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ScienceDirect
European Journal of Protistology 43 (2007) 179–184
European Journal of PROTISTOLOGY
www.elsevier.de/ejop

Description of a mirror-image doublet from a Brazilian strain of *Gastrostyla setifera* (Engelmann, 1862) Kent, 1882 (Ciliophora: Stichotrichia)

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Received 20 November 2006; received in revised form 15 February 2007; accepted 6 March 2007

Abstract

The present work describes a mirror-image doublet morph found in a Brazilian strain of the stichotrich ciliate *Gastrostyla setifera* (Engelmann, 1862) Kent, 1882, obtained from a sample of water and sediment from an urban freshwater stream in the city of Juiz de Fora (Minas Gerais, Brazil). The doublet measured 63 × 49 μm, and had two components where the right one has upside-down arranged adoral membranelles with a set of small oblique membranelles at its proximal (posterior) end. The fronto-ventral-transverse ciliature comprised 34 cirri, mostly related to the left component, as well as two marginal rows. On the dorsal surface there were eight dorsal kineties and six caudal cirri. Dorsomarginal kineties were lacking. The macronucleus comprised one irregular-shaped transverse nodule and two smaller roughly ellipsoid longitudinal nodules.

Keywords: Allomorphism; Ciliate; Doublet; Gastrostylidae; South America; Stylonychinae

Introduction

Doublets are morphs that occur in ciliates where one individual develops two major cellular components and survives with, effectively, a double body. They can be of the homopolar type if the components are united by their opposing dorsal surfaces, or of mirror-image type (also called "jumelles"), a rare condition when the two components are joined laterally (Berger 1999; Frankel 1989). According to Shi and Frankel (1990), doublets can be interpreted as a developmental modification with consequent perpetuation of fused normal cells.

In stichotrich ciliates, mirror-image doublets possess one cell component whose pattern of ciliature is rather similar to that of the normal individual (singlet) and a second component bearing apparently inverted somatic and oral ciliatures (Frankel 1989; Jerka-Dziadosz 1983; Shi and Frankel 1990). These morphs may occur spontaneously or be induced by exposure to UV light,

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doi:10.1016/j.ejop.2007.03.002

a laser beam, an intense electric field or microsurgery, with the implantation of the oral primordium from a normal cell in divisional morphogenesis (Banchetti et al. 1997; Berger 1999; Totwen-Nowakowska 1965).

The present paper describes the morphology of a mirror-image doublet from a strain of *Gastrostyla setifera* (Engelmann, 1862) Kent, 1882, a rare limnetic species (Berger 1999), found in a sample collected from an urban freshwater stream in the state of Minas Gerais, Brazil. In spite of the paper by Shi et al. (2003), few contributions on the morphology of this species have been published so far (for a review, see Berger 1999).

We believe this work is the first report of a mirror-image doublet of a species of the genus *Gastrostyla* Engelmann, 1862, as well as the second record of *G. setifera* from Brazilian territory (Paiva and da Silva-Neto 2005).

Material and methods

Samples of water with bottom sediments were collected in the year of 2005 from the São Pedro stream (UTM = 668 307, 7 591 772), an urban freshwater body located in the city of Juiz de Fora, Minas Gerais, Brazil. After transfer to the laboratory, ordinary limnetic cultures were made from small aliquots of the samples, as explained in Foissner et al. (2002). Specimens were isolated with micropipettes and identified through living observations (phase and Nomarski contrasts at 100–1000 × magnification) and after protargol preparations made following the protocol described by Dieckmann (1995). The doublet was found in a protargol-impregnation slide containing numerous singlets. The cells presented in this work were photographed at 400–1000 × and measured at 1000 × magnification. Schematic drawings of live specimens are reconstructions made from data of both live individuals and specimens on protargol slides. Drawings of protargol-impregnated specimens were made at 1000 × magnification with the aid of a camera lucida. The terminology adopted follows mainly Shi and Frankel (1990), Berger (1999) and Shi et al. (2003). The slide containing the doublet and other voucher protargol slides with several specimens of *G. setifera* were deposited in the collection of Laboratório de Protistologia, Departamento de Zoologia, Instituto de Biologia, Universidade Federal do Rio de Janeiro.

Results

Morphology of normal (singlet) interphasic cells (Figs 1–3, 7–10)

The overall morphology of singlets is very similar to that of the Chinese population of *G. setifera* studied by Shi et al. (2003), so we considered both conspecific. Nevertheless, some variation was observed in the cirral pattern of the population from Minas Gerais and in another strain of *G. setifera* from southern Brazil (work in preparation), and which were not reported in the Chinese study, e.g. two buccal cirri originating from ventral anlage II (Figs 1, 2). As such discussion will be the focus in a future paper from our group, we present here a brief description of the normal interphasic cells of *G. setifera* from Minas Gerais: *Gastrostyla* measuring about 145 × 65 µm, dorsoventrally flattened with ellipsoid outline, narrowed in the posterior region. Cell rigid and without cortical granules, with granulous cytoplasm greenish in the middle region of the organism (often dark at low magnification) but clear at posterior and anterior ends. One contractile vacuole located adjacent to the left margin of the cell, above the equatorial region (Fig. 1). Food vacuoles usually located close to cell margins. Sometimes may ingest large prey, such as diatoms (Fig. 10). Adoral zone of membranelles (AZM) conspicuous with about 55 membranelles and paroral and endoral membranes apparently crossing over one another in their median region. Fronto-ventral-transverse (FVT) ciliature formed by, on average, three frontal cirri, six fronto-ventral, two buccal, ten ventral and five transverse cirri split into two sets. One left and one right marginal cirral rows, bearing 23 and 32 cirri respectively. The dorsal ciliature comprises four dorsal kineties, of which kineties 1, 2 and 4 each bear one caudal cirrus, plus two dorsomarginal kineties, numbered 5 and 6 in Figs 3, 8. Nuclear apparatus formed by two macronuclear nodules measuring about 25 × 12 µm each and two spheroid micronuclei measuring 4–5 µm in diameter (Figs 1–3, 7–10).

Morphology of mirror-image doublet (Figs 4–6, 11–15)

Only one doublet was found in a sample of more than 30 cells. It measures 63 µm long (length of the left component) and 49 µm wide. Most of the structures of the left component are similar to those from singlets. In this component's oral apparatus, the AZM has 35 adoral membranelles that are conspicuously similar to those of other stylonychine ciliates (Foissner and Al-Rasheid 2006; Grim 1972), and arranged in the same manner as in singlets (Figs 4, 5, 12).

Conversely, the inverted right component is shorter, measuring 54 µm in length, has a reduced and apparently inverted ventral ciliature in relation to the left one, the most noticeable feature being the position of the adoral membranelles, which are flipped about 180° to the right, resulting in an upside-down orientation that gives a false impression that they are mirror-inverted