

Proteins; Their Hard and Soft Wares

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Proteins are composed of amino acids and small amount of other elements. Amino acids form a polypeptide chain, which folds into a tertiary structure. I will talk about two types of proteins involved in the energy transduction systems from the view point of hard and soft wares. One is a kind of electron transport proteins, cytochromes [1], the other is H^+ -ATP synthase [2-4]. Cytochromes are ubiquitous proteins that are involved in a wide variety of redox reactions in most living cells. Some cytochromes have multiple hemes - generally protoporphyrins coordinated irons. Multiheme cytochromes are mainly found in bacteria, the ancestors of which can be traced back more than 500 million years to the anaerobic world. I will discuss multiheme architectures in *c*-type cytochromes that have hemes covalently linked to the polypeptides. F_0F_1 -ATP synthase is a multisubunit enzyme that catalyzes ATP synthesis in oxidative phosphorylation and photophosphorylation using the electrochemical potential of proton gradient. This enzyme consists of two components, F_0 and F_1 . The simplest F_1 portion (F_1 -ATPase) has five kinds of subunits with a stoichiometry of $\alpha_3\beta_3\gamma_1\delta_1\epsilon_1$. The catalytic site is located in the β subunit at the α - β interface. In the crystal structure of F_1 from bovine heart mitochondria (MF_1), the three catalytic sites located in the β subunits are not equivalent. Membrane-integrated F_0 mediates H^+ -translocation across the membrane. Simplest F_0 comprises $a_1b_2c_{10-14}$ subunits. I will discuss how the expression of the function is programmed in the hard ware.

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