Coalescence in soy protein-stabilized emulsion drops during drying

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During drying, sessile drops of colloidal suspensions, including emulsions, often develop a solid-like shell as evaporation progresses. The drying Péclet number captures the balance between the diffusion and evaporation time scales. It predicts the occurrence of instabilities, such as the formation of a skin due to particle accumulation near the interface [1]. In an evaporating emulsion drop, in consequence of water loss, dispersed oil droplets are compressed and the increasing oil volume fraction promotes destabilization processes such as coalescence due to film rupture [2]. We study the development of those instabilities in emulsions formed using commercial soy protein (whole and fractions thereof), under specific temperature and physico-chemical conditions, in real time. These are not only rich colloidal questions, but also relevant in the context of the shift toward more sustainable food ingredients (e.g plant based milk powder).
Controlled sessile drop drying experiments, used as a model for industrial spray-drying [3], combined with image analysis, allow us to characterize in real time the emergence and evolution of coalescence in plant-protein-stabilized emulsions. Adjusting the air flow, temperature, and humidity allows us to tune the drying Péclet number and the formation of the shell. The dynamics of coalescence are being analyzed to quantify how formulation parameters (protein concentration, oil fraction, ionic strength) and drying conditions (temperature, airflow, relative humidity) influence this process. We capture the dynamics of droplet-droplet coalescence, as well as oil leakage occurring during the slow drying of an emulsion drop on a hydrophobic surface (Figure 1).

Keywords:
Emulsion, Drying, Plant protein, Coalescence, Food

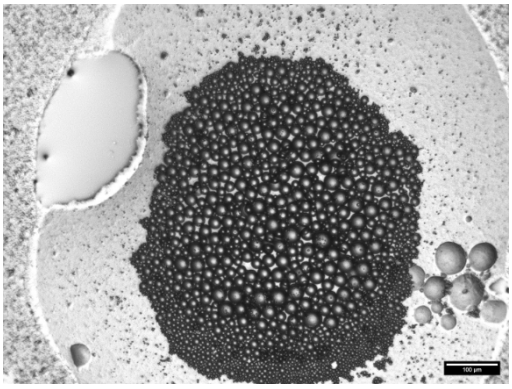

Figure 1: Bottom view of an evaporating emulsion drop (slow drying) on a hydrophobic surface

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