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Occurrence of the Ciliate Protozoa *Bütschlia parva* Schuberg in the Rumen of the Ovine[1]

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The holotrich ciliate protozoa, *Bütschlia parva* Schuberg, has been observed in the rumen of the ovine. Limited data suggest that the concentration of *B. parva* in the rumen follows a diurnal cycle similar to that of the other holotrichs.

The species *Bütschlia parva* was first observed in rumen contents from cattle by Schuberg (17) in 1888. He established the species and genus, which were subsequently placed in the family *Bütschliidae*, suborder *Rhabdophorina*, order *Gymnostomatida*, subclass *Holotricha* under the class *Ciliata*. Since that time, only a few reports have appeared in the literature on the occurrence of this species. Although no details are given, Sharp (18) implied that *B. parva* was observed in some samples of rumen contents gathered from a large number of cattle and sheep on the Pacific Coast of the United States. In 1933, Kofoid and MacLennan (10) reported the occasional occurrence of this species in *Bos indicus* or humped cattle. Hungate (8), in 1943, mentioned observation of the genus *Bütschlia* in the rumen contents of cattle in Texas. More recently, in 1965, Clark (3) reported the occurrence of this ciliate in four cows in New Zealand. Becker and Talbot (2) specifically mentioned that this genus was not observed in their survey of 26 cattle in Iowa. Thus, with the possible exception of the report by Sharp (18), I am not aware of any previous observation of *B. parva* in sheep. Comprehensive studies of the protozoan fauna of the ovine rumen have been reported from Australia, Egypt, Scotland, the United States, and Japan, with no mention of this species (1, 4, 5, 11–13, 15, 16, 19, 21).

The samples of rumen contents in which *B. parva* Schuberg was observed were obtained from a fistulated Cheviot wether, housed at Michigan State University, East Lansing. The animal was being fed once daily, 800 g of a ration containing corncob pellets (45%), dehydrated alfalfa meal-17% crude protein (35%), rolled oats (12.6%), molasses (5%), urea (0.4%), and a mineral and vitamin mix (2%). An experiment was being conducted to determine the effects on holotrich concentrations of feeding a limited quantity of the daily ration (1/5 or 160 g) at normal feeding time and the remainder of the ration (4/5 or 640 g), 4 hr later. Protozoa were counted by the method of Purser and Moir (14).

Photomicrographs of *B. parva*, varying considerably in size and shape, are shown in Fig. 1. From measurements taken on 36 different cells, the mean and standard error of the mean for length and width were 55.3 ± 1.2 μm and 35.4 ± 0.8 μm, respectively. The range in length was from 41 to 67 μm, and for width, from 26 to 48 μm. These dimensions are slightly larger than those reported by Clarke (3) for measurements taken on 10 specimens. He reported a mean, standard error of the mean, and range for length of 46.9 ± 1.6 μm, 38 to 57 μm; for width, 24.7 + 0.8 μm, 22 to 30 μm. Schuberg (17) listed ranges of 30 to 50 μm for length and 20 to 30 μm for width.

Figure 2 presents the results of the experiment to study concentration changes of the holotrichs with respect to feeding only a limited portion of the ration at the regular feeding time. It appears that the immediate increase in total holotrich numbers is primarily a multiplication of *Dasytricha*, whereas *Isotricha* species were responsible for the increase observed 4 hr later, when the remainder of the ration was fed. Although total numbers were considerably less, the concentration of *B. parva* began to increase with the first feeding, reached a maximum immediately after the second feeding, and then began to decline at roughly the same rate as the other holotrich species. On the basis of these very limited data, and previously published diurnal cycles for the holotrichs and entodiniomorphs (13, 20, 22), it is suggested that the numbers of *B. parva* follow a diurnal cycle similar to that of the other holotrich species.

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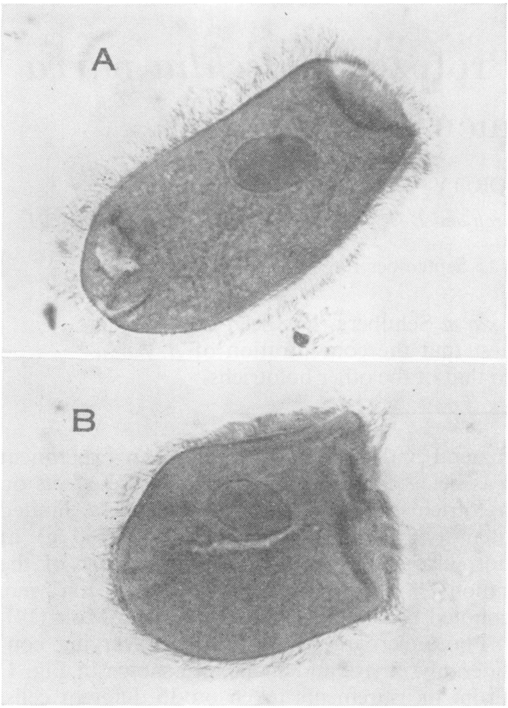

FIG. 1. *Photomicrographs of two different cells of Bütschlia parva, illustrating the range of length and width observed between individual organisms. (A) 67 × 33 μm; (B) 52 × 40 μm. Direct illumination. Magnification: ca. 1,350×.*

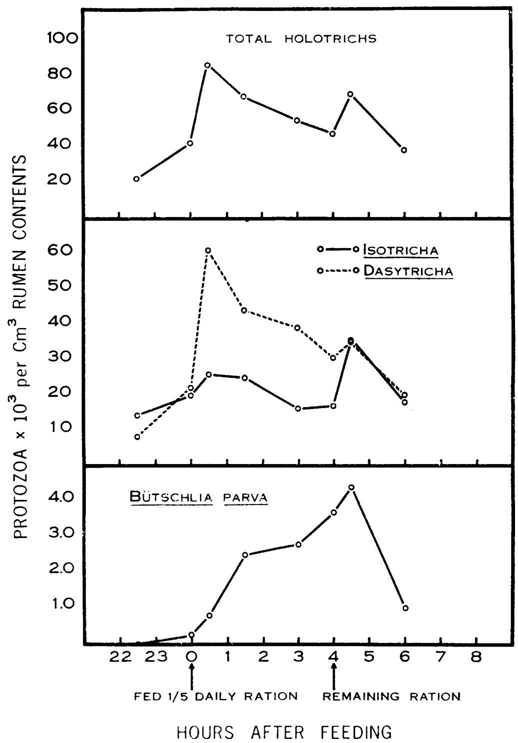

FIG. 2. *Concentration changes of total holotrichs, Isotricha, Dasytricha, and Bütschlia parva, in response to feeding a very limited amount of the daily ration (1/5) at normal feeding time. The remaining daily ration (4/5) was fed 4 hr later.*

Unfortunately, the animal went off feed several days after completion of the above experiment, and was not included in further studies. Protozoal counts on these particular samples were not made until considerably later, at which time the presence of *B. parva* was first noted. Although this animal was in close contact with other sheep being used for experiments on holotrich numbers, *B. parva* was not observed when samples from these sheep were counted.

Plant particles were not observed within the cells of *B. parva* at any of the sampling times, possibly suggesting that this species resembles the other holotrichs in utilizing soluble sugars as a primary source of energy (6, 7). Although numerous attempts were made to stain the formaldehyde-preserved samples with iodine, to reveal the possible accumulation of storage polysaccharide, no conclusive results were obtained. Possible explanations for the difficulties encountered might be that the holotrichs were not starved or depleted of their reserves prior to feeding, as outlined by Gutierrez (6), or that the concentration of soluble sugars was quite low with this ration.

To compare the numbers of *B. parva* found in this study to those reported by Clarke (3) in cattle, total protozoa counts were made on the 4- and 4.5-hr postfeeding samples, and the percentage of *B. parva* of the total ciliates was calculated. Values of 0.43 and 0.52% were obtained. Clarke (3) reported values of 0.2, 0.2, 0.2, 3.4, 2.4, and 0.6%. With the exception of the two high values, 3.4 and 2.4%, the present data would be in approximately the same range. Those animals with the high percentages of *B. parva* also had an exceptionally high percentage of *Dasytricha* at the same time, indicating favorable conditions for the growth of holotrichs.

LITERATURE CITED

1. Abou Akkada, A. R., and K. el-Shazly. 1964. Effect of absence of ciliate protozoa from the rumen on microbial activity and growth of lambs. Appl. Microbiol. 12:384–390.
2. Becker, E. R., and M. Talbot. 1927. The protozoan fauna of the rumen and reticulum of American cattle. Iowa State Coll. J. Sci. 1:345–371.
3. Clarke, R. T. J. 1964. Ciliates of the rumen of domestic cattle (*Bos taurus* L.). N.Z.J. Agr. Res. 7:248–257.
4. Eadie, J. M. 1962. The development of rumen microbial populations in lambs and calves under various conditions of management. J. Gen. Microbiol. 29:563–578.

5. Eadie, J. M. 1962. Inter-relationships between certain rumen ciliate protozoa. J. Gen. Microbiol. **29**:579–588.

6. Gutierrez, J. 1955. Experiments on the culture and physiology of holotrichs from the bovine rumen. Biochem. J. **60**:516–522.

7. Howard, B. H. 1959. The biochemistry of rumen protozoa. 1. Carbohydrate fermentation by *Dasytricha* and *Isotricha*. Biochem. J. **71**:671–675.

8. Hungate, R. E. 1943. Further experiments on cellulose digestion by the protozoa in the rumen of cattle. Biol. Bull. **84**: 157–163.

9. Kofoid, C. A., and J. F. Christenson. 1934. Ciliates from *Bos gaurus* H. Smith. Univ. Calif. (Berkeley) Publ. Zool. **39**: 341–392.

10. Kofoid, C. A., and R. F. MacLennan. 1933. Ciliates from *Bos indicus* Linn. 3. *Epidinium* Crawley, *Epiplastron* gen. nov., and *Ophryoscolex* Stein. Univ. Calif. (Berkeley) Publ. Zool. **39**:1–34.

11. Naga, M. A., A. R. Abou Akkada, and K. el-Shazly. 1969. Establishment of rumen ciliate protozoa in cow and water buffalo (*Bos bubalus* L.) calves under late and early weaning systems. J. Dairy Sci. **52**:110–112.

12. Nakamura, K., and S. Kanegasaki. 1969. Densities of ruminal protozoa of sheep established under different dietary conditions. J. Dairy Sci. **52**:250–255.

13. Purser, D. B. 1961. A diurnal cycle for holotrich protozoa of the rumen. Nature **190**:831–832.

14. Purser, D. B., and R. J. Moir. 1959. Ruminal flora studies in the sheep. IX. The effect of *p*H on the ciliate population of the rumen *in vivo*. Aust. J. Agr. Res. **10**:555–564.

15. Purser, D. B., and R. J. Moir. 1966. Variations in rumen volume and associated effects as factors influencing metabolism and protozoa concentrations in the rumen of sheep. J. Anim. Sci. **25**:516–520.

16. Purser, D. B., and H. H. Weiser. 1963. Influence of time of addition of antibiotic on the life of rumen holotrich protozoa *in vitro*. Nature **200**:290.

17. Schuberg, A. 1888. Die Protosoen de Wiederkauermagens. 1. (*Bütschlia*, *Isotricha*, *Dasytricha*, *Entodinium*). Zool. Jahrb. Abt. Syst. Oekol. Geog. Tiere **3**:365–418.

18. Sharp, R. G. 1914. *Diplodinium eucadatum* with an account of its neuromotor apparatus. Univ. Calif. (Berkeley) Publ. Zool. **13**:43–122.

19. Warner, A. C. I. 1962. Some factors influencing the rumen microbial population. J. Gen. Microbiol. **28**:129–146.

20. Warner, A. C. I. 1966. Diurnal changes in the concentrations of microorganisms in the rumens of sheep fed limited diets once daily. J. Gen. Microbiol. **45**:213–235.

21. Warner, A. C. I. 1966. Periodic changes in the concentrations of microorganisms in the rumen of a sheep fed a limited ration every three hours. J. Gen. Microbiol. **45**:237–241.

22. Warner, A. C. I. 1966. Diurnal changes in the concentrations of microorganisms in the rumens of sheep fed to appetite in pens or at pasture. J. Gen. Microbiol. **45**:243–251.