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Interfacial proteins and peptides: Steric protection of oil-in-water emulsions for oxidative stability

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Proteins and peptides are amphiphilic macromolecules that exhibit affinity for both lipids and water. At the oil/water interface, the adsorbed proteins act as a physical barrier and create a hydration layer to prevent oil droplets from coalescence. Comminuted meat batters, whipped creams and soymilk are examples of emulsion products where proteins function as a stabilizer. The role of a protein membrane, in comparison with small surfactants such as tween 20 and lecithin, is beyond its emulsifying activity. The presence of radical-scavenging as well as reducing and metal ion-chelation groups within a protein or a peptide lends itself to chemical antioxidant potential. Interestingly, the antioxidative capacity of proteins and peptides is significantly accentuated when they are located at the oil/water interface, indicating steric hindrances against reactive oxygen species (ROS) and other oxidants. In our studies, that compare antioxidant activities of muscle, soy and milk proteins distributed in the continuous aqueous phase versus proteins located at the surface of emulsion oil droplets, we have observed remarkable efficacy of interfacial proteins. This is manifested by the more pronounced oxidative changes in interfacial proteins and peptides (carbonyl formation, sulfhydryl loss, intrinsic fluorescence attenuation, as well as aggregation) than proteins in the aqueous phase which, in effect, spares unsaturated lipids from oxidative attack. Confocal laser scanning microscopy (CLSM), total internal reflection fluorescence (TIRF), as well as cryo-transmission electron microscopy (CTEM) provides physical evidence for such ROS-deterring effects of the interfacial proteinaceous membrane. Structural and rheological characteristics of the membrane and the hydrated interface can be modulated through the modification of protein structure and manipulation of the surrounding ionic environment. Novel analytical instrumentation has made it possible to probe the insight into such biophysical roles of proteins and peptides.

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