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Structural and Functional Stabilization of Protein Entities

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Stabilization of protein and protein-like molecules translates into preservation of both structure and functionality during storage and/or targeting, and such stabilization is mostly attained through establishment of a thermodynamic equilibrium with the (micro)environment. The basic thermodynamic principles that govern protein structural transitions and the interactions of the protein and/or peptide molecule with its (micro)environment will, therefore, be tackled. Protein stabilization is based upon dampening the molecular motions and, therefore, eliminating conformational transitions while the molecule is still in the native 3D (folded) state. The 3D structure of a protein molecule depends mostly on two types of interactions: intramolecular interactions between aminoacid moieties and intermolecular interactions with solute and/or solvent molecules present in its microenvironment. Stabilizing a biomolecule (aiming at preserving its function) involves dampening its molecular motions, and this can be achieved by reducing the chemical activity of the water present in its microenvironment, thus stabilizing both its structure and functionality. Recently, the simultaneous entrapment-stabilization of proteins and enzymes based on nanoencapsulation in a nanoemulsion (W/O/W) matrix with an hydrophilic core has started to gain momentum. Similarly to the stabilization mechanism of osmolytes, in nanoencapsulation the water activity is altered thus affecting the molecular motions of the proteins. Highlights will also be given to structural and functional stabilization of protein entities (viz. enzymes, (macro)peptides, (recombinant) proteins, and bacteriophages) by chemical methodologies. Modification of the biomolecule's microenvironment via multipoint covalent attachment onto a solid surface followed by hydrophylic polymer co-immobilization, are some of the (latest) strategies that will be discussed.

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