Interfacial properties of pea and lupin protein ingredients: a pivotal effect of endogenous lipids and aqueous suspension pre-homogenization

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The incorporation of plant protein isolates or concentrates as functional ingredients in foods is a means to promote the transition from animal to vegetable proteins. Pea and lupin farming meet sustainability demands and their protein ingredients display promising nutritional properties, yet sometimes poor functionalities. However, the involved mechanisms are still unclear, partly because comprehensive and systematic characterization of those ingredients in terms of composition and physicochemical properties is still lacking. In this work, commercial protein isolate and concentrate of pea and lupin were first thoroughly characterized. A high-pressure homogenization (HPH) treatment was applied to their aqueous suspensions (pH 7.0) to alter their colloidal state and potentially improve their subsequent functionalities. Even though isolates displayed a higher protein content (about 70 wt.% against 40 wt.%), their solubility (defined as the protein fraction remaining in the supernatant after centrifugation) was lower than for the concentrates. Substantial amounts of endogenous lipids in the powders were measured by Folch extraction (from 3.5 to 11 wt.%), of which half were phospholipids, which can have important implications for the interfacial properties of the ingredients. Detailed microscopic investigations (including confocal fluorescence microscopy), as well as static and dynamic light scattering measurements showed that HPH was useful to break down undispersed powder grains, thus enhancing protein solubility and freeing endogenous lipid structures. The interfacial properties of the different suspensions were investigated with an automated drop tensiometer; in particular, oscillatory dilatational deformations of the oil-water interface were conducted to probe the interfacial rheological behaviour of the formed interfacial films. The raw data were analysed by Lissajous plots, which allow for obtaining insights into complex structural arrangements within the films. We have thereby been able to approach the repartition and potential competition between protein and phospholipids for the oil-water interface of ingredients with a complex composition. Those new insights into the non-protein composition and behaviour (in aqueous media and at the oil-water interface) of plant protein fractions are key for improving their functionalities and facilitating food products' rational formulation.