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SHORT COMMUNICATION

Genomic and phenotypic analysis of siderophore-producing *Rhodococcus qingshengii* strain S10 isolated from an arid weathered serpentine rock environment

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Abstract

The success of members of the genus *Rhodococcus* in colonizing arid rocky environments is owed in part to desiccation tolerance and an ability to extract iron through the secretion and uptake of siderophores. Here, we report a comprehensive genomic and taxonomic analysis of *Rhodococcus qingshengii* strain S10 isolated from eathered serpentine rock at the arid Khalilovsky massif, Russia. Sequence comparisons of whole genomes and of selected marker genes clearly showed strain S10 to belong to the *R. qingshengii* species. Four prophage sequences within the *R. qingshengii* S10 genome were identified, one of which encodes for a putative siderophore-interacting protein. Among the ten non-ribosomal peptides synthase (NRPS) clusters identified in the strain S10 genome, two show high homology to those responsible for siderophore synthesis. Phenotypic analyses demonstrated that *R. qingshengii* S10 secretes siderophores and possesses adaptive features (tolerance of up to 8% NaCl and pH 9) that should enable survival in its native habitat within dry serpentine rock.

Keywords *Rhodococcus qingshengii* · Desiccation · Siderophores · Serpentinite · Phenotype · Pan-genome

Members of the genus *Rhodococcus* (phylum *Actinobacteria,* family *Nocardiaceae*) can degrade and transform a range of environmental pollutants or synthesize compounds with commercially useful applications (Christofi and Ivshina 2002). Over the past 20 years, rhodococci have found predominant use as a bioremediation and bioconversion tool with relatively little attention given to their potential for biosynthesis of natural products for use in the pharmaceutical and agricultural sectors (Ceniceros et al. 2017).

Along the spectrum of rhodococcal metabolites, there are several hydroxamate- and catecholate-type siderophores, including heterobactins, rhodobactin, rhodochelin, rhequichelin and rhequibactin (Bosello et al. 2011, 2013; Carrano et al. 2001; Dhungana et al. 2007; Miranda-CasoLuengo et al. 2008). Siderophores also find numerous applications in ecology (increasing iron availability to soil microorganisms), agriculture (biological control of plant pathogens and plant growth promotion), bioremediation (detoxifying heavy metal contaminated sites), and medicine (regulation of oxidative stress, providing of antibacterial activity, mediating delivery of antibiotics to antibiotic resistant bacteria, treatment of iron overload diseases, antimalarial activity, and cancer therapy) (Johnstone and Nolan 2015; Saha et al. 2016).

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