**Solubility influences the colloidal stability of lentil protein emulsions**

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This study investigates the enhancement of thermal and colloidal stability of lentil protein-stabilised emulsions through high-pressure homogenisation (HPH) pre-treatments. Lentil protein dispersions were homogenised at pressures ranging from 0 to 150 MPa and subsequently used to formulate emulsions at total solid concentrations of 29% w/w. The results showed that HPH significantly (p<0.05) improved protein solubility, with an increase from 55.7% at 0 MPa to 93.2% at 50 MPa. This is agreement with the literature on the effect of HPH on the plant proteins ingredients1,2. When the ingredients were used to prepare an emulsion, the particle size distribution analysis showed a reduction in oil globule size, with the volume-weighted mean diameters decreasing from 1.4 µm (0 MPa) to 1.19 µm (150 MPa), indicating an improvement of the interfacial properties of the lentil protein isolate. Indeed, soluble proteins can effectively adsorb at the newly created oil-water interface during homogenisation, therefore reducing interfacial tension and forming a layer around oil droplets and allowing for better physical and heat stabilisation of emulsions3,4. Emulsions prepared from HPH pre-treated dispersions exhibited improved physical stability, with separation rates decreasing from 16.75%/h (at 0 MPa) to 2.05%/h (at 150 MPa). Rheological analysis showed that HPH pre-treatments led to initial apparent viscosities ranging between 28.30 and 22.56 mPa·s for the samples HPH pre-treated at 0 and 150 MPa, respectively. After a thermal treatment at 90°C for 2 min, the pre-treated emulsions had a final viscosity of 34.88 mPa·s, which was significantly (p<0.05) lower than the one measured in the untreated samples (60.52 mPa·s). Confocal laser scanning microscopy images showed a more homogeneous distribution of oil globules and reduced flocculation after the thermal treatment in emulsions prepared from HPH-treated dispersions. Overall, the results indicated an enhancement of the colloidal and thermal stability of the HPH pre-treated samples, and this has been linked with the improved solubility of lentil protein isolates upon the HPH treatment. These findings highlight the potential of HPH as an effective pre-treatment to enhance the techno-functional properties of lentil protein-stabilised emulsions, supporting the development of stable and sustainable plant-based food products.

*References:*

1 Saricaoglu, F.T. (2020). Application of high-pressure homogenization (HPH) to modify functional, structural and rheological properties of lentil (Lens culinaris) proteins. International *Journal of Biological Macromolecules* 144, 760–769.

2 Yang, J., Liu, G., Zeng, H., and Chen, L. (2018). Effects of high pressure homogenization on faba bean protein aggregation in relation to solubility and interfacial properties. Food Hydrocolloids 83, 275–286.

3 Fayaz, G., Plazzotta, S., Calligaris, S., Manzocco, L., and Nicoli, M.C. (2019). Impact of high pressure homogenization on physical properties, extraction yield and biopolymer structure of soybean okara. *LWT*, 113, 108324.

3 Yang, J., Liu, G., Zeng, H., and Chen, L. (2018). Effects of high pressure homogenization on faba bean protein aggregation in relation to solubility and interfacial properties. *Food Hydrocolloids,* 83, 275–286.

4 Yang, J., and Sagis, L.M. (2021). Interfacial behavior of plant proteins—novel sources and extraction methods. *Current Opinion in Colloid & Interface Science*, 56, 101499.