Protein structure and function

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Introduction DNA polymerase is an enzyme that plays a central role in the synthesis of DNA molecules through the process of DNA replication. It does so by catalyzing the formation of phosphodiester bonds between the phosphate group of a deoxynucleoside 5’-triphosphate and a 3’-hydroxyl end of a nucleotide in the growing chain (Styrer et al. 2002).

Primary Structure

The primary structure of DNA polymerase depends on the organism from which the enzyme has been isolated. The number and sequences of amino acids vary in the different subunits in different species. The amino acid sequence is responsible for the activities of the different subunits, for example, the exonuclease and excision activities in DNA polymerase I of prokaryotes (Gilbert 2000).

Secondary Structure

The secondary structure of DNA polymerase comprises both the alpha helices and beta sheets as shown in the below diagram.

Helices and beta sheets in DNA polymerase (Argiriadi et al. 2006)

Tertiary Structure

The alpha helices in DNA polymerase organize themselves in the form of coiled coils, which are bundles of alpha helices that form superhelices. Hydrogen bonds and Van der Waal forces of attraction play a significant role in the tertiary structure of DNA polymerase. This gives a 3-D appearance of a clamp. For example in Gram-negative bacteria such as E. coli, DNA polymerases sustain nearness with nucleic acid templates by means of contact with sliding clamps, which enclose DNA thus connecting the polymerase and the substrate of the DNA (Argiriadi et al. 2006).

Quaternary Structure

DNA polymerase has several non-identical subunits depending on the type of organism in question. In eukaryotes, there are five different subunits namely alpha, beta, gamma, delta, and epsilon (Gilbert 2000). These subunits interact in the process of DNA replication with each subunit playing a distinct role.

DNA polymerase also has several domains such as the zinc finger domain and the DNA binding domains. The zinc fingers comprise of interactions between sulphide, nitrogen and oxygen atoms of the neighbouring peptides with a zinc ion. These regions influence the function of DNA polymerase by enabling the binding of the enzyme to the template strand of DNA at the replication fork before the process of replication can commence (Styrer et al. 2002).

References

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