

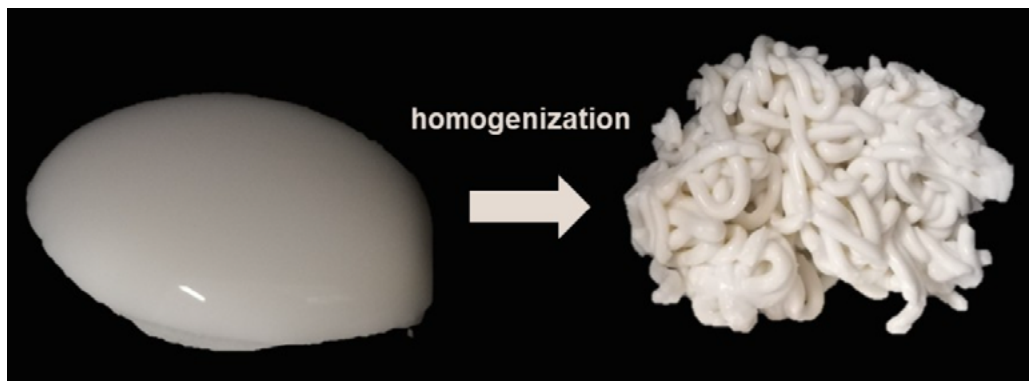
Oleosomes (natural lipid droplets) as building blocks for structured emulsion gels

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Structured emulsion gels are semi-solid systems in which liquid oil is entrapped within a three-dimensional network formed by structuring agents [1]. These systems have attracted significant interest in food, pharmaceutical, and cosmetic applications as healthier alternatives to solid fats. In this context, oleosomes, natural lipid droplets derived from plant seeds, are promising candidates for emulsion gel formation due to their semi-solid nature and interfacial stability provided by their phospholipid-protein membranes [2]. At high ζ -potential values, oleosomes act as repulsive emulsions, where electrostatic interactions among densely packed droplets can induce gelation. Here, building on this repulsive behavior, we aimed to create a structured material by downsizing the oleosomes using a high-pressure homogenizer (20,000 psi, six cycles). Rheological (SAOS, LAOS) characterization revealed that reducing droplet size ($D_{[4,3]}$ from 3.92 ± 0.02 to 0.80 ± 0.04 μm) markedly increased the elastic modulus (from 120 to 5600 Pa) and the intensity of G'' overshoots due to structural relaxation, suggesting the formation of a repulsively jammed state upon high-pressure homogenization. Although the ζ -potential remained unchanged (46.92 ± 0.54 and 43.57 ± 0.87 mV), the enhanced elasticity indicates denser packing due to the increase in effective volume fraction of the oil droplets [3]. Thus, these findings highlight that oleosomes can be engineered as a self-structured material to develop natural structured emulsion gels that mimic the textural and functional properties of solid fats.



Effect of high-pressure homogenization on electrostatically repulsive oleosome emulsion.

References:

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