



Occurrence of Holotrichous Ciliated Protozoa Inhabiting the Rumen of Domestic Goat *Capra Hircus* (L.) Families Isotrichidae (Trichostomatida) and Buetschliidae (Prostomatida)

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Article History	Abstract
Received: 14 June 2022 Revised: 05 March 2023 Accepted: 06 March 2023	Rumen fluid samples of domestic goats (<i>Capra hircus</i> L.) were collected from slaughter houses of Kannad (Aurangabad M.S.) for the study of holotrichous ciliate protozoa. As a result of the survey of 169 rumen fluid samples the 3 species of ciliates (<i>Isotricha intestinalis</i>, <i>I. prostoma</i> and <i>Dasytricha ruminantum</i>) from two genera, Family Isotrichidae and one species from the genus <i>Buetschlia</i> (<i>Buetschlia parva</i>) Family Buetschliidae were studied. All these recognized ciliates were morphologically described and compared with their original descriptions and previous reports. The similarities and differences were discussed. The paper reveals that <i>Isotricha intestinalis</i> and <i>Buetschlia parva</i> are the first report in India from the rumen of goat.
CC License CC-BY-NC-SA 4.0	Keywords: Protozoa, Rumen, Goat, Isotrichidae, Buetschliidae

1. Introduction

Rumen protozoa play an important role in rumen metabolism by removal of carbohydrates from bacterial attack and digestion of bacteria (Coleman⁵). The ruminal microflora comprises bacteria, fungi & protozoa. Out of them protozoa contribute about 50 % of total biomass. They are large and of two types, flagellates and ciliates. The flagellates are few in numbers while ciliates are a morphologically diverse group representing the two subclass Gymnostomatia Butschli 1889 and Vestibulifera Puytorac *et al* (Dehority 1974).

The family Buetschliidae (Poche 1913) is included in the order Prostomatida suborder Archistomatina which comprises the genus *Buetschlia*, Schuberg (1888). The family Isotrichidae (Butschli 1889) included in the subclass Vestibulifera order Trichostomatida possesses 3 genera (*Isotricha*, *Dasytricha* and *Oligoisotricha*) and the species covered by dense fur like cilia all over the body (Ogimoto K. & Imai S. 1981).

The present study deals with the occurrence of ciliate protozoa belonging to the families Isotrichidae and Buetschliidae from the rumen of domestic goat. As a result, 3 species *Isotricha intestinalis* I.

prostoma and *Dasytricha ruminantum* from the family Isotrichidae and *Buetschlia parva* from the family Buetschliidae is reported. The measurements recorded here were compared with their previous reports and similarities and differences were discussed.

Dogiel (1927) studied ciliate protozoa from the rumen of domestic cattle in U.S.S.R. After that, it had been described from different geographical parts all over the world and several hosts. Dehority (1974) from Alaska, Ogimoto & Imai (1981) from Japan, G. Gurelli (2019) studied Entodiniomorphid ciliates from elephants and described 3 new species from the Genus Buetschlia, Talu (1999) from the rumen of Goat in Turkey. The study of ciliate protozoa from different ruminants in various areas all over the world reveals the knowledge about geographical distribution of rumen ciliates, the physiology and feeding habits of hosts and the specificity and phylogeny of individual species (Gocman *et al* 2002). Becker and Talbott (1927) studied in American cattle, Clarke (1964) studied in New Zealand domestic cattle, Hsiung (1932) studied in Chinese cattle. Imai & Tsunoda (1972) studied scanning electron microscopy of rumen ciliate from sheep in Japan. However, very few morphological studies have been done on the ciliate fauna found in the rumen of Indian goat. Kofoed and MacLennan (1930, 1932 & 1933) studied in different ruminants of India and Ceylon, Banerjee (1955) studied on rumen ciliates of cow, Buffalo and sheep, in India, Dasgupta, M. (1935) observed ciliates in the rumen of Indian goat, Mukherjee & Sinha (1989 & 1990) studied ciliate protozoa from black Bengal goats, Kshirsagar *et al* (1995), Kulkarni (2001) observed Entodiniid ciliates from cattle, Sanghai (2007 & 2019) studied from the rumen of cattle & goat. Gogoi *et al* (2018) described rumen protozoal population from domestic ruminants in which ciliates upto genera are described. Zacarias Da silva, *et al* (2022) studied geographic distribution, host specificity, phylogeny and molecular dating Rumen ciliates (Alveolata, Ciliophora associated with goats. The 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 (Ogimoto & Imai 1981).

2. Material and Method

In the present study, rumen contents from 169 adult goats *Capra hircus* slaughter houses of Kannad, Dist. Aurangabad of Maharashtra State (India) were collected. The materials were preserved and permanent stained slides were prepared by using the technique as described in previous reports Kshirsagar *et al* (1995) Kulkarni (2001), Sanghai P.K. (2007 & 2019). The species were identified and classified taxonomically as described by earlier workers Dehority (1993). The body dimensions of the ciliates described by taking 20 individuals (n=20) with an ocular micrometer.

3. Results and Discussion

Family - Isotrichidae

Genus –Isotricha Stein 1859

Species-*Isotricha intestinalis*, Stein 1859 (Plate- I Fig.2)

Description of the species:

The body of this species is oval-shaped large in size possessing longitudinal rows of cilia uniformly distributed all over the body. The ectoplasm is thin and clear and the endoplasm is thick dense uniform spread within the body. The macronucleus is kidney- shaped, large in size, thick and a spherical micronucleus is situated around it. The species is identified by the position of the cytostome located at the lateral side nearly at the level of macronucleus. The body shows a depression at the opening of the cytostome it runs forward and opens into the endoplasmic sack. The body measurements are given below in microns (Table1).

Comments

A comparison of the measurements of the species described here and those given by earlier workers are given in Table1. The average length of the body described here is larger as compare to the average length given by Dehority (1993) while it is smaller than the average length recorded by Gocman &

Oktem(1991), Kshirsagar *et al* (1995), Oktem *et al* (1997) and Gocman & Atatur (2002). The average width given here is similar to the average width described by Gocman & Atatur (2002). The L/W ratio is higher than given by Oktem *et al* (1997) and smaller than reported by Gocman & Atatur (2002).

Table 1: Comparative body dimensions of *Isotricha intestinalis*
All measurements are in microns (μm).

Parameters	Authors					
	Gocman & Oktem (1991)	Dehority (1993)	Kshirsagar <i>et al</i> (1995)	Oktem <i>et al</i> (1997)	Gocman& Atatur (2002)	Present Study (n=20)
Length	45-195 (138.78)	90-200 (110)	85.6-214 (135.93)	116.60- 184.50 (147.74)	104.85-174.79 (140.29)	97.28- 151.04 (125.95)
Width	17.5-116.25 (79.38)	45-150 (60)	51.36-107 (75.71)	87.20- 122.60 (89.03)	53.59-97.86 (71.48)	51.20- 94.72 (71.30)
L/W ratio	--	-	-	1.26-2.08 (1.67)	1.55-2.70 (1.99)	1.26-2.36 (1.79)
Ma.Nu.L	12.5-47.5 (30.99)	-	17.12-42.8 (25.82)	21.40-52.40 (39.00)	18.64-53.59 (37.51)	23.04- 38.40 (30.91)
Ma.Nu. Dia	6.25-35 (20.64)	-	8.50-25.6 (15.45)	19.00-32.10 (24.27)	13.98-30.29 (20.36)	Ant.End 10.24- 23.04 (13.56)
Mi. Nu. (w)						3.84-6.4 (5.59)
Mouth (L)	25-37 (30.40)	-	17.12-42.8 (24.09)	-	--	--
Mouth (w)	12.5-27 (18.63)	-	6.42-17.12 (11.27)	-	--	--

Species-*Isotricha prostoma*, Stein 1859(Plate- I Fig.3)

Description of the species:

This species is characterized by oval shaped body, large in size and having uniform covered longitudinal rows of cilia. The ectoplasm is thin and clear around the body line and endoplasm is thick dense uniform distributed within the body. The macronucleus is large possess a depression at middle and receives a kidney shape. The micronucleus found around the macronucleus. The mouth is situated at the broad end of the body which is a identifying feature of this species. There are 4-6 contractile vacuoles found in the middle portion of endoplasm. The body dimensions are as below in microns (Table- 2).

Comments

The description of the species given here is compared with previous study and mentioned in Table 2. The average length of the body given here is slightly similar to the average length given by Oktem *et al* (1997) and smaller than the length reported by other workers and average width is similar to the average width reported by Gocman & Atatur (2002) and smaller than the width given by other workers. The average L/W ratio is higher than reported by Oktem *et al* (1997) and slightly similar to recorded by Gocman & Atatur (2002).

Table 2: Comparative body dimensions of *Isotricha prostoma*
All measurements are in microns (μm).

Parameters	Authors					
	Gocman & Oktem (1991)	Dehority (1993)	Kshirsagar <i>et al</i> (1995)	Oktem <i>et al</i> (1997)	Gocman& Atatur (2002)	Present Study

Length	50-227.5 (137.27)	80-200 (135)	89.88-192.6 (138.67)	97.60- 154.70 (127.94)	100.19-174.75 (132.67)	99.84- 171.52 (129.41)
Width	20-148.8 (71.90)	50-120 (70)	29.96-94.16 (61.45)	53.60-90.40 (69.81)	34.95-69.90 (51.45)	35.84-74.24 (52.35)
L/W ratio	--	-	-	1.67-2.16 (1.84)	2.00-4.00 (2.63)	1.86-3.35 (2.52)
Ma.Nu.L	22.5- 72.5 (48.50)	-	25.68-64.2 (38.75)	30.90-52.40 (39.40)	23.30-67.57 (41.61)	25.6-48.64 (36.67)
Ma.Nu. Dia	6.25- 22.5 (14.63)	-	6.42-21.4 (11.10)	10.70-16.70 (13.56)	9.32-18.64 (13.65)	Ant. End 7.68-12.8 (10.24)
Mi. Nu. (w)						3.84-6.4 (5.67)
Mouth (L)	14-33 (23.79)	-	8.56-24.4 (16.34)	--	--	--
Mouth (w)	10-24 (15.10)	-	4.28-8.56 (5.82)	--	--	--

Genus –*Dasytricha* Schuberg 1888

Species-*Dasytricha ruminantum* Schuberg, 1888 (Plate- I Fig.4)

Description of the species:

The body of this species is oval in shape smaller as compare to the *Isotricha* species. The cilia are present all over the body spirally organized which is striking feature of the species. The ectoplasm lies just beneath the body line which is thin, clear as compare to the thick dense endoplasm found inside the body. The mouth is situated at the broader end as similar to *I. prosotoma* but smaller in size. The ellipsoidal macronucleus found in the middle portion of the body. The spheroidal micronucleus is present around the macronucleus. The body dimensions are given below in microns (Table- 3).

Comments

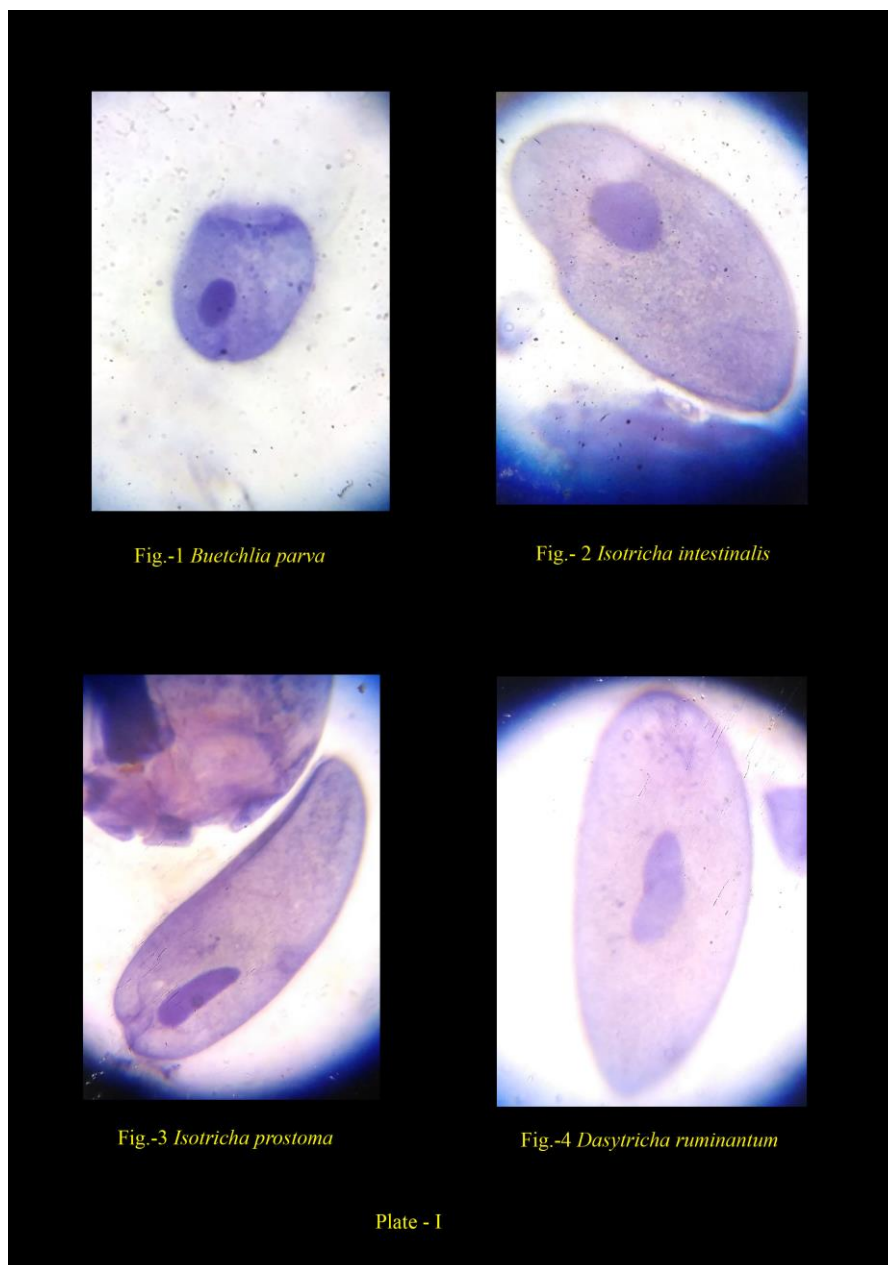
The body measurements of this species are compared with earlier workers as shown in table 3. The average length is more as compare to the average length given by Dehority (1993) and Kshirsagar *et al* (1995) and it is less than the average length given by Oktem *et al* (1997) and Gocman & Atatur (2002). The average width is slightly similar to the average width described by Dehority (1993) and it is smaller as compared to other workers. The average L/W ratio described here is exactly similar to the average L/W ratio reported by Oktem *et al* (1997).

Table 3: Comparative body dimensions of *Dasytricha ruminantum*
All measurements are in microns (µm).

Parameters	Authors				
	Dehority (1993)	Kshirsagar <i>et al</i> (1995)	Oktem <i>et al</i> (1997)	Gocman & Atatur (2002)	Present Study (n=20)
Length	46-100 (58)	38.32-89.88 (54.41)	46.40-86.90 (69.85)	34.95-116.50 (72.84)	40.96-122.88 (63.27)
Width	22-50 (27)	21.4-51.36 (33.94)	22.60-41.70 (32.99)	25.63-41.94 (33.88)	17.92-66.56 (28.74)
L/W ratio	-	-	1.71-2.48 (2.11)	1.07-3.42 (2.17)	1.22-2.55 (2.11)
Ma.Nu.L	-	8.56-21.4 (13.61)	8.30-25. (17.93)	11.65-27.96 (19.34)	11.52-35.84 (14.750)
Ma.Nu. Dia	-	4.28-12.84 (8.65)	--	9.32-27.96 (14.66)	Ant End 3.84- 35.84 (14.75)

Mi. Nu. (w)					3.84-6.4 (4.59)
Mouth (L)	-	4.28-21.4 (9.43)	-	--	-
Mouth (w)	-	4.28-8.56 (4.53)	-	--	-

Description of the species: (Fig. 1)



***Buetschlia parva* Schuberg, 1888 (Plate- I Fig.1)**

The body of this species is smaller in size ovoid in shape truncated anteriorly and rounded posteriorly. The entire body is covered with cilia except in the anterior around the cytostome longer cilia are found. The ectoplasm in the anterior region is thick, endoplasm thin and found uniform in the body. The cytostome is situated in the anterior region truncated extends forward and opens into the endoplasmic sack. The macronucleus is situated slightly posterior, spheroidal in shape. The body dimensions are given below (Table 4).

Comments

The body dimensions of the present species and previous reports are mentioned in table 4. The length of the species described during the present study is smaller as compared to the length given by Dehority (1993), Gocman & Ozbel (2001) and Baraka (2012) while the average width described here is close to the average width given by Dehority⁸.

Table 4: Comparative body dimensions of *Buetschlia parva*
All measurements are in microns (µm).

Parameters	Authors			
	Dehority (1993)	Gocman & Ozbel (2001)	Baraka T.A. (2012)	Present Study
Length	30-70 (58)	30-67	30-70	33.28-43.52 (38.40)
Width	20-50 (27)	20-48	20-50	23.04-30.72 (25.78)
L/W ratio	-	-	-	1.18-1.89 (1.52)
Ma.Nu.L	-	-	-	11.52-14.08 (12.44)
Mi. Nu. (w)				3.84-6.4 (4.21)

4. Conclusion

In this article, rumen fluid samples of domestic goats (*Capra hircus* L.) were collected from slaughter houses of Kannad (Aurangabad M.S.) for the study of holotrichous ciliate protozoa. As a result of the survey of 169 rumen fluid samples, the 3 species of ciliates (*Isotricha intestinalis*, *I. prostoma* and *Dasytricha ruminantum*) from two genera, Family Isotrichidae and one species from the genus *Buetschlia* (*Buetschlia parva*) Family Buetschliidae were studied. All these recognized ciliates were morphologically described and compared with their original descriptions and previous reports. The similarities and differences were discussed. The paper reveals that *Isotricha intestinalis* and *Buetschlia parva* are the first report in India from the rumen of goat.

Acknowledgements

The author would like to thanks to Dr. Babasaheb Ambedkar Marathwada University, Aurangabad providing research grant (letter No.STAT/VI/RG/2017-18/2957-58) for this study and Principal, Shivaji A.C. & Sci. College, Kannad, Dist. Aurangabad for providing laboratory and Library facilities.

Conflict of Interest

The authors declare no conflict of interest.

Funding:

The author would like to thank Dr. Babasaheb Ambedkar Marathwada University, Aurangabad for providing a research grant (letter No.STAT/VI/RG/2017-18/2957-58)for this study.

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