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Original Article

First report of *Trichodinella* and new geographical records of trichodinids in Nile tilapia (*Oreochromis niloticus*) farmed in Brazil

Primeiro relato de *Trichodinella* e novos registros geográficos de tricodinídeos em tilapia do Nilo (*Oreochromis niloticus*) cultivada no Brasil

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Abstract

Massive occurrence of trichodinids is frequently accompanied by serious disease in fish farms. In this study, trichodinid species from the gills and skin of Nile tilapia (*Oreochromis niloticus*) farmed in the central-western region of Brazil (state of Goiás) were morphologically characterized. Dried slides were prepared from the parasites and were impregnated with silver nitrate (2%). Morphometric characteristics were determined and schematic drawings of the denticles were made using photomicrographs produced from the slides. Seven species of trichodinid ectoparasites (Protozoa: Ciliophora: Trichodinidae) were found parasitizing the gills: four of the genus *Trichodina* Ehrenberg, 1838; one of *Tripartiella* Lom, 1959; one of *Paratrichodina* Lom, 1963; and one of *Trichodinella* Šrámek-Hušek, 1953. On the body surface, three specimens of the genus *Trichodina* were identified. This study presents new geographical records of trichodinids in Brazil, thus confirming that *Trichodina centrostrigeata*, *Trichodina compacta*, *Trichodina heterodentata*, *Paratrichodina africana* and *Tripartiella orthodens* are widely distributed worldwide. Additionally, the first record of the genus *Trichodinella* in Brazil is presented.

Keywords: Trichodinids, trichodiniasis, parasite, taxonomy, aquaculture.

Resumo

O parasitismo intenso por tricodinídeos está frequentemente relacionado à doença grave em fazendas de peixes. Neste estudo, espécies de tricodinídeos das brânquias e da pele de tilápias do Nilo (*Oreochromis niloticus*) cultivadas na região centro-oeste do Brasil (estado de Goiás) foram caracterizadas morfologicamente. As lâminas secas foram preparadas a partir dos parasitas e impregnadas com nitrato de prata (2%). As características morfométricas foram determinadas e desenhos esquemáticos dos dentículos foram confeccionados com fotomicrografias produzidas a partir das lâminas. Sete espécies de ectoparasitos tricodinídeos (Protozoa: Ciliophora: Trichodinidae) foram encontradas parasitando as brânquias: quatro do gênero *Trichodina* Ehrenberg, 1838; um de *Tripartiella* Lom, 1959; um de *Paratrichodina* Lom, 1963; e um de *Trichodinella* Šrámek-Hušek, 1953. Na superfície do corpo, três espécimes do gênero *Trichodina* foram identificados. Este estudo apresenta novos registros geográficos de tricodinídeos no Brasil, confirmando que *Trichodina centrostrigeata*, *Trichodina compacta, Trichodina heterodentata*, *Paratrichodina africana* e *Tripartiella orthodens* estão amplamente distribuídas mundialmente. Adicionalmente, é apresentado o primeiro registro do gênero *Trichodinella* no Brasil.

Palavras-chave: Tricodinídeos, tricodiníase, parasita, taxonomia, aquicultura.

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Introduction

The prevalence and spread of diseases have become more and more important since aquatic food production has transitioned from being primarily based on catching wild fish to farming of increasing numbers of fish species (FAO, 2016). Captive fish and their parasites are routinely translocated around the world (BASSON & VAN AS, 1994; REINERTSEN & HAALAND, 1995; VALLADÃO et al., 2014), which may affect the health status of fish farms. Therefore, studies focusing on identifying parasites and their distribution are important.

Trichodinids are mobile peritrichous ciliated protozoa that are important within marine and inland aquaculture. More than 300 species of trichodinids have been recognized as parasites or symbionts of aquatic organisms (GONG et al., 2005; MITRA et al., 2013; MACIEL et al., 2018). They are perhaps the most frequent protozoa invading the surface of fish and have been implicated in severe disease and mortality in various parts of the world (NIKOLIĆ et al., 2003; KHAN, 2004; KHOSHNOOD & KHOSHNOOD, 2014; VALLADÃO et al., 2014).

Considering the socioeconomic importance of Nile tilapia (*Oreochromis niloticus*) within Brazilian aquaculture and the economic impact of parasitic diseases, very little information on these groups is available. Only three out of the eleven genera of the family Trichodinidae have so far been reported parasitizing Nile tilapias in Brazil, namely *Trichodina* Ehrenberg, 1838 (*Trichodina centrostrigeata* Basson, Van As and Paperna, 1983, *T. compacta* Van As and Basson, 1989, *T. heterodentata* Duncan, 1977, *T. magna* Van As and Basson, 1989, *T. migala* Van As and Basson, 1989), *Paratrichodina* Lom, 1963 (*Paratrichodina africana* Kazubski and El-Tantawy, 1986) and *Tripartiella* Lom, 1959 (*Tripartiella orthodens* Basson and Van As, 1987) (GHIRALDELLI et al., 2006; MARTINS & GHIRALDELLI, 2008; PANTOJA et al., 2012; VALLADÃO et al., 2013, 2016; ZAGO et al., 2014; NUNES et al., 2016).

Trichodinids are usually identified through the morphology of the denticles in the adhesive disc and the development of the adoral ciliary spiral, and the denticles have very high systematic value (GONG et al., 2005). Correct identification depends mainly on the quality of the impregnation and staining techniques that are used to evaluate these characteristics. Nevertheless, some trichodinids become impregnated less than others do, thus making it difficult to describe the species. Difficulties in evaluating the results from impregnation are commonly encountered in relation to *Trichodinella* Šrámek-Hušek, 1953, in which the correct picture is sometimes misread as artefacts because of the insignificant dimensions of the denticles, which can easily become damaged when the smear preparation dries out (LOM, 1963). Although some species have a wide variety of hosts and geographical distributions (LOM & HALDAR, 1977; BASSON & VAN AS, 1987), there are very few records of these small trichodinids in the literature.

Nile tilapia are freshwater cichlids native to Africa. They are one of the most important farmed fish worldwide (FAO, 2016). They grow fast in different aquaculture systems and over a wide range of temperatures, and also have high market value (EL-SAYED, 2006; LIM & WEBSTER, 2006). In Brazil, which ranks 13th among the world's top aquaculture producers and second in the Americas (FAO, 2016), Nile tilapias were introduced into aquatic ecosystems in the 1970s to improve fisheries and aquaculture (MOREIRA et al., 2007). Actually, this is the main species produced, representing more than 45% of all fish production (IBGE, 2015). The relationship between tilapia translocation and the spread of parasites in freshwater ecosystems has been documented by many authors (VAN AS & BASSON, 1989; BONDAD-REANTASO & ARTHUR, 1989). Trichodinids are the main protozoa associated with tilapia translocation worldwide.

In the present study, trichodinids from the gills and body of farmed Nile tilapia in a new geographical location, the central-western region of Brazil (state of Goiás), were identified and described.

Materials and Methods

Study area and fish

Specimens of *O. niloticus* (Supreme strain) were collected in June 2016, from floating net-cages in a reservoir at the fishery facilities of the Department of Animal Science of the School of Veterinary and Animal Sciences of the Federal University of Goiás, State of Goiás, central-western region of Brazil (16° 35' 42" S; 49° 16' 52" W).

The water quality parameters in the net-cages were measured during the fish sampling as follows (mean ± SD): the dissolved oxygen was 7.09 ± 0.39 mg L^{-1}; the temperature was 20.75 ± 0.57 °C; the pH was 7.00 ± 0.22; and the ammonia content was 0.03 ± 0.015 mg L^{-1}. The dissolved oxygen and temperature were determined using a digital oxygen meter (AT 155; Alfakit Ltd.); the pH was determined using a digital pH meter (AT 315; Alfakit Ltd.) and the ammonia concentration was determined using a digital photo colorimeter (AT 100PBS II; Alfakit Ltd.).

The experimental procedures were approved by the Ethics and Animal Welfare Committee (CEUA) of the Federal University of Goiás, under protocol number 015/2016.

Parasite diagnosis and taxonomic evaluation

Eleven fish (13.62 g ± 1.78) were collected randomly from four net-cages (0.7 m^3 useful volume and density of 300 fish per cage). They were desensitized through thermal shock in water with ice (proportion 1:1) and then euthanized via medullary sectioning to conduct a parasitological survey. Samples from the gills and body mucus were collected separately through scraping. The material thus collected was deposited on glass slides and was observed while fresh under an optical microscope (40, 100 and 400 x).

Slides containing parasites were air-dried and subsequently impregnated with silver nitrate (2%) for evaluation of all their taxonomic characteristics (KLEIN, 1958). Measurements of the components of the adhesive discs and denticles were made as described by Arthur & Lom (1984) and, additionally, the numbers of denticles and pins were counted. The measurements were made on photomicrographs (1000 x) that were obtained using a Nikon® E200 optical microscope (Nikon Instruments Inc., Melville, United States) equipped with a Motic® 5.0 image capture system (Motic Instruments Inc., Hong Kong, China). These measurements were presented in micrometers as suggested by Lom (1958) and Van As & Basson (1989). All the measurements were made using the

Image Pro Plus® software media (Cybernetics Inc, Rockville, United States). The measurement data thus obtained were presented as the mean ± standard deviation (with minimum and maximum and the number of repetitions).

In order to describe the shape of the denticle, schematic drawings of the denticles were produced as proposed by Van As & Basson (1989), by means of vectorization using the CorelDraw® X8 software (Corel Corporation, Ottawa, Canada).

Results

Trichodinid description: from body

The measurements of the taxonomic characteristics of each population of trichodinids collected from the body surface of the fish are presented in Table 1.

Trichodina compacta

The blade was large, filling most of the space between the y-axes. The anterior margin touched the y-axes and sometimes went slightly beyond it. A prominent apophysis was observed at the anterior margin of the blade. The central part extended to half of the space between the axes and had a rounded presentation. The connection between the central part and ray had uniform thickness and was similar to the ray. The rays were generally parallel to the y-axes with greater thickness, filling almost the entire space between the y-axes. The central circle was characteristic for the species, presenting scattered darker spots (Figure 1a).

Trichodina heterodentata

The blade was large and filled almost the entire space between the y-axes. The anterior portion of the blade went significantly beyond the limit of the y-axes. A prominent apophysis was common at the anterior margin of the blade. The central part extended to half of the space between the axes and had a rounded presentation. The ray had a prominent apophysis in its anterior

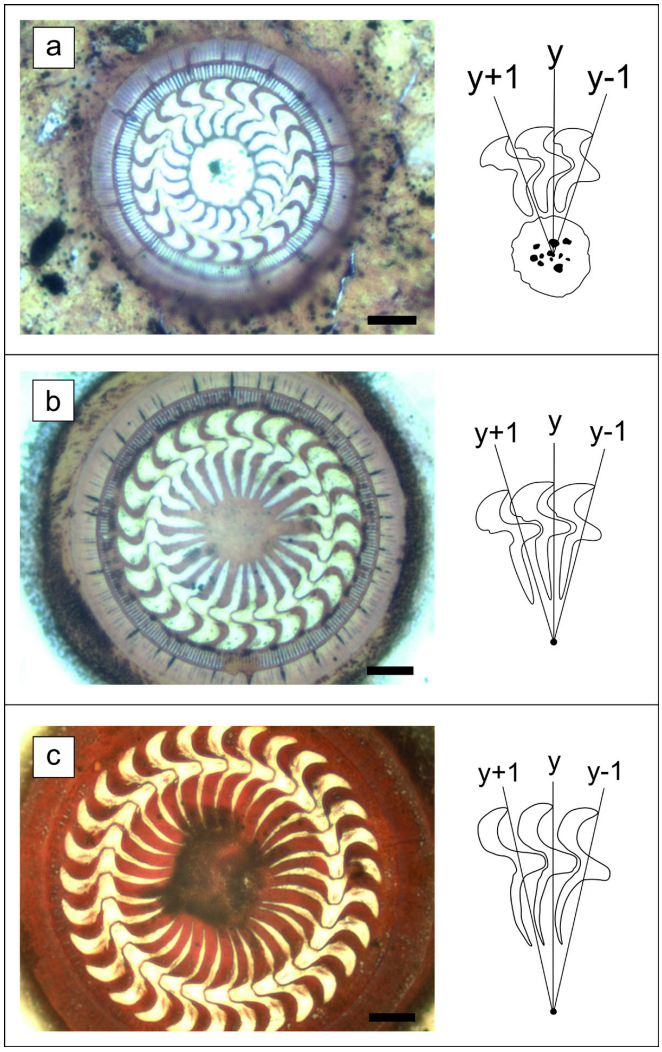

Figure 1. Photomicrographs of silver impregnated adhesive discs and schematic drawing of the denticles of *Trichodina compacta* (a); *T. heterodentata* (b) and *T. magna* (c) found in the body of Nile tilapia *Oreochromis niloticus* cultured in Central-West region of Brazil. Scale bars: 10 µm.

Table 1. Measurements of trichodinids from body of Nile tilapia *Oreochromis niloticus*. The data are presented as arithmetic mean ± standard deviation (minimum-maximum values; number of individuals measured).

Trichodinids species	*Trichodina compacta*	*Trichodina heterodentata*	*Trichodina magna**
Body diameter	54.61 ± 3.39 (48.9-61.4; 22)	70.10 ± 6.15 (60.2-79.8; 18)	91.86
Border membrane	4.57 ± 0.47 (3.4-5.2; 22)	5.37 ± 0.70 (4.3-7.7; 18)	7.86
Adhesive disc	45.41 ± 3.30 (40.0-53.2; 22)	59.41 ± 6.14 (49.1-69.2; 18)	75.79
Denticulate ring	28.19 ± 2.71 (23.5-34.4; 22)	37.61 ± 3.92 (31.0-43.8; 18)	49.56
Central circle	13.75 ± 1.73 (10.4-18.0; 22)	-	-
Denticle span	11.86 ± 0.73 (10.8-13.1; 22)	17.90 ± 1.41 (15.0-19.8; 18)	24.41
Ray length	4.91 ± 0.55 (4.1-5.9; 22)	9.60 ± 1.05 (7.5-10.9; 18)	13.10
Central part	2.51 ± 0.32 (1.9-3.0; 22)	2.66 ± 0.32 (2.1-3.3; 18)	3.63
Blade length	4.43 ± 0.35 (3.7-5.3; 22)	5.55 ± 0.62 (4.2-6.7; 18)	7.44
Denticle length	8.23 ± 0.56 (7.2-9.4; 22)	9.44 ± 1.06 (7.4-11.4; 18)	10.09
Number of denticles	19.29 ± 0.96 (18-21; 21)	23.67 ± 1.03 (22-26; 18)	29
Pins/denticle	8.32 ± 0.48 (8-9; 22)	10.76 ± 0.90 (10-12; 17)	

*Only one parasite well impregnated of this species was found in the present study.

portion and its thickness varied from wider to thinner. The tip of the ray was sharp (Figure 1b).

Trichodina magna

This trichodinid had a large body size, compared with the other species. The denticle blade was tight, filling almost half of the space between the axes. The anterior margin of the blade was slightly flattened (straight) and did not touch the y-axes. The ray had a prominent apophysis. It was thin and curved, and pointed slightly in the anterior direction, but did not go beyond the y-axes (Figure 1c).

Trichodinids description: from gills

The measurements of the taxonomic characteristics of each population of trichodinids collected from the gills are presented in Table 2.

Trichodina centrostrigeata

The blade of the denticle was thin and the anterior and posterior margins were similar and almost parallel to each other. The blade filled a large portion of the space between the y-axes and its anterior margin went beyond the y-axes. The central part was short and rounded. The ray had uniform thickness with a sharp tip, positioned parallel or anteriorly to the y-axes, and sometimes going beyond them. This trichodinid had a central ridge that was characteristic for the species (Figure 2a).

Trichodina compacta

The morphological characteristics were similar to those described in specimens that were found on the body surface (Figure 2b).

Trichodina heterodentata

The morphological characteristics were similar to those described in specimens that were found on the body surface (Figure 2c).

Trichodina migala

The blade was thin and did not fill much of the space between the y-axes. The anterior portion did not touch the y-axes and, in some cases, a small apophysis was seen. The central part occupied more than half of the area between the y-axes. Ray apophyses were prominent. The ray was thin, curved, sharp and displaced in the anterior direction, sometimes going beyond the limit of the y-axes (Figure 2d).

Table 2. Measurements of trichodinids of from gills of Nile tilapia *Oreochromis niloticus*. The data are presented as arithmetic mean ± standard deviation (minimum-maximum values; number of individuals measured).

Characters	*T. centrostrigeata*	*T. migala*	*T. heterodentata*	*T. compacta*	*Paratrichodina africana*	*T. orthodens*	*Trichodinella* sp.
Body diameter	55.73 ± 5.02 (47.0-64.9; 22)	76.01 ± 5.66 (70.5-83.6; 4)	70.45 ± 6.06 (63.9-80.4; 9)	53.09 ± 2.20 (49.9-57.9; 9)	25.04 ± 2.50 (21.6-29.8; 20)	27.36 ± 1.35 (24.9-29.1; 9)	22.94 ± 2.38 (20.2-25.7; 6)
Border membrane	3.71 ± 0.84 (2.1-5.4; 22)	5.67 ± 0.50 (5.1-6.2; 4)	5.43 ± 0.53 (4.6-6.0; 9)	4.61 ± 0.53 (3.6-5.4; 9)	1.80 ± 0.19 (1.3-2.1; 20)	2.50 ± 0.31 (1.8-2.9; 9)	2.04 ± 0.38 (1.5-2.5; 6)
Adhesive disc	49.03 ± 5.31 (39.1-60.1; 23)	64.71 ± 6.83 (57.7-73.7; 4)	59.61 ± 5.58 (53.5-68.3; 9)	44.35 ± 2.09 (42.0-49.1; 9)	21.24 ± 2.42 (17.7-26.3; 20)	22.36 ± 1.34 (19.8-24.2; 9)	21.65 ± 2.84 (18.5-24.4; 6)
Denticulate ring	26.04 ± 2.89 (21.7-32.0; 24)	40.79 ± 5.50 (35.8-48.5; 4)	39.09 ± 6.99 (29.7-50.6; 10)	27.13 ± 2.13 (25.2-32.3; 9)	12.42 ± 1.88 (9.4-16.3; 20)	10.88 ± 0.88 (9.3-12.5; 9)	12.01 ± 1.72 (10.2-14.4; 6)
Central circle	-	-	-	13.11 ± 1.66 (10.7-16.1; 9)	5.82 ± 0.48 (4.7-6.7; 20)	7.42 ± 0.73 (6.3-8.5; 9)	4.37 ± 0.35 (4.0-5.0; 6)
N of central ridges	13.22 ± 1.93 (10.0-17.0; 24)	-	-	-	1.88 ± 0.33 (1.3-2.5; 20)	1.91 ± 0.23 (1.5-2.2; 9)	0.56 ± 0.08 (0.5-0.7; 5)
Denticle span	12.82 ± 1.94 (9.8-16.3; 24)	18.48 ± 2.02 (15.8-20.2; 4)	17.64 ± 1.64 (14.8-19.8; 10)	11.80 ± 0.87 (10.9-13.7; 9)	0.54 ± 0.10 (0.3-0.7; 20)	0.54 ± 0.06 (0.4-0.6; 9)	1.3 ± 0.15 (1.2-1.5; 5)
Ray length	4.57 ± 0.98 (2.5-6.7; 24)	8.30 ± 1.59 (6.0-9.7; 4)	9.61 ± 1.33 (7.3-11.6; 10)	5.38 ± 0.50 (4.7-6.2; 9)	3.33 ± 0.27 (2.7-3.8; 20)	4.87 ± 0.60 (3.7-5.7; 9)	2.34 ± 0.47 (1.7-2.8; 6)
Central part	2.42 ± 0.54 (1.4-3.3; 24)	3.43 ± 0.81 (2.6-4.3; 4)	2.46 ± 0.27 (2.1-3.0; 10)	2.30 ± 0.33 (1.6-2.7; 9)	2.42 ± 0.39 (1.7-3.4; 20)	2.57 ± 0.33 (2.1-3.1; 9)	2.21 ± 0.28 (1.9-2.6; 6)
Blade length	5.73 ± 0.94 (4.1-7.5; 24)	6.56 ± 0.87 (5.3-7.2; 4)	5.51 ± 0.52 (4.6-6.1; 10)	4.12 ± 0.51 (3.5-4.9; 9)	22.17 ± 1.10 (20-25; 18)	21.44 ± 1.01 (20-23; 9)	21.00 ± 1.41 (19-22; 5)
Denticle length	4.51 ± 0.37 (3.8-5.3; 24)	8.53 ± 0.48 (8.0-9.0; 4)	9.00 ± 1.03 (7.1-10.7; 10)	8.16 ± 0.51 (7.5-8.9; 9)	-	5 ± 0 (5-5; 1)	-
Number of denticles	27.71 ± 1.00 (26-30; 24)	27.00 ± 1.41 (26-29; 4)	23.90 ± 2.08 (22-28; 10)	19.00 ± 0.76 (18-20; 8)	25.04 ± 2.50 (21.6-29.8; 20)	27.36 ± 1.35 (24.9-29.1; 9)	22.94 ± 2.38 (20.2-25.7; 6)
Pins/denticle	9.33 ± 1.15 (8-10; 3)	10.00 ± 0 (10-10; 4)	10.40 ± 1.14 (9-12; 5)	8.89 ± 1.05 (8-10; 9)	1.80 ± 0.19 (1.3-2.1; 20)	2.50 ± 0.31 (1.8-2.9; 9)	2.04 ± 0.38 (1.5-2.5; 6)

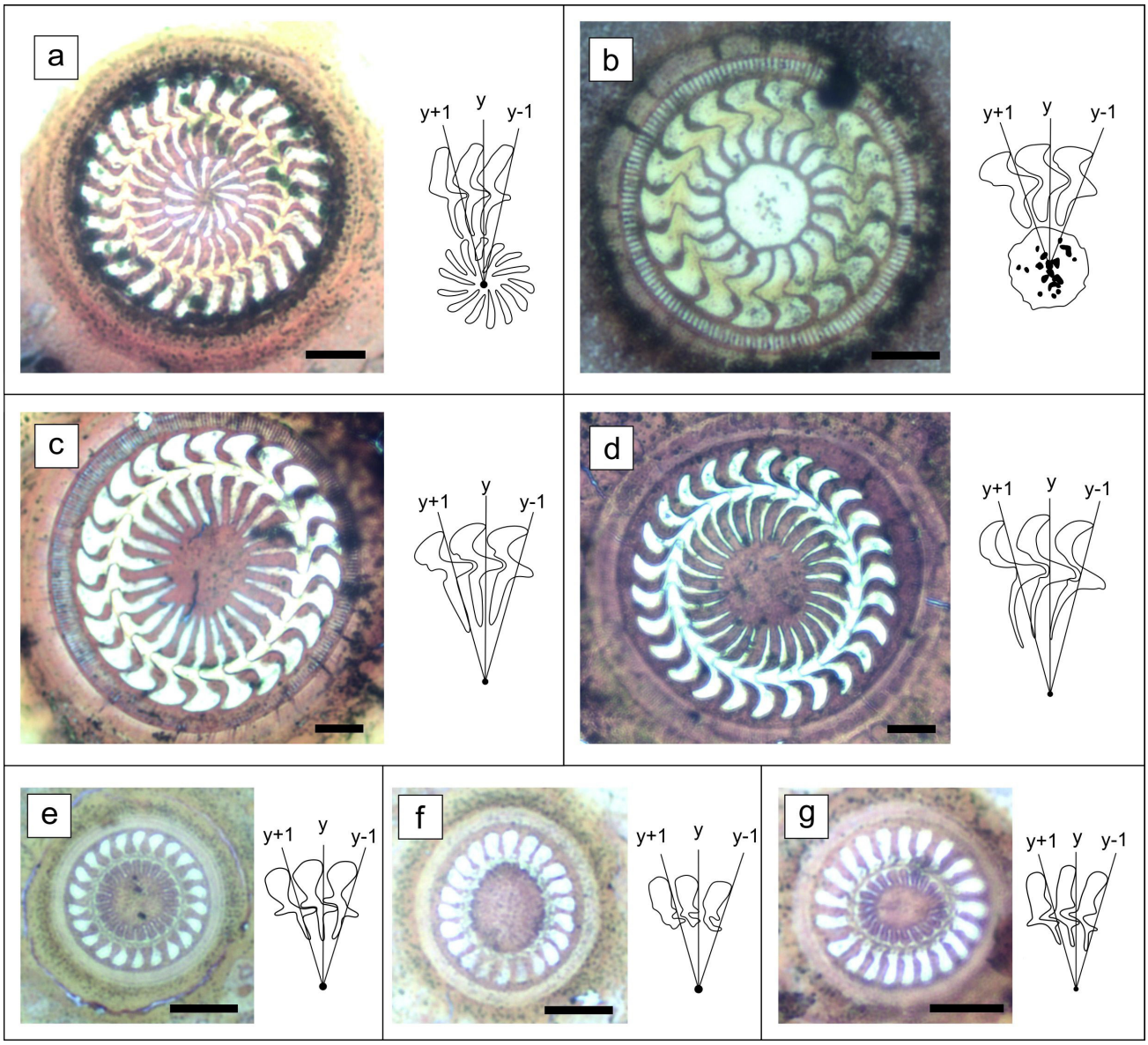

Figure 2. Photomicrographs of silver impregnated adhesive discs and schematic drawing of the denticles of *Trichodina centrostrigeata* (a); *T. compacta* (b); *T. heterodentata* (c); *T. migala* (d); *Paratrichodina africana* (e); *Trichodinella* sp. (f) and *Tripartiella orthodens* (g) found in the gills of Nile tilapia *Oreochromis niloticus* cultured in Central-West region of Brazil. Scale bars: 10 μm.

Paratrichodina africana

This trichodinid had a rounded blade that was not sickle-shaped, thus differing from the genus *Trichodina*. The central part had a large and characteristic elongated part that was parallel to the central part of the adjacent denticle. The central part was thin, rounded and filled about half of the space between the y-axes. The ray was thin, with the rounded tip lying parallel to the y-axes (Figure 2e).

Trichodinella sp.

This trichodinid was difficult to impregnate because of its small size and minute denticle. The blade had a small projection and the anterior margin extended well into the space between the y-axes. The central part was delicate, short and did not go beyond the y-axis. The denticles were small and inserted together in the central parts and projections, which made it difficult to see them in the silver-impregnated specimens. The ray formed a characteristic short delicate curved hook (Figure 2f).

Tripartiella orthodens

This was a small-sized trichodinid. The anterior margin of the blade was straight and the posterior margin was rounded. In the posterior portion, this trichodinid had a prominent projection. In the anterior portion, between the blade and the central part, another prominent projection was observed, which went beyond the y-axes. The central part was small

and occupied a small portion of the space between the y-axes. The ray was straight, with similar thickness up to its tip, and it was parallel to or was positioned slightly posteriorly to the y-axis (Figure 2g).

Discussion

In the present study four genera of trichodinids were found parasitizing Nile tilapia cultivated in Brazil: *Trichodina* (*T. centrostrigeata*, *T. compacta*, *T. heterodentata*, *T. magna* and *T. migala*), *Paratrichodina* (*P. africana*), *Tripartiella* (*T. orthodens*) and *Trichodinella* (*Trichodinella* sp.). All the trichodinids identified from this study have an African origin (BASSON et al., 1983; BASSON & VAN AS, 1987, 1994; VAN AS & BASSON, 1989). However, they have also been found parasitizing fish in the Americas (AGUILAR-AGUILAR & ISLAS-ORTEGA, 2015) and in Eurasia (DUNCAN, 1977; BASSON & VAN AS, 1994; MITRA & HALDAR, 2004; MITRA & BANDYOPADHYAY, 2006; MITRA et al., 2012; MOHILAL & HEMANANDA, 2012).

In Brazil, there have also been records of *T. centrostrigeata* in the southeastern region (VALLADÃO et al., 2016) and in the northern region (BITTENCOURT et al., 2014); *T. compacta* in the southern region (GHIRALDELLI et al., 2006) and southeastern region (VALLADÃO et al., 2016); *T. heterodentata* in the southern region (MARTINS et al., 2010) and southeastern region (VALLADÃO et al., 2016); *T. magna* in the southern region (MARTINS & GHIRALDELLI, 2008) and southeastern region (ZAGO et al., 2014); *T. migala* in the southeastern region (VALLADÃO et al., 2016); *P. africana* in the southern region (GHIRALDELLI et al., 2006; JERÔNIMO et al., 2011), southeastern region (VALLADÃO et al., 2016), northern region (BITTENCOURT et al., 2014) and northeastern region (VALLADÃO et al., 2013); and *T. orthodens* in the southeastern region (VALLADÃO et al., 2016). In the present study, trichodinids were identified in the central-western region of Brazil (state of Goiás) and the first record of the genus *Trichodinella* in this country was presented.

The trichodinids in this study has a very constant denticle shape that became impregnated well with silver nitrate, although in some species the denticles were somewhat less impregnated, thus making it difficult to identify them (*Paratrichodina, Tripartiella* and *Trichodinella*). The morphometric and morphological characteristics of *T. centrostrigeata*, *T. compacta*, *T. heterodentata*, *T. magna*, *T. migala*, *P. africana* and *T. orthodens* that were identified in the present study were similar to those in previous descriptions of these species in Nile tilapias in Brazil. Nevertheless, the body diameter of *T. heterodentata* was slightly larger (64-80 versus 38-59) than those reported by Valladão et al. (2016), but was similar to those described by Duncan (1977) (64-80 versus 58-122). We consider that small differences are common, since variability in morphometric and morphological characteristics of trichodinids has been observed in other populations of these protozoa (LOM, 1958). Such differences usually relate to the developmental stages of the denticle, the host and the environmental conditions (DUNCAN, 1977; GONG et al., 2005).

The genus *Trichodinella* was described by Lom (1963) as having one incomplete turn of the two adoral ciliary rows in the adoral zone, a peculiarly shaped denticle and small dimensions, and was reported as only parasitizing the gills of fish. So far, about eight species have been identified from marine and freshwater organisms. The *Trichodinella* sp. from this study was collected from the gills and due to its small size and the minuteness of the denticles, the impregnation was not good enough to perform species identification. However, some elements of their structure, e.g. body diameter, border membrane, adhesive disc, denticulate ring, denticle span, denticle ray, central part of the denticle and blade, were fairly well preserved in the preparations. These enabled comparisons with other small trichodinids that have already been described in the literature.

The *Trichodinella* sp. of the present study seems to be identical to the species identified by Lom (1963) as *Trichodinella epizootica* Šrámek-Hušek, 1953, which occurs in the gills of different species of fish on the Eurasian continent. All the measurements of taxonomic characteristics relating to that species are very close to those of *Trichodinella* sp. in the present study. The measurements of our specimens are also similar to the *T. epizootica* populations of Basson et al. (1983) from *Cyprinus carpio*; of Albaladejo & Arthur (1989) from *Cyprinus carpio*; of Al-Rasheid et al. (2000) from *Mormyrus kannume*; of Mitra & Haldar (2004) from *Puntius gelius*; and of Basson (2010) from *Tinca tinca.*

In the literature, schematic drawings of *T. epizootica* vary significantly between each description (Figure 3). The schematic drawing of *Trichodinella* sp. identified here was very similar to the record of Mitra & Haldar (2004) (Figure 3). These differences may be due to the common variations observed in *T. epizootica* morphology within the same population or in populations from different hosts (LOM, 1963; LOM & HALDAR 1977; BASSON & VAN AS, 1987; BASSON, 2010). These variations occur mainly due to difficulties in impregnation with silver nitrate, which culminates in different interpretations by different authors. Furthermore, Figure 3 shows that the schematic drawing of *T. epizootica* described by Al-Rasheid et al. (2000) is quite similar to the schematic drawing of *Trichodinella carpi* Duncan, 1977, from Tang et al. (2005). These presented more similarities than between the records of *T. epizootica*. Measurement data and schematic drawings indicate that the parasite of our study may be of the species *T. epizootica*. However, due to the small number of well-impregnated specimens and the confusion in the literature, we have only described the genus.

The present investigation has extended the distribution area of identified trichodinid species to the central-western region of Brazil and has added one more country to the checklist of *Trichodinella* distribution around the world. These findings confirm that *T. centrostrigeata, T. compacta*, *T. heterodentata, P. africana* and *T. orthodens* are widely distributed worldwide, occurring in various habitats. So far, *Trichodinella* appears to be rare in Brazil, but this may only be because researchers' interest in identifying trichodinids down to species level is comparatively recent and because of the small sizes of these species, which make it difficult to identify them even when they have been impregnated with silver nitrate.

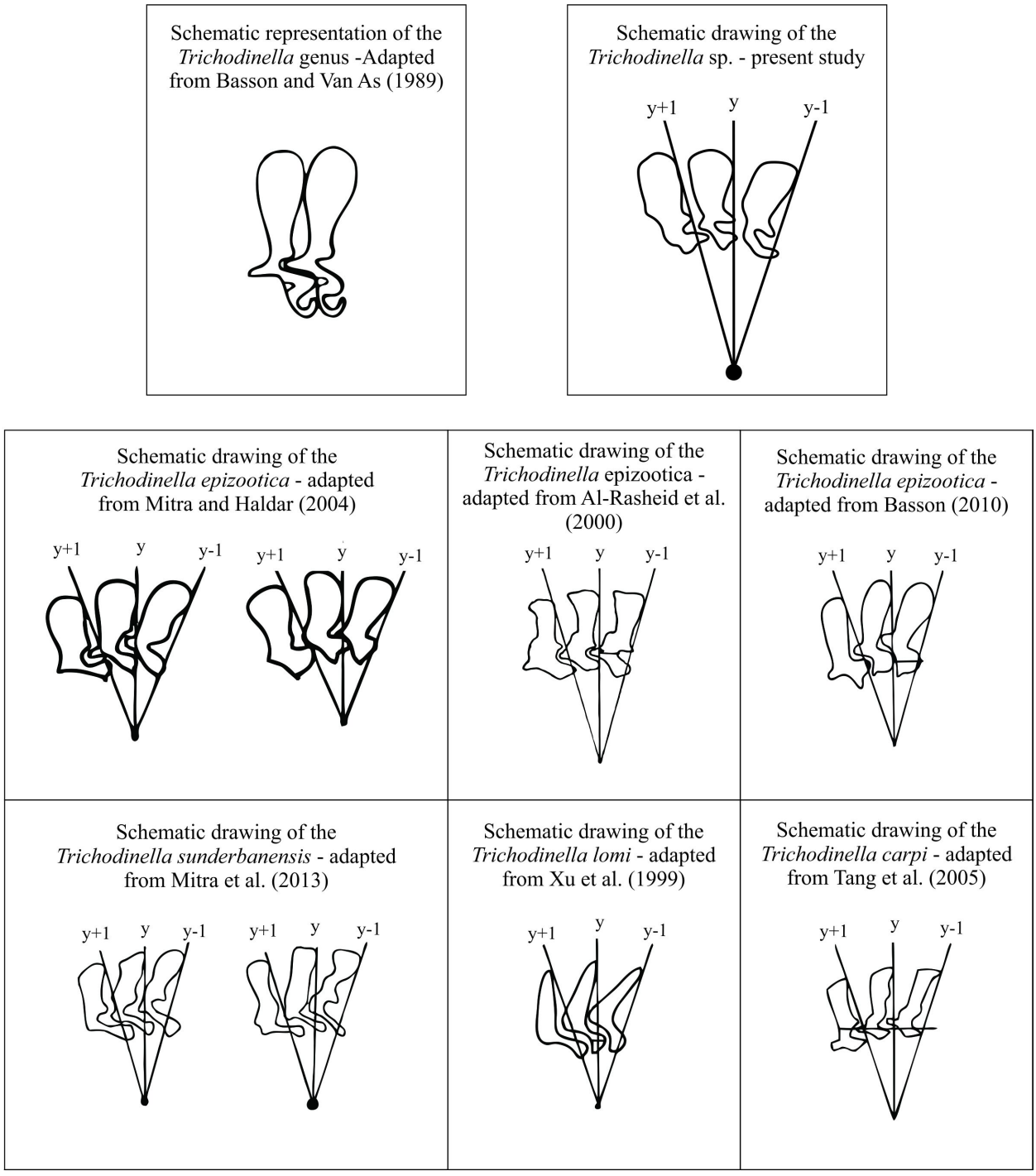

Figure 3. Schematic drawing of the denticles of *Trichodinella* demonstrating the diversity of denticle shape among *Trichodinella epizootica* (redrawn from various sources: BASSON & VAN AS, 1989; MITRA & HALDAR, 2004; AL-RASHEID et al., 2000; BASSON, 2010; MITRA et al., 2013; XU et al., 1999 and TANG et al., 2005).

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