Processing-induced structural changes in pea proteins and their impact on interfacial functionality and emulsion stability

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In the plant-protein sector, industrial processing is still primarily optimised to maximise extraction yield rather than to tailor functional properties relevant to food applications. Yet, in modern food design, emulsions are not only structural components but also key modulators of lipid digestion, which in turn can trigger physiological mechanisms related to satiation and satiety. The interfacial performance of plant proteins is therefore crucial for designing emulsions that behave predictably both in the product and throughout digestion. To support a shift toward functionality-driven processing, we investigated how three specific steps in pea-protein production (extraction conditions, thermal treatment, and drying) affect protein (micro)structure, interfacial behaviour, and ultimately oil-in-water (o/w) emulsion stability.

Salt extraction and alkaline extraction at mild pH produced proteins with comparable structural features, while extraction at pH 11 resulted in more extensive unfolding and aggregation. Despite this, pH 11 proteins also produced emulsions with small, stable initial droplet sizes and showed superior creaming stability. Drying techniques had only minor effects on protein conformation, whereas thermal treatment considerably increased aggregation and yielded emulsions with larger droplets and reduced stability across all extraction routes. These results demonstrate that processing-induced structural modifications strongly determine the interfacial properties of pea proteins and the resulting stability of o/w emulsions. Understanding these structure-process-function relationships offers valuable insights for developing plant-based emulsifiers that not only stabilise food emulsions but can ultimately be tailored to influence lipid digestion, satiety responses, and the delivery of lipophilic nutrients.

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emulsion stability, pea protein, processing, extraction, protein structure

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