



Abstract

Taxonomic Assessment of the Cyanobacteria from the BACA Culture Collection: Contribution to the Knowledge of Their Diversity and Monitoring in the Azores [†]

Rúben Luz ^{1,2,*}, Rita Cordeiro ², Jan Kaštovský ³, Jeffrey R. Johansen ³, Elisabete Dias ², Amélia Fonseca ^{1,2}, Ralph Urbatzka ⁴, Vitor Vasconcelos ^{4,5} and Vitor Gonçalves ^{1,2}

- ¹ Faculdade de Ciências e Tecnologia, Universidade dos Açores, 9501-801 Ponta Delgada, Portugal; maria.ao.fonseca@uac.pt (A.F.); vitor.mc.goncalves@uac.pt (V.G.)
 - ² Centro de Investigação em Biodiversidade e Recursos Genéticos (CIBIO), InBIO Laboratório Associado, Pólo dos Açores, Universidade dos Açores, 9501-801 Ponta Delgada, Portugal; rita.ip.cordeiro@uac.pt (R.C.); elisabete.f.dias@uac.pt (E.D.)
 - ³ Department of Botany, Faculty of Science, University of South Bohemia, 37005 České Budějovice, Czech Republic; hany.s@prf.jcu.cz (J.K.); johansen@jcu.edu (J.R.J.)
 - ⁴ Interdisciplinary Centre of Marine and Environmental Research—CIIMAR/CIMAR, University of Porto, Terminal de Cruzeiros do Porto de Leixões, Av. General Norton de Matos s/n, 4450-208 Matosinhos, Portugal; rurbatzka@ciimar.up.pt (R.U.); vmvascon@fc.up.pt (V.V.)
 - ⁵ Department of Biology, Faculty of Sciences, University of Porto, 4069-007 Porto, Portugal
- * Correspondence: ruben.fs.luz@uac.pt
- [†] Presented at the 7th Iberian Congress on Cyanotoxins/3rd Iberoamerican Congress on Cyanotoxins, Ponta Delgada, Portugal, 18–20 June 2022.
- ‡ Presenting author (oral communication).



Citation: Luz, R.; Cordeiro, R.; Kaštovský, J.; Johansen, J.R.; Dias, E.; Fonseca, A.; Urbatzka, R.; Vasconcelos, V.; Gonçalves, V. Taxonomic Assessment of the Cyanobacteria from the BACA Culture Collection: Contribution to the Knowledge of Their Diversity and Monitoring in the Azores. *Biol. Life Sci. Forum* **2022**, *14*, 4. <https://doi.org/10.3390/blsf2022014004>

Academic Editor: Pedro Raposeiro

Published: 18 July 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Abstract: Cyanobacteria taxonomy is changing significantly, with many new genera and species having been uncovered from a variety of cultures over the last decade. The use of cultures allowed for genetic studies using molecular markers, e.g., 16S rRNA and 16S-23S internal transcribed spacer (ITS) rRNA, complementing the morphological and ecological information traditionally used in the description of new taxa. Presently, the culture collection BACA (Azorean Bank of Algae and Cyanobacteria) comprises more than 350 strains of cyanobacteria isolated from terrestrial, aquatic, and thermal habitats in the Azores. The phylogenetic study of more than 200 strains shows new phylogenetic clades and possibly many new genera and species. Strains belonging to possible new taxa were selected for further genetic studies by 16S rRNA and 16S-23S ITS rRNA gene amplification using the 27F and 23S30R primers and sequenced. The secondary structure of the ITS gene was predicted using the mFold web server, and the D1-D1' helix, Box-B helix and V3 helix were compared. Transmission electron microscopy was performed on simple coccoid and filamentous strains to visualize the thylakoid position in the cell. The use of a polyphasic approach enabled the identification of several new cyanobacteria taxa, supported by the phylogenetic analysis and the identification of diacritical morphological characters. The description of these new taxa contributes to the knowledge of cyanobacteria biodiversity and a better understanding of their taxonomy, which is still very confusing and problematic, allowing a better clarification of species and genera distribution.

Keywords: taxonomy; 16S rRNA; 16S-23S rRNA; internal transcribed spacer; biodiversity; phylogeny; transmission electron microscopy

Author Contributions: All authors contributed equally. All authors have read and agreed to the published version of the manuscript.

Funding: Rúben Luz was supported by a Ph.D. grant (M3.1.a/F/002/2020) from the Fundo Regional da Ciência e Tecnologia (FRCT). This work was funded by FEDER funds through the Interreg-MAC

2014-2020 Program under the projects REBECA—Red de excelencia en biotecnología azul (algas) de la región macaronesia (MAC1.1a/060) and REBECA-CCT—Red de Excelencia en Biotecnología Azul de la Región Macaronésica; Consolidación, Certificación y Transferencia (MAC2/1.1b/269); and by Portuguese National Funds, through FCT—Fundação para a Ciência e a Tecnologia, the European Union, QREN, FEDER, COMPETE, by funding from the CIBIO/InBIO (project UID/BIA/50027/2013 and POCI-01-0145-FEDER-006821). CIIMAR acknowledges funding from the FCT through UIDB/04423/2020 and UIDP/04423/2020.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.