Ectoparasitic Trichodinians Infecting catfish *Clarias gariepinus* inhabiting Nile Delta Water of the River Nile, Dakahlia Province, Egypt

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Abstract: This work was done to identify the ectoparasitic trichodinians infecting the freshwater catfish *clarias gariepinus* inhabiting the Nile Delta water near Mansoura city in Egypt. The fish specimens were collected monthly. During this study some ectoparasitic protozoan were identified as: *Trichodina matsu, T. magna, T. maritinkae* and *T. sangwala*. The aim of this work is for morphological, taxonomical and anatomical studies of the protozoan parasities infesting the gills and skin. Morphometric data were also given for each species and interspecific variations were discussed. [Journal of American Science 2010; 6(9):656-668]. (ISSN: 1545-1003).

Keywords: Trichodinid, catfish, ectoparasites ciliophora – River Nile – Egypt

1. Introduction

The Egyptian teleost *C. gariepinus* is one of the most popular fish kinds inhabiting the River Nile and the interconnecting lakes. It can survive for a long time outside water and this can facilitate the transport of this fish from the site of collection to the laboratory. Moreover, it is less expensive than the other Nile fishes which are important sources of animal protein. Coinciding with the growing economic value of this fish is the increased interest in its parasite loads and what effect they hold for the aquaculture industry. To all previous reasons, in addition to its economic importance, *C. gariepinus* has been selected for the present study.

Ectoparasites, including protozoa, are cited as the major problem in warm water pond fish culture where high temperature and organic content accelerate the life cycles of parasites and promote their spread (Sarig, 1975). Ectoparasitic protozoa represents one of the most hazardous threats to fish health. These parasites attack the fish and cause massive destruction of the skin and gill epithelium (Ali et al., 2002; Kim et al., 2002; Sterud et al., 2003). Even moderate infection of these organisms may cause a fatal disease, since the infected fish lose their appetite and stop feeding (Meyer, 1966; Hoffman, 1970). Fry and very small fingerlings can not survive for only extended period without feeding, so infected fish may die without exhibiting any symptoms other than debilitation. Symptoms are usually not striking and the behaviour of fish is as useful in recognizing infections as is physical appearance. A notable exception occurs, however, in the case of ichthyophthiriasis. Infected fish may exhibit over-secretion of mucus with the accumulated slime giving the fish a grayish or bluish appearance. Wurtsbaug and Tapia (1988) attributed the death of the 18 million Killifish to the ciliate protozoan Ichthophirius muttifils. Parasitic ciliates, particularly those of the genus Trichodina, are the most frequently encountered fish ectoparasites (Lom and Dykovà, 1992). Opinions differ as to the pathogenicity of the ciliates, but it has been generally recognized that the ciliates are harmful to fishes. Since the ciliates are morphologically adapted to adhesion to body surface of fish and have a projected cytostamal opening, they will be an obligate parasites of fishes and produce a direct injury to infected fish.

The ciliates of family Trichodinidae are characterized by proteinaceous cytoskeleton of the adhesive disc which consists of a ring of hollow conical elements with flat lateral projections, known as denticles. The centrifugal projections of denticles, mostly semicircular, are called blades and the thorn-like centripetal projections are called thorns. The denticles are inserted into each other subtended by a ring of fine skeletal rods, called radial pins. The disc is encircled by a moveable border membrane, reinforced by fine skeletal rays appearing as fine striations. Apically, above the border membrane, there is a ciliary wreath of a single row of cilia separated by a pellicular fold or septum from a powerful locomotory wreath constituted by obliquely arranged short rows of 6 to 9 cilia. These cilia are covered apically by a more or less prominent pellicular fold, the vellum, beneath which a single row of upwards protruding marginal cilia is inserted (Lom, 1973; Maslin-Leny and Bohatier, 1984).

In the genus Trichodina Ehreberg, 1838, the denticles have massive central conical parts, with flat, often semicircular blades and straight thorns. The peritrichian genus Trichodina comprises more than 150 species, most of which are associated with freshwater fish as ectoparasites or symbionts. Some Trichodina species were described from marine Piscean hosts (Raabe, 1958, 1959; Lom, 1962 ; Lom and Laird, 1969; Lom, 1970a, b; Stein, 1973, 1976, 1979, 1982) while others were recorded from amphibians (Lom, 1958; Raabe, 1959; Chen, 1963, Kazubski, 1979), a coelenterate (Van As and Basson, 1986), moulluscs (Raabe, 1965) and some from planktonic copepods (Migala and Grygierek, 1972). The first taxonomic description of trichodinids from fresh water fish in Southern Africa were provided by Basson et al. (1983), followed by many authors e.g Basson and Van As (1991, 1994, 2002).

Various reports exist of diseases and mortalities of fish in fish farms caused by ectoparasitic trichodinid (Rogers, 1971; Lom, 1973; Plumb, 1973; Jackson, 1978). Trichodinid ectoparasites can cause serious threats, particularly under culture conditions (Van As and Basson, 1988). Trichodina infection in young cultured Scophtalmus maximus can cause about 26% weight loss over a 12 month period (Sanmartin Duran et al., 1991). In a trichodinad firmly attached to the host epithelium, the sharp rim of the border membrane bites into the surface of the host epithelial cells, and forcibly acts as a sucker. These activities are the main cause of host irritation (Lom and Dykovà, 1992). In a fish debilitated by some other factors, or on fish larva or young fry, the natural repellent ability of the fish surface is impaired and the trichodinids can massively proliferate and cause serious damage to the epithelial or epidermal cells by their constant attachment and also by their movement. Most trichodinids feed on the disrupted cells and of the hosts gills and skin and may even penetrate deeply into the gill or skin tissue (Lom and Dykovà, 1992). Heavy trichodiniasis may cause loss of up to 50 % of the fish stocks and growth inhibition which has been seldom recorded (Lom and Dykovà, 1992). In Egypt, few studies were carried out on trichodinids (El-Tantawy and Kazubski 1986; Abdel-Ghaffar et al., 1996; Ghoneim, 1998; Ahmed et al., 2000; Enayat et al., 2008). Ghoneim (1998) recorded *T. magna, T. centerstrigeata* and *T. compacta* from *Oreochromis aureus* and *Tilapia zillii*. Ahmed et al. (2000) recorded *T. magna* from *O. niloticus, T. zillii, Sarotherdon galilaeus* and *Clarias gariepinus* and *T. heterodentata* from *O. niloticus, T. zillii* and *S. galilaeus*.

2. Materials and Methods

The present study was restricted to fishes (*Clarias gariepinus*) inhabiting Nile Delta waters particularly the Damietta branch of the River Nile, Dakahlia Province, Egypt. Specimens of the catfish *Clarias gariepinus* were collected monthly from different localities in Nile Delta particularly Damietta branch near Mansoura city. Fishes were transported immediately alive to the laboratory. Smears were taken from skin, fins, gills and suprabranchial organ to search for any ectoparasitic protozoan.

Smears containing protozoans were air dried, then impregnated with 2% aqueous solution of AgNo for 10-15 minutes, followed by rinsing in distled water. The slides were then placed in white clean dish, covered with distilled water and exposed to UV (diffused day light) for about 2 hours (modification of Klein's dry silver impregnation method). To study the nuclear apparatus, the respective parasites were stained by Giemsa stain. The smears were fixed in methanol for 5-10 minutes, and stained with 5% Giemsa solution in phosphate buffer (pH 7.3) for 30-45 minutes. Smears were then examined, measured and photographed using Leitz research microscope.

The systematic descriptions used in the present study were based on the observations of living as well as silver-impregnated and Giemsa stained specimens. Terminology and the method of measurements of trichodinids followed the uniform specific characteristic system proposed by Lom (1958). The detailed description of the denticles are presented in accordance with the method proposed by Van As and Basson (1992).

3. Results

In the present study, several species of ectoparasitic protozoans were detected from the gills of the catfish *Clarias gariepinus* inhabiting Damietta branch of the River Nile near Mansoura. All these parasites were classified according to Van As and Basson (1989).

1- *Trichodina matsu* Basson and Van As, 1994

This trichodinid is recorded from the gills of the catfish *Clarias gariepinus*. It is a medium-sized trichodinid with a concave adhesive disc (Figs. 1, 2). All measurements of this parasite are shown in Table 1. The diameter of the body ranges from 42.4 to 49.3 µm with an average of 44.6 µm. The center of the adhesive disc is texture identical to the rest of the adhesive disc. The latter is surrounded by a distinct border membrane provided with fine striations (Fig. 1). There are 26 (24-27) denticles, each consisting of three main parts: a blade, a central part and a ray

(Figs. 1, 2, 9). The number of radial pins per denticle is 9 (8-11). The blade is sickle-shaped, broad and fills a large portion between Y and Y+1 axes (Fig. 9). The distal surface of the blade is sloping down from the tangent point and in some specimens appears flat, truncated and lies parallel to the border membrane (Figs. 1, 2, 9). The tangent point is sharply rounded and situated slightly lower than the distal surface of the blade. The anterior margin of the blade forms a smooth slight curve towards the prominent apex that extend slightly beyond Y+1 axis (Fig. 9). The blade apophysis is prominent. The posterior blade surface forms triangular curve with the deepest point at the lower end corresponding to the apex of the anterior surface. The blade connection is thin and extended while the posterior projection is not visible. The central part is well developed but delicate and tapers to a sharp point that fits tightly into the preceding denticle (Figs. 1, 2, 9). The central part extends more than half way to Y-1 axis. The two sections of the central part above and below X axis are nearly similar in shape and form perpendicular triangles (Fig. 9). The indentation on lower central part is absent. The ray connection is broad and short. The ray apophysis is present and directed in an anterior direction. The rays are thin, of equal thickness throughout, with sharp points and directed slightly in a posterior direction. The section of denticle above X axis is slightly shorter than that below (Ratio is less than one).

2- *Trichodina magna* Van As and Basson, 1989

This trichodinid is recorded from the gills of the catfish *Clarias gariepinus*. It is a large-sized trichodinid with a flattened disc-shaped body. All measurements of this parasite are shown in Table 2. The diameter of the body ranges from 61.6 to 79.2 µm with an average of 70.3 µm. The adhesive disc is concave and surrounded by finely striated border membrane (Figs. 3, 4). The center of the adhesive disc is finely granular. There are 28 (26-29) denticles and 10 (9-11) radial pins per a denticle. The blade is narrow and sickle-shaped (Figs. 3, 10). The distal surface of the blade is curved and the tangent point is slightly lower than the distal surface (Fig. 10). The posterior margin forms deep semi-lunar curve and the deepest point lies in the middle of this curve. The anterior margin of the blade is rounded with slightly flattened apex at the same level with the deepest point of the posterior margin.The blade apophysis is not distinct. The connection between the blade and the central part is delicate. The central part is robust and extends halfway to Y axis. The point of the central part is rounded and lies in close association with the following denticle (Figs. 3, 4, 10). The posterior projection and the indentation in the lower central part is absent.

The shape of the central part above X axis is similar to the section below. The connection between the central part and the ray is thin. The apophysis of the ray is prominent and pointed in the distal direction. The ray is thin and extends past Y+1 axis and the crossing point of Y+1 axis is approximately at the mid-length of the ray (Fig. 10). The ratio between the denticle above and below X axis is less than one.

3- *Trichodina maritinkae* Basson and Van As, 1991.

This parasite is recorded from the gills of the catfish *Clarias gariepinus*. It is a large-sized trichodinid with a saucer-shaped body (Figs. 5, 6). All measurements of this parasite are shown in Table 3. The diameter of the body ranges from 57.2 to 68.2 µm with an average of 65.6 µm. The adhesive disc is surrounded by a distinct border membrane which is covered externally by permanent pellicular fold (Figs. 5, 6). Fine striations were not observed in the border membrane. There are 27 (26-29) denticles and 8 (7-10) radial pins per each denticle. The blade of the denticle is broad and fills large portion between Y and Y+1 axes (Fig. 11). The distal surface is slightly curved with tangent point lower than distal surface. The posterior margin of the blade curves downwards and its deepest point is slightly lower or at the same level as the apex of the blade which is rounded. The anterior and posterior margins of the blade appear to follow almost the same curve. The apophysis and posterior projection of the blade are absent (Figs. 5, 6, 11). The blade connection is thin. The central part of the denticle is broad at the base and has rounded point that fits with the preceding denticle (Figs. 5, 6, 11). The two sections of the central part above and below x axis are similar in shape (Fig. 11). The indentation in the lower central part is absent. The connection part between the ray and the central part is short and thin. The apophysis of the ray is absent. The ray is straight and lies parallel to Y axis (Fig. 11). It is almost of equal thickness throughout but tapers only slightly towards a rounded point. The ratio of the denticle above X axis to denticle below is less than one.

4- *Trichodina sangwala* Van As and Basson, 1992

This parasite is recorded from the gills of the catfish *Clarias gariepinus*. It is a large-sized trichodinid with a flattened disc-shaped body, surrounded by a border membrane with distinct striations (Figs. 7, 8). All measurements of this parasite are shown in Table 4. The diameter of the

body ranges from 50.6 to 70.5 µm with an average of 60.1 µm. The center of the adhesive disc is finely granular similar to the rest of the adhesive disc. The number of radial pins per a denticle is 8 (8–10) while that of the denticle is 25 (23- 27). The denticle is mainly composed of a blade, a central part and a ray (Figs. 7, 8, 12). The blade is broad and its distal surface is rounded and forms a smooth curve extending to the anterior surface and lying parallel to the border membrane (Figs. 7, 8, 12). The tangent point of the blade is blunt and situated almost at the same level of the distal surface. The anterior surface of the blade is slightly rounded but does not extend to Y+1 axis. In many specimens examined, the posterior part of the anterior surface has fine projection (Figs. 7, 8, 12) which may represent the apophysis of the blade. The apex of the blade is not conspicuous. The curve of the posterior margin of the blade is deep and semi-lunar. The blade connection with the central part is thin (Fig. 12). The posterior projection is absent. The central part slopes slightly downwards with sharp rounded point that fits tightly into the preceding denticle (Figs. 7, 8, 12). The section of the central part above and below X axis are triangular and resemble each other in shape but the above section is slightly larger than below section (Fig. 12). The indentation in lower central part is absent. The central part of the denticle extends more than half-way to Y-1 axis. The ray connection is short and robust (Fig. 12). The ray apophysis is remarkably developed and sharply pointed in a straight anterior direction (Figs. 12, 7). The ray is straight and well developed and lies parallel to Y axis. Section of the ray close to the central part is constricted, followed by a bulge and then tapers to form a sharp point. The ray fills almost half the space between Y and Y+1 axes. Ratio of the denticle above X axis to that below is less than one.

4. Discussion

Trichodina matsu *Basson and Van As, 1994*

The trichodinid *Trichodina matsu* was originally described by Basson and Van As (1994) from the gills of the freshwater fish *Crossostoma lacustre* (Steindachner) and from the gills, skin and fins of the fish *Leiocassis adiposalis* inhabiting the confluence of Nankang and Deikang Rivers in Taiwan. The present study represents the first record of *T. matsu* from the gills of the freshwater catfish *Clarias gariepinus*. Also, as far as our knowledge is concerned, this parasite is recorded for the first time in Egypt.

Although the main features of the present study resemble those described by Basson and Van As (1994) for the same species but some differences were recorded (Table 1). First, the average size of *T. matsu* of the present study appears to be slightly greater than that recorded in the specimens of Basson and Van As (1994). Secondly, the blade apophysis of the present trichodinid is more prominent than that of Bsson and Van As (1994). Moreover, Basson and Van As (1994) recorded indentation on the lower central part of the blade whereas in the present study none of these indentations were observed. The blade length recorded by Basson and Van As (1994) appeared to be greater than that of the present study. It should be emphasized that these differences are intraspecific variations between individuals of the same species.

T. matsu shows resemblance with three species of trichodinids, one described from Eastern Europe namely *T. strelkovi* (Chan, 1961) and two from Africa namely *T. nkasa* (Van Aas and Basson, 1992) and *T. kazubskii* (Van As and Basson, 1989). *T. matsu* falls within the same size range as *T. strelkovi* and *T. kasubskii*, but is larger than *T. nkasa*. The trichodinid *T. matsu* of the present study differs from *T. strelkovi* in the shape of denticles, where the anterior surface of the blade in *T. strelkovi* forms a more distinctly rounded curve. The central part of the blade of *T. strelkovi* is robust with a rounded point and the rays are straight and not directed posteriorly. The resemblance between *T. matsu* of the present study and *T. nkasa* is only superficial and includes only some features of the denticle morphology. *T. nkasa* is smaller in size and the blades are rounded. In case of *T. kasubskii*, the head of the blade is broader and tapering towards the blade connection. The central part is triangular with a sharp point extending less than halfway beyond Y axes. The curve formed by the posterior blade margin is very deep with a very delicate connection.

Trichodina magna *Van As and Basson, 1989*

The protozoan Trichodina magna was originally described by Van As and Basson (1989) from the skin and fins of the following fishes: *Macrosenius macrolepidotus* (Zambezi River), *Petrocephalus catostoma* (Zambezi River), *Apolocheilichthys johnstonii* (Limpopo River system), *M. salmoides* (Lowveld Fisheries Research Station), *Oreochromis andersoni* (Zambezi River system), *O. mossambicus* (Limpopo River system), *Pseudocrenilabrus philander*, *Tilapia rendalli rendalli*, *T. rendalli swierstrea* and *Hepsetus odoe* (Lowvled Fisheries Station). The present specimens of *T. magna* are described from the gills of the catfish *Clarias gariepinus*. Although the present specimens resemble those originally described by Van As and

Basson (1989), some variations were recorded. The diameter and other morphometric data of *T. magna* of the present study appear to be lesser than the corresponding measurements (Table 2) of T. magna of Van As and Basson (1989). In the present study, the apex of the blade is situated at the same level of the deepest point of the posterior margin whereas in the originally described specimens, the apex of the blade lies at a level lower than the deepest point of the posterior margin. The indentation of the central part is present in the originally described specimens but absent in the present specimens.

T. magna is widely distributed in Africa as reported by Van As and Basson (1989, 1992). In Egypt, Ali (1992) was the first to describe *T. magna* from *O. niloticus* in Serw fish farm followed by El-Deep (1995) and Koura et al. (1997). Ghoneim (1998) described *T. magna* from the gills and skin of *O. aureus* and *T. zillii* inhabiting Ehamia-Basarta canal staion of the River Nile, EL-Aasar station of the River Nile estuary and El Sayala station of Lake Manzalah. Ahmed et al. (2000) recorded *T. magna* from the gills and skin of *O. niloticus, T. zillii, Sarotherodon galilaeus* and *C. gariepinus*. The specimens of *T. magna* of the present study resemble those described by Ali (1992), El-Deep (1995), Koura et al. (1997), Ghoniem (1998) and Ahmed et al. (2000) but the present specimens are slightly smaller than those previously described. *T. pediculus* which was originally described by Kazubski (1967) appears to be the closet species to *T. magna*. However, there are some differences which can be used to differentiate between the two species. The blade of *T. pediculus* resembles that of *T. magna* but lakes the prominent apex. The main distinguishing feature between *T. magna* and *T. pediculus* is the shape of the ray which in the latter case is broad and tapers to a sharp point. In *T. pediculus*, there is no clear connecting part between the ray and the central part as in *T. magna*. The rays in *T. pediculus* are straight, parallel to the Y axis and do not extend in an anterior direction whereas in *T. magna* the ray extends past Y+1 axis and crosses it at its mid length.

Trichodina maritinkae *Basson and Van As, 1991*

The trichodinid *T. maritinkae* was originally described by Basson and Van As (1991) from the gills of the catfish *Clarias gariepinus* inhabiting Orange and Olifants River systems in South Africa. The same parasite was described by Van As and Basson (1992) from the gills of *C. stapersii* inhabiting Zambesi River system and by Basson and Van As (1994) from the gills of *C. focus* inhabiting the confluence of Nankang and Peikang River system in Taiwan. Therefore, the present study is the first record of this parasite in Egypt. Although the main features of the present study resemble those described by Basson and Van As (1991, 1994) and Van As and Basson (1992) for the same species, some differences were recorded (Table 3). The average size of *T. maritinkae* of the present study appears to be slightly greater than that recorded in specimens of Basson and Van As (1991, 1994) and Van As and Basson (1992). Moreover, Basson and Van As (1991) described the apophysis of the blade, the indentation in the central part and the apophysis of the ray whereas in the present study none of these structures were observed. It appears from the previously mentioned data that the trichodinid *T. maritinkae* was not recorded from fish species other than members of the Clariidae. Therefore, it can be concluded that this species is highly specific parasite to members of the genus Clarias.

Trichodina sangwala *Van As and Basson, 1992*

The trichodinid *Trichodina sangwala* was originally described by Van As and Basson (1992) from the gills of Schilbe mystus inhabiting Zambesi River at Katima Mulio of South Africa. The present study represents the first record of *T. sangwala* from the gills of the catfish *Clarias gariepinus*. Also, as far as our knowledge is concerned, this parasite is recorded for the first time in Egypt. Although the main features of the present study resemble those described by Van As and Basson (1992) for the same species, some differences were recorded (Table 4). First the average size of body of *T. sangwala* of the present study appears to be greater than that recorded in the specimens of Van As and Basson (1992). Secondly, the indentation in the lower central part of the present specimens is absent, whereas in the originally described specimens the indentation is prominent. *T. sangwala* can be compared with *T. maritinkae* and *T. heterodentata* on the morphological basis. In these species, the blade is broad and tapers towards the central part. The difference between *T. sangwala* and *T. heterodentata* is found in the shape of the blade where in *T. heterodentata* a prominent apex is present, which in some cases extends beyond the Y-1 axis, but in *T. sangwala* the apex is not conspicuous and the rays are well developed and straight with a uniform length. The morphological difference between *T. sangwala* and *T. maritinkae* is also clearly shown in the head of the blades. In *T. maritinkae*, a clear apex is found on the sickle-shaped blade with a sharp tangent point that opposes a round tangent point in *T. sangwala*.

Table (1): A comparison between morphometrical data of *T. matsu* of the present study and that recorded by Basson and Van As (1994).

Parameter	Present study	Basson and Van As, 1994
Diameter of: Body	42.2-49.3 (44.6 ± 2.2, 20)	35.5-46.5 (40.4 ± 2.7, 25)
Adhesive disc	33.1-40.8(36.5 ± 2.3, 20)	26.0-40.0(33.1 ± 3.1, 25)
Border membrane	3.1-4.0(3.4 ± 0.4, 20)	15.0-22.0(19.0 ± 1.8, 25)
Number of: Denticles	24-27(26, 20)	20-27(21, 25)
Radial pins/denticle	8-11(9, 20)	6-8(7, 25)
Dimensions of denticle: Length	4.6-6.9(5.9 ± 0.8, 20)	5.0-7.0(5.5 ± 0.6, 25)
Blade	3.9-4.6(4.2 ± 0.3, 20)	3.0-5.0(4.2 ± 0.4, 25)
Central part	1.5-2.0(1.6 ± 0.1, 20)	1.5-2.0(4.2 ± 0.4, 25)
Ray	4.6-5.4(5.1 ± 0.4, 20)	3.0-5.0(4.1 ± 0.4, 25)
Center of adhesive disc	8.5-11.6(9.9 ± 1.1, 20)	--------
Span	8.5-12.3(9.5 ± 1.4, 20)	8.0-12.0 (10.5 ± 0.9, 25)

Table (2): A comparison between morphometrical data of *T. magna* of the present study and those of the same parasite previously described by different authors.

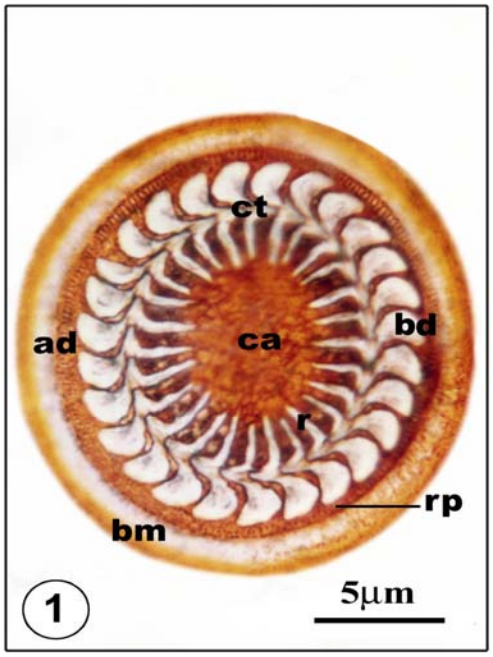
Parameter	Present study	Van AS and Basson, 1989	Van As and Baoon, 1992	Abdel-Ghaffar, *et aL*, 1996	Koura *et al.*, 1997	Ghoneim, 1998	Ahmed *et al.*, 2000
Diameter of: Body	61.6-79.2 (70.3 ± 6.0, 20)	71.2-112 (99.1 ± 9.5, 22)	62-98.5 (82.3 ± 9.8, 12)	72.5-84.3 (76.2 ± ?, 26)	72.5-80.3 (72.6 ± ?,?)	60.6-82.1 (67.0 ± 5.6, 26)	70-92.8 (77.3 ± ?, ?)
Adhesive disc	39.6-56.1 (49.0 ± 4.2, 20)	59.7-94.8 (81.7 ± 8.2, 22)	46.5-80.0 (69.2 ± 9.6,12)	58.8-74.5 (64.9 ± ?, 26)	58.4-67.8 (62.1 ± ?, ?)	49.3-67.6 (55.2 ± 5.0, 26)	60-72.1 (62.3 ± ?, ?)
Denticulate ring	26.4-37.4 (27.9 ± 2.8, 20)	36.6-57.5 (50.0 ± 9.2, 22)	31-52.5 (42.9 ± 6.2, 12)	36.3-43.1 (38.8 ± ?, 26)	42.4-45.6 (43 ± ? ,?)	29.7-41.1 (33.9 ± 3.1, 26)	30-45.2 (37.5 ± ?, ?)
Border membrane	4.4-5.5 (5.0 ± 0.5, 20)	6.2-13.9 (8.9 ± 1.4, 22)	4.5-8.5 (6.2 ± 1.0, 12)	3.9-7.8 (5.6 ± ?, 26)	3.8-5.8 (4.9 ± ?, ?)	5.1-6.9 (5.9 ± 1.0, 12)	4.1-5.9 (4.5 ± ?, ?)
Number of: Denticles	26-29 (28, 20)	24-27 (25, 22)	24-30 (27, 12)	23-27 (25, 26)	26-28 (27, ?)	23-30 (27, 26)	23-30 (26, ?)
Radial pins/denticle	9-11 (10, 20)	10-13 (11, 22)	9-14 (12, 12)	10-12 (?, 26)	11-12	9-12 (10, 26)	11-13
Dimensions of denticle: Length	5.5-8.8 (7.6 ± 0.7, 20)	7.4-13.2 (10.9 ± 1.4, 22)	7-12 (9.5 ± 1.4, 12)	9.8-10.8 (10 ± ?, 26)	8.8-11 (9.8 ± ?, ?)	6.3-9.8 (7.8 ± 0.7, 26)	----------
Blade	5.5-6.6 (5.6 ± 0.3, 20)	6-10.9 (8.6 ± 0.8, 22)	6.5-9 (7.6 ± 0.9, 12)	6.9-8.8 (7.8 ± ?, 26)	7.2-8.7 (8.3 ± ?, ?)	5.1-7.1 (5.5 ± 0.6, 26)	7-8.4 (7.8 ± ?, ?)
Central Part	1.1-2.2 (1.7 ± 0.5, 20)	3.7-7.4 (5.6 ± 0.9, 22)	1.5-4 (3.2 ± 0.7, 12)	2.9-3.9 (3.2 ± ?, 26)	2.9-4 (3.3 ± ?, ?)	2.8-5.7 (3.7 ± 0.6, 26)	3-4 (3.4 ± ?, ?)
Ray	5.5-6.6 (6.2 ± 0.5, 20)	7.7-16 (13 ± 1.7, 22)	7-14.5 (10.7 ± 2.1, 12)	9.8-12.7 (10.8 ± ?, 26)	9.9-10.9 (10.1 ± ?, ?)	5.4-9.8 (7.5 ± 1.0, 26)	11-12 (11.1 ± ?, ?)
Center of adhesive disc	12.1-18.1 (14.9 ± 1.9, 20)	---------	----------	----------	----------	----------	---------
Span	13.2-16.5 (14.5 ± 1.3, 20)	----------	15.5-25.5 (21.5 ± 3.4, 12)	19.6-23.5 (22 ± ?, 26)	18-22.5 (21 ± ?, ?)	14.2-21.2 (16.6 ± 1.7, 26)	---------

Table (3): A comparison between morphometrical data of *T. maritinkae* and those of the same parasite previously described by different authors.

Parameter	Present study	Basson and Van As, 1991	Van As and Basson, 1992	Basson and Van As, 1994
Diameter of: Body	57.2-68.2 (65.6 ± 4.1, 20)	36.5-60.5 (51.2 ± 6.3, 17)	43.5-59.5 (52.0 ± 7.2, 25)	44.0-56.0 (50.0 ± 3.2, 30)
Adhesive disc	36.3-50.6 (43.5 ± 3.8, 20)	31.1-50.2 (42.9 ± 5.4, 17)	35.0-50.5 (43.4 ± 6.6, 25)	43.5-48.0 (46.6 ± 3.4, 30)
Denticulate ring	20.9-31.9 (26.9 ± 3.6, 20)	21.4-31.9 (27.3 ± 2.9, 17)	20.5-29.5 (25.4 ± 2.5, 25)	21.5-31.5 (25.9 ± 2.6, 30)
Border membrane	3.3-5.5 (4.1 ± 0.8, 20)	2.2-5.4 (4.2 ± 0.9, 17)	3.0-5.5 (4.3 ± 0.6, 25)	3.5-6.0 (4.9 ± 0.4, 30)
Number of: Denticles	26-29(27, 20)	23-26(25, 17)	20-25(22, 25)	22-32(25, 30)
Radial pins/denticle	7-10(8, 20)	-----	8-10(9, 25)	7-9(8, 30)
Dimensions of denticle: Length	5.5-7.7 (6.5 ± 0.6, 20)	5.3-7.7 (6.6 ± 0.7, 17)	5.0-7.5 (6.2 ± 0.6, 25)	5.0-7.0 (5.8 ± 0.5, 30)
Blade	3.3-5.5 (4.7 ± 0.7, 20)	3.8-5.8 (4.8 ± 0.6, 17)	3.0-5.0 (4.10 ± 4, 25)	3.5-4.5 (4.0 ± 0.3, 30)
Central part	1.1-2.2 (1.3 ± 0.4, 20)	1.6-2.7 (2.2 ± 0.3, 17)	1.0-2.5 (2.0 ± 0.3, 25)	1.5-2.0 (2.0 ± 0.1, 30)
Ray	3.3-6.6 (4.6 ± 1.1, 20)	5.7-8.4 (6.9 ± 0.8, 17)	4.0-7.5 (6.1 ± 0.8, 25)	4.0-6.5 (5.4 ± 0.6, 30)
Center of adhesive disc	13.2-18.7 (15.6 ± 1.9, 20)	------	------	------
Span	13.2-15.4 (14.6 ± 0.8, 20)	------	9.0-14.0 (12.2 ± 1.1, 25)	10.0-14.0 (11.5 ± 0.9, 30)

Table (4): A comparison between morphometrical data of *T. sangwala* of the present study and that recorded by Van As and Basson (1992).

Parameter	Present study	Van As and Basson (1992).
Diameter of: Body	50.6-70.5 (60.1 ± 6.4, 20)	49.5-69.5(61.1 ± 5.6, 26)
Adhesive disc	39.1- 48.4 (44.2 ± 2.8, 20)	39.0-59.0 (50.7 ± 5.5, 26)
Denticulate ring	25.5-33.0 (27.7 ± 2.3, 20)	23.5-37.0 (29.9 ± 3.2, 26)
Border membrane	4.4-5.5 (5.2 ± 0.5, 20)	4.5-6.5 (5.1 ± 0.5, 26)
Number of: denticles	23-27 (25, 20)	23-31(28, 26)
Radial pins/denticle	8-10 (8, 20)	9-12(10, 26)
Dimensions of denticle: Length	5.5-7.7 (6.4 ± 0.6, 20)	5.5-7.5 (6.4 ± 0.5, 26)
Blade	5.5-6.6 (5.6 ± 0.2, 20)	4.0-6.5(5.5 ± 0.3, 26)
Central part	2.2-3.3 (2.3 ± 0.2, 20)	2.0-3.0(2.5 ± 0.3, 26)
Ray	5.5-7.7 (6.8 ± 0.6, 20)	4.0-10.0(7.5 ± 1.4, 26)
Center of adhesive disc	9.9-13.2 (9.9 ± 1.0, 20)	----------
Span	13.2-17.6 (15.3 ± 1.5, 20)	12.5-18.5 (15.5 ± 1.7, 26)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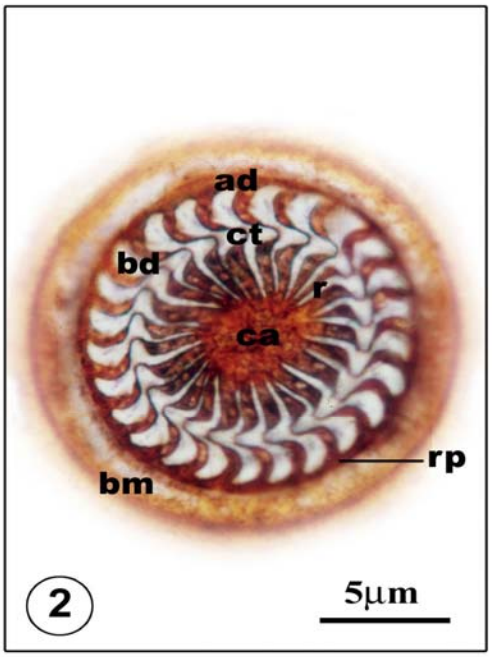
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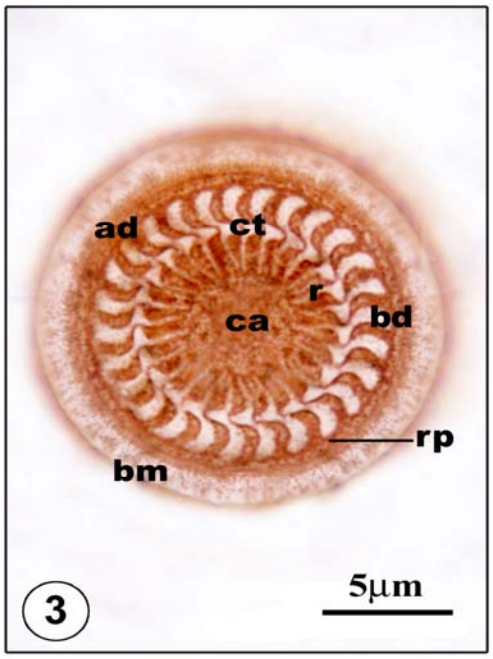
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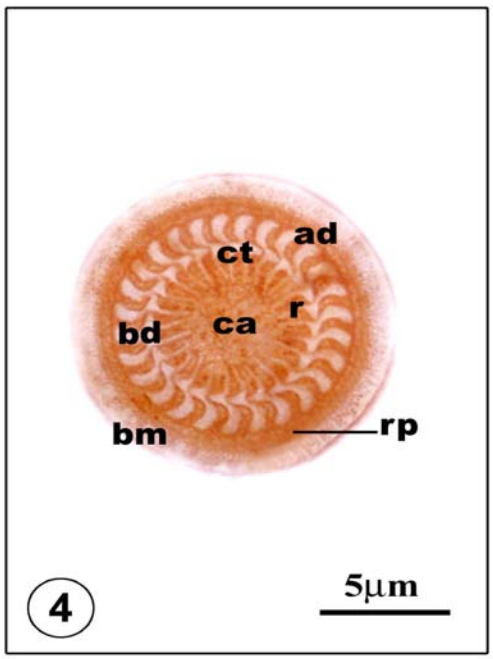
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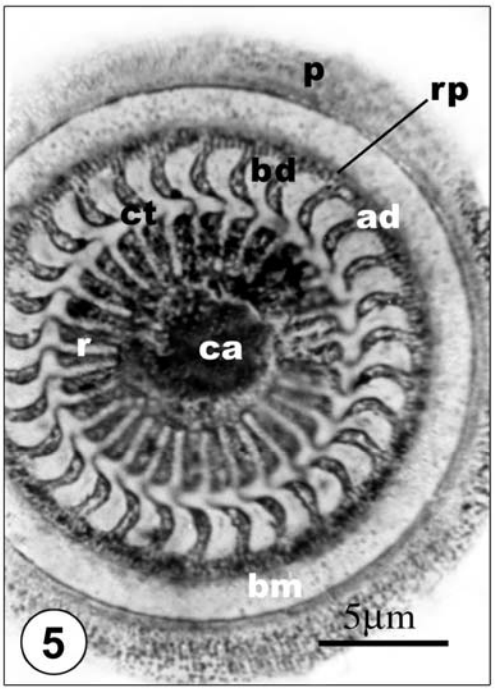
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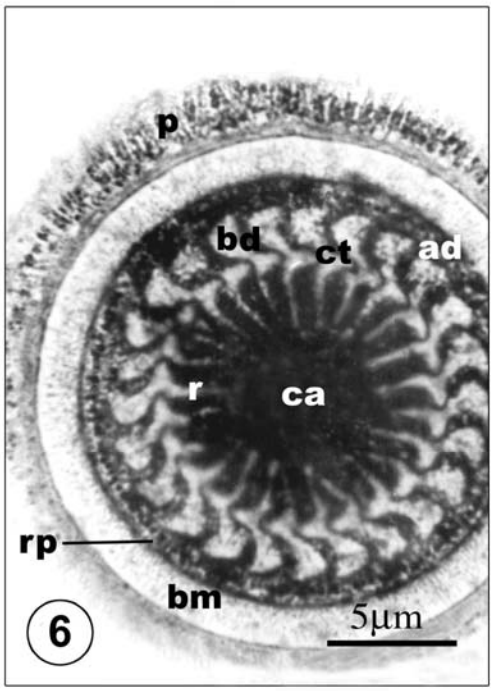
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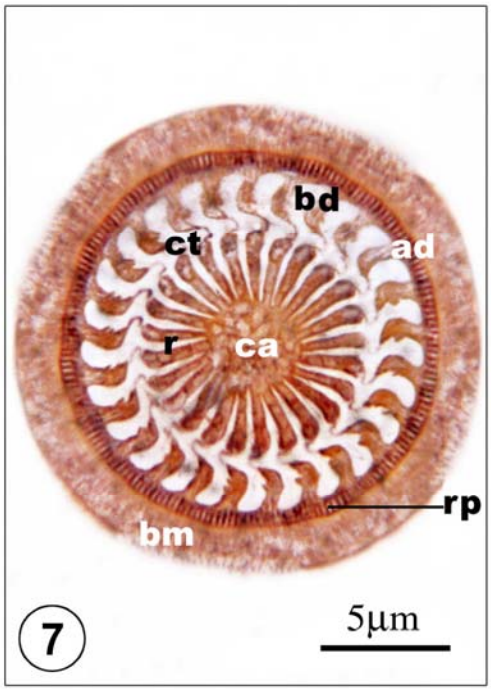
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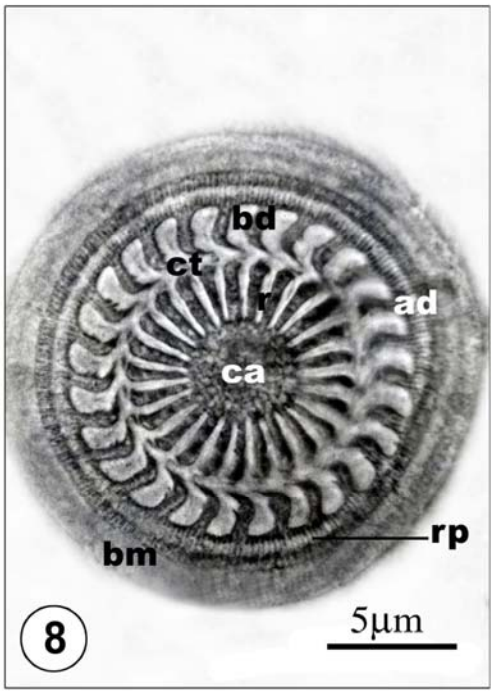
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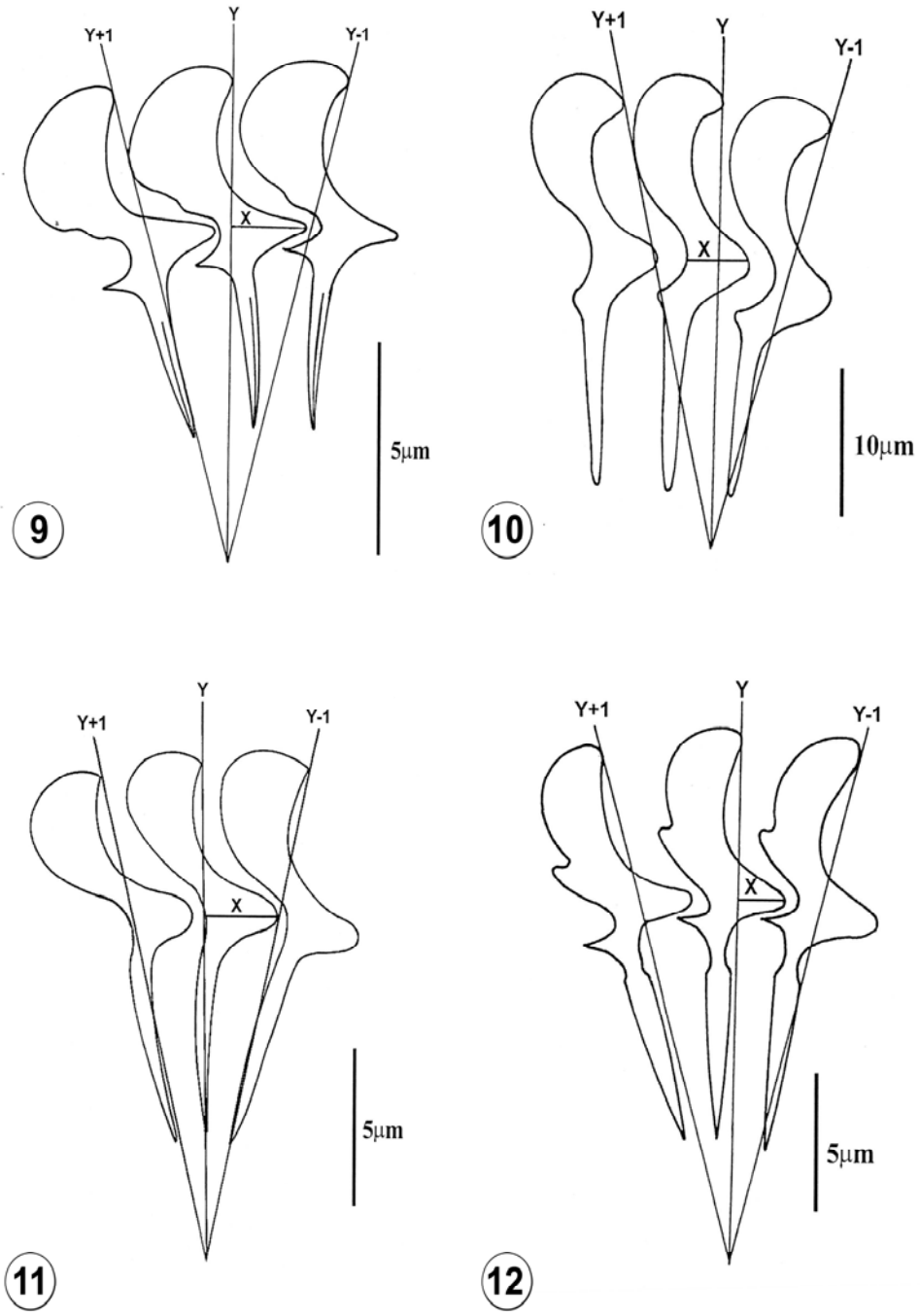

Figures

Fig. (1): Photomicrograph of silver-impregnated specimen of *Trichodina matsu*. ad, Adhesive disc; bd, blade; bm, border membrane; ca, center of adhesive disc; ct, central part; r, ray; rp, radial pins. Scale bar = 5µm

Fig. (2): Photomicrograph of silver-impregnated specimen of *Trichodina matsu*. ad, Adhesive disc; bd, blade; bm, border membrane; ca, center of adhesive disc; ct, central part; r, ray; rp, radial pins. Scale bar = 5µm

Fig. (3): Photomicrograph of silver-impregnated specimen of comparatively large-sized *Trichodina magna*. ad, Adhesive disc; bd, blade; bm, border membrane; ca, center of adhesive disc; ct, central part; r, ray; rp, radial pins. Scale bar = 5µm

Fig. (4): Photomicrograph of silver-impregnated specimen of comparatively large-sized *Trichodina magna*. ad, Adhesive disc; bd, blade; bm, border membrane; ca, center of adhesive disc; ct, central part; r, ray; rp, radial pins. Scale bar = 5µm

Fig. (5): Photomicrograph of silver-impregnated specimen of *Trichodina maritinkae.* ad, Adhesive disc; bd, blade; bm, border membrane; ca, center of adhesive disc; ct, central part; p, permanent pellicular fold; r, ray; rp, radial pins. Scale bar =5µm

Fig. (6): Photomicrograph of silver-impregnated specimen of *Trichodina maritinkae.* ad, Adhesive disc; bd, blade; bm, border membrane; ca, center of adhesive disc; ct, central part; p, permanent pellicular fold; r, ray; rp, radial pins. Scale bar = 5µm

Fig. (7): Photomicrograph of silver-impregnated specimen of *Trichodina sangwala*. ad, Adhesive disc; bd, blade; bm, border membrane; ca, center of adhesive disc; ct, central part; r, ray; rp, radial pins. Scale bar = 5µm

Fig. (8): Photomicrograph of silver-impregnated specimen of *Trichodina sangwala*. ad, Adhesive disc; bd, blade; bm, border membrane; ca, center of adhesive disc; ct, central part; r, ray; rp, radial pins. Scale bar = 5µm

Fig. (9): Schematic drawing of the denticles of *Trichodina matsu* Basson and Van As, 1994. Scale bar = 5µm

Fig. (10): Schematic drawing of the denticles of *Trichodina magna* Van As and Basson, 1989. Scale bar = 5µm.

Fig. (11): Schematic drawing of the denticles of *Trichodina maritinkae* Basson and Van As, 1991. Scale bar = 5µm.

Fig. (12): Schematic drawing of the denticles of *Trichodina sangwala* Van As and Basson, 1992. Scale bar = 5µm.

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