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Research Article

STUDY ON THE OCCURRENCE OF THE RUMEN CILIATE *DIPLODINIUM SPHERICULATUM* FROM THE RUMEN OF INDIAN GOAT *CAPRA HIRCUS*

***Sanghai P.K.**
Department of Zoology, Shivaji A.C. & Science College, Kannad -431103, District Aurangabad (M.S.) India
**Author for Correspondence*

ABSTRACT
A survey has been made to observe the morphology of rumen ciliate protozoa from the subfamily Diplodiniinae. A total 458 rumen fluid samples of the Indian goat *Capra hircus* were collected for one year. The study reveals that occurrence of *Diplodinium sphericulatum* (Sanghai *et al.,* 2010). The body dimensions and variations of characters recorded from the specimens taken (n=20) at random from different slides and compared with earlier findings and critical comments were made on their specific identity. The presence of *D. sphericulatum* in the rumen of goat is the new host record in the world.

Keywords: *Rumen, Goat, Protozoa, Ciliates, Diplodinium*

INTRODUCTION
Gruby and Delafond (1843) first reported the protozoa from ruminants since then a number of protozoan species have been reported from different parts of the world Dogiel (1927) Becker & Talbott (1927), Hsiung (1932), Clarke (1964), Ogifmoto & Imai (1981) and Dehority (1993, 2005) Gocman (1999a, 1999b, 2000), Gocman *et al.,* (2005) Martenele *et al.,* (2008), Gocman and Gurelli (2009), Dirk *et al.,* (2010), Dirk and Dehority (2011) and Gurelli (2014), but very few studies have been made in India. Kofoid and Maclennan (1930, 1932, 1933), Dasgupta (1935), Banerjee (1955), Mathur (1963), Misra (1972), Mukherjee & Sinha (1989, 1990) Sanghai and Kshirsagar (2015) studied, rumen ciliates from different hosts. The present paper deals with the occurrence of *Diplodinium sphericulatum* (Sanghai *et al.,* 2010) recorded first time from the rumen of goat (*C. hircus*), earlier it was reported as n. sp. from the rumen of cattle by the author. The size and morphology of this species is compared to those previously reported and also compared with the similar species.

MATERIALS AND METHODS
During the present study rumen fluid samples were collected from 458 adult Indian goats *Capra hricus* slaughtered at abattoirs of Kannad, District Aurangabad of Maharashatra 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 specimens 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 1993). All the measures of the ciliates were based on a study of 20 specimens (n=20) with an ocular micrometer.

RESULTS AND DISCUSSION
Diplodinium sphericulatum, Sanghai et al., (2010)
Description of the Species: - (Microphotograph of D. sphericulatum)
The body is heavy, rounded in shape. The adoral ciliary zone is large encloses mouth. It is inclined ventrally at an angle of 25-30º. The adoral lips are well developed. The left ciliary zone is smaller than the

adoral ciliary zone. The operculum is broad, prominent and extended anterior to the oral area. It separates both the ciliary zones. Both the body surfaces are greatly convex. The greatest curvature found at the middle of the body. The ventral surface extends posteriorly becomes narrower and gives a thick, blunt rounded lobe. The dorsal surface posteriorly gives a short flange like appearance.

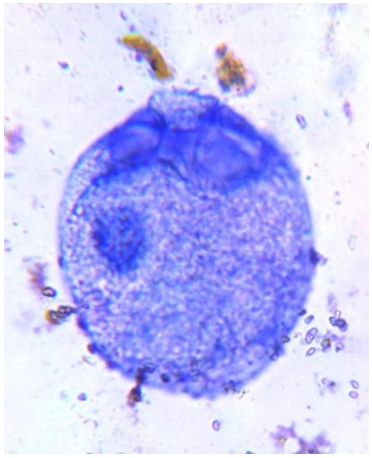
The oesophagus is wide tubular, arises from the base of the mouth extends a short distance to the right side. It opens into the endoplasmic sack. The endoplasmic sack heavy, rounded occupies greater portion of the body following the body surfaces terminates posteriorly. The ectoplasm is thick especially anterior and in the caudal region of the body. It is differentiated from the endoplasm by a distinct boundary line. The rectum is long tubular starts from posteroventral region of the endoplasmic sack. It opens by an elliptical anus. The anus is situated in the mid region of the posterior end left to the caudal lobe.

The macronucleus is heavy rounded, bulbous body located mid dorsally slightly behind the left ciliary zone. The position of macronucleus varies from dorsal to ventral side as well as it is observed slightly in the middle region of the body. The micronucleus is rounded, thick structure lies around left dorsal side of the macronucleus. The position of micronucleus also varies around the macronucleus. There are two large ovoid contractile vacuoles found in ectoplasm close against boundary line. The anterior contractile vacuole lies just behind the left ciliary zone while the posterior contractile vacuole found in the posterior third region of the body.

The body dimensions and other measurements of *Diplodinium sphericulatum* (Sanghai *et al.*, 2010) are given in table 1.

Table 1: The Body Dimensions and Other Measurements of *Diplodinium sphericulatum* (2010) are as below, all Measurements are in Microns (n=20)

Sr. No.	Parameters	Minimum	Maximum	Average
1	**Body**			
	Length	67.54	85.96	76.51
	Width	55.26	73.68	64.27
	L/W Ratio	1.00	1.31	1.17
2	**Macronucleus**			
	Length	12.28	19.95	16.11
	%Length to the Body	18.18	23.20	21.05
3	**Micronucleus**	3..07	3.07	3.07
4	**Adoral ciliary zone (Mouth)**	9.21	16.88	14.02
5	**Left ciliary zone**	6.14	12.28	8.81



Microphotograph of *Diplodinium sphericulatum*

This species first observed by author in 2007 (article published in 2010) during the investigation of rumen ciliates of cattle *Bos indicus*. In present study it is observed from the rumen samples of goat *Capra hircus.* It is compared with the following other species and also with the species observed in the rumen samples of cattle.

This species is similar to *D. psittaceum* (Kofoid & Maclennan 1932), *D. costatum* (Dogiel, 1927) and *D. mahidoli* (Imai & Ogimoto 1983) in having rounded heavy body, with a prominent ventral lobe.

However, it differs from all above species in most of the characters. It differs from *D. psittaceum* in having more rounded body.

The L/W ratio is 1.17 as against the L/W ratio of 1.48 of *D. psittaceum*. The macronucleus of the *D. psittaceum* is rod shaped, bent anteriorly forming a notch, lies under the right surface of the body while this species possess a rounded macronucleus lies below the ciliary zone with variable positions. The micronucleus lies around the macronucleus while in *D. psittaceum* it is observed in the anterior depression of the macronucleus. It also differs in having a blunt, rounded ventral lobe as against a ventral spine with a flange in *D. psittaceum*.

It is smaller than the *D. costatum* in size range and it differs from *D. costatum* in having a thick rounded macronucleus against the elongated anteriorly bent macronucleus. It differs in the position of micronucleus varies around the macronucleus against the fix position of micronucleus in the depression at anterior bent region of macronucleus in *D. costatum*. It further differs in having a prominent rounded ventral lobe, which is very short in *D. costatum*.

It differs from *D. mahidoli* in size and the more rounded shape. The L/W ratio is 1.17 against the L/W ratio 1.49. The macronucleus is rounded in shape against the elongated anteriorly bent macronucleus in *D. mahidoli*. The micronucleus lies around the macronucleus while in *D. mahidoli* it is found in anterior notch. It also differs from the *D. mahidoli* in having a prominent, blunt ventral lobe against a ventral spine or lobe.

The species observed during the present study is compared with the species observed from cattle which is smaller in size. The average length and the range is small than the average length found in the species found in cattle. The L/W ratio is less 1.17 as compared to 1.26.

The Comparative body dimensions of *Diplodinium sphericulatum* Sanghai *et al.,* (2010) with closely related species given in table 2.

Table 2: Comparative Body Dimensions of *Diplodinium sphericulatum*

Parameters	**Authors**				
	***D. psittaceum* Kofoid & Maclennan (1932)**	***D. costatum* Dogiel (1927)**	***D. mahidoli* Imai & Ogimoto (1983)**	***Diplodinium sphericulatum* Sanghai *et al.*, (2010)**	**Present Study**
Length	95-150 (122)	80-180 (115)	117-167.5 (138.7)	57.6-150.4 (109.86)	67.54-85.96 (76.51)
Width	60-105 (83)	55-110 (81)	77.5-112.5 (93.5)	41.6-121.6 (87.59)	55.26-73.26 (64.27)
L/W ratio	1.34-1.61 (1.48)	1.4	1.25-1.72 (1.49)	1.00-1.56 (1.26)	1.00-1.31 (1.17)
Manu. L	40-85 (58)	--	--	6.4-25.6 (15.17)	12.28-19.95 (16.11)
V. lobe L	6-15 (11)	--	--	3.2-16 (10.24)	

Distinguishing Characters

Rounded body, posteriorly large blunt ventral lobe seen. Thick, heavy rounded macronucleus was seen.

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