Ultrastructure of the lorica of Trachelomonas Ehr. from the Colombian Amazonia

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ABSTRACT

The ultrastructure of 37 taxa belonging to the genus Trachelomonas Ehr. (Euglenophyta) from the Colombian Amazonia have been studied by scanning electron microscopy. On the basis of these observations we propose one new species T. duquei and two new forma T. armata var. gordeievii fo. minor and T. armata var. nana fo. spinosa n. fo.

KEYWORDS: Ultrastructure — Taxonomy — Trachelomonas — Euglenophyta — Colombian Amazonia.

RESUMEN

ULTRAESTRUCTURA DE LA LORICA DE TRACHELOMONAS EHR. DE LA AMAZONIA COLOMBIANA

En este trabajo se analiza la ultraestructura de 37 taxones pertenecientes al género Trachelomonas Ehr. (Euglenophyta) provenientes de la Amazonia Colombiana. Como resultados de nuestras observaciones decidimos describir una especie T. duquei y dos formas T. armata var. gordeievii fo. minor y T. armata var. nana fo. spinosa como nuevos taxones.


RÉSUMÉ

ULTRASTRUCTURE DE LA LOGETTE DE TRACHELOMONAS EHR. DE L’AMAZONIE COLOMBIENNE


INTRODUCTION

The water bodies of the Amazonian floodplain offer excellent conditions to the development of Euglenophyta. This is mainly due to the great content of organic matter that strongly favours growth of these flagellates, both in diversity and number. In spite of a high species richness, the studies in Amazonian algae are precarious; many investigations have been carried out in the Brazilian sector (Thomasson, 1971; Uherkovich, 1976 and 1981; Uherkovich and Franken, 1980; Uherkovich and Rai, 1979; Uherkovich and Schmidt, 1974), the most exhaustive being those from Camaleao lake near Manaus (Conforti, 1993 and 1994; Rodrigues, 1992). Recently, Coute and Therzie (1985, 1994) studied the ultrastructure of numerous Euglenophyta from the Bolivian Amazonia. Duque (1995) described Euglenophyta from the Colombian region, observed with optical microscope. In this paper we analyse the ultrastructure of 37 taxa belonging to the genus Trachelomonas Ehr. (Euglenophyta) from the floodplain lakes and river of the Colombian Amazonas, between Cotuhe River and the Amazonas.

As a result of our observations, we propose one new species T. duquei, and two new forms T. armata var. gordeievii fo. minor and T. armata var. nana fo. spinosa.

MATERIALS AND METHODS

The materials analysed in this work were provided by Prof. Santiago Duque, Instituto de Ciencias Naturales (Estacion Cientifica de Leticia) Universidad de Colombia.

The samples were collected from several water bodies of the Trapecio Amazonico Colombiano during the period 1991-93, and were identified by a code number:

0042 — Lago Buutah, Rio Cotuhé, 26/6/91
0066 — Cano Pacatua, Rio Amazonas, 3/12/91
0104 — Lago Tarapoto, Rio Amazonas, 23/4/92
0110 — Lago Pozo Hondo, Rio Amazonas, 29/4/92
0117 — Lago Tarapoto, Rio Amazonas, 21/5/92

The qualitative samples of phytoplankton were taken superficially, sieved through a 40 μm mesh net, and fixed with a Transeau solution, 1:1 dilution. Identifications were carried out by means of a Leitz binocular microscope. For SEM observations the organisms were isolated under a dissecting microscope with the aid of micropipettes, dehydrated in a series of ethanol solutions (50 to 100%), and air-dried on aluminium foil, to be subsequently coated with gold palladium. Specimens were examined and photographed by means of a SEM (Philips 505) at the Electron Microscopy Service of CITEFA, Argentina.

Samples were deposited at Ficoteca Amazónica de Estación Científica de Leticia, in the Colombian National Herbarium (COL) and in the collection of the Limnology Laboratory of the Department of Biological Sciences, University of Buenos Aires.

TAXONOMICAL DESCRIPTIONS

FAMILY EUGLENACEAE

Trachelomonas Defl.
T. abrupta var. obesa (Playf.) Defl (pl. I, fig. 5)
Lorica 29-31 μm long, 25-27 μm broad, ellipsoid-cylindrical with slightly arched, sometimes parallel sides, poles broadly rounded. Pore without collar. Membrane yellowish to brownish, strongly punctuate (80-100/100 μm²) scabrous, ornamented with granulations or protuberances. Europe, Australia. In America: Argentina.

Occurrence: 0104.

T. armata var. armata fo. involuta Defl (pl. IV, fig. 9)
The organisms observed from Colombian Amazonia were smaller, 27-30 μm long, 24-27 μm diam., than those described by Telle and Conforti (1986), 38 x 31 μm. Lorica widely cylindrical or quadrangular with broad poles and more or less parallel sides. Membrane fine and sparsely punctuate. It can be observed a group of areolae (1-2 μm diam.), resembling the bases of spines, around the posterior end. Pore with an annular thickening. Europe. In America: Argentina.

It is necessary to clarify that the areolae do not resemble broken spines, we observed this character many times and the cut is never so “clean” nor in all spines. In addition, we found many specimens in these conditions.

Occurrence: 0042.

var. gordeievii Skv. (pl. IV, figs. 1, 2)
Lorica 37-40 μm long, 28-31 μm diam., broadly ellipsoidal or ovoid with anterior end narrower than the posterior one. Membrane yellowish to brownish, apparently smooth, ornamented with conical spines (1-1.5 μm long) at the anterior end and a crown of very long spines at the posterior one (15-18 μm long). Pore surrounded by 10-12 conical spines (1.5-2.5 μm long).
long). This variety has been originally described with S.E.M. by Coutée and Thérezien (1985). Manchuria. In America: Bolivia.

Occurrence: 0042.

**var. gordeievii fo. minor n. fo. (pl. III, figs. 10-12)**

A varietate minoribus dimensionibus differt. Lorica 31-34 μm long., 29-31 μm lat. In Duutaé lacua, Colombia. 26/V1/91. Holotypus tab. III, fig. 10. This forma presents the same characteristics as the variety, the only difference being the minor dimensions of the lorica, 31-34 μm long, 29-31 μm broad.

Occurrence: 0042.

**var. longispina Playf. em. Defl. (pl. IV, figs. 3, 4)**

Lorica 39-41 μm long, 29-31 μm broad, ellipsoid. Membrane yellowish sometimes colourless, finely punctuate (120-150/100 μm²) and with conical spines (1.8-2 × 0.3-0.5 μm) regularly distributed (6-10/100 μm²). Posterior end ornamented with a crown of very long curved spines (12-14 × 2-3 μm). This variety was already described with S.E.M. by Coutée and Iltis (1981) and Coutée and Thérezien (1985). Widespread. In America: Argentina, Brazil.

Occurrence: 0110.

**var. nana Balech fo. spinosa n. fo. (pl. IV, fig. 8)**

A varietate spinis conicis praesentibus circum flagellarem porum et in lorica pariete differt. Lorica 29-32 μm long., 25-27 μm lat. In Pozo Hondo lacua. 29/IV/92. Holotypus tab. IV, fig. 8. Lorica 29-32 μm long, 25-27 μm broad, ellipsoid or slightly ovoid with rounded ends, anterior end narrower than the posterior one. Pore surrounded by a crown of 8-12 short conical spines (1-1.5 μm long). Membrane yellowish to deep brown, with closely distributed punctuations and very scattered (13-15/100 μm²) short conical spines (0.8-1 μm long). Posterior end ornamented with a crown of well developed (10-12 μm long), curved, more or less convergent conical spines.

Balech in his description of var. nana, reported "...ovoid with flattened poles, specially the posterior one..." and this fact is shown in his photo 184, although in the fig. 65, the anterior pole is very much narrower than the posterior one. This forma presents the characteristics of the type variety, the only difference being the short conical spines that ornamented the pore and the body of the lorica.

Occurrence: 0110.

**T. armata var. setosa Drez. (pl. IV, fig. 7)**

Lorica 35-38 μm long, 27-29 μm broad, ellipsoid. Membrane finely punctuate (120-150/100 μm²) with scattered (10-20/100 μm²) conical spines (0.3-0.5 μm long). Posterior end ornamented with a crown of long spines (6-8 μm), straight or slightly divergent. Pore without collar surrounded by short spines at the distal end. Europe, Asia. Recorded in America for the first time.

This variety could be considered T. superba var. swirenkiana, but in this taxon the spines are not regularly distributed on the body surface, as in the specimen shown. Moreover, the length/breadth ratio in our specimens is closer to that in T. armata var. setosa than in T. superba var. swirenkiana.

Occurrence: 0042.

**var. steini Lemm. em. Defl. (pl. IV, figs. 5, 6)**

Lorica 34-37 μm long, 29-32 μm broad, ellipsoid with both ends rounded. Membrane finely (100-150/100 μm²) punctuate. Anterior end ornamented with conical spines of variable length (0.5-1.5 μm long) and very long curved spines (8-12 μm long) at the posterior one. Pore surrounded by an annular thickening, ornamented with a crown of spines (1-2 μm long). This variety has been described with S.E.M. by Coutée and Iltis (1981) and Conforti and Tell (1986). Widespread. In America: Argentina, Brazil.

Occurrence: 0110.

**T. australica var. granulata (Playf.) Defl. (pl. I, figs. 7-9)**

Lorica 22-24 μm long, 17-21 μm broad, ellipsoid. Membrane finely punctuate (80-100/100 μm²), ornamented with short conical spines densely (30-50/100 μm²) distributed, sometimes the ornamentation includes granules or papillae loosely arranged. Pore surrounded by a double annular thickening dentate at the distal end. Widespread. In America: Bolivia.

Occurrence: 0110.

**T. bernardinensis Vischer em. Defl. (pl. V, figs. 5, 6)**

Lorica 35-37 μm long, 18-20 μm broad, elongate-ellipsoidal with the sides usually regularly arched, but sometimes slightly attenuated towards the anterior...
end. Membrane deep brown sparsely punctuate with numerous adhered particles on its surface. Pore surrounded by a wide conical collar (3-4 x 5.5 μm) with spines or crenulate at the tip. Posterior end gradually tapering to a conical cauda. Europe, India. In America: Argentina.

Deflandre (1926) described this taxon as showing a strongly scrobiculated membrane. Within the material examined, we found a pool of specimens, with a punctuated membrane that presented variable quantities of agglutinated particles. Perhaps, this material could appear as scrobiculations in light microscope.

Occurrence: 0104.

T. caudata (Ehr.) Stein fo. (pl. V, fig. 7)

The lorica observed in plate V, fig. 7 differs from the typical species in its elongate ellipsoidal contour, 46-48 μm long, 15-17 μm broad. Pore surrounded by a straight cylindrical collar (5-5.5 x 6-6.5 μm), ornamented with short spines. Posterior end gradually tapering to a conical cauda (6-6.5 x 5-5.5 μm). Membrane yellowish to reddish-brown, punctuated (75-501 μm²) with scattered (15-20/100 μm²) spines similar to those observed along the neck and the cauda.

Occurrence: 0066, 0117.

T. dastuguei Balech (pl. VI, figs. 1-4)

Lorica 54-59 μm long, 16-20 μm broad, spindle-shaped, sides regularly arched. Anterior end narrowed into a cylindrical neck (8-9 x 5-6 μm). Posterior end gradually tapering towards a subconical tail (12-13 x 5-6 μm). Membrane yellowish to deep brown, punctuated and ornamented with conical spines arranged in definite areas. Around the distal end of the neck there is a crown of 5-6 robust spines (4-5 x 1.5-2 μm). The body presents conical spines of variable length: the longer ones are located on the ends and the smaller (1.5-2 x 0.5-1 μm) spines are distributed scattered (7-10/100 μm²) on the central part of the body. The tail is like a truncated cone with 4 robust spines (4-5 x 1-1.5 μm) on the free end. This species was only recorded in materials from South America: Argentina, Brazil.

From comparison with other descriptions of this species in S.E.M., we can conclude that the number of punctuations seems to be very variable: from 60-70/100 μm² (Tell and Couté, 1980) or 80-85/100 μm² (Conforti and Tell, 1986), to very scattered, as we observed in our materials (20-40/100 μm²).

Occurrence: 0104.
**T. granulosa var. subglobosa** Playf. (pl. III, fig. 7, 8)

Lorica 26-28 μm long, 24-26 μm broad, subspherical. Membrane yellowish or reddish-brown, loosely punctuated (60-100 μm²), ornamented with short obtuse spines (0.5 x 0.8 μm long) irregularly scattered (10-15/100 μm²), which confers to the contour of the lorica an undulate appearance. Pore without collar. Poland, Australia. This is the first record of this variety in America.

Occurrence: 0117.

**T. hirta da Cunha** (pl. II, fig. 11)

Lorica 21-24 μm long, 19-21 μm wide, broadly ellipsoidal with round ends to subspherical. Pore without collar. Membrane reddish-brown to deep brown, notoriously punctuated (80-100/100 μm²) with long conical spines (2-3 μm long) irregularly distributed (8-10/100 μm²). This species was already described with S.E.M. by Conforti and Tell (1986). It was only recorded in America: Argentina, Brazil.

Occurrence: 0042.

**T. hispida** (Perty) Stein em. Defl. var. hispida (pl. II, figs. 1, 2)

Lorica 21-23 μm long, 18-20 μm broad, ellipsoid. Pore surrounded by an annular thickening (pl. II, fig. 2). Membrane deep to reddish-brown, finely punctuated (84-100 μm²) with short conical pointed spines (0.7-1 μm long), scatterly distributed (50-70/100 μm²), among these there are very little papillae irregularly located. Cosmopolitan.

Occurrence: 0104.

**var. hispida fo. minor** Bourr. (pl. II, fig. 3)

Lorica 21-23 μm long, 16-18 μm broad, ellipsoid, covered densely (15-20/100 μm²) with short conical pointed spines (1-1.5 μm long). Pore with or without annular thickening surrounded by spines (1-2 μm long). Membrane yellowish or reddish-brown finely punctuated (100-200/100 μm²) punctuated. This species has been already described with S.E.M. by Couté and Ilris (1981). Guadeloupe, Africa.

Occurrence: 0042, 0104.

**var. crenulatocollis** (Maskell) Lemm. (pl. II, figs. 5, 6)

Lorica 26-32 μm long, 20-23 μm broad, ellipsoid, strongly and irregularly punctuate (80-100/100 μm²) with scattered (9-15/100 μm²) conical spines (0.5-1.5 μm long), distributed mainly around the ends. Pore surrounded by a cylindrical neck ornamented with 10-12 spines at the tip, which are longer than those in the body, which diverge distally. France. In America: Argentina.

The observed specimens presented the neck almost cylindrical; notwithstanding, we shouldn’t say our specimens belong to fo. recta because the spines are divergent from the edge of the neck.

Occurrence: 0104.

**var. duplex** Defl. (pl. II, fig. 4)

Lorica 28-30 μm long, 23-25 μm broad, ellipsoidal. Membrane yellowish to reddish-brown, notoriously punctuate (80-100/100 μm²), with short conical spines irregularly distributed mainly around the ends, some also scattered on the middle surface. Pore surrounded by a depressed annular thickening. This species was already described with S.E.M. by Couté and Thérezien (1985). Widespread. In America: Argentina, Bolivia.

Occurrence: 0042.

**T. horrida var. spinicollis** Conf. (pl. IV, figs. 10-12)

Lorica 39-41 μm long, 25-27 μm broad, ellipsoid. Pore surrounded by a cylindrical collar (5.5-6 x 4.5-5 μm) with conical spines (1-1.5 μm long) at the distal end and some others placed on the lateral (pl. IV, fig. 11). Membrane reddish-brown, punctuated, ornamented with robust conical spines (3.5-4 μm long), irregularly distributed (32-38/100 μm²), among these spines little granulations are present.

This variety was originally described by Conforti (1993) in materials from Camaleão Lake (Brazil). This is the first record outside this country.

Occurrence: 0110.

**T. intermedia var. papillata** (Skuja) Popova (pl. I, fig. 6)

Lorica 24-27 μm long, 21-23 μm broad, ellipsoid. Membrane finely punctuated (100-200/100 μm²) ornamented with short conical spines scatterly (10-20/100 μm²) distributed. This variety was originally reported in materials from Lithuania, the present is the second record of it in the world.

Occurrence: 0104.

**T. irregularis** Swir. (pl. I, figs. 10, 11)

Lorica 23-25 μm long, 18-20 μm broad, ellipsoid. Posterior end slightly flattened. Pore (4-4.5 μm diam.) surrounded by an annular thickening or a very short collar. Membrane scrobiculated, strongly

T. kelloggii Skv. (pl. II, fig. 12)

Lorica 32-34 μm long, 30-32 μm broad, ellipsoid or ovoid with rounded ends. Pore surrounded by a crown of 8-10 conical spines (1.5-2 μm long). Membrane reddish brown, finely punctuated (100-110/100 μm²) ornamented with conical spines, distributed mainly around the ends (7-10/100 μm²). In some specimens we could observe scattered spines on the middle surface. This species was already described with S.E.M. by CONFORTI and TELL (1986). Widespread. Occurrence: 0104.

T. megalacantha var. crenulatocollis Bourr. et Manguin (pl. III, figs. 5, 6)

Lorica 53-55 μm long, 29-31 μm broad, ellipsoid. Membrane strongly (100-200/100 μm²) punctuated, with robust long and divergent conical spines (10-12 × 2-4 μm) scatteredly (3-4/100 μm²) distributed. Pore with a depressed collar (6-7 μm diam.) bearing teeth on the distal end (13 μm long). Guadeloupe, Argentina. Occurrence: 0117.

T. planctonica var. flexicollis Balech (pl. V, figs. 1, 2)

Lorica 21-23 μm long, 17-19 μm broad, ellipsoid, with the posterior end slightly flattened. Pore with an oblique or sometimes curved collar (3-4 μm long) and irregularly denticulated at the tip (1-1.2 μm long). Membrane with scattered punctuations (38-70/100 μm²). France. In America: Argentina, Brazil. Occurrence: 0104.
are disposed irregularly at the anterior end, with no organization in concentric circles at all.

Occurrence: 0042.

**T. robusta** Swir. *em.* Defl. (pl. II, figs. 7, 8)

Lorica 19-23 μm long, 17-20 μm broad, ellipsoid, strongly and irregularly punctuate (84-100/100 μm²), with robust scattered (5-12/100 μm²) conical spines (1.5-4 μm long). Pore without collar, normally surrounded by some spines the length of which is equal or greater than that of the ones on the body of the lorica, divergent or not. Membrane deep or reddish-brown. Europe. In America: Argentina, Bolivia, Brazil, Venezuela.

This species has been already described with S.E.M. by Couté and Iltis (1981), Conforti and Tell (1986), Couté and Thérèzien (1985) and Conforti (1993).

Occurrence: 0042.

**T. rugulosa** fo. steinii Defl. (pl. I, figs. 2, 3)

Lorica 22-24 μm diam, spherical; pore with an annular thickening (1.5-2 μm diam.); membrane thick, yellowish to reddish-brown, ornamented with a number of more or less regular, slightly anastomosing ribs that appear to radiate from the pore. Austria, France. This is the first record of it in America.

Occurrence: 0110.

**T. similis** var. spinosa Hub. — Pest. (pl. V, figs. 3, 4)

Lorica 24-25 μm long, 16-17 μm broad, ellipsoid, with ends rounded or the posterior slightly acuminate. Pore surrounded by a collar oblique (3.5-4 × 4.5 μm), ornamented with spines irregularly placed on the sides and the distal end (1-1.5 μm). Membrane reddish-brown, strongly and regularly punctuated (100-150/100 μm²), ornamented with robust (4-6 μm long) conical spines regularly (8-10/100 μm²) distributed. Russia. In America: Argentina.

The determination of this taxon was specially uneasy. We included it in *T. zingeri*, though in the figure given by Roll (Huber-Pestalozzi, 1955), the sides are slightly straighter than in our specimens. In addition, though the anterior spines are not longer than posterior ones in the specimens shown, we observed this feature many times under light microscope. Finally, it differs from *T. spectabilis* Defl. by its larger dimensions (53-55 × 32-35 μm).

Occurrence: 0110.

**CONCLUSIONS**

var. flexicollis, T. superba var. spinosa and T. zingari. Among these, 3 were considered as new taxa: T. armata var. gordieiani fo. minor, T. armata var. nana fo. spinosa and T. duquei.

Five taxa were recorded only in America: T. dastuquei, T. hirta, T. horrida var. spinicollis, T. madaleniana and T. megalacantha var. crenulatocollis.

Six taxa were recorded for the first time in South America: T. armata var. selosa, T. globularis fo. crenulatocollis, T. granulosa var. subglobosa, T. intermediata var. papillata, T. rugulosa fo. steinii and T. superba var. spinosa.

Twenty-three taxa present a widespread distribution.

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REFERENCES


**Plate II**
PLATE III

Fig. 1, 2. T. duquei, 1. general view, 2. detail of the envelope surface; 3, 4. T. zingeri, 3. detail of the envelope surface, 4. general view; 5, 6. T. megalacantha var. crenulatocollis, 5. general view, 6. detail of the flagellar pore; 7, 8. T. granulosa var. subglobosa, 7. general view, 8. detail of the envelope surface; 9. T. superba var. spinosa; 10-12. T. armata var. gordeievii fo. minor, 10. general view, 11. detail of the posterior end spines, 12. detail of the anterior end.

Fig. 1, 2. T. armata var. gordeievii, 1. general view, 2. detail of the anterior end; 3, 4. T. armata var. longispina, 3. general view, 4. detail of the anterior end; 5, 6. T. armata var. steinii, 5. general view, 6. detail of the anterior end; 7, 8. T. armata var. setosa; 9. T. armata var. nana fo. spinosa; 10-12. T. horrida var. spinicollis, 10. general view, 11. detail of the neck ornamentation, 12. detail of the envelope surface.

PLATE V

Fig. 1-2. T. planctonica var. flexicollis, 1. general view, 2. detail of the neck; 3-4. T. similis var. spinosa, 3. general view, 4. detail of the neck; 5-6. T. bernardinensis, 5. general view, 6. detail of the envelope surface; 7. T. caudata fo.; 8-11. T. pseudocaudata, 8-10. general views, 11. detail of the envelope surface; 12. T. pseudocaudata fo.

PLATE VI

FIG. 1-4. T. dastuguei, 1. general view, 2. detail of the neck ornamentation, 3. detail of the envelope surface, 4. detail of the cauda ornamentation; 5-7. T. magdaleniana, 5. detail of the neck ornamentation, 6. general view, 7. detail of the cauda ornamentation.