Extremophilic Proteins

Life has been found across the planet in conditions that vary greatly in temperature, acidity, salinity and aridity. Proteins are the molecules that do the work in keeping cells alive, so to survive in extreme conditions these proteins need to be adapted. These adaptations adjust the forces that hold the molecules together. The proteins are then able to carry out the processes essential to cell survival. This includes the fundamental mechanism of interactions between proteins and the nucleic acids, DNA and RNA.

The Cold Shock Protein has been identified in many organisms from various environments. This protein binds to nucleic acids when there is a drop in temperature and is thought to help maintain protein production. It has a highly conserved structure but small differences in the amino acid sequence can cause folding incorrectly. Understanding extreme proteomes helps us appreciate how life may have evolved in past climates. It also exposes the limits of what can be survived, which may aid the search for life outside our planet.

Measuring Protein Mechanics

The mechanical properties of proteins can be measured using an Atomic Force Microscope. This uses the deflection of a small cantilever to measure piconewton forces and can be utilised to pull apart proteins one molecule at a time. The force required to unfold a protein indicates its stability, and this method can be used to measure other mechanical data.

Protein-DNA Interactions

DNA needs to constantly be copied, repaired and read for healthy growth and reproduction. Any mistakes have the potential to cause huge problems for the organism. Much of this work is carried out by proteins.

Applications

Proteins as Building Blocks

Protein based hydrogels are exciting new materials being explored for biomedical and biotechnological applications, with the potential for smart materials which respond to external stimuli. These hydrogels could be applied to wound healing, targeted drug delivery and have the advantage of being biocompatible. Mechanically and thermally stable proteins are required for this application.

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