NMR-Study of the Lac Repressor-Lac Operator Interaction

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Specific binding of the lac repressor to the lac operator of Escherichia coli as well as non-specific binding to non -operator DNA and to synthetic polynucleotides have been studied with NMR. It can be demonstrated by proton NMR spectroscopy that the amino-terminal region of the lac repressor (residues 1 to 59) forms an independent structural domain which is linked to the tetrameric repressor core by a flexible hinge region (1). The narrowness of the corresponding proton resonances indicates that the DNA-binding domains have a faster tumbling rate than would be expected if they were an integral part of the repressor.
The interaction of the N-terminal DNA binding domain of the lac repressor with synthetic oligo(d (AT)) was studied using a photo CIDNP technique (2). Three of the four tyrosines of the "headpiece" are found to be accessible to the photo sensitive dye, since the corresponding ring proton resonances are enhanced in the photo CIDNP ^{1}H-NMR spectrum. Also the only histidine (His 27) is located at the surface of the domain.After complex formation of the headpiece with oligo (d (AT)) two of the three tyrosine residues are no longer accessible to solvent or photo sensitive dye which is strong evidence that the two tyrosines are part of the contact region.
In the 500 MHz ^{1}H-NMR spectrum the base pair H-bond proton resonances of the lac operator appear as well resolved separable signals. Using a ring current shift calculation procedure structural parameters may be obtained. With the addition of small amounts of the lac repressor headpiece characteristic changes are observed in the spectrum. It can be concluded that the lac operator changes its DNA structure when interacting with the lac repressor.

1. Buck, F., Rüterjans, H. and Beyreuther, K. (1978) FEBS Lett. 96, 335 - 338.
2. Buck, F., Rüterjans, H., Kaptein, R. and Beyreuther, K. (1980) Proc. Natl.Acad. Sci. U.S. in press.