SL309

Signal Transduction and Regulatory Mechanisms of the Phosphate Regulon in *Escherichia coli*

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In *Escherichia coli* at least 31 genes, which are involved in the roles related to the transport and assimilation of phosphate and phosphorus compounds, are induced by phosphate starvation. They constitute a single phosphate (Pho) regulon and are under the same physiological and genetic control. The proteins PhoB and PhoR, which are regulatory systems for the transcriptional regulation of the pho genes, belong to a family of two-component regulatory factors that respond to a variety of environmental stimuli in bacteria. PhoB is the transcriptional activator, which binds to the promoters of the pho genes. PhoR is a transmembrane protein that modulates the activity of PhoB by promoting specific phosphorylation and dephosphorylation of PhoB in response to the phosphate signal. The phosphorylation of PhoB protein occurs concurrently with acquisition of the ability to activate transcription from the pho promoters in concert with RNA polymerase that consists of the 2 α, β, β' and σ^{70} subunits. Mutational analysis has indicated that PhoB interacts with the σ^{70} subunit in transcriptional activation. Structural analysis of C-terminal half of PhoB protein was performed by NMR. Based on the structure and mutational analysis, I will demonstrate that the DNA-binding structure of PhoB is like the Helix-turn-Helix motif that found in the Histon 5H. Mutational analysis has indicated that the turn structure of PhoB interacts with RNA polymerase in transcriptional activation. To determine the specific amino-acid residues that interact with target DNA, I have isolated an allele specific PhoB mutant that transcribed a mutant promoter, but could not transcribe the wild-type promoter. The mutation site is located in the second helix of the helix-turn-helix motif.