

Title:

Emulsifying performance and thermal stability of hemp-whey microparticulated protein in oil-in-water emulsion systems

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Abstract:

Hemp is a sustainable and promising source of plant-based protein. However, the functionality of commercial hemp protein (HP) remains limited, restricting its broader application in food systems. This study introduces a microparticulation approach to create hybrid protein microparticles by complexing HP with whey protein isolate (WPI) and evaluates their emulsifying properties and potential for stabilizing o/w emulsions.

Emulsions containing 10% oil and 0.25–1.8% protein (either non-microparticulated or microparticulated HP/WPI), were produced to investigate the impact of microparticulation on emulsifying performance and heat stability. Emulsifying ability was assessed using static light scattering, Confocal Laser Scanning Microscopy (CLSM), Transmission Electron Microscopy (TEM) and SDS-PAGE. Additionally, the thermal stability of then emulsions was tested at different temperatures (60, 70, 80 and 90 °C, 20 min).

The emulsions stabilized by non-microparticulated HP/WPI exhibited preferential adsorption of whey protein at the oil–water interface, resulting in effective interfacial coverage across a wide range of protein concentrations (0.25–1.8%). This led to relatively small droplet sizes (~0.5 µm) and minimal flocculation. In contrast, emulsions stabilized by microparticulated HP/WPI in the emulsifier-poor regime (0.25–1%) showed larger droplet sizes and clear signs of bridging flocculation. However, at higher protein concentrations (≥1.5%), microparticulated HP/WPI achieved comparable droplet sizes and stability to the non-microparticulated system, with minimal flocculation.

Microparticulation enhanced the interfacial loading of hemp protein, whereas the non-microparticulated HP/WPI system showed limited hemp protein adsorption. Transmission electron microscopy confirmed the presence of microparticles at the interface. Furthermore, emulsions stabilized by microparticulated HP/WPI demonstrated improved thermal stability compared to those stabilized by non-microparticulated HP/WPI.

These findings highlight the potential of microparticulated HP/WPI systems as effective emulsifiers, expanding the functional applications of hemp protein in the food industry.