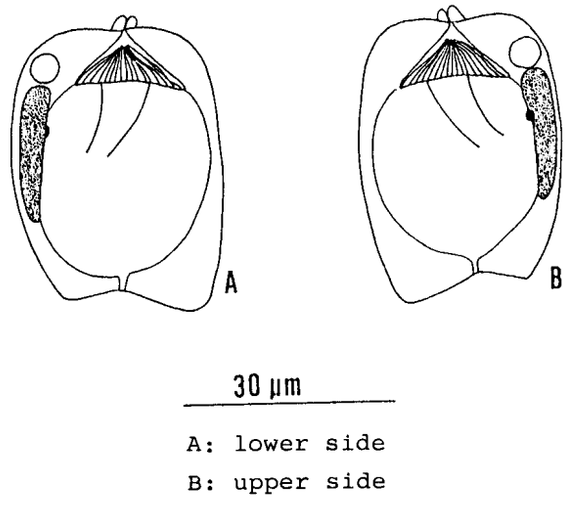

Figure 1 Rumen ciliate, *Entodinium ogimotoi* sp. n., (Imai, 1981) from water buffalo in tropical Asia

Table 2 Number of rumen ciliate species found in different protozoal families in tropical Asia and other areas (See Ogimoto & Imai, 1981 — Atlas of Rumen Microbiology for references)

Ruminant species and region	Families of Protozoa			
	Entodiniinae	Diplodiniinae	Ophryoscolecidae	Isotrichidae, Blepharocorythidae and others
Water buffalo in tropical Asia	21	13	1	3
Water buffalo in west Asia	10	15	3	0
African buffalo in Africa	7	8	2	1
Zebu in India and Sri Lanka	20	22	7	ND[a]
Cattle in Japan	15	21	4	5

[a]ND: Not surveyed

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