In vivo and in vitro study on 3-hydroxypropionic acid-inducible transcription activator protein, MmsR of Pseudomonas denitrificans

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MmsR (33.4 kDa) is a putative LysR-type transcriptional activator protein of Pseudomonas denitrificans. With the help of 3-hydroxyproionic acid (3-HP), MmsR regulates the expression of mmsA and hbdH-4, which encode methylmalonylsemialdehyde dehydrogenase and 3-hydroxyisobutyl dehydrogenase, respectively, the enzymes involved in valine degradation. Transcription of the mmsA and hbdH-4 was enhanced by >140 fold in the presence of 3-HP as an inducer. The transcription activation disappeared when mmsR was deleted from the chromosome, but was recovered by complementation of mmsR from a plasmid. Electrophoretic mobility shift assay indicated that MmsR could bind to two adjacent operator sites located in the divergently overlapping promoter region present between mmsR and mmsA. The two operators, designated O1 and O2, contained sequences of dyad symmetry centered at position −58 and −9, respectively, upstream of the mmsA transcription start site. This study should be useful for developing inducible promoter and sensor which responds to 3-HP, an important platform chemical.