



Rumen ciliates of domestic cattle (*Bos taurus taurus*) in Kastamonu, Turkey, with the description of a new species

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Received 12 March 2016; received in revised form 28 June 2016; accepted 12 July 2016

Available online 19 July 2016

Abstract

Species composition and distribution of ciliates were investigated in the rumen contents of 25 domestic cattle (*Bos taurus taurus* L.) living in Kastamonu, Turkey. Forty-seven species and 37 morphotypes representing 15 genera were identified. Of them, a new species of *Ostracodinium* was recognized and described as *Ostracodinium anatolicum* n. sp. This new species has two caudal lobes. The dorsal lobe is small and rounded and the ventral lobe is triangular shaped and bent toward the dorsal side like a thick hook. Furthermore, the anterior end of the macronucleus (1/5 of the length) is bent toward the left like a hook. The density of rumen ciliates in cattle was $96.8 \pm 43.3 \times 10^4$ cells mL⁻¹ and the mean number of ciliate species per host was 14.2 ± 4.4 . *Entodinium longinucleatum*, *E. nanellum*, *E. simulans* and *Isotricha prostoma* were the most abundant species, each with a prevalence of 88%. *Entodinium chatterjeei*, *E. bifidum* m. monospinosum, *Hsiungia triciliata*, *Oligoisotricha bubali*, *Ostracodinium dogieli*, *O. mammosum* and *O. munham* are new host records for cattle from Turkey.

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Keywords: Cattle; Ciliates; Kastamonu; *Ostracodinium anatolicum* n. sp.; Turkey

Introduction

Symbiotic ciliated protozoa are found in the gastrointestinal tract of herbivores. In ruminants, these ciliates inhabit the rumen and are involved in the digestion of cellulose and starch (Ogimoto and Imai 1981; Williams and Coleman 1992). Ruminants acquire these ciliates by contact with other ruminants (Imai 1988; Moon-van der Staay et al. 2014). For example, salivation on the feed by a faunated animal, followed by ingestion of the contaminated material by a ruminant can lead to faunation. Grooming by a dam and her offspring is another example (Dehority 1986). Thus, the investigation of the rumen ciliate composition of various ruminants in different parts of the world provides useful

information on the relationship not only among the rumen ciliates, but also among the host ruminants (Selim et al. 1999).

Ever since the investigation on rumen ciliates in domestic cattle living in İzmir, Turkey (Göçmen et al. 2003), there has been no additional faunistic research published on rumen ciliates from cattle from other locations in Turkey. Therefore, the aims of the present study were to determine the rumen ciliate fauna of domestic cattle (*Bos taurus taurus* L. 1758) living in Kastamonu, Turkey and to compare this information with data from previous studies conducted both in Turkey and other geographical areas.

Material and Methods

Samples of rumen contents were obtained from 25 domestic cattle at the slaughterhouses around Kastamonu, Turkey

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between March 2012 and May 2012. Immediately after slaughter, the rumen was obtained and cut open with a knife. A well-mixed ruminal digesta sample was obtained, by inserting a ladle into the open rumen, and fixed with an equal volume of 18.5% formalin (Dehority 1984). An aliquot of each sample was stained in methylgreen formalin saline (MFS) solution for total and differential cell counts (Ogimoto and Imai 1981; Gürelli 2014). MFS was also used as a nuclear stain and Lugol's iodine was used to visualize skeletal plates (Gürelli and Ito 2014).

The infraciliary bands were stained using the pyridinated silver carbonate impregnation (PSCI) method. The term poly-brachkinety was used for infraciliary bands composed of numerous, short, parallel kineties (Ito and Imai 1998, Ito and Imai 2006).

Some samples were examined with a scanning electron microscope (SEM). For this purpose, MFS-fixed specimens were washed in distilled water overnight and post-fixed in a 2% (w/v) osmium tetroxide aqueous solution for 4 h at room temperature. After five washes with distilled water, the specimens were dehydrated through an ethanol series (20 min in each concentration) and dried in a CO₂ critical point dryer (Imai et al. 1992). The dried specimens were sputter-coated with gold, and examined using a FEG 250 SEM (FEI-Quanta, Kastamonu).

Cell measurements were made from 25 fixed cells at 400× magnification using a Zeiss compound microscope and imaging system. Drawings were based on photomicrographs and light microscope observations of the protozoal cells, which were previously stained with MFS and Lugol's iodine, or PSCI. Ciliate densities were calculated at 400× magnification with a Neubauer hemocytometer counting chamber. Differential counts of species were estimated from smear slides with a total of 200–1000 cells, for each species.

The orientation of the ciliates for description was adopted from Dogiel (1927), where the side closest to the macronucleus was termed the dorsal side and the opposite side was termed the ventral side.

Classification and identification of species was based on previously published species descriptions and taxonomic lists (Dogiel 1927; Gürelli 2014; Gürelli and Dehority 2013; Imai 1988; Ito and Imai 1990, Ito and Imai, 2003; Ito et al., 1994; Lynn 2008; Mishima et al. 2009; Ogimoto and Imai 1981).

Results

The mean number of ciliates in the rumen contents from 25 domestic cattle (*Bos taurus taurus* L. 1758) in Kastamonu, Turkey was $96.8 \pm 43.3 \times 10^4$ cells mL⁻¹. Individual densities ranged from 23.5×10^4 to 169.0×10^4 cells mL⁻¹. Forty-seven species and 37 morphotypes belonging to 15 genera were identified. Of the ciliate species found, *Entodinium longinucleatum*, *E. nanellum*, *E. simulans* and *Isotricha prosotoma* were the most abundant, each with a prevalence of 88%, whereas *Diplodinium anisacanthum*, *Entodinium chatterjeei*,

E. kastamonicum, *E. okoppensis*, *E. palmare*, *Hsiungia triciliata* and *Ostracodinium anatolicum* n. sp. were detected only in one animal (4% prevalence) (Table 1). For individual cattle, the total number of species ranged from 6 to 22 with an average of 14.2 ± 4.4 species. *E. chatterjeei*, *E. bifidum* m. monospinosum, *H. triciliata*, *Oligoisotricha bubali*, *Ostracodinium dogieli*, *O. mammosum* and *O. munham* are new host records for cattle from Turkey. A new rumen ciliate species of the order Entodiniomorpha, family Ophryoscolecidae Stein, 1959 was identified, using the PSCI method, and proposed as *O. anatolicum* n. sp. (Table 1, Fig. 1).

Ostracodinium anatolicum n. sp.

Diagnosis

Body roughly ellipsoidal and laterally compressed with two caudal lobes; dorsal lobe small and rounded, ventral lobe triangular shaped and bent toward the dorsal side like a thick hook; macronucleus long and narrow with two slight depressions along the dorsal surface; anterior end (1/5 of the length) of the macronucleus bent toward the left like a hook; ellipsoidal micronucleus positioned near the left-dorsal surface of the macronucleus between the first and second contractile vacuoles; three contractile vacuoles occur at the left dorsal edge of the macronucleus.

Description

The body is roughly ellipsoidal and laterally compressed with two caudal lobes. The dorsal lobe is small and rounded, and the ventral lobe is triangular shaped and bent toward the dorsal side like a thick hook. A small, slightly concaved, operculum is at the anterior end of the body. The adoral and dorsal ciliary zones are at the same level at the anterior end of the body. The vestibulum is long and tubular and the macronucleus is long and narrow with two slight depressions along the dorsal surface. The anterior end (1/5 of the length) of the macronucleus is bent toward the left like a hook. The micronucleus is ellipsoidal and positioned near the left-dorsal surface of the macronucleus between the first and second contractile vacuoles. Three contractile vacuoles occur at the left dorsal edge of the macronucleus. One broad skeletal plate, resembling a honeycomb, is present and extends beneath the right surface, laterally from the macronucleus toward the cytoproct. The skeletal plate extends longitudinally from the anterior end of the body to the posterior end of the macronucleus. The dorsal side of the skeletal plate turns slightly inward near the ventral side of macronucleus and extends ventrally, while its anteroventral side appears slightly ventral without turning inward. The cytoproct is located between two lobes, but near the ventral lobe (Table 2, Figs 1–3).

Type host and locality

Domestic cattle (*Bos taurus taurus*) from Kastamonu, Turkey.

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