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Hassallia littoralis sp. nov. (Cyanobacteria, Microchaetaceae) from Mexico's marine supralittoral based on morphological and molecular evidence

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Abstract

A new species of *Hassallia* (Cyanobacteria, Nostocales, Microchaetaceae) from a supralittoral tropical marine biotope is described. *Hassallia littoralis* is a false-branched nostocalean cyanobacterium with caespitose free filaments or with fasciculated individual filaments not in a common sheath. Filaments are mainly heteropolar, bearing mono- and bi-pored heterocysts and isopolar or heteropolar hormogonia. The sheath is often widening, with pronounced rounded terminals. This new species is defined according to molecular, morphological and ecological criteria, considering data from different stages of its life cycle as well as the 16S rRNA partial gene sequence.

Introduction

In recent decades, many important revisions have occurred for Cyanobacteria, applying the polyphasic approach that generated a modern classification system (Hoffmann *et al*. 2005). This strategy has led to major advances in taxonomy and the phylogenetic cyanobacterial classification by combining the traditional morphological characterization with the inclusion of molecular and ecological data from cultured, and especially field material. This new approach has provided essential support for the modern classification system of cyanobacteria (Komárek 2006). Key studies such as those of Flechtner *et al*. (2002), Gugger *et al*. (2002), Iteman *et al*. (2002), Rajaniemi *et al*. (2005), and Komárek *et al*. (2012), among others, have contributed to support the relevance of this approach, that has produced the description of numerous new taxa, as well as species being transferred into different generic entities.

The family Microchaetaceae (Nostocales) has been under intensive revision, with several new species and even genera being described, such as *Spirirestris* Flechtner & Johansen in Flechtner *et al*. (2002: 6), *Rexia* Casamatta, Gomez & Johansen (2006: 23), *Streptostemon* Sant'Anna, Azevedo, Kastovský & Komárek (2010: 220), *Ophiotrhix* Sant'Anna, Azevedo, Kastovský & Komárek (2010: 218), *Godleya* Novis & Visnovsky (2011: 14), *Toxopsis* Lamprinou & Pantazidou in Lamprinou *et al*. (2012: 2872), and *Calochaete* Hauer, Bohunická & Mühlsteinová (2013: 38). Currently, the family Microchaetaceae contains 13 genera (Table 1).

Hassallia Berkeley ex Bornet & Flahault (1886–1888: 115), *Coleodesmium* Borzì ex Geitler (1942: 154) and *Tolypothrix* Kützing ex Bornet & Flahault (1886–1888: 118) are genera that show some morphological overlapping traits, and therefore have delimitation problems. Even *Hassallia* and *Coleodesmium* have not been accepted in some identification manuals (Komárek *et al*. 2012), for instance Starmach (1966) included several species of *Hassallia* within *Tolypothrix*, and similar criteria were used by Bourrelly (1969, 1970). Similar morphotypes of *Hassallia* have been sometimes identified as members of genus *Tolypothrix*, such as

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