Protein Nanofibers as Pickering Emulsion Stabilizers

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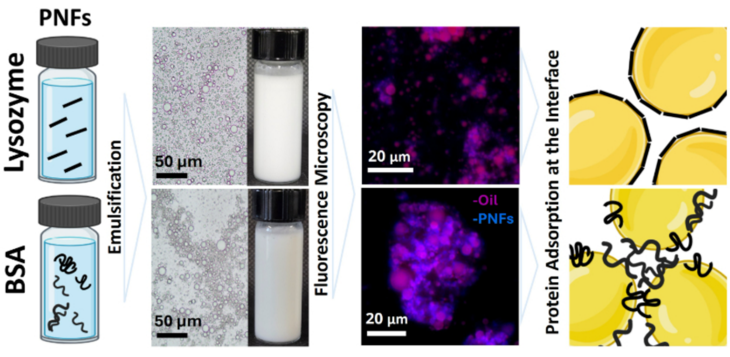
Pickering emulsions are systems in which solid particles rather than conventional surfactants stabilize the interface between immiscible phases. [1] Although traditional surfactants are highly effective, many are derived from petroleum sources and in addition may pose risks to human health and the environment. [2] Protein-based materials are attractive due to their abundance, relatively low cost, surface activity, and the presence of diverse amino acid functional groups. However, native proteins are prone to degradation, whereas emulsion-based products typically require extended shelf lives. Proteins can self-assemble into highly organized fibrillar aggregates, also known as protein nanofibers (PNFs). [3] High-purity proteins obtained as byproducts of agricultural processes and food processing, such as bovine serum albumin from beef production and lysozyme from chicken eggs, have emerged as promising candidates for PNF formation. [4,5]

In this work, protein nanofibers derived from bovine serum albumin and lysozyme were evaluated as stabilizers for oil-in-water Pickering emulsions. Stable emulsions with discrete, well-dispersed droplets and monomodal size distributions were obtained at oil contents of up to 50 wt.% and remained stable for up to six months, demonstrating highly competitive long-term stabilization relative to previously reported bio-based nanoparticles. The effects of protein concentration, pH, ionic strength, and suspension conditions on emulsion stability were systematically investigated. Overall, lysozyme nanofibers provided superior stabilization compared to BSA nanofibers. This difference is attributed to the higher surface charge of lysozyme PNFs, which promotes stronger electrostatic repulsion between droplets, as well as more effective interfacial coverage compared with the more flexible BSA PNFs. These results demonstrate the potential of protein nanofibers as bio-based Pickering stabilizers for formulations in food, cosmetics, and pharmaceutical applications.

Keywords:
Protein nanofibers, Pickering emulsion, BSA, Lysozyme



Schematic of protein nanofiber emulsions and proposed mechanism of adsorption at the interface

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