

## Rumen ciliated protozoa of the Turkish domestic goats (*Capra hircus* L.)

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### Abstract

Rumen contents obtained from eight adult domesticated goats (*Capra hircus* L.) at slaughterhouses in the southeastern area of Turkey were surveyed for ciliate protozoa. As a result of our survey, 12 genera including 39 species were identified. Fifteen of the species were further divided into 35 formae. The average ciliate density in the rumen contents of Turkish goats ( $33.21 \times 10^4$ /ml) was less than that of other ruminants from Turkey and other domestic goats reported previously from different geographical areas. However, the number of genera, species and forms living in the rumen of Turkish goats were found to be higher than that of the goats in different countries around the world. The rich faunal content of the southeastern Turkish domestic goats shows the zoogeographical importance of SE Anatolia.

**Key words:** *Capra hircus*, goat, ciliate protozoa, fauna, rumen, Turkey

### Introduction

Rumen ciliates vary with the host species and from different geographic areas, because the transfaunation of ciliates has been assumed to occur only by direct contact between hosts (Ito et al. 1994; Imai 1985; Imai 1986; Ogimoto & Imai 1981). Although the composition of the rumen ciliate protozoal populations of domesticated ruminants have been surveyed in various geographical areas, our knowledge about the overall distribution of protozoa in different animal hosts in different countries around the world is limited. There have been several studies on the rumen fauna of domestic cattle, sheep and goats in Turkey (Göçmen 1993, 1999a, b, c; Göçmen and Öktem 1996; Göçmen et al. 1999, 2001a, b, c, 2002, 2003a, b; Göçmen & Atatür 2002; Göçmen & Rastgeldi 2004; Mermer et al. 2003; Öktem & Göçmen 1996; Öktem et al. 1997; Rastgeldi & Göçmen 2003; Rastgeldi et al. 2003). However, no compilation has been published on the ciliate fauna occurring in Turkish domestic goats.

Comparative studies of the rumen ciliate populations of various hosts in different regions should provide information on phylogenetic relationships between the rumen ciliates and the host ruminants (Imai 1988; Ogimoto & Imai 1981). The aim of this study is to identify and examine the rumen ciliate fauna in a larger number of Turkish domestic goats, an important food source in Turkey, especially in the Mediterranean region, and to compare this information with data from previous studies conducted both in Turkey and other geographical areas.

## Materials and Methods

Samples of rumen contents were obtained from eight mature domestic goats (*Capra hircus* L.) at the slaughterhouses in Adana (Kadirli, Ceyhan) and Urfa on 10 Feb 1999, 28 Mar 1999 and 30 Oct 2000. The animals were allowed to graze on the plateaus all day and fed 0.5–1 kg of wheat straw and barley fracture twice a day. Collection, fixation, storage and counting of samples have been described in previous publications (Göçmen 1993, 1999a,b; Göçmen and Budak 2000; Göçmen *et al.* 2001). Specimens were examined using a Jena “NF-binocular” microscope and photomicrograph camera-accessory. All measurements were made with a calibrated ocular micrometer. Classification and identification of species were based on previously published species descriptions and taxonomic lists (Dehority 1986a, b; Dogiel 1927; Göçmen 1999a, b, c; Göçmen *et al.* 2001a, b, c; Göçmen & Atatür 2002; Göçmen *et al.* 2002; Göçmen & Rastgeldi 2004; Grain 1994; Hsiung 1932; Imai 1981, 1984; Kofoid and MacLennan 1930, 1932, 1933; Mermer *et al.* 2003; Ogimoto & Imai 1981; Rastgeldi & Göçmen 2003; Rastgeldi *et al.*, 2003; Williams and Coleman 1992). Microsofts Excel program was used to organize the observations on various morphological characteristics.

## Results

The mean number ( $\pm$  SD) of ciliates in rumen contents from the eight Turkish goats was  $33.21 \pm 11.50 \times 10^4$  cells per ml (SE=4.06). Values ranged from  $17.8 \times 10^4$  to  $47.9 \times 10^4$  (Table 1). Only three ciliate families were present in the rumen contents of Turkish domesticated goats; Isotrichidae, Entodiniidae, and Ophryoscolecidae. The majority of ciliates present in all eight animals were entodinia, which constituted from 49.3% to 100% of the total protozoa. As a result of our survey, 39 species and 35 formae in 12 genera were detected in Turkish domestic goats (Table 2).

Of the known four holotrichous ciliate (order Vestibuliferida) families (Isotrichidae, Paraisotrichidae, Blepharocorythidae and Buetschliidae), only Isotrichidae was represented by *Isotricha prostoma*, *I. intestinalis* and *Dasytricha ruminantium* in our seven goat specimens (Table 2). Twenty species of *Entodinium* belonging to the family E

ntodiniidae were present. All of the seven genera (*Diplodinium*, *Eudiplodinium*, *Metadinium*, *Ostracodinium*, *Polyplastron*, *Elytroplastron* and *Enoploplastron*) belonging to the subfamily Diplodiniinae (family Ophryoscolecidae) were found. Our results indicate the presence of these genera (*l.c.*) as 3, 2, 3, 3, 1, 1 and 1 species, respectively. Both *Polyplastron* and *Enoploplastron* were present in two goats and each of the other five in three goats. With the exception of Goats # 5 & 6, *Epidinium ecaudatum* (Ophryoscolecidae) was detected with seven forms; two forms in Goats # 1, 2, 4, 7 and 8, and seven forms in Goat # 3. Three forms of *Ophryoscolex purkynjei* (Ophryoscolecinae, Ophryoscolecidae) were identified, which were found in Goats #1, 3 and 6 and the number of forms per animal were two, three and three, respectively. For individual goats, the total number of species per animal ranged between 13 and 29 (mean=21.25; SE= 1.92).

**TABLE 1.** Concentrations (ml<sup>-1</sup>) and family distribution of ciliates in the rumen contents of eight goats from the southeastern of Turkey.

	Goat No.							
	1	2	3	4	5	6	7	8
Total ciliates x 10 <sup>4</sup> ml <sup>-1</sup>	42.8	30.0	21.0	32.1	47.2	47.9	25.9	17.8
Family distribution (%)								
Isotrichidae	8.7	5.5	18.6	13.4	-	1.4	2.6	2.1
Entodiniidae	68.5	85.3	49.3	69.3	100	95.6	89.7	97.4
Ophryoscolecidae	22.8	9.2	32.1	17.3	-	3	7.7	0.5

**TABLE 2:** Percentage distribution of species and forms of rumen ciliates in the rumen contents from eight goats from the southeastern Turkey.

Species Form	Goats							
	1	2	3	4	5	6	7	8
<i>Isotricha prostoma</i> Stein	1.00	0.01	4.97	1.42	-	0.36	0.50	1.30
<i>Isotricha intestinalis</i> Stein	0.80	-	-	2.06	-	0.14	1.84	0.78
<i>Dasytricha ruminantium</i> Schuberg	6.89	5.47	13.74	9.95	-	0.90	0.24	-
<i>Entodinium basoglui</i> Öktem & Göçmen	-	-	-	-	-	1.56	-	-
<i>Entodinium bovis</i> Wertheim	-	8.20	0.68	3.00	7.69	-	-	-
<i>Entodinium bursa</i> Stein	-	-	1.14	1.20	-	-	-	-
<i>Entodinium caudatum</i> Stein								
f. <i>caudatum</i> Stein	7.09	10.00	-	-	8.13	-	4.39	5.96
f. <i>dubardi</i> Lubinsky	-	11.70	-	2.21	2.81	4.72	2.74	4.17
f. <i>lobosporosum</i> Dogiel	-	8.98	7.09	2.00	-	-	-	0.60
<i>Entodinium constrictum</i> Dehority	-	-	0.68	2.00	7.40	4.44	1.65	-
<i>Entodinium dalli</i> Dehority								
f. <i>rudidosporosum</i> Göçmen & Öktem	-	-	1.82	2.30	-	2.63	-	7.45

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TABLE 2 (continued)

Species Form	Goats							
	1	2	3	4	5	6	7	8
<i>Entodinium dilobum</i> (Dogiel)	7.84	2.10	1.14	1.13	-	3.77	6.31	3.88
<i>Entodinium dubardi</i> Buisson	0.37	-	2.59	4.19	12.14	14.12	6.31	10.43
f. <i>dubardi</i> Buisson								
<i>Entodinium ellipsoideum</i> Kofoid & MacLennan	-	5.48	0.23	-	-	1.00	-	-
<i>Entodinium exiguum</i> Dogiel	7.09	9.71	4.55	7.52	9.69	6.70	8.50	10.73
<i>Entodinium longinucleatum</i> Dogiel								
f. <i>longinucleatum</i> Dogiel	7.84	3.20	6.37	9.89	5.63	2.08	3.84	3.58
<i>Entodinium minimum</i> Schuberg	0.37	2.23	2.51	-	0.63	0.79	-	1.19
<i>Entodinium nanellum</i> Dogiel	13.19	7.25	0.46	14.24	12.50	9.15	6.31	5.66
<i>Entodinium ovinum</i> Dogiel	1.12	-	-	-	-	0.52	1.10	2.68
<i>Entodinium parvum</i> Buisson								
f. <i>parvum</i> Buisson	6.72	4.49	8.19	7.15	8.44	10.21	10.69	8.35
<i>Entodinium rectangulatum</i> Kofoid & MacLennan								
f. <i>rectangulatum</i> Kofoid & MacLennan	5.97	3.00	-	0.40	-	1.05	3.02	4.17
f. <i>lobosopinosum</i> Lubinsky	-	-	7.51	-	3.13	-	6.03	4.47
f. <i>dubardi</i> Lubinsky	-	-	-	1.52	2.29	-	9.60	6.86
<i>Entodinium salmani</i> Göçmen & Rastgeldi								
f. <i>salmani</i> Göçmen & Rastgeldi	-	-	-	-	-	1.55	-	-
f. <i>monospinosum</i> Göçmen & Rastgeldi	-	-	-	-	-	1.60	-	-
f. <i>bispinosum</i> Göçmen & Rastgeldi	-	-	-	-	-	2.20	-	-
f. <i>trispinosum</i> Göçmen & Rastgeldi	-	-	-	-	-	0.65	-	-
<i>Entodinium simplex</i> Dogiel	7.58	0.75	4.00	6.02	13.13	10.50	7.40	5.66
<i>Entodinium simulans</i> Lubinsky								
f. <i>caudatum</i> Lubinsky	3.36	9.70	-	-	4.38	4.97	8.77	7.45
f. <i>lobosopinosum</i> Lubinsky	-	-	-	-	-	3.40	-	2.68
<i>Entodinium williamsi</i> Göçmen & Öktem								
f. <i>williamsi</i> Göçmen & Öktem	-	-	0.23	4.00	2.04	4.97	2.47	1.49
f. <i>turcicum</i> Göçmen & Öktem	-	-	-	-	-	3.14	-	-
<i>Diplodinium crista-galli</i> Dogiel	0.16	-	-	-	-	-	-	-
<i>Diplodinium dentatum</i> (Stein)								
f. <i>anisacanthum</i> (Da Cunha)	0.98	0.53	-	-	-	-	-	-
<i>Diplodinium flabellum</i> Kofoid & MacLennan								
f. <i>flabellum</i> Dehority & Potter	-	-	0.04	-	-	-	-	-
f. <i>aspinatum</i> Dehority & Potter	12.46	0.08	0.04	-	-	-	-	-
f. <i>monospinatum</i> Dehority & Potter	-	-	0.04	-	-	-	-	-
f. <i>laterospinatum</i> Dehority	0.16	-	-	-	-	-	-	-
<i>Eudiplodinium bovis</i> Dogiel								
f. <i>bovis</i> Dogiel	-	-	12.13	-	-	-	-	-
<i>Eudiplodinium maggii</i> (Fiorentini)	0.90	-	2.04	1.39	-	-	-	-

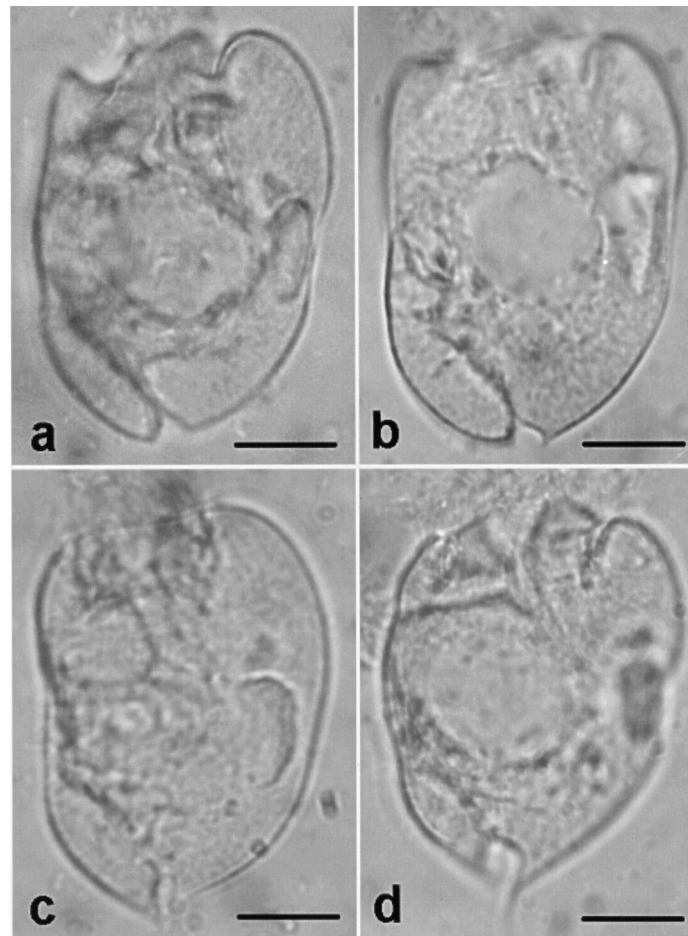
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TABLE 2 (continued)

Species Form	Goats							
	1	2	3	4	5	6	7	8
<i>Metadinium affine</i> (Dogiel & Fedorowa)	2.70	-	0.68	-	-	-	-	-
<i>Metadinium banksi</i> (Dehority)	0.25	-	-	-	-	-	-	-
<i>Metadinium tauricum</i> (Dogiel & Fedorowa)	0.82	0.16	0.07	-	-	-	-	-
<i>Ostracodinium gracile</i> (Dogiel)								
f. <i>gracile</i> Dogiel	-	1.64	-	+	-	-	-	-
<i>Ostracodinium quadrivesiculatum</i> Kofoid & MacLennan	-	-	0.07	-	-	-	-	-
<i>Ostracodinium trivesiculatum</i> Kofoid & MacLennan	-	1.27	0.01	-	-	-	-	-
<i>Polyplastron multivesiculatum</i> (Dogiel & Fedorowa)	-	-	-	-	-	0.10	-	0.39
<i>Elytroplastron bubali</i> (Dogiel)	1.06	2.01	-	2.98	-	-	-	-
<i>Enoploplastron triloricatum</i> (Dogiel)	-	-	5.30	11.24	-	-	-	-
<i>Epidinium ecaudatum</i> (Fiorentini)								
f. <i>ecaudatum</i> (Fiorentini)	-	-	0.21	-	-	-	4.65	0.02
f. <i>caudatum</i> (Fiorentini)	-	-	2.23	-	-	-	3.65	0.03
f. <i>bicaudatum</i> (Sharp)	-	-	0.85	-	-	-	-	-
f. <i>tricaudatum</i> Sharp	-	-	0.64	-	-	-	-	-
f. <i>quadricaudatum</i> Sharp	-	-	1.70	-	-	-	-	-
f. <i>parvicaudatum</i> (Awerinzew & Mutafówa)	1.32	1.40	2.87	0.78	-	-	-	-
f. <i>cattanei</i> (Fiorentini)	1.55	0.65	2.55	1.41	-	-	-	-
<i>Ophryoscolex purkynjei</i> Stein								
f. <i>purkynjei</i> Stein	0.21	-	0.30	-	-	0.90	-	-
f. <i>tricornatus</i> Dogiel	0.20	-	0.23	-	-	1.53	-	-
f. <i>bicornatus</i> Dogiel	-	-	0.11	-	-	0.37	-	-
<b>Total Species Number</b>	<b>29</b>	<b>21</b>	<b>28</b>	<b>21</b>	<b>13</b>	<b>23</b>	<b>17</b>	<b>18</b>

## Discussion

When compared with ciliate surveys from other ruminants living in Turkey, the average ciliate density in the rumen of domestic goats ( $33.21 \pm 11.50 \times 10^4$  cells per ml) was considerably less than that of Turkish domestic cattle  $59.2 \times 10^4$  (Öktem *et al.* 1998);  $52.4 \times 10^4$  (Göçmen *et al.* 2003a) and sheep,  $53.9 \times 10^4$  (Öktem *et al.* 1997) cells per ml. The overall mean concentration of ciliates in Turkish domestic goats was also less than the average ciliate density in Tokara native goats ( $43.9 \times 10^4$  per ml, Ito *et al.* 1995) and an Alaskan goat ( $53.7 \times 10^4$  per ml, Dehority 1975), suggesting that differences between the numbers of rumen ciliates from different locations may be related with the kind and type of nutrition and geographical location.



**FIGURE 1.** Photomicrographs of the left aspects of *Entodinium salmani*, seems to be an endemic species of the ciliated fauna in the rumens of Turkish domestic goats. **a:** *salmani* form, **b:** *monospinosum* form, **c:** *bispinosum* form. **d:** *trispinosum* form (bars 10  $\mu\text{m}$ , all specimens were fixed and stained with MFS solution).

Thirty-nine species and 35 formae in 12 genera were detected in Turkish domestic goats (Table 1). The number of genera, species and formae living in the rumen of Turkish goats were higher than that of Indian (Das-Gupta 1935) and Japanese (Imai *et al.* 1978; Ito *et al.* 1995) goats (Table 3). The southeastern area of Turkey constitutes a bridge between two continents and is an intersection area between palearctic, afrotropical and saharo-sindian elements. Therefore, the diversity of the rumen ciliates in the rumen contents of the Turkish goats is not surprising.

Isotrichid ciliates are represented by three species (*Isotricha intestinalis*, *I. prostoma* and *Dasytricha ruminantium*) in the eight Turkish goat specimens. Das-Gupta (1935) did not find any *I. intestinalis* in Indian goats, while in Japan all three species were found to be present in goats (Imai *et al.* 1978; Ito *et al.* 1995) (Table 3). All eight Turkish goats had *E*

*ntodinium exiguum*, *Ent. nanellum*, *Ent. parvum* f. *parvum*, *Ent. simplex*, *Ent. longinucleatum* f. *longinucleatum*. The frequencies of appearances of these *Entodinium* species in goats are significantly higher than those of the other ciliates, including our present results ( $p < 0.05$ ). This probably stems from the better adaptation of those species to the goat rumen with respect to the other entodiniomorphid (Order: Entodiniomorphida) ciliates. Of them *Ent. simplex* and *Ent. nanellum* are distributed in many ruminants in wide areas (Dogiel 1927; Ogimoto & Imai 1981). *Entodinium constrictum* and *Ent. dalli*, originally described from Alaskan Dall mountain sheep (*Ovis dalli*) (Dehority 1974) were detected in the rumen of Turkish goats. This study is the first report of their occurrence in the rumen of goats. Interestingly, both *Ent. constrictum* and *Ent. dalli* have been previously reported from Turkish cattle (*Bos taurus*) (Göçmen & Öktem 1996; Göçmen *et al.* 2003a). Almost all of the species detected in this investigation represent the first report for their occurrence in Turkish domestic goats, excluding several species that were observed previously: *Isotricha prostoma*, *I. intestinalis*, *Dasytricha ruminantium*, *Entodinium salmani*, *Diplodinium flabellum*, *Diplodinium crista-galli*, *Metadinium banksi*, *Elytroplastron bubali*, *Polyplastron multivesiculatum*, *Epidinium ecaudatum* (Göçmen & Atatür 2002; Göçmen & Rastgeldi 2004; Mermer *et al.* 2003; Rastgeldi & Göçmen 2003, Rastgeldi *et al.* 2003). *Entodinium salmani*, *Diplodinium crista-galli*, *Diplodinium flabellum*, *Metadinium banksi* and *Elytroplastron bubali* were firstly reported from Turkish domesticated ruminants. Of them *Ent. salmani* seems to be an endemic species of the ciliated fauna in the rumens of Turkish domestic goats, but it was only in one of eight goats examined.

It is of interest that as many as seven forms of *Epidinium ecaudatum* were present in the eight Turkish goats examined, whereas only three and two forms of the species were detected in Indian and Japanese goats, respectively (Das-Gupta 1935; Imai *et al.* 1978). Das-Gupta (1935) did not find the forms of *bicaudatum*, *tricaudatum*, *quadricaudatum* and *parvicaudatum* in the rumens of goats in India, while in Japan only one study (Imai *et al.* 1978) indicated the presence of the forms of *ecaudatum* and *caudatum*. In this viewpoint, the four formae of *Epi. ecaudatum* (*bicaudatum*, *tricaudatum*, *quadricaudatum* and *parvicaudatum*) were reported for the first time from domesticated goats with the range of frequency appearances from 12.5% to 50%. Another interesting case is the co-occurrence of *Epi. e. f. parvicaudatum* and *Epi. e. f. cattanei* in Turkish domesticated goats.

*Ophryoscolex caudatus* and *Oph. purkynjei*, previously described as two different species (Dogiel 1927; Kofoid & MacLennan 1933; Ogimoto & Imai 1981; Williams & Coleman 1992), were combined by Göçmen (1996, 1999a) into a single species, *Oph. purkynjei*, with the establishment of six new forms. Although no forms belonging to *Oph. purkynjei* were observed in Japanese goats (Imai *et al.* 1978; Ito *et al.* 1995), three forms (*purkynjei*, *bicoronatus* and *tricoronatus*) were found in Turkish goats. In Indian goats, the form of *purkynjei* was observed (Das-Gupta 1935) (Table 3).

**TABLE 3:** Frequency of appearance of each ciliate species and formae detected in the rumen contents of goats from Turkey and some other countries. [1: Das Gupta (1935) - India, 2: Imai *et al.* (1978) - Japan, 3: Ito *et al.* (1995) Japan, 4: Present study Turkey].

Species/Formae	1 (n= 12)	2 (n= 10)	3 (n=15)	4 (n= 8)
<i>Isotricha prostoma</i>	100.00	70.00	53.30	87.50
<i>Isotricha intestinalis</i>	-	40.00	60.00	62.50
<i>Dasytricha ruminantium</i>	100.00	50.00	86.70	75.00
<i>Entodinium basoglui</i>	-	-	-	12.50
<i>Entodinium bovis</i>	-	-	-	50.00
<i>Entodinium bursa</i>	-	-	-	25.00
<i>Entodinium caudatum</i> f. <i>caudatum</i>	16.60	90.00	-	62.50
<i>Entodinium caudatum</i> f. <i>dubardi</i>	-	-	-	75.00
<i>Entodinium caudatum</i> f. <i>lobosospinosum</i>	-	-	-	50.00
<i>Entodinium constrictum</i>	-	-	-	62.50
<i>Entodinium dalli</i> f. <i>rudidorsospinosum</i>	-	-	-	50.00
<i>Entodinium dilobum</i>	16.60	70.00	-	87.50
<i>Entodinium dubardi</i> f. <i>dubardi</i>	83.30	10.00	-	87.50
<i>Entodinium ellipsoideum</i>	-	-	-	37.50
<i>Entodinium exiguum</i>	-	50.00	-	100.00
<i>Entodinium longinucleatum</i> f. <i>longinucleatum</i>	25.00	90.00	-	100.00
<i>Entodinium minimum</i>	-	70.00	-	75.00
<i>Entodinium nanellum</i>	8.33	100.00	100.00	100.00
<i>Entodinium ovinum</i>	25.00	70.00	40.00	50.00
<i>Entodinium parvum</i> f. <i>parvum</i>	-	100.00	93.30	100.00
<i>Entodinium rectangulatum</i> f. <i>rectangulatum</i>	16.60	-	66.70	75.00
<i>Entodinium rectangulatum</i> f. <i>lobosospinosum</i>	-	-	86.70	50.00
<i>Entodinium rectangulatum</i> f. <i>dubardi</i>	-	-	100.00	50.00
<i>Entodinium salmani</i> f. <i>salmani</i>	-	-	-	12.50
<i>Entodinium salmani</i> f. <i>monospinosum</i>	-	-	-	12.50
<i>Entodinium salmani</i> f. <i>bispinosum</i>	-	-	-	12.50
<i>Entodinium salmani</i> f. <i>trispinosum</i>	-	-	-	12.50
<i>Entodinium simplex</i>	100.00	100.00	100.00	100.00
<i>Entodinium simulans</i> f. <i>caudatum</i>	-	-	-	75.00
<i>Entodinium simulans</i> f. <i>lobosospinosum</i>	-	-	-	25.00
<i>Entodinium williamsi</i> f. <i>williamsi</i>	-	-	-	75.00
<i>Entodinium williamsi</i> f. <i>turcicum</i>	-	-	-	12.50
<i>Diplodinium crista-galli</i>	16.60	-	-	12.50
<i>Diplodinium dentatum</i> f. <i>anisacanthum</i>	33.30	30.00	-	25.00
<i>Diplodinium flabellum</i> f. <i>flabellum</i>	-	-	-	12.50
<i>Diplodinium flabellum</i> f. <i>aspinatum</i>	-	-	-	37.50
<i>Diplodinium flabellum</i> f. <i>monospinatum</i>	-	-	-	12.50
<i>Diplodinium flabellum</i> f. <i>laterospinatum</i>	-	-	-	12.50

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TABLE 3 (continued)

Species/Formae	1 (n= 12)	2 (n= 10)	3 (n=15)	4 (n= 8)
<i>Eudiplodinium bovis</i> f. <i>bovis</i>	-	-	-	12.50
<i>Eudiplodinium maggii</i>	33.30	50.00	-	37.50
<i>Metadinium affine</i>	8.33	-	46.70	25.00
<i>Metadinium banksi</i>	-	-	-	12.50
<i>Metadinium tauricum</i>	-	-	-	37.50
<i>Ostracodinium gracile</i> f. <i>gracile</i>	-	-	-	12.50
<i>Ostracodinium quadrivesiculatum</i>	-	-	-	12.50
<i>Ostracodinium trivesiculatum</i>	-	-	-	25.00
<i>Polyplastron multivesiculatum</i>	-	-	73.30	12.50
<i>Elytroplastron bubali</i>	33.30	-	-	37.50
<i>Enoploplastron triloricaum</i>	-	-	-	25.00
<i>Epidinium ecaudatum</i> f. <i>ecaudatum</i>	16.60	50.00	-	37.50
<i>Epidinium ecaudatum</i> f. <i>caudatum</i>	33.30	50.00	-	37.50
<i>Epidinium ecaudatum</i> f. <i>bicaudatum</i>	-	-	-	12.50
<i>Epidinium ecaudatum</i> f. <i>tricaudatum</i>	-	-	-	12.50
<i>Epidinium ecaudatum</i> f. <i>quadricaudatum</i>	-	-	-	12.50
<i>Epidinium ecaudatum</i> f. <i>parvicaudatum</i>	-	-	-	50.00
<i>Epidinium ecaudatum</i> f. <i>cattanei</i>	33.30	-	-	50.00
<i>Ophryoscolex purkynjei</i> f. <i>purkynjei</i>	-	-	-	37.50
<i>Ophryoscolex purkynjei</i> f. <i>tricornatus</i>	16.60	-	-	37.50
<i>Ophryoscolex purkynjei</i> f. <i>bicornatus</i>	-	-	-	25.00
<b>Total Species Number</b>	<b>17</b>	<b>16</b>	<b>10</b>	<b>39</b>

On the other hand, our survey is the first record of the occurrence of some other rumen ciliates in the rumens of goats around the world: *Ent. bovis*, *Ent. bursa*, *Ent. ellipsoideum*, *Ent. caudatum* f. *dubardi*, *Ent. c.* f. *lobosospinosum*, *Ent. simulans* f. *lobosospinosum*, *Ent. williamsi* f. *williamsi*, *Ent. w.* f. *turcicum*, *Ent. basoglui*, *Dip. flabellum* f. *flabellum*, *Dip. flabellum* f. *flabellum*, *Dip. f.* f. *aspinatum*, *Dip. f.* f. *monospinatum*, *Dip. f.* f. *laterospinatum*, *Eud. bovis* f. *bovis*, *Met. tauricum*, *Ost. gracile* f. *gracile*, *Ost. quadrivesiculatum*, *Ost. trivesiculatum*, *Eno. triloricaum*, *Oph. purkynjei* f. *purkynjei* and *Oph. p.* f. *bicornatus*. The ranges in both size and shape of all determined ciliates in our survey were quite similar with their original descriptions and previous reports.

Rumen ciliate populations have been divided into four main types, A, B, K and O (Eadie, 1956, 1962; Imai et al. 1978, 1979; Ogimoto & Imai 1981; Williams & Coleman 1992). All three types contain vestibuliferids (*Isotricha* and *Dasytricha*) and *Entodinium*, but are distinguished from each other as follows: type-A population is designated as one which specifically includes *Polyplastron multivesiculatum* and usually, but not always, *Metadinium affine*; type-B population is characterized by *Epidinium* spp., *Eudiplodinium maggii* or both; type K population, normally restricted to cattle populations, specifically

contains *Elytroplastron bubali*; while type O includes none of the type A and B species, only *Isotricha*, *Dasytricha* and *Entodinium*. It is generally believed that the existence of type A and B populations results from the predatory activity of *P. multivesiculatum*, which eliminates *Epidinium* spp. as well as *Eud. maggii* and several other species of Diplodiniinae. Three (Goats # 2, 4 and 7) of eight Turkish goats (37.5%) were type B, one (Goat # 6) was type A (12.5%) and one (Goat # 5) was type O (12.5%). The remaining three goats (# 1, 3 and 8) contained some or all of the ciliates belonging to type A and B populations together. Imai *et al.* (1979) reported that the B population was dominant in goats from Japan and other far eastern countries. Similarly, the type B population is frequent in Turkish goats.

In conclusion, based on the survey of ciliate protozoa in the rumen contents from eight domestic goats (*Capra hircus* L.) in the southeastern of Turkey, three species of Isotrichidae, 20 species of Entodiniidae and 16 species of Ophryoscolecidae were identified. The rumen microfauna of Turkish domestic goats has greater diversity than that of Indian (Das-Gupta 1935) and Japanese (Imai *et al.* 1978; Ito *et al.* 1995) goats. The rich faunal content of the southeastern Turkish domestic goats shows the zoogeographical importance of SE Anatolia. This bridge between two continents (Asia & Europe) and is an intersection area between Palearctic, Afrotropical and Saharo-Sindian elements of the protozoa-fauna in the Mediterranean region.

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