Rescaling of flow curves for food emulsions

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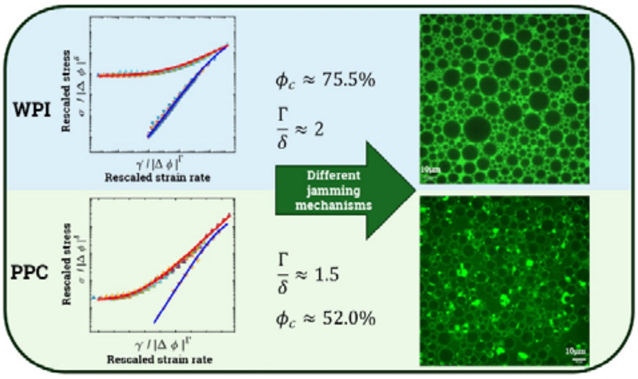
There is growing interest in replacing dairy proteins with plant-based counterparts in food emulsions. This substitution is likely to alter how droplets interact, because plant-based emulsions contain a substantially higher insoluble protein fraction. Plant proteins can therefore act as Pickering particles, which significantly alter interfacial properties. In this study, we mechanically characterize emulsions stabilized by dairy or plant proteins by measuring their steady-state flow curves near the jamming point. For both protein types, flow curves can be rescaled onto master curves above and below jamming. However, we find two important differences. First, plant proteins dramatically reduce the jamming volume fraction compared to its value for soluble dairy proteins. And second, the scaling exponents required to collapse the data differ significantly. Using microscopy and an effective packing fraction in Pickering emulsions, we relate these differences to the interfacial microstructure of the emulsions. These findings provide new insights into how insoluble plant protein fractions alter emulsion behavior, which is essential for the rational design of plant-based food formulations with desired flow properties.

Keywords:
Emulsion, Rheology, Pea protein, Whey protein, Rescaling



From left to right: Rescaled stress - Rescaled strain curves for whey protein isolate (WPI) and pea protein concentrate (PPC), their corresponding critical packing fractions and rescaling coefficient ratio and the resulting difference in emulsion microstructure.