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Occurrence of ciliate protozoa *Epidinium bulbiferum* (Dogiel 1927) and *Epidinium hamatum* (Schulze 1924) from the rumen of cattle (*Bos indicus*)

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Abstract
To study the morphology of rumen ciliates from the subfamily Ophryoscolecinae from the rumen of Indian cattle (*Bos indicus*) rumen samples were collected. The present paper deals with the study of ciliates from the genus *Epidinium.* Occurrence of *Epidinium bulbiferum* and *Epidinium hamatum* is identified. Morphology of both the species with variations is described and body dimensions are recorded from the specimen taken at random (n=50) from different slides and compared with earlier reports. This study reports *Epidinium bulbiferum* (Dogiel[9]) and *Epidinium hamatum* (Schulze, 1924) recorded for the first time in India.

Keywords: rumen, cattle, protozoa, ciliates, Ophryoscolecinae, *Epidinium*

Introduction
Rumen microbial communities composed of bacteria, anaerobic fungi, viruses, and protozoa play an important role in nutritious physiological, immunological & protective functions of the host (Durand F.C. & Ossa F.) [10].
Gruby and Delafond[17] first reported the protozoa from ruminants since then a number of protozoan species have been reported from different parts of the world Dogiel,[9] Becker & Talbott [2], Hsiung T.S., [19] Clarke R.T.J. [5], Ogifmoto & Imai, [29] Gabriel *et al* [11] and Dehority [7, 8] Gocman B [12, 13, 14]. Gocman *et al*, [16] Martenele I. *et al* [25, 26], Gocman and Gurelli [15], Booyse D. *et al* [4], Booyse D. and Dehority B.A. [3] and Gurelli [18], but very few studies have been made in India. Kofoid and Maclennan [20, 21, 22], Dasgupta M. [6], Banerjee A.K. [1], Kubesy & Dehority [23], Mathur C.S. [24] (1963), Misra S.K. [27], Mukherjee & Sinha [28] Kulkarni [29], Sanghai & Kshirsagar [30, 31] studied rumen ciliates from different hosts. Thus the surveys of rumen ciliate composition of various ruminants from the various locations and the comparison of the results with those of the other domestic ruminants seem to offer the exchange of information not only about rumen ciliate but also the hosts. The present paper deals with the microscopic study of two species of the genus *Epidinium* from the rumen of Indian cattle (*B.indicus*), *Epidinium bulbiferum* and *Epidinium hamatum*. Morphology of the species with variations is described and body dimensions are recorded from the specimens taken at random (n=50) from different slides and compared with earlier reports.

Material and Methods
During the present study rumen fluid samples were collected from 814 adult Indian cattle slaughtered at abattoirs of Kannad, Dist. Aurangabad of Maharashtra State (India). After the removal of the stomach the rumen was slit open and 10-15ml of rumen fluid was collected in a glass vial then the immediately the glass vial was closed airtight and brought to the laboratory. It was centrifuged and preserved by adding 1:1 glycerine alcohol solution. To determine the intensity of the ciliates live specimen were examined under the microscope by taking drop of fluid on a clean glass slide.
The permanent slides of the sample were made in duplicate stained by wet Tungstophosphoric Haematoxylin stain. Identification of genera and species of rumen ciliates were based on description published by earlier workers (Dehority [7]). All the measures of the ciliates were based on a study of 50 specimens (n=50) with an ocular micrometer, line drawings were made with a camera lucida at magnification 10x X 40x.

Results & Discussion
Epidinum bulbiferum, Dogiel 1927
Description of the species: - (Photomicrograph 1)
The body of this species is elongated slightly ellipsoidal posteriorly it is heavy. The adoral ciliary zone is well developed encloses mouth. The left ciliary zone lies behind the anterior end of the body. It is slightly smaller than the adoral ciliary zone. The operculum is well developed which is in continuous of the both the ciliary zones. Both the body surfaces are slightly convex more at the middle of the body posteriorly it extends straight becomes flat. This species is characterized by the presence of bulb like ventral lobe formed by the prolongation of ventral surface at the posterior ventral end of the body.

Fig 1: *Epidinium bulbiferum*

The mouth extends into the tubular oesophagus. The endoplasmic sack occupies almost all portion of the body from the base of the ciliary zones. The ectoplasm is well developed and separated by distinct boundary line. The rectum is the tubular ectoplasmic structure extends parallel shortly along the ventral surface opens through an ellipsoidal anus situated at the base of the ventral lobe.

The macronucleus is thick, elongated rod shape body. The anterior end of the macronucleus is smooth, broad. The posterior end is nearly equal in size, blunt ended. The small ellipsoidal micronucleus lies in a slight depression in the middle of the left dorsal side of the macronucleus. There are two contractile vacuoles lie in ectoplasm close against the boundary line. Anterior contractile vacuole found just behind the left ciliary zone, while the posterior vacuole situated at the level of posterior end of the macronucleus.

The three skeletal plates lie anteriorly from the base of the adoral ciliary zone. The dorsal plate is narrowing adjacent to the ventral edge of the macronucleus. The median plate starts from the ventral half of the right side of the oral area. It lies between the dorsal and ventral plate. The ventral plate arises from the left ventral side of the oral area extends posteriorly up to the posterior third of the ventral surface. The ventral and median plates extend posteriorly together throughout their whole length.

The body dimensions and other measurements of *Epidinium bulbiferum* are given in the table 1.

Comments

Dogiel [9] firstly described *Epidinium bulbiferum* as *Epidinium ecaudatum* f. *bulbiferum* cattle from U.S.S.R. A comparison of the dimensions of the species described here and those given by Dogiel [9] are shown in table 2.

The table reveals that the length of the species recorded here is slightly smaller than the length given by Dogiel [9] however; the width of the species is larger as compare to the width given by Dogiel [9]. The L/W ratio and the length of lobe are smaller as compared to the dimensions given by Dogiel [9].

In the present study, this species is recorded for the first time from the rumen of cattle in India.

Table 1

Sr. No.	Parameters	*E. bulbiferum* (n=50)	*E. hamatum* (n=50)
1	Body	83.2-150.4	76.8-128
	Length	(117.87)	(95.26)
	Width	48-70.4 (58.37)	35.2-57.6 (43.52)
	L/W Ratio	1.60-2.38 (2.03)	1.71-3.33 (2.15)
2	Macronucleus Length	35.2-76.8 (69.32)	32-76.8 (43.49)
	%Length to the Body	36.84-53.13 (45.82)	32.35-60 (45.44)
	Diam. Ant. End.	6.4-12.8 (9.47)	4.8-9.6 (6.62)
	Diam. Post. End	6.4-12.8 (9.47)	3.2-8 (5.38)
3	Micronucleus	4.8-9.6 (6.75)	3.2-8 (5.11)
	Adoral ciliary zone (Mouth)	12.8-22.4 (16.08)	9.6-17.6 (14.12)
	Left ciliary zone	11.2-19.2 (14.47)	8-16 (11.51)
4	Lobe/ Spine	3.2-12.8	1.6-8
	Ventral lobe	(7.52)	(4.7)
5	Skeletal Plate	48-80	38.4-70.4
	Dorsal	(63.04)	(52.82)
	Length	8-16	6.4-11.2
	Width	(16.89)	(8.42)
6	Median	44.8-76.8	38.4-70.4
	Length	(60.35)	51.34
	Width	8-16 (11.87)	6.4-11.2 (8.90)
7	Ventral	35.2-76.8	38.4-70.4
	Length	(58.38)	51.82
	Width	6.4-14.4 (12.80)	6.4-11.2 (8.13)

Table 2: Comparative body dimensions of *E. bulbiferum* and *E. hamatum*

Parameters	*Epidinium bulbiferum*		*Epidinium hamatum*	
	Dogiel[9]	Present Study	Dogiel[9]	Present Study
Length	98-150 (123)	83.2-150.4 (117.87)	104-150 (130)	76.8-128 (95.26)
Width	40-55 (47)	48-70.4 (58.37)	43-61 (51)	35.2-57.6 (43.52)
L/W ratio	2.6	1.6-2.38 (2.03)	2.5	1.71-3.33 (2.15)
V. Lobe L	7-17 (11)	3.2-12.8 (7.52)	--	1.6-8.0 (4.7)

***Epidinium hamatum*, Schulze 1924**

Description of the species: - (Photomicrograph 2)

The body of this species is elongate, slightly ellipsoidal and posteriorly narrow. The adoral ciliary zone is well developed encloses mouth. The left ciliary zone is smaller than the adoral ciliary zone lies below the level of operculum. The operculum

is broad and well developed. The ventral surface is weakly concave than the dorsal slight convex surface. Posteriorly body surfaces narrows and the ventral surface gives out a thin, blunt ventral spine, which is much smaller, slightly inward and blunt as, compare to the spine observed in *Epidinium caudatum*.

Fig 2: *Epidinium hamatum*

The mouth opens into the tubular oesophagus. It extends posteriorly into the endoplasmic sack. It is elongate occupies all portion of the body following the body surfaces. The ectoplasm is clear and separated by a prominent boundary line. The rectum is tubular structure situated in the posteroventral end of the body opens through the circular anus lies at the base of the ventral spine.

The macronucleus is an elongated rod shaped structure lies in middorsal region of the body. The anterior end of the macronucleus is broad smooth rounded while the posterior end narrows blunt. The micronucleus is an ellipsoidal body lies in a small depression of the middorsal side of the macronucleus.

The two contractile vacuoles lies in ectoplasm close against the boundary line. Anterior found located behind the left ciliary zone posterior lies at the level of posterior end of the macronucleus. There are three skeletal plates arises from the base of the oral area. The dorsal skeletal plate starts from the dorsal edge of the oral area extends posterior close to the ventral surface of the macronucleus. The median plate lies in between the dorsal and ventral skeletal plates arises from the ventral half of the oral area. The ventral skeletal plate starts from the ventral left side of the oral area it runs posteriorly along the median plate.

The body dimensions and other measurements of *Epidinium hamatum* are given in table 1.

Comments

Dogiel [9] described *Epidinium hamatum* as *Epidinium ecaudatum* f. *hamatum* with thin ventral spine. The comparative measurements of the species described here and those given by earlier workers are shown in table 2.

The table indicates that the species described here is smaller as compared to the species described by Dogiel [9]. The L/W ratio is also less than the species described by Dogiel [9].

In the present studies, *Epidinium hamatum* recorded for the first time in cattle in India.

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