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Intestinal ciliate composition found in the feces of the Turk rahvan horse *Equus caballus*, Linnaeus 1758

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Abstract

Species composition and distribution of large intestinal ciliates were investigated in the feces from 15 Turk rahvan horses, living in the vicinity of Izmir, Turkey. Twenty-two ciliate genera consisting of 36 species were identified. This is the first report on intestinal ciliates in Turk rahvan horses and no previously unknown species were observed. The mean number of ciliates was $14.2 \pm 13.9 \times 10^4$ cells ml^{-1} of feces and the mean number of ciliate species per host was 9.9 ± 7.1. No ciliates were observed in 2 horses. *Bundleia* and *Blepharocorys* were considered to be the major genera since these ciliates were constantly found in high proportions. In contrast, *Paraisotricha*, *Didesmis* and *Gassovskiella* were only observed at low frequencies. The ciliates found in this survey had almost the same characteristics as those described in previous reports, suggesting that there was no significant geographic variation in the intestinal ciliate fauna of equids.

Keywords: Intestinal ciliates; Turkey; Rahvan horse; Feces; *Equus caballus*

Introduction

Endocommensal ciliates that live in the intestine of equids were first reported by Gruby and Delafond (1843). Since then, many investigations concerning the intestinal ciliate fauna of equids have been reported (Fiorentini 1890; Gassovsky 1919; Hsiung 1930b; Ozeki et al. 1973; Strelkow 1939). It is assumed that these ciliates play a role in the hindgut digestion of cellulose and starch (Dehority 1986). They have no resistant cysts (Ike et al. 1985; Ozeki et al. 1973). The ciliates invade the equid host by oral ingestion (coprophagy) and become established in its large intestine (Ike et al. 1985). They are subsequently excreted alive in the feces (Ike et al. 1981, 1983a,b; Imai et al. 1999; Ito et al. 1996; Tung 1992).

Although the composition of the intestinal ciliate community of various equids is known in general, no investigations have been conducted on the ciliate fauna in the Turk rahvan horses *Equus caballus* Linnaeus, 1758. The objective of this study was to identify and quantify the fecal ciliate fauna from those animals living in the vicinity of Izmir and compare the data with previous studies on equids from various other locations.

Material and Methods

Fecal samples were collected from 15 Turk rahvan horses *Equus caballus* Linnaeus, 1758 located in the vicinity of Izmir in Turkey. The samples were collected from January 2007 up to May 2008. The fecal samples were collected immediately after defecation and fixed and stained in 2 times as much methylgreen formalin saline solution (MFS) as their original volume (Gürelli and Göçmen 2010; Ogimoto and Imai 1981). This procedure was used to preserve the integrity

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Table 1. Frequency of appearance[a] and percentage composition of intestinal ciliate genera and species in the feces of 15 Turk rahvan horses.

Familia/genus/species	Frequency of appearence (%)	Percentage composition (%)	
		Mean ± SD	Range
Paraisotrichidae			
Paraisotricha	6.7	0.3 ± 1.2	0–4.7
colpoidea Fiorentini, 1890	6.7	0.2 ± 0.8	0–4.1
minuta Hsiung, 1930	6.7	0.1 ± 0.4	0–1.6
Buetschliidae			
Bundleia	86.7	19.9 ± 17.0	0–64.6
postciliata (Bundle, 1895)	80.0	7.9 ± 11.5	0–38.7
piriformis Strelkow, 1939	6.7	0.7 ± 2.7	0–10.3
elongata Strelkow, 1939	46.7	3.8 ± 4.9	0–14.8
triangularis Strelkow, 1939	6.7	0.2 ± 0.8	0–2.9
dolichosoma Strelkow, 1939	33.3	3.3 ± 6.6	0–24.4
inflata Strelkow, 1939	26.7	1.8 ± 3.8	0–11.0
Didesmis	6.7	0.1 ± 0.2	0–0.8
ovalis Fiorentini, 1890	6.7	0.1 ± 0.2	0–0.8
Polymorphella	46.7	1.8 ± 2.2	0–5.6
ampulla (Dogiel, 1929)	46.7	1.8 ± 2.2	0–5.6
Blepharoconus	46.7	1.5 ± 2.0	0–5.9
benbrooki (Hsiung), 1930	46.7	1.5 ± 2.0	0–5.9
Alloiozona	26.7	0.5 ± 1.2	0–4.8
trizona Hsiung, 1930	26.7	0.5 ± 1.2	0–4.8
Holophryoides	66.7	8.4 ± 10.4	0–37.6
ovalis (Fiorentini, 1890)	53.3	6.0 ± 10.3	0–37.6
macrotricha Strelkow, 1939	26.7	2.4 ± 5.0	0–17.3
Blepharosphaera	13.3	0.4 ± 1.4	0–5.5
ellipsoidalis Hsiung, 1930	13.3	0.4 ± 1.4	0–5.5
Hemiprorodon	13.3	0.4 ± 1.2	0–4.8
gymnoposthium Strelkow, 1939	13.3	0.4 ± 1.2	0–4.8
Blepharoprosthium	13.3	1.1 ± 3.0	0–9.2
pireum Bundle, 1895	13.3	0.1 ± 0.3	0–0.8
polytrichum Strelkow, 1939	20.0	1.5 ± 3.1	0–8.4
Blepharocorythidae			
Blepharocorys	86.7	35.3 ± 25.5	0–82.1
curvigula Gassovsky, 1919	86.7	21.4 ± 22.3	0–82.1
angusta Gassovsky, 1919	40.0	4.4 ± 7.5	0–25.6
microcorys Gassovsky, 1919	53.3	11.4 ± 6.8	0–24.7
uncinata (Fiorentini, 1890)	6.7	0.02 ± 0.1	0–0.4
Ochoterenaia	26.7	0.4 ± 0.7	0–1.9
appendiculata Chavarria, 1933	26.7	0.4 ± 0.7	0–1.9
Circodinium	20.0	0.4 ± 0.8	0–2.5
minimum (Gassovsky, 1919)	20.0	0.4 ± 0.8	0–2.5
Cycloposthiidae			
Cycloposthium	26.7	3.6 ± 9.6	0–35.4
bipalmatum (Fiorentini), 1890	13.3	0.3 ± 0.8	0–2.9
edentatum Strelkow, 1928	13.3	3.3 ± 9.6	0–35.4
Tripalmaria	26.7	1.6 ± 4.1	0–8.8
dogieli Gassovsky, 1919	26.7	1.6 ± 4.1	0–8.8
Spirodiniidae			
Ditoxum	33.3	1.2 ± 1.9	0–5.6
funinucleum Gassovsky, 1919	33.3	1.2 ± 1.9	0–5.6
Cochliatoxum	13.3	0.2 ± 0.6	0–2.2
periachtum Gassovsky, 1919	13.3	0.2 ± 0.6	0–2.2
Tetratoxum	53.3	2.8 ± 3.6	0–10.8
unifasciculatum (Fiorentini, 1890)	26.7	1.5 ± 3.1	0–10.8
excavatum Hsiung, 1930	20.0	0.7 ± 1.7	0–5.6
parvum Hsiung, 1930	13.3	0.5 ± 1.4	0–4.2

Table 1 (*Continued*)

Familia/genus/species	Frequency of appearence (%)	Percentage composition (%)	
		Mean ± SD	Range
Spirodinium	20.0	0.8 ± 1.8	0–5.7
confusum Hsiung, 1935	20.0	0.8 ± 1.8	0–5.7
Triadinium	66.7	6.0 ± 6.1	0–16.2
caudatum Fiorentini, 1890	66.7	6.0 ± 6.1	0–16.2
Gassovskiella	6.7	0.2 ± 1.0	0–3.7
galea (Gassovsky), 1919	6.7	0.2 ± 1.0	0–3.7
Allantosomatidae			
Allantosoma	26.7	0.8 ± 2.0	0–7.4
intestinale Gassovsky, 1919	26.7	0.8 ± 2.0	0–7.4
Total	22 genera 36 species		

[a]The ratio of the number of hosts in which a species appeared divided by the total number of animals surveyed.

of the cell and its internal structures. The MFS served as a nuclear stain and Lugol's iodine was used to stain skeletal plates. Fecal samples were passed through 2.56 mm mesh gauze and kept in the dark until examination. Details of the ciliate morphology were investigated at 1000× magnification using an oil immersion objective microscope.

For detailed observation of the individual species, the protozoa were examined using the pyridinated silver carbonate impregnation technique of Fernández-Galiano (1976) and Ito and Imai (2006), and the silver nitrate impregnation technique of Ito et al. (1996).

Total cell counts were made at 400× magnification with a Neubauer hemocytometer counting chamber. The Neubauer hemocytometer counting chamber has slender grooves cut at regular intervals. The number per 1 ml of intestinal contents can be calculated by the following formula: $N = 10/4 \times a \times d$ (N: number of ciliates per 1 ml of intestinal contents, a: number of ciliates in 4 divisions on the Neubauer hemocytometer, d: sample dilution).

Differential counts of species were estimated from smear slides with a total of 400–500 cells identified for each species (Göçmen and Gürelli 2009; Gürelli and Göçmen 2010).

Classification and identification of species was based on previously published species descriptions and taxonomic lists (Hsiung 1930b; Kornilova 2003, 2004; Lynn 2008; Ozeki 1977; Strelkow 1939).

Results

Frequency of appearance (i.e. the number of hosts in which the species was detected/number of hosts examined) and the relative composition of genera and species are shown in Table 1. We identified 36 species belonging to 22 genera. The ciliate fauna consisted of 1 genus and 2 species of Paraisotrichidae, 9 genera and 16 species of Buetschliidae, 3 genera and 6 species of Blepharocorythidae, 2 genera and 3 species of Cycloposthiidae, 6 genera and 8 species Spirodiniidae and 1 genus and 1 species of Allantosomatidae (Figs 1–38).

For individual Turk rahvan horses, the total number of species per animal ranged from 4 to 21, with an average of 9.9 ± 7.1 (SD).

Two of the 15 horses had no ciliates. The genera *Bundleia* and *Blepharocorys* were present in all 13 of the remaining horses with the species *Blepharocorys curvigula* occuring in all animals (Table 1). Of the other species, frequency of appearance of individual species ranged from 6.7% for *Paraisotricha colpoidea*, *Paraisotricha minuta*, *Bundleia piriformis*, *Bundleia triangularis*, *Didesmis ovalis*, *Blepharocorys uncinata*, *Gassovskiella galea* up to 80.0% for *Bundleia postciliata.*

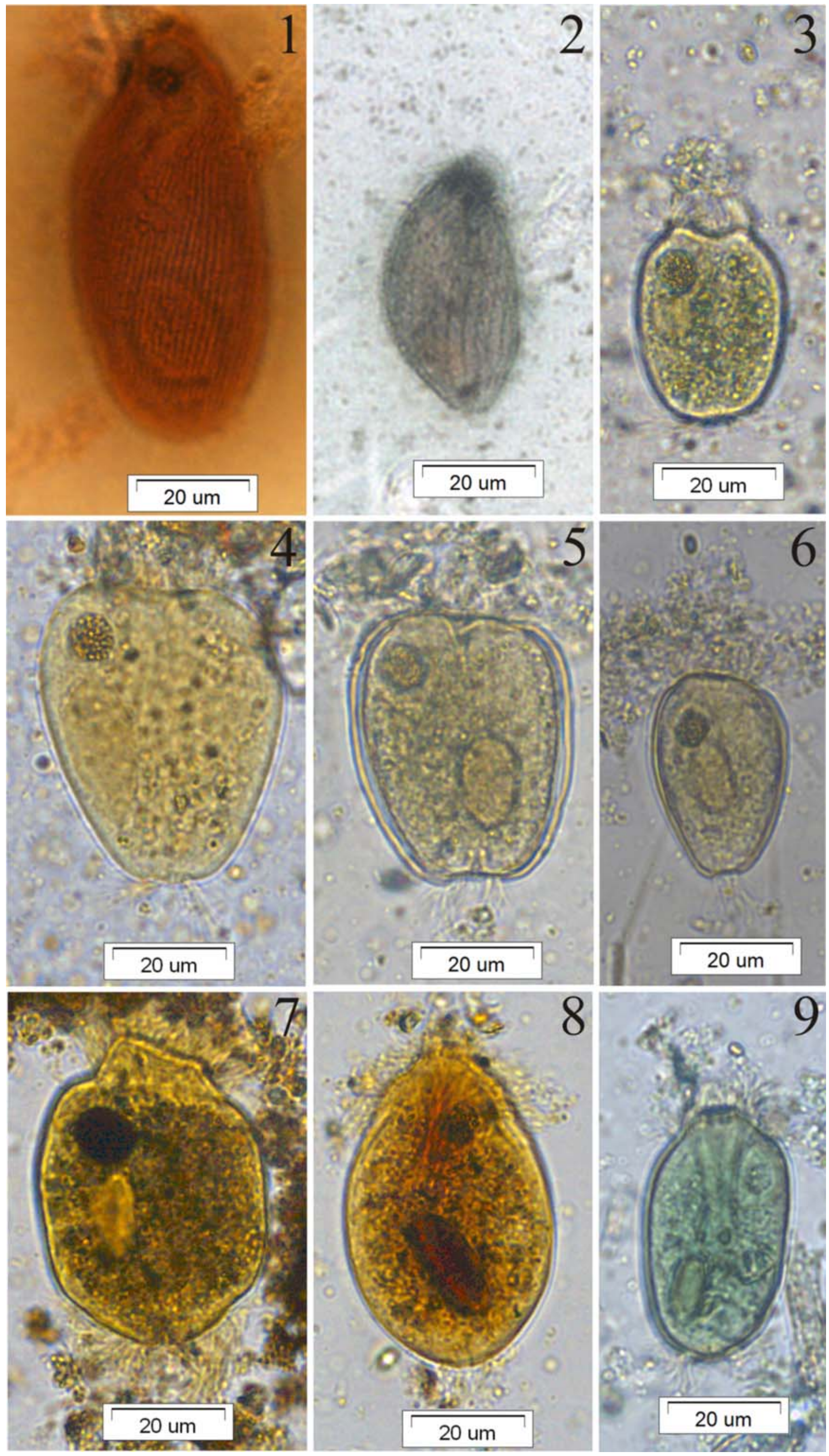
The average abundance of ciliates in the feces from the 15 Turk rahvan horses was $14.2 \pm 13.9 \times 10^4$ cells ml^{-1}. Values ranged from 0 to 45.5×10^4 cells ml^{-1} (Table 2).

Tables 3 and 4 report the abundance and occurrence of intestinal ciliates from seven different geographical locations around the world.

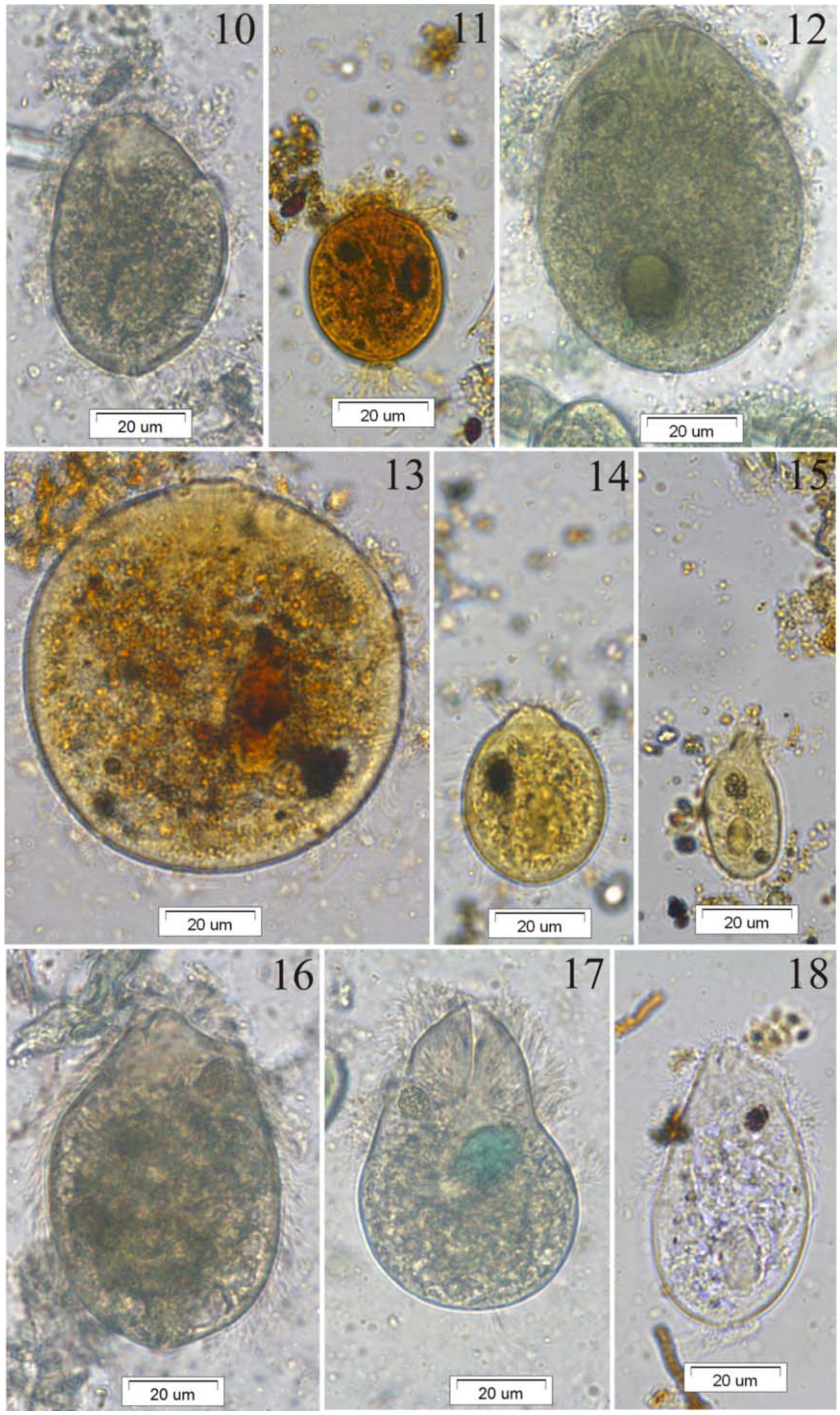
Table 2. Abundance of intestinal ciliates in the feces of 15 Turk rahvan horses.

Horse no.	Ciliate density ($\times 10^4$ cells ml^{-1})
1	15.8
2	6.0
3	6.5
4	3.0
5	0
6	21.0
7	0
8	2.5
9	45.5
10	16.5
11	9.0
12	42.5
13	7.5
14	8.0
15	14.5

Total ciliates ($\times 10^4$ cells ml^{-1}).
Mean ± SD = $(14.2 \pm 13.9) \times 10^4$ cells ml^{-1}.



Figs 1–9. Photomicrographs of the studied species. **1**. *Paraisotricha colpoidea* after silver nitrate impregnation, **2**. *Paraisotricha minuta* after silver nitrate impregnation, **3**. *Bundleia postciliata* in MFS, **4**. *Bundleia piriformis* after silver carbonate impregnation, **5**. *Bundleia elongata* in MFS, **6**. *Bundleia triangularis* in MFS, **7**. *Didesmis ovalis* after silver carbonate impregnation, **8**. *Bundleia inflata* after silver carbonate impregnation, **9**. *Bundleia dolichosoma* in MFS.

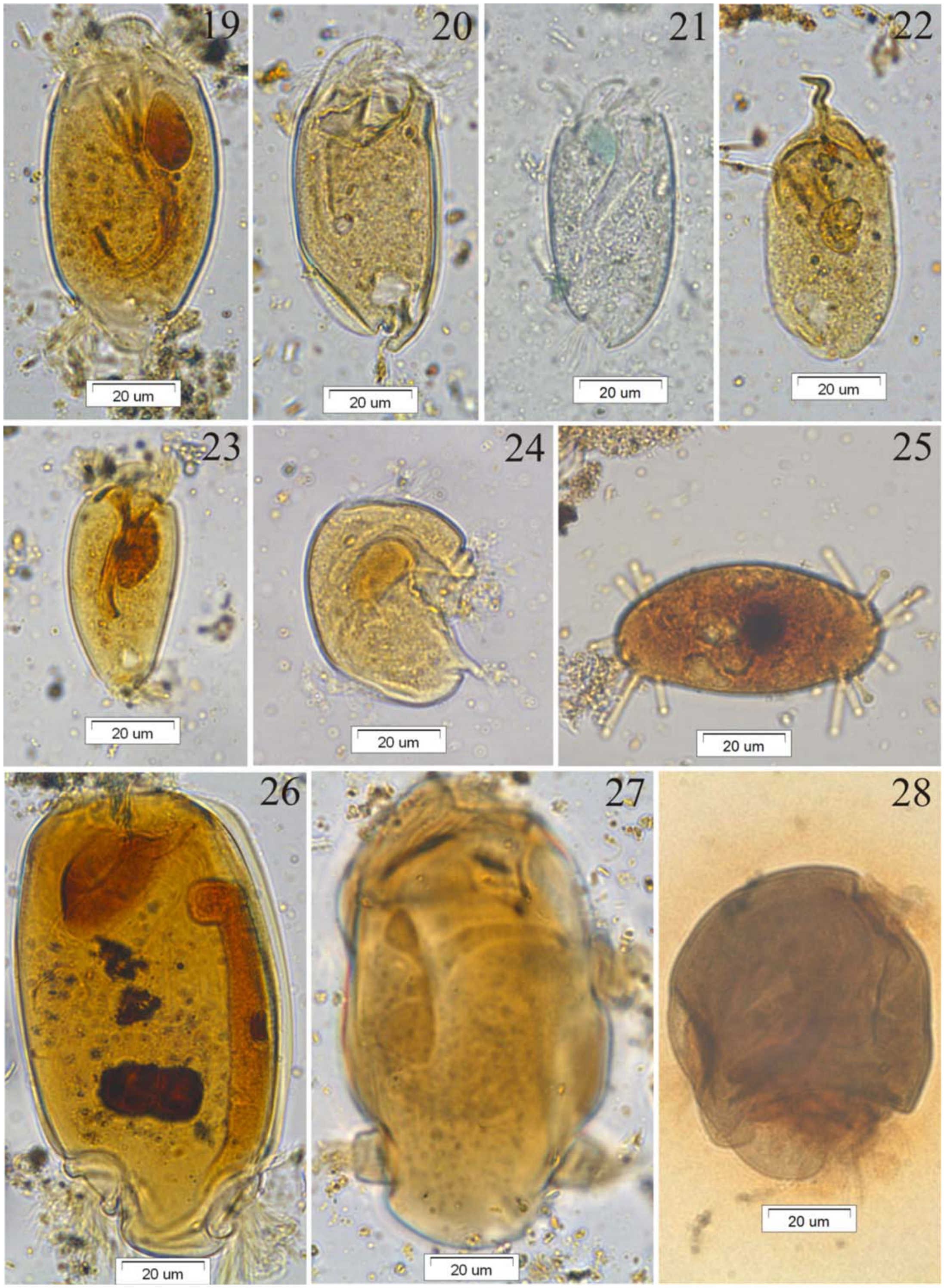


Figs 10–18. Photomicrographs of the studied species. **10**. *Alloiozona trizona* in MFS, **11**. *Blepharoconus benbrooki* after silver carbonate impregnation, **12**. *Blepharosphaera ellipsoidalis* in MFS, **13**. *Holophryoides ovalis* after silver carbonate impregnation, **14**. *Holophryoides macrotricha* after silver carbonate impregnation, **15**. *Polymorphella ampulla* after silver carbonate impregnation, **16**. *Hemiprorodon gymnoposthium* in MFS, **17**. *Blepharoprosthium pireum* in MFS, **18**. *Blepharoprosthium polytrichum* after silver carbonate impregnation.

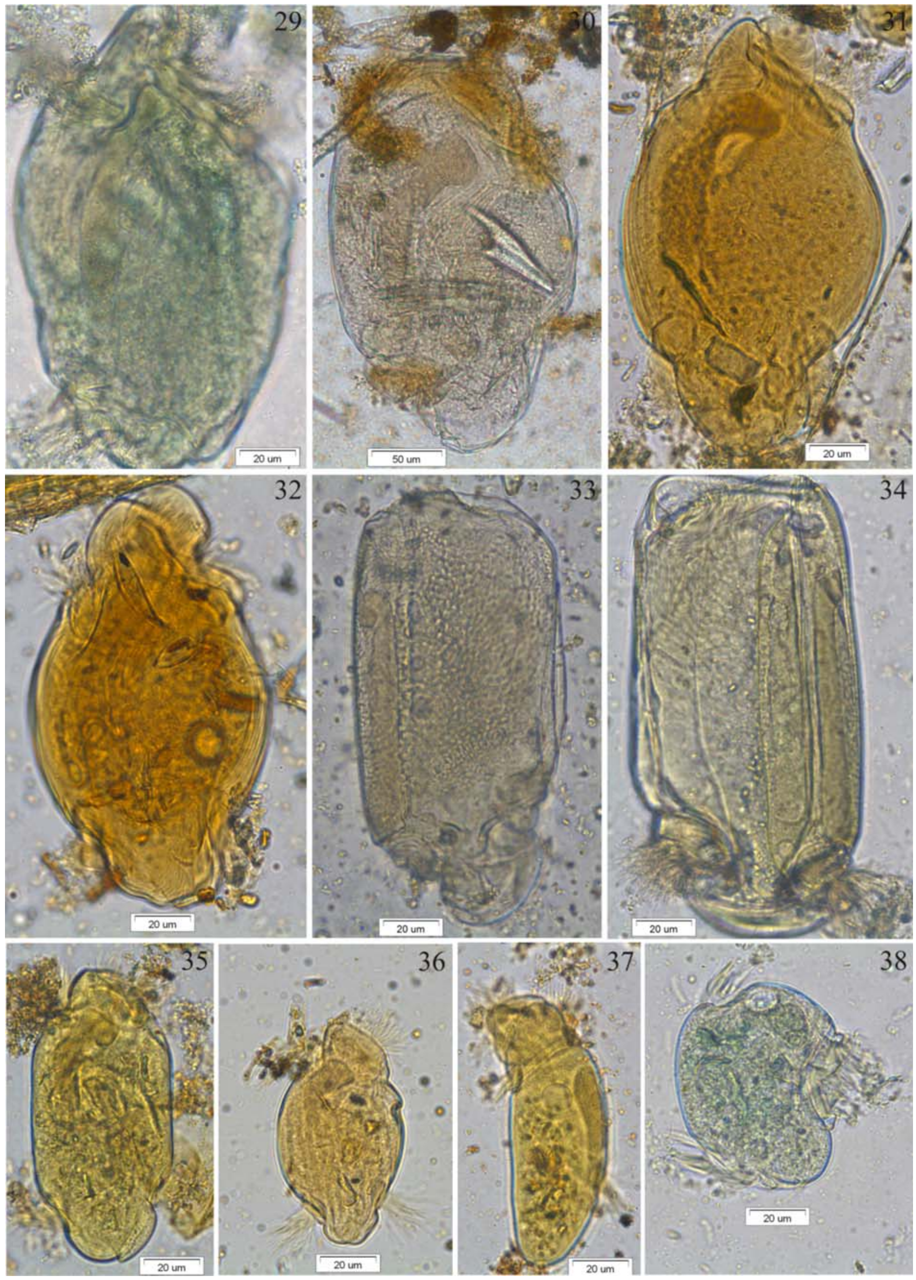
Discussion

In the present study, 36 ciliate species representing 22 genera were identified (Figs 1–38), but no new species were detected. This is the first report on intestinal ciliates in Turk rahvan horses, and the fauna was quite similar to reports from other equids around the world (Table 3).

Strelkow (1939) classified *Cycloposthium edentatum* into four morphotypes based on its body surface and its body size. Two morphotypes were found in the present study, *C. edentatum* m. edentatum (Fig. 33), and *C. edentatum* m. scutigerum



Figs 19–28. Photomicrographs of the studied species. **19**. *Blepharocorys curvigula* after silver carbonate impregnation, **20**. *Ochoterenaia appendiculata* after silver carbonate impregnation, **21**. *Blepharocorys microcorys* in MFS, **22**. *Blepharocorys uncinata* after silver carbonate impregnation, **23**. *Blepharocorys angusta* after silver carbonate impregnation, **24**. *Circodinium minimum* after silver carbonate impregnation, **25**. *Allantosoma intestinale* after silver carbonate impregnation, **26**. *Cycloposthium bipalmatum* after silver carbonate impregnation, **27**. *Tripalmaria dogieli* after silver carbonate impregnation, **28**. *Gassovskiella galea* after silver nitrate impregnation.



Figs 29–38. Photomicrographs of the studied species. **29**. *Ditoxum funinucleum* in MFS, **30**. *Cochliatoxum periachtum* after silver carbonate impregnation, **31**. *Tetratoxum unifasciculatum* after silver carbonate impregnation, **32**. *Tetratoxum excavatum* m. excavatum after silver carbonate impregnation, **33**. *Cycloposthium edentatum* m. edentatum in MFS, **34**. *Cycloposthium edentatum* m. scutigerum in MFS, **35**. *Tetratoxum parvum* m. parvum after silver carbonate impregnation, **36**. *Tetratoxum parvum* m. sulcatum after silver carbonate impregnation, **37**. *Spirodinium confusum* after silver carbonate impregnation, **38**. *Triadinium caudatum* in MFS.

(Fig. 34), both occurring in a single (different) animal. These morphotypes, that is, both morphotypes of *C. edentatum* had a low frequency of appearance (6.7%).

In addition, Strelkow (1939) classified both *Tetratoxum excavatum* and *T. parvum* in two morphotypes based on longitudinal rows on the surface of the body. We found only the one morphotype, *T. excavatum* m. excavatum (longitudinal rows on both the dorsal and ventral surfaces of the body); however, we observed both morphotypes of *T. parvum*, *T. parvum* m. parvum (longitudinal rows on both the dorsal and ventral surfaces of the body) and *T. parvum* m. sulcatum (longitudinal rows on the whole surface of the body) (Figs 32–36). The second morphotype, *T. parvum* m. sulcatum was found in only one of the 15 Turk horses.

When compared with ciliate surveys from other equids living in various countries, the average ciliate density in the feces of Turk horse ($14.2 \pm 13.9 \times 10^4$ cells ml^{-1}) was considerably less than that of the kiso horse (Imai et al. 1999) and riding horse (Tung 1992). On the other hand, concentrations were higher than those in the other equids examined,

Table 3. Total ciliate abundance and distribution of the total number of genera and species of the ciliates in the intestine contents of equids from various locations around the world.

Locality[a]	Total ciliates ($\times 10^4$ cells ml^{-1})	Range ($\times 10^4$ cells ml^{-1})	Total no. of genera	Total no. of species	References[b]
China	[d]	[d]	19	30	1
Japan	3.4[d]	[d]	19	40	2
Japan	9.0[d]	0.4–113.0	22	49	3
Taiwan	38.1 ± 35.9c	0.2–127.0	19	38	4
Japan	1.4[d]	[d]	11	18	5
Japan	140.0[d]	[d]	23	50	6
Middle Asia	d	[d]	25	57	7
Cyprus	3.0 ± 2.5[c]	0.5–8.5	16	22	8
Turkey	14.2 ± 13.9[c]	0–45.5	22	36	Present study

[a] Number of animals and breed: China (20 horse, donkey and mule); Japan (17 light horse); Japan (60 race horse); Taiwan (40 riding horse); Japan (20 tokara pony); Japan (18 kiso horse); Middle Asia (184 kulan); Cyprus (13 wild donkey); Turkey (15 Turk rahvan horse).

[b] (1) Hsiung (1935a,b, 1936); (2) Ike et al. (1981); (3) Ike et al. (1983a); (4) Tung (1992); (5) Ito et al. (1996); (6) Imai et al. (1999); (7) Kornilova (2003); (8) Gürelli and Göçmen (2010).

[c] Mean ± SD.

[d] Data not reported.

i.e. the light horse (Ike et al. 1981), race horse (Ike et al. 1983a) tokara pony (Ito et al. 1996) and Cypriot wild donkey (Gürelli and Göçmen 2010) (Table 3). Presumably these variations are the result of differences between host animals and feeding habits. However, no report is available on the ciliate density in the intestines of other donkeys, mules and kulans.

Turk rahvan horses came to Anatolia from Middle Asia and are noted for being swift and strong. They move both legs together on each side which differs from the normal gait of most horses. The use of Turk rahvan horses increased especially during the Ottoman era, because they were fast, could go anywhere, could carry heavy loads and their gait does not tire the rider. The origin of Turk rahvan horses remains unclear, but it is believed they are derived from the Tarpan horse (Batu 1962; Güleç 1996; Yarkın 1962).

The fact that many of the same protozoa species which had been found in the various countries also live in Turkey indicate that there are few geographic variations in the fauna of equids.

Ozeki (1977) reported that the ciliate fauna in the large intestine changed when the host fell into digestive disorder such as chronic intestinal catarrh. From this standpoint, it may be suggested that surveying the ciliate fauna in feces would be useful as an indicator of digestive illness of the host and have clinical significance (Ike et al. 1983a). In this study 2 of 15 horses had no ciliates, suggesting that these horses could have been ill, were possibly treated with medication resulting in defaunation of the intestine or simply were never exposed to adult animals at birth.

The eight species found in this study, *Bundleia postciliata*, *Polymorphella ampulla*, *Blepharoconus benbrooki*, *Blepharocorys curvigula*, *Circodinium minimum*, *Cycloposthium edentatum*, *Tetratoxum unifasciculatum*, *Triadinium caudatum* were widespread in all equids around the world (Table 4).

Bundleia piriformis, observed in this examination, was previously found only in equids in Russia and Middle Asia. *Bundleia elongata*, *B. dolichosoma*, *B. inflata*, *Hemiprorodon gymnoposthium*, *Blepharoprosthium polytrichum* were reported from equids in Japan, Russia and Middle Asia and Turkey. *B. triangularis* was reported from Russia and Middle Asia, Cyprus and Turkey, but these species were not recorded from China and Taiwan (Table 4). Since Turkey, Russia and Middle Asia, China, Japan, Taiwan and Cyprus are located on the Eurasian continent and are connected, the absence of these species in Taiwan and China is noteworthy.

Bundleia vorax, *B. asymmetrica*, *Blepharoconus hemiciliatus*, *Blepharozoum zonatum*, *Blepharosphaera citriformis*, *Spirodinium magnum*, *Allantosoma cucumis*, *A. biseriale*, *A. dicorniger*, *A. brevicorniger*, *A. japonensis*, *A. linerae* were found in Russia and Middle Asia, and Japan, but were not recorded from China, Taiwan, Cyprus or Turkey (Table 4). Suctor species, except *A. intestinale*, were not recorded from Turk rahvan horses; this could be caused either by the feeding habits of hosts or by the low number of animals examined.

Hsiung (1930a) reported a new species, *Blepharoconus cervicalis*, from horses, but Strelkow (1939) considered that this species was simply a different shape of *Blepharoconus hemiciliatus*. Subsequently, numerous researchers in this area observed these species (Ike et al. 1981, 1983a,b, 1985; Ozeki et al. 1973; Tung 1992); however, our studies suggest that *B. cervicalis* and *B. hemiciliatus* are the same species.

Ampullacula ampulla was first reported from Italy by Fiorentini (1890). Later, this species was recorded from U.S.A., Taiwan, Japan and Cyprus (Table 4). Based on our studies, we have concluded that this species is a different shape of *Blepharoprosthium pireum*.

Sulcoarcus pellucidulus was reported from mules in China (Hsiung 1935b). Kornilova (2003) and Strelkow (1939) found it from kulans and horses (Table 4). It is a rare species and has not been observed at any other locations.

Spirodinium nanum was first recorded from zebras in Africa (Strelkow 1931), and later only recorded from Japanese horses (Ike et al. 1985). *Spirodinium uncinuclea-*

Table 4. Distribution of species of intestinal ciliates of equids at various locations around the world.

Species	Geographical location[a]						
	U.S.A (1)	China (2)	Japan (3)	Russia and Middle Asia (4)	Taiwan (5)	Cyprus (6)	Turkey (7)
Paraisotricha colpoidea	+	–	+	+	–	–	+
P. minuta	+	+	+	+	–	–	+
P. beckeri	+	–	+	+	–	–	–
Bundleia postciliata	+	+	+	+	+	+	+
B. piriformis	–	–	–	+	–	–	+
B. nana	–	–	+	+	–	–	–
B. elongata	–	–	+	+	–	–	+
B. triangularis	–	–	–	+	–	+	+
B. dolichosoma	–	–	+	+	–	–	+
B. inflata	–	–	+	+	–	–	+
B. vorax	–	–	+	+	–	–	–
B. asymmetrica	–	–	+	+	–	–	–
Didesmis ovalis	+	+	+	+	+	–	+
D. quadrata	+	–	+	+	+	–	–
D. spiralis	+	–	+	+	+	–	–
Polymorphella ampulla	+	+	+	+	+	+	+
Blepharoconus hemiciliatus	–	–	+	+	–	–	–
B. benbrooki	+	+	+	+	+	+	+
B. cervicalis	?	–	?	–	?	–	–
Ampullacula ampulla	?	–	?	–	?	?	–
Paraisotrichopsis composita	–	+	+	+	–	–	–
Alloiozona trizona	+	–	+	+	+	–	+
Blepharozoum zonatum	–	–	+	+	–	–	–
Holophryoides ovalis	–	–	+	+	+	+	+
H. macrotricha	–	–	+	+	+	–	+
Blepharosphaera ellipsoidalis	+	+	+	+	+	–	+
B. intestinalis	+	+	+	+	–	+	–
B. citriformis	–	–	+	+	–	–	–
Hemiprorodon gymnoposthium	–	–	+	+	–	–	+
Prorodonopsis coli	–	+	+	+	–	+	–
Blepharoprosthium pireum	+	+	+	+	+	–	+
B. polytrichum	–	–	+	+	–	–	+
Sulcoarcus pellucidulus	–	+	–	+	–	–	–
Wolskana tokarensis	–	–	+	–	–	–	–
Blepharocorys curvigula	+	+	+	+	+	+	+
B. uncinata	+	+	+	+	–	–	+
B. jubata	+	–	+	+	+	–	–
B. cardionucleata	+	–	+	+	+	–	–
B. valvata	+	+	+	+	+	+	–
B. angusta	+	–	+	+	+	+	+
B. microcorys	–	–	+	+	+	+	+
Ochoterenaia appendiculata	–	–	+	+	+	–	+
Circodinium minimum	+	+	+	+	+	+	+
Charonina equi	+	+	+	+	+	+	–
Cycloposthium bipalmatum	+	+	+	+	+	–	+
C. edentatum	+	+	+	+	+	+	+
C. scutigerum	+	–	+	+	+	–	–
C. corrugatum	+	–	+	+	–	–	–
C. piscicauda	–	–	–	+	–	–	–
C. dentiferum	+	–	+	+	+	–	–
C. affine	+	–	+	+	–	–	–
C. plicatocaudatum	–	–	–	+	–	–	–
C. ponomarevi	–	–	–	+	–	–	–
C. hemioni	–	–	–	+	–	–	–
T. dogieli	+	–	+	+	+	–	+
Ditoxum funinucleum	+	–	+	+	–	–	+

Table 4 (*Continued*)

Species	Geographical location[a]						
	U.S.A (1)	China (2)	Japan (3)	Russia and Middle Asia (4)	Taiwan (5)	Cyprus (6)	Turkey (7)
Ditoxum brevinucleatum	−	+	+	+	−	+	−
Cochliatoxum periachtum	+	+	+	+	+	−	+
Tetratoxum unifasciculatum	+	+	+	+	+	+	+
T. excavatum	+	−	+	+	+	+	+
T. parvum	+	+	+	+	+	−	+
Spirodinium equi	+	+	+	+	+	−	−
S. confusum	−	+	+	+	−	+	+
S. nanum	−	−	+	−	−	−	−
S. uncinucleatum	−	+	−	+	−	+	−
S. magnum	−	−	+	+	−	−	−
Triadinium caudatum	+	+	+	+	+	+	+
Triadinium magnum	−	+	−	+	−	−	−
Gassovskiella galea	+	+	+	+	+	−	+
Allantosoma intestinale	+	−	+	+	+	+	+
A. cucumis	−	−	+	+	−	−	−
A. biseriale	−	−	+	+	−	−	−
A. dicorniger	+	−	+	+	+	−	−
A. brevicorniger	+	−	+	+	+	−	−
A. japonensis	−	−	+	+	−	−	−
A. lineare	−	−	+	+	−	−	−
Strelkowella urunbasiensis	−	−	−	+	−	−	−

[a]References: (1) Hsiung (1930b); (2) Hsiung (1935a,b, 1936); (3) Ike et al. (1981, 1983a,b,c, 1985), Imai et al. (1999), Ito et al. (1996) and Ozeki et al. (1973); (4) Gassovsky (1919), Kornilova (2003, 2006) and Strelkow (1939); (5) Tung (1992); (6) Gürelli and Göçmen (2010); (7) Present study.

tum was first reported from mules in China (Hsiung 1935b), and later it was observed in kulans (Kornilova 2003) and wild donkeys (Gürelli and Göçmen 2010) (Table 4). To date, this species has not been observed in horses. A similar pattern was observed for *Triadinium magnum*.

Wolskana tokarensis was only recorded from Japanese horses (Ito et al. 1996) and *Cycloposthium piscicauda*, *C. plicatocaudatum*, *C. ponomarevi*, *C. hemioni* and *Strelkowella urunbasiensis* were only recorded from equids in Russia and Middle Asia (Kornilova 2003, 2006; Strelkow 1939) (Table 4). Possibly these species could be considered endemic for these geographical locations.

In conclusion, the fauna of Turk rahvan horses shows the zoogeographical importance of Anatolia. Anatolia is the bridge between two continents (Asia and Europea) and has an important strategic position in the Mediterranean region. Therefore, additional studies of the endocommensal ciliates from various equids in this area are needed to provide further information about possible intermediate hosts and help explain the migration of intestinal ciliates to the different continents.

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