Cyanochelins, lipopeptides employing double β-hydroxyaspartate motif for iron chelation, are widely distributed in cyanobacteria.

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Cyanobacteria are diverse and important photoautotrophic prokaryotes that contribute significantly to the global carbon fixation. They live in a wide range of habitats, among others also in places with limited iron supply. Production of siderophores – low molecular weight compounds facilitating iron uptake – is a common adaptive strategy of bacteria to cope with iron limitation. Production of siderophores by cyanobacteria is expected yet there are only very few described examples. Recently we identified 3 novel cyanobacterial siderophores and demonstrated that cyanobacterial genomes frequently harbour gene clusters encoding synthesis of lipopeptides featuring β-hydroxyaspartate (β-OH-Asp), a residue known to be involved in iron chelation.

Iron starvation triggered the synthesis of β-OH-Asp lipopeptides in cyanobacteria Rivularia sp. PCC 7116, Leptolyngbya sp. NIES-3755 and Rubidibacter lacunae KORDI 51-2. The induced compounds were confirmed to bind iron by mass spectrometry and were capable of Fe3+ to Fe2+ photoreduction accompanied by the compound cleavage when exposed to sunlight. The siderophore isolated from Rivularia sp. PCC 7116, named cyanochelin A, was described in detail by MS and NMR and contains a hydrophobic tail bound to phenolate and oxazole moieties followed by a peptide sequence Gly-Gly-(β-OH-Asp)-Gly-Dhaba (dihydroxy-amino-butyric acid). Phylogenomic analysis revealed the presence of 26 additional cyanochelin-like gene clusters across a broad range of cyanobacterial lineages. Our data suggests that cyanochelins are widespread cyanobacterial siderophores that feature β-OH-Asp and are produced by phylogenetically distant species upon iron starvation. The presence of photolabile siderophores in cyanobacteria, as phototrophic organisms, raises intriguing questions about the possible recipients of the benefits implied by the siderophore presence in the environment.