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EDITORIAL

PROTEINS FUNCTIONALIZATION: A STRATEGY THAT BOOST THE PERFORMANCE OF THESE MACROMOLECULES FOR INNOVATIVE PHARMACEUTICAL AND FOOD DEVELOPMENTS

Proteins are macromolecules exhibiting amphiphilic properties, good biocompatibility, biodegradability, high nutritional value, and show strong interactions with several types of active compounds via hydrogen bonding and electrostatic interactions (1). These plant or animal-derived macromolecules differ in their molecular size depending on the number of amino acids present in their structure, which in turn, are linked by peptide bonds between the carbonyl (-CO-) and amino groups (-NH) (2). This amino acid sequence has its particular three-dimensional or folded organization, which provides each protein with (i) techno-functional characteristics (i.e., gelling, emulsifying, coagulating and encapsulating capabilities, softener, adsorbents, etc); (ii) biological (i.e., nutritional value, transport, and other enzymatic functions); and (iii) bioactive (i.e., antioxidant, antimicrobial, anticoagulant or anti-inflammatory activities) characteristics, which are essential in the pharmaceutical and food fields (3). Another factor that affects the functional characteristics of proteins is their source. Thus, proteins derived from vegetable sources are larger, less flexible, and less soluble in extreme pH ranges. Further, they have a globular conformation with more hydrophobic groups hidden within the molecular structure as compared to the animal counterparts (4). However, animal-derived proteins are the most widely used due to their easy processing and water solubility. In order to match those characteristics vegetable proteins can be functionalized, making them more biodegradable and biocompatible. Moreover, they are renewable, highly available, their productions implies less natural resources, and are considered as "environmentally economical" (5).

The most widely used strategy to potentiate or award a techno-functional, biological or bioactive characteristic to proteins, independent of their source is by incorporating structural modifications resulting in the exposure of a substituent, size decrease or the addition of a new functional group. Thus, protein modifications can be classified as chemical, enzymatic or physical (4). Chemical and enzymatic modifications involve the cleavage of peptide bonds in smaller peptides, or the incorporation of functional groups by hydrolytic processes, acylation reactions (i.e., fatty molecules), cationization reactions (i.e., cationic groups), or Maillard reactions (i.e., reducing sugars). It is known, that by conducting some of these modifications peptides with antioxidant and/or antimicrobial capacity are obtained (6). For instance, the hydrolyzed bovine blood proteins acquire the capacity to capture the ABTS, FRAP, and DPPH radicals; and inhibit the growth of mesophilic microorganisms, molds and yeasts in a colloidal matrix. Other studies increased the emulsifying and encapsulating capacity of proteins (7). For example, by conducting the Maillard reaction in proteins is possible to encapsulate the tomato oleoresin using soy proteins conjugated with gum arabic as a coating material. This modification was carried out at 60°C and relative humidity of 79% for 3, 6 and 9 days, rendering the best encapsulation efficiency (i.e., 69.25% to 84.69%) after 9 days of reaction. On the other hand, the work of Nesterenko *et al*. 2014 (8) was focused on the encapsulation of α-tocopherol by spray-drying employing hydrolyzed, acylated and cationized soy proteins and native sunflower seeds. Interestingly, all the structural modifications in the proteins favored the stability of the resulting emulsions, increasing the encapsulation efficiencies by 13% and 20% for the acylated soybean and sunflower proteins, respectively.

On the other hand, a physical modification, such as the high-pressure and thermal treatments, can affect the hydrophobic or electrostatic interactions, and disulfide or hydrogen bondings, which are responsible for the stabilization of the quaternary, tertiary and secondary protein structures. Thus, it is reported that the high hydrostatic pressure (400 MPa) in bovine lactoferrin and bovine serum albumin causes a modification in the tertiary and secondary structure in a more deployed conformation improving the solubility, foam and emulsifying properties, whereas the stability of the emulsion was decreased (9).

The above-mentioned studies demonstrate the great awareness and impact of modified proteins in the development of new materials intended for pharmaceutical or food consumption.

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