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Editorial OMICS International

Cyanobacteria: Can a Toxic Foe Become a Therapeutic Friend?

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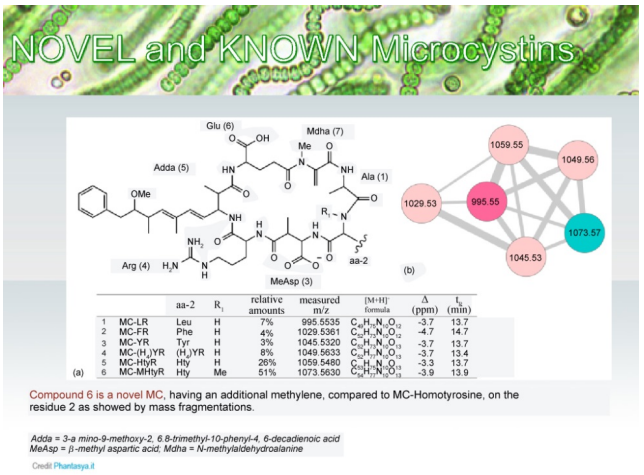
Editorial

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-phycocyanin (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 ferintoic 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 mcyBAd1 gene from the MC biosynthetic cluster.



		aa-2	R_1	relative amounts	measured m/z	[M+H]$^+$ formula	Δ (ppm)	t_R (min)
1	MC-LR	Leu	H	7%	995.5535	$C_{49}H_{75}N_{10}O_{12}$	-3.7	13.7
2	MC-FR	Phe	H	4%	1029.5361	$C_{52}H_{73}N_{10}O_{12}$	-4.7	14.7
3	MC-YR	Tyr	H	3%	1045.5320	$C_{52}H_{73}N_{10}O_{13}$	-3.7	13.7
4	MC-(H$_2$)YR	(H$_2$)YR	H	8%	1049.5633	$C_{52}H_{77}N_{10}O_{13}$	-3.7	13.4
5	MC-HtyR	Hty	H	26%	1059.5480	$C_{53}H_{75}N_{10}O_{13}$	-3.3	13.7
6	MC-MHtyR	Hty	Me	51%	1073.5630	$C_{54}H_{77}N_{10}O_{13}$	-3.9	13.9

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!

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