

Conformational Change of the Glucose/Galactose-Binding Protein

Katherine Robinson, and Amil G. Anderson

Department of Chemistry, Wittenberg University, Springfield, OH

Galactose/glucose-binding protein (GGBP) is a periplasmic monomeric protein found in a number of gram negative bacteria, including *Escherichia coli* (Fonin, et al. 2017). The protein stimulates chemotaxis towards D-galactose and D-glucose and binds with a high affinity to glucose (Fonin, et al. 2017). GGBP is made up of two globular domains that are connected by a hinge region to form the sugar binding site (Borrok, et al. 2007). When the protein interacts with the ligand, it undergoes significant conformational changes (Brown, et al. 2016).

Understanding how the ligand binds with the protein and the free energy change associated with the protein conformational change is the focus of this research. GROMACS was used to perform free energy molecular dynamic simulations. Using center of mass pulling to move one of the globular domains of the protein in the closed form, GGBP was forced open while bound to the β -anomer of glucose. Umbrella sampling and Weighted Histogram Analysis Method (WHAM) were used to determine the free energy change of the system.

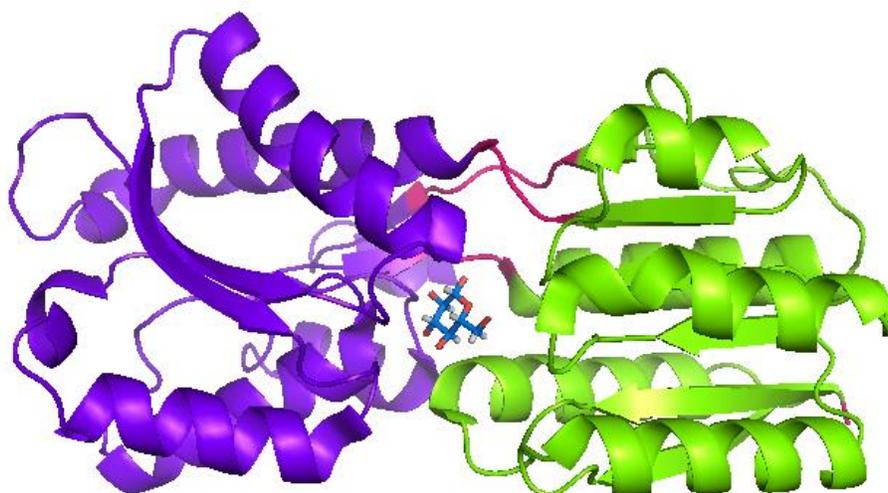


Figure 1: Closed conformation of the glucose/galactose-binding protein with β -anomer glucose (using stick rendering). C-terminal (residues 112-252 and 297-306) is shown in purple, N-terminal (residues 3-108 and 258-291) is shown in green, and hinge region displayed in pink. Image rendered using PyMOL.

Borrok, J. M. Kiessling, L. L. Forest, K. T. (2007). Conformational changes of glucose/galactose-binding protein illuminated by open, unliganded, and ultra-high-resolution ligand-bound structures. *Protein Science*, **16**: 1032–1041.

Brown, S. R. El-Sayed, M. M.H. Mupparapu, K. Tolosa, L. (2016). The effect of pH on the glucose response of the glucose–galactose binding protein L255C labeled with Acrylodan. *International Journal of Biological Macromolecules*, **86**: 282-287.

Fonin, A. V. Silonov, S.A. Sitdikova, A. K. Kuznetsova, I. M. Turoverov, K. K. Uversky, V. N. (2017). Structure and Conformational Properties of D-Glucose/D-Galactose-Binding Protein in Crowded Milieu. *Molecules*, **22**:1-16.