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High binding affinity of repressor IolR avoids costs of untimely induction of myo-inositol utilization by Salmonella Typhimurium.

Hellinckx J[1], Heermann R[2], Felsl A[1], Fuchs TM[1,3].

Author information

Abstract

Growth of Salmonella enterica serovar Typhimurium strain 14028 with myo-inositol (MI) is characterized by a bistable phenotype that manifests with an extraordinarily long (34 h) and variable lag phase. When cells were pre-grown in minimal medium with MI, however, the lag phase shortened drastically to eight hours, and to six hours in the absence of the regulator IolR. To unravel the molecular mechanism behind this phenomenon, we investigated this repressor in more detail. Flow cytometry analysis of the iolR promoter at a single cell level demonstrated bistability of its transcriptional activation. Electrophoretic mobility shift assays were used to narrow the potential binding region of IolR and identified at least two binding sites in most iol gene promoters. Surface plasmon resonance spectroscopy quantified IolR binding and indicated its putative oligomerization and high binding affinity towards specific iol gene promoters. In competitive assays, the iolR deletion mutant, in which iol gene repression is abolished, showed a severe growth disadvantage of ~15% relative to the parental strain in rich medium. We hypothesize that the strong repression of iol gene transcription is required to maintain a balance between metabolic flexibility and fitness costs, which follow the inopportune induction of an unusual metabolic pathway.

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