

The Occurrence of the Rumen Ciliate *Metadinium banksi* Dehority, 1985 (Ophryoscolecidae, Entodiniomorphida) from Domestic Goats (*Capra hircus* L.) in Southeastern Turkey

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Abstract: *Metadinium banksi* was observed in rumen contents from a single goat out of eight living in southeastern Turkey. It constituted 0.25% of the total ciliate population and had a 12.5% frequency of appearance. The size and percentage occurrence of this species in the present study are compared to those previously reported for other animal hosts living in different geographical locations. This study reports for the first time in Turkey the presence of *Metadinium banksi* in arctic ruminants.

Key Words: Goat, *Metadinium banksi*, protozoa, rumen, Turkey.

Türkiye'nin Güneydoğusunda Yaşayan Evcil Keçilerde (*Capra hircus* L.) İşkembe Siliyatı *Metadinium banksi* Dehority, 1985 (Ophryoscolecidae, Entodiniomorphida)'nin Bulunuşu

Özet: Türkiye'nin güneydoğusunda yaşayan sekiz evcil keçiden birinin işkembe içeriğinde *Metadinium banksi* gözlenmiştir. Toplam işkembe siliyat faunasının %0.25'ini oluşturan bu siliyat keçilerimizde %12.5'lik bir görülme sıklığına sahiptir. Bu çalışmada belirlenen vücut ölçümleri ve bulunma yüzdesi, diğer coğrafi bölgelerde yaşayan farklı konaklardan rapor edilen değerlerle karşılaştırılmıştır. Bu çalışma *Metadinium banksi*'nin Türkiye'de arktik ruminantlarda bulunduğuna ilişkin ilk kayıttır.

Anahtar Sözcükler: Keçi, *Metadinium banksi*, protozoa, işkembe, Türkiye.

Introduction

Metadinium banksi belonging to the sub-family Diplodiniinae, family Ophryoscolecidae, order Entodiniomorphida, was first described as *Diplodinium (Eudiplodinium) banksi* from Canadian musk-oxen (*Ovibos moschatus*) by Dehority (1). Subsequently, species of *Eudiplodinium* that have skeletal plates fused at the posterior end have been placed in the genus *Metadinium* (2,3). *Metadinium banksi* has also been reported from elk (*Cervus canadensis*) in the northwestern United States (4) and in Australian red deer (*Cervus elaphus*) (5).

The identification of rumen protozoal populations in different areas provides information about the

geographical distribution of ciliates, the physiology and feeding habits of hosts and the specificity and phylogeny of individual ciliate species. Although some detailed investigations have been conducted in domestic cattle and sheep in Turkey (6-9), no studies have been conducted on the ciliate population in the rumen of Turkish domestic goats (*Capra hircus* L.).

Materials and Methods

Rumen content samples were obtained from eight mature domestic goats (*Capra hircus* L.) at the slaughterhouses in Adana (Kadirli and Ceyhan) and Şanlıurfa on 2/10/99, 3/28/99 and 10/30/00. Prior to slaughter, the animals had been allowed to graze on

plateaus for three months and had been fed 0.5-1 kg of wheat straw and barley fracture twice a day. The rumen wall was cut with a knife and a sample of the contents was removed via a catheter (6). A well-mixed sample of the rumen contents was diluted with an equal volume of 50% formalin (18.5% formaldehyde) as soon as possible after the animal was killed (10). A portion of each sample was also immediately fixed and stained in methylgreen-formalin-saline (MFS) solution (11) for total and differential counts. The MFS served as a nuclear stain and Lugol's Iodine was used to stain skeletal plates. Differential counts of species were estimated from smear slides, with a total of 400 to 500 cells identified. All cell measurements were made with a calibrated ocular micrometer. Specimens were examined with a Jena "NF-binocular" microscope at 40x and 100x.

Terminology for orientation used in describing the structure of the ciliate species conforms to the conventional system of the ciliate kingdom proposed by Dogiel (12) and Grain (13).

Results and Discussion

This study reports for the first time the presence of *M. banksi* in a host, domestic goats (*Capra hircus*), in Turkey. *M. banksi* was found in only one of the eight domestic goats examined and thus had a frequency of appearance of 12.5%. It constituted 0.25% of the total ciliate population. Previously, *M. banksi* was observed in 12 musk-oxens (*Ovibos moschatus*) studied in Canada

(100%) (1), one of two elks (*Cervus canadensis*) in the northwestern United States (50%) (4) and four of 12 Australian red deer (*Cervus elaphus*) (33.3%) (5). Occurrence rates were 0.1-2.1%, 1.3% and 0.8-12.6%, respectively. Thus, both the frequency of appearance and occurrence rate of this species in the Turkish goat was lower than that reported from other host species and geographical areas. Whether this is related to the physiological conditions in the rumen or the result of competition with other protozoan species present in the fauna of the goat is unknown. This may also be the result of the low number of hosts investigated.

The cell dimensions of *M. banksi* in the Turkish goat are given in Table 1. The body of *M. banksi* is ellipsoidal (Figure); the dimensions measured in this study were

Table 1. Dimensions (μm) of *Metadinium banksi* from goat rumen contents¹ [¹n = 28, ²SD = standard deviation].

Characteristic	Dimensions in μm	
	Mean \pm SD ²	Range
Length (L)	109.3 \pm 11.8	90.9-128.1
Width (W)	69.7 \pm 7.7	58.3-86.2
Length of macronucleus (MaL)	73.7 \pm 10.9	48.9-93.2
Width of macronucleus (MaW)	12.5 \pm 2.2	9.3-16.3
L/W	1.57 \pm 0.06	1.46-1.68
MaL/MaW	5.92 \pm 0.94	4.28-7.50
L/MaL	1.50 \pm 0.12	1.32-1.90

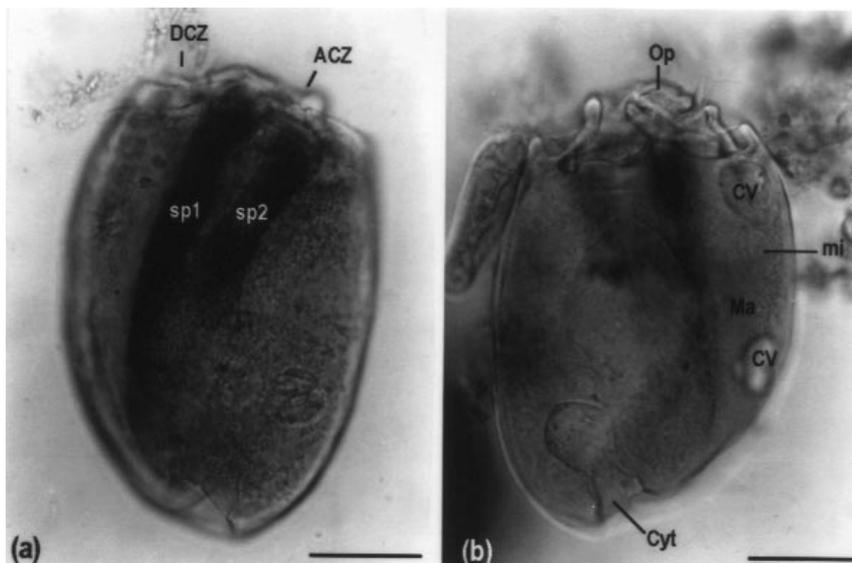


Figure. Photomicrographs of the right (a) and left (b) aspects of *Metadinium banksi* from Turkish domestic goats (*Capra hircus* L.). – a. Cell focused to show the skeletal plates (sp1 and sp2) on the right side (fixed and stained with MFS and then restained with Lugol's Iodine solution). – b. Cell focused on the left side of the body to indicate the contractile vacuoles (CV), cytoproct (Cyt), micro- (mi) and macronucleus (Ma) (fixed and stained with MFS). DCZ = Dorsal Ciliary Zone, ACZ = Adoral Ciliary Zone, Op = Operculum (Bars = 20 μm).

109.3 x 69.7 μm , length/ width ratio = 1.57; both body sides slightly convex; posterior end smoothly rounded; two narrow skeletal plates on the right side, fused posteriorly; plates not parallel, further apart at anterior end; operculum small; adoral and dorsal ciliary zones nearly at right angles to main body axis; endoplasmic sac occupies most of body cavity; cytoproct wide; length of macronucleus, which was reported to be between 69-108 μm in the original description (1), was 49-93 μm in the present study; small anterior lobe, large middle lobe, and small posterior lobe on dorsal side of the macronucleus; micronucleus ellipsoidal, lying in a depression anterior to middle lobe; two contractile vacuoles between macronucleus and dorsal body margin, one anterior to micronucleus and one in the depression between the middle and posterior lobes.

Dimensions of *M. banksi* from different hosts are given in Table 2. Specimens in the present study are larger than those from Australian red deer, but similar in size to those from elk. In contrast, the cells are smaller than those observed in Canadian musk-oxen. An explanation for the difference in the size of *M. banksi* between these hosts is not obvious; however, the differences may simply reflect the types of food available in the different geographical locations. Moreover, such variations have been observed previously between protozoan species and hosts. For example, specimens of *M. medium* from Canadian musk-oxen (1) were on

average 40% larger than those reported earlier from cattle (14,15).

The occurrence of red deer in Turkey (16,17) may suggest a possible route of transmission of *M. banksi* to the goat. However, except for the report by Dehority (5), no species of *Metadinium* have been observed in the rumen of red deer from at least seven other geographical locations. Therefore, it would be desirable to investigate the rumen ciliate fauna of deer inhabiting Turkey.

Several other points are of interest. First, the host species for *M. banksi* to date are elk and red deer, both in the same subfamily of Cervidae (Cervinae), and now the domestic goat, which is in the same subfamily as the musk-oxen (Caprinae). Second, *M. banksi* was first found in an arctic ruminant and would be the second species in this category to be found in Turkey. Göçmen and Öktem (7) reported the occurrence of *Entodinium dalli*, originally described from the Dall mountain sheep in Alaska, in Turkish cattle.

The occurrence of *M. banksi* in such widely divergent geographical locations is perplexing. Further studies on the fauna of both wild and domestic ruminants in Turkey, Australia and Canada might provide additional information about possible intermediate hosts and help explain the migration of this species to different continents.

Table 2. Comparison of *Metadinium banksi* dimensions from different hosts in various locations [¹Dehority (1985), ²Dehority (1997), ³unpublished, ⁴present study, ⁵Mean \pm SD].

	Location/host			
	Canada / Musk-oxen ¹	Australia / Red deer ²	United States / Elk ³	Turkey / Goat ⁴
Number of samples	40	75	25	28
Length(μm)	138.1 \pm 2.0 ⁵	91.6 \pm 1.0	111.6 \pm 8.2	109.3 \pm 11.8
Range in length	118-162	73-110	99-127	91-128
Width(μm)	94.6 \pm 1.5	59.7 \pm 0.6	84.2 \pm 8.0	69.7 \pm 7.7
Range in width	77-118	50-75	69-97	58-86
Length/Width ratio	1.46	1.54	1.33	1.57
Range in L/W ratio	1.30-1.61	1.36-1.81	1.22-1.59	1.46-1.68

References

1. Dehority, B.A., Rumen ciliates of musk-oxen (*Ovibos moschatus* L.) from the Canadian arctic. *J. Protozool.*, 32: 246-250, 1985.
2. Latteur, B., Contribution à la systématique de la famille des *Ophryoscolecidae* Stein. *Ann. Soc. R. Zool. Belg.*, 96: 117-144, 1966
3. Dehority, B.A., The rumen protozoa. In: Kreier, J.P. & Baker, J.R. (ed.), *Parasitic Protozoa (2nd ed.)*, New York: Academic Press, 3:1-42, 1993.
4. Dehority, B.A., Rumen ciliates of the pronghorn antelope (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*) and elk (*Cervus canadensis*) in the Northwestern United States. *Arch. Protistenkd.*, 146:29-36, 1995.
5. Dehority, B.A., Rumen ciliate protozoa in Australian red deer (*Cervus elaphus* L.). *Arch. Protistenkd.*, 147:157-165, 1997.
6. Göçmen, B., Sığır İşkembesindeki bazı simbiyont siliyatların (*Isotricha* spp.) morfolojik ve sitolojik yapıları. *Ege Üniv. Fen Bil. Enst. (Yüksek lisans tezi)*, Bornova-İzmir, 77 s, 1991.
7. Göçmen, B. and Öktem, N., New rumen ciliates from Turkish domestic cattle (*Bos taurus* L.): I. The presence of *Entodinium dalli* Dehority, 1974 with a new forma, *E. dalli f. rudidorsospinatum* n. f. and comparisons with *Entodinium williamsi* n. sp. *Europ. J. Protistol.*, 32: 513-522, 1996.
8. Göçmen, B., Torun, S. and Öktem, N., A preliminary study on the rumen ciliate fauna of Turkish domestic sheep (*Ovis ammon aries*): II- Family Ophryoscolecidae (Entodiniomorphida). *Tr. J. of Zoology*, 23 (Turk. Supl. 2): 473-490, 1999.
9. Göçmen, B., New rumen ciliates from Turkish domestic cattle (*Bos taurus* L.). II. *Epidinium graini* n. sp. (Ophryoscolecidae, Entodiniomorphida). *Turk. J. Zool.*, 24: 23-31, 2000.
10. Dehority, B.A., Evaluation of subsampling and fixation procedures used for counting rumen protozoa. *Appl. Environ. Microbiol.*, 48:182-185, 1984.
11. Ogimoto, K. and Imai, S., Atlas of rumen microbiology. Japan Scientific Societies Press, Tokyo: 231 pp, 1981.
12. Dogiel, V.A., Monographie der familie Ophryoscolecidae. *Arch. Protistenkd.*, 59:1-288, 1927.
13. Grain, J., Infusoires Ciliés (Ordre des Entodiniomorphida). In: *Traité de Zoologie, Grasse, P. (ed.)*, Paris, 2 (2): 327-364, 1994.
14. Kofoed, C.A. and MacLennan, R.F., Ciliates from *Bos indicus* Linn. II A revision of *Diplodinium* Schuberg. *Univ. Calif. Publ. Zool.*, 37: 53-152, 1932.
15. Dehority, B.A., Grings, E.E. and Short, R.E., Effects of cross-inoculation from elk and feeding pine needles on the protozoan fauna of pregnant cows: Occurrence of *Parentodinium africanum* in domestic U.S. cattle (*Bos taurus*). *J. Eukaryot. Microbiol.*, 46: 632-636, 1999.
16. Demirsoy, A., Yaşamın Temel Kuralları, Omurgalılar/Amniota, Cilt 3, Kısım 2. Ankara: Meteksan A.S., 942 s, 1992.
17. Kuru, M., Omurgalı Hayvanlar (5. baskı), Ankara: Palme Yayıncılık, 841 s., 1999.