Metabolomic Profiling of Cyanobacteria by Mass Spectrometry

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Introduction

Cyanobacteria can produce a vast diversity of oligopeptides, many of which are responsible for episodes of fatalities to animals and humans due to their highly toxicity and presence in water environments.

Matrix assisted laser desorption ionization time-of-flight mass spectrometry (MALDI-TOF-MS) has been used successfully to identify microorganisms on the basis of their production of secondary metabolites or proteomic patterns.

The work presented herein aims the cyanobacteria typifying by MALDI-TOF-MS through metabolic profiling.

Results and Discussion

Six cyanobacteria species were evaluated. *Microystis aeruginosa* PCC7820, *Nostoc sp.* PCC 9237, *Nodullaria harveyana* PCC 7804, *Planktothrix agardhii* PCC 7811, *Anabaena cylindrica* PCC 7122 and *Oscillatoria sp.* PCC 6506 were cultivated with BG-11 media at 25 ^{0}C, light intesity of 5μmol de fótons m^{-2}. s^{-1} with light-dark cycle - 12 hours for 3 weeks and analyzed by MALDI-TOF (Micromass®, Manchester, UK). Their biomass were pipetted from culture media and spotted directly into the MALDI plate followed by addition of α-cyano-4-hydroxycinnamic acid matrix. Mass spectra were acquired using a nitrogen laser (337 nm) in reflectron and positive ion mode.

Figure 1 shows the metabolic profile of the evaluated cyanobacteria species by MALDI-TOF-MS. Each species presented a unique secondary metabolites profile (such as peptides), a sort of fingerprinting, which enable their identification.

The main detected peptides were microcystins, nodularins, anabaenopeptins, microviridins, microginins, aeroginosins, nostophycins and nostopeptide. The hepatotoxic cyclic peptides microcistyns and nodularins and their respective ions are described in **Table 1**.
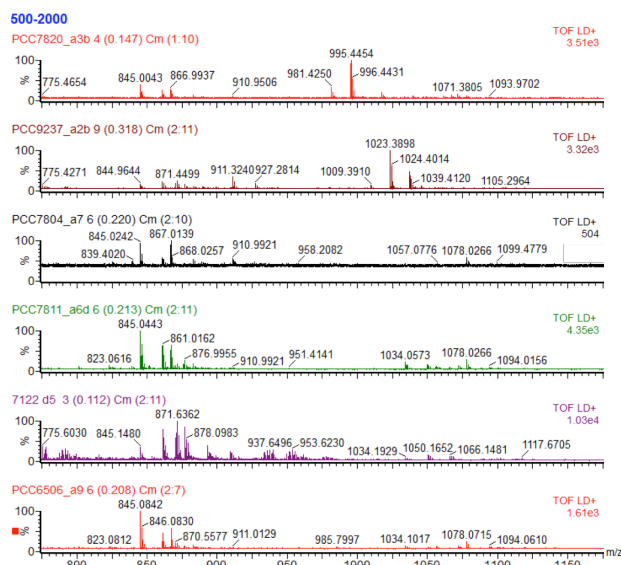

Figure 1. MALDI-TOF-MS spectra of each evaluated cyanobacteria species.

Table 1. Microcistyns and nodularins MALDI-TOF-MS pattern of the evaluated cyanobacteria.

Cyanobacteria	Metabolites
M. aeruginosa PCC7820	Microcystin-LR (*m/z* 995) [D-Asp^{3}]-Microcystin-LR (*m/z* 981)
Nostoc sp. PCC 9237	[ADMAdda^{5}]-Microcystin-LR (*m/z* 1009) [D-Asp^{3}-ADMAdda^{5}]-Microcystin-LR (*m/z* 1023) [ADMAdda^{5}]-Microcystin-LHar (*m/z* 1039)
N. harveyana PCC 7804,	Nodularin-R (*m/z* 839) [Har]-Nodularin-R (*m/z* 839)
P. agardhii PCC 7811	[D-Asp^{3}, Dha^{7}]-Microcystin-RR (*m/z* 981)
A. cylindrica PCC 7122	Microcystin-YR (*m/z* 1067)
Oscillatoria sp. PCC 6506	Microcystin-LL (*m/z* 952)

Conclusion

MALDI-TOF MS has been shown to be a fast and efficient tool to distinguish peptide profile when metabolically diverse cyanobacteria were analyzed.

Acknowledgement

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[1] Biswas, S. and Rolain, J. M., *J. Microbiol. Methods* **2013**, *92*, 14-24.