

Cyanobacteria: Can a Toxic Foe Become a Therapeutic Friend?

Costantino V* and de Sterlich C

The NeaNat Group, Dipartimento di Farmacia, Università degli Studi di Napoli Federico II, via D. Montesano 49, 80131 Napoli, Italy

*Corresponding author: Costantino V, Università di Napoli Federico II, Italy, Tel: +39 081 678504; E-mail: valeria.costantino@unina.it

Received date: 02 Oct, 2016; Accepted date: 26 Oct, 2016; Published date: 31 Oct, 2016

Copyright: © 2016 Costantino V, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Editorial

In the last five year our research group have been starting to explore the unique and extremely different cyanobacteria world, a group of Gram-negative photosynthetic bacteria, able to inhabit any kind of water environment, such as coastal and inland waters. Their name derives from the capacity to produce, during their photosynthetic processes, a blue-green coloured pigment, called c-phycoyanin (C-PC). Cyanobacteria are interesting from two different points of view: they have a broad ecological impact that reflects on human and animal health. In fact, in some conditions some species of cyanobacteria extensively blooms and produce secondary metabolites toxic for humans called cyanotoxins that can affect health in humans and animals. It is now well demonstrated that these blooms are increasing during recent decades due to eutrophication of the waters, related to human activities.

On the other hand, compounds produced by cyanobacteria are regarded by natural products chemists as a treasure of unexplored new molecules for drug discovery research programs. Dolastatins [1], cryptophycins [2], and curacins [3], that are the nature inspiration of more efficient synthetic analogues, are example of cyanobacteria-produced molecules that have been studied for their pharmacological properties and are now in phase II and phase III of clinical trials, and one has been approved by FDA as a drug [4].

It has been noted that recently pharmacological interesting molecules, extracted by sponges, are indeed produced by the sponge-associated cyanobacteria [5-7]. Studying the chemistry of the Caribbean sponge *Smenospongia aurea*, smenothiazole B [8] has been isolated by our research group during our anticancer screening program. This compound is structurally related to the neurotoxin jamaicamide B [9], a peptide/polyketide structure isolated from the cyanobacterium *Moorea producens* (previously known as *Lyngbya majuscula*).

The study of the metabolic composition of a sample of cyanobacteria can be done using a new approach that combined high-resolution LC-MS with a bioinformatics tool called “molecular networking” elaborated by Gerwick’s group at Scripps Institution. This combined technology allowed fast dereplication of the sample (using only few milliliters) and the identification of novel metabolites. Studying the composition of a sample collected at Green Lake, Seattle (WA, USA) during the 2014 summer bloom, we discovered a novel microcystin, structurally related to mycrocistin-LR and two new feritoic acids [10]. The metagenomic analysis of the sample allowed us to identify as a strain of *Microcystis aeruginosa* the cyanobacteria responsible of the production of the (Figure 1) novel microcystin and to identify a fragment of the *mcvBAD1* gene from the MC biosynthetic cluster.

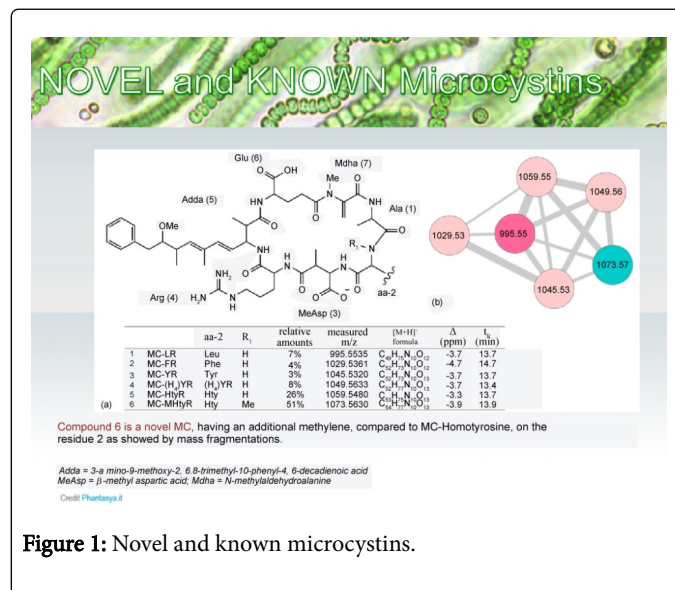


Figure 1: Novel and known microcystins.

Due to the enormous relevance of the problem related to the public health and the economic losses deriving from cyanobacteria blooms, awareness of the risk associated to cyanobacteria blooms by public community and politics is needed. Monitoring programs based on early detection and accurate risk assessment that will prevent health risks of diseases for human health are urgently needed. On the other hand, a toxic foe can also regard as a therapeutic friend!

References

- Pettit GR, Kamano Y, Herald CL, Tuinman AA, Boettner FE, et al. (1987) The isolation and structure of a remarkable marine animal antineoplastic constituent: dolastatin 10. *J Am Chem Soc* 109: 6883-6885.
- Schwartz RE, Hirsch CF, Sesin DF, Flor JE, Chartrain M, et al. (1990) Pharmaceuticals from cultured algae. *J Ind Microbiol* 5: 113-123.
- Gerwick WH, Proteau PJ, Nagle DG, Hamel E, Blokhin A, et al. (1994) Structure of curacin A, a novel antimitotic, antiproliferative, and brine shrimp toxic natural product from the marine cyanobacterium *Lyngbya majuscula*. *J Org Chem* 59: 1243-1245.
- Dixit RB, Suseela MR (2013) Cyanobacteria: potential candidates for drug discovery. *Antonie van Leeuwenhoek* 103: 947-961.
- Della Sala G, Hochmuth T, Costantino V, Teta R, Gerwick W, et al. (2013) Polyketide genes in the marine sponge *Plakortis simplex*: a new group of mono- modular type I polyketide synthases from sponge symbionts. *Environ Microbiol Rep* 5: 809-818.
- Della Sala G, Hochmuth T, Teta R, Costantino V, Mangoni A (2014) Polyketide synthases in the microbiome of the marine sponge *Plakortis halichondrioides*: a metagenomic update. *Mar Drugs* 12: 5425-5440.
- Luesch H, Moore RE, Paul VJ, Mooberry SL, Corbett TH (2001) Isolation of dolastatin 10 from the marine cyanobacterium *Symploca species* VP642

-
- and total stereochemistry and biological evaluation of its analogue symplostatins 1. J Nat Prod 64: 907-910.
8. Esposito G, Teta R, Miceli R, Ceccarelli LS, Della Sala G, et al. (2015) Isolation and assessment of the in vitro anti-tumor activity of smenothiazole A and B, chlorinated thiazole-containing peptide / polyketides from the Caribbean sponge, *Smenospongia aurea*. Mar Drugs 13: 444-459.
9. Edwards DJ, Marquez BL, Nogle LM, McPhail K, Goeger DE, et al. (2004) Structure and biosynthesis of the jamaicamides, new mixed polyketide-peptide neurotoxins from the marine cyanobacterium *Lyngbya majuscula*. Chem Biol 11: 817-833.
10. Teta R, Della Sala G, Glukhov E, Gerwick L, Costantino V, et al. (2015) A combined LC-MS and molecular networking approach reveals new cyanotoxins from the 2014 cyanobacterial bloom in Green Lake, Seattle. Environ Sci Technol 49: 14301-14310.