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A structural and functional investigation of the periplasmic arsenate-binding protein, ArrX from Chrysiogenes arsenatis

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Arsenic is a toxic metalloid found both naturally in the environment and as a harmful pollutant generated from industrial waste waters and gold mines. Arsenic can exist in both organic and inorganic forms and in four oxidation states: arsines and methyl arsines (As3-), elemental arsenic (As0), arsenite (AsO33-) and arsenate (AsO43-). Although arsenic is toxic and hazardous to human health, some prokaryotes have developed unique mechanisms that utilise inorganic forms of arsenic, such as arsenite (AsO33-) and arsenate (AsO43-) for respiration [2].

Such prokaryotes include Rhizobium NT-26 and Chrysiogenes arsenatis which utilise the arsenite oxidase enzyme (Aio) and the arsenate reductase enzyme (Arr), respectively for their crucial respiratory activities. In these bacteria, the periplasmic binding proteins (PBPs) AioX and ArrX bind to arsenite (AsO33-) and arsenate (AsO43-), respectively and trigger, through sensor histidine kinase signalling, the expression of their respective respiratory enzymes [3]. The structure of the AioX protein has been previously reported in the presence and absence of arsenite (AsO33-) [4]. In order to investigate the structural basis of arsenate (AsO43-) binding to the ArrX protein, we determined its crystal structure in the presence and absence of substrate. This presentation will describe the structure of ArrX and a structural comparison between it and that of the AioX protein, in order to determine the molecular mechanisms by which these proteins discriminate between the chemically similar substrates arsenate (AsO43-) and arsenite (AsO33-).

Keywords: arsenate, Chrysiogenes arsenatis, periplasmic binding protein (PBP), X-ray crystallography.

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Primary author(s) : Ms PODDAR, Nilakhi; Dr BADILLA, Consuelo; Dr MAGHOOL, Shadi; Dr OSBORNE, Thomas H; Prof. SANTINI, Joanne; MAHER, Megan (A/Prof)

Presenter(s) : Ms PODDAR, Nilakhi

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