STABILITY OF FABA BEAN PROTEIN NANOEMULSIONS

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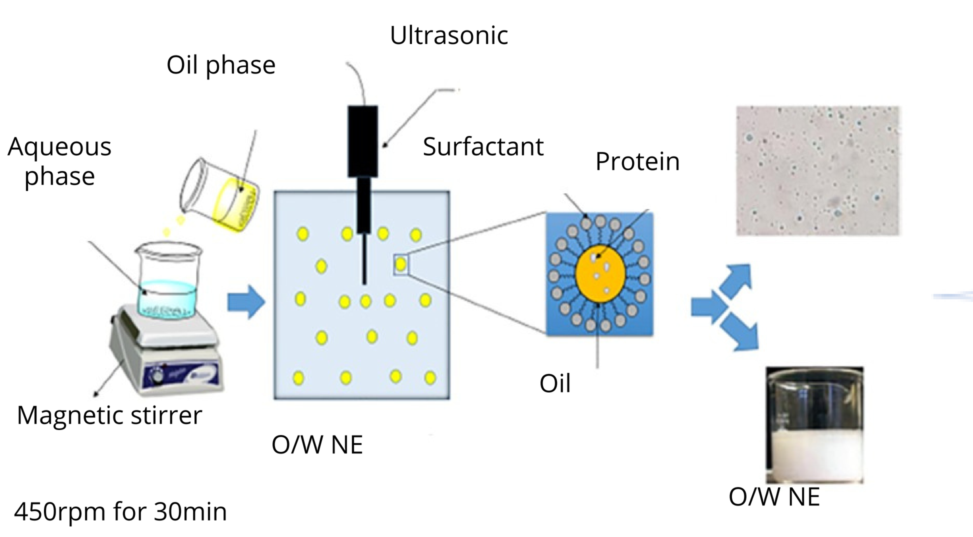
INTRODUCTION

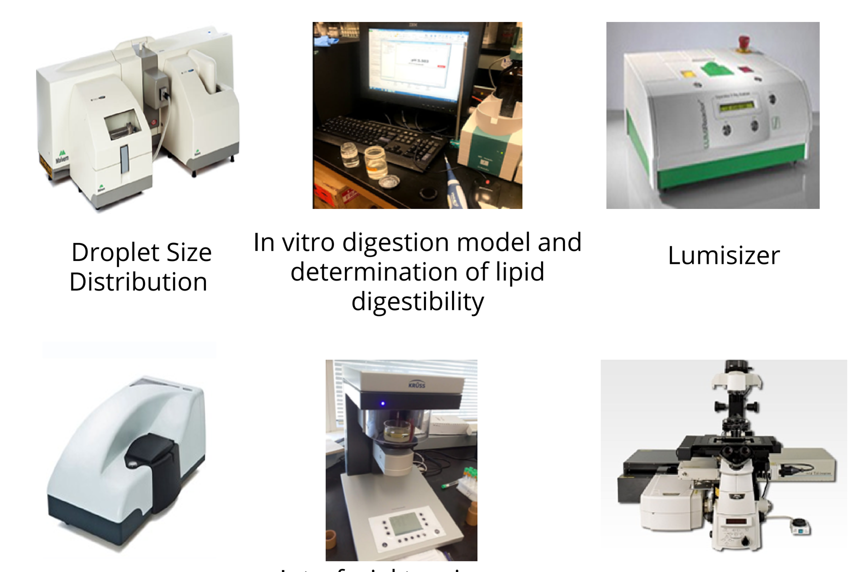
An economically feasible method to form nanoemulsions from faba bean protein isolate (FBPI) and canola oil would not only to increase the nutritional content of processed foods, but would also make delivery of nutraceuticals easier and improve the shelf life of many foods, such as ready to consume baked goods, as well as serving as an emulsifier with food, beverage, pharmaceutical and cosmetic applications.

The current study investigated the use of FBPI in nanoemulsions using high-pressure homogenization (20,000 psi) as a natural emulsifier in oil-in-water emulsions using canola oil.

MATERIAL AND METHODS

Nanoemulsions were prepared by high-pressure homogenization of 5w% oil phase and 95w% aqueous phase at pH 2. The effect of homogenization parameters on physico-chemical properties, such as particle size and stability of FBPI nanoemulsions, were evaluated to identify conditions for optimal properties.





RESULTS AND DISCUSSION

DROPLET SIZE DISTRIBUTION

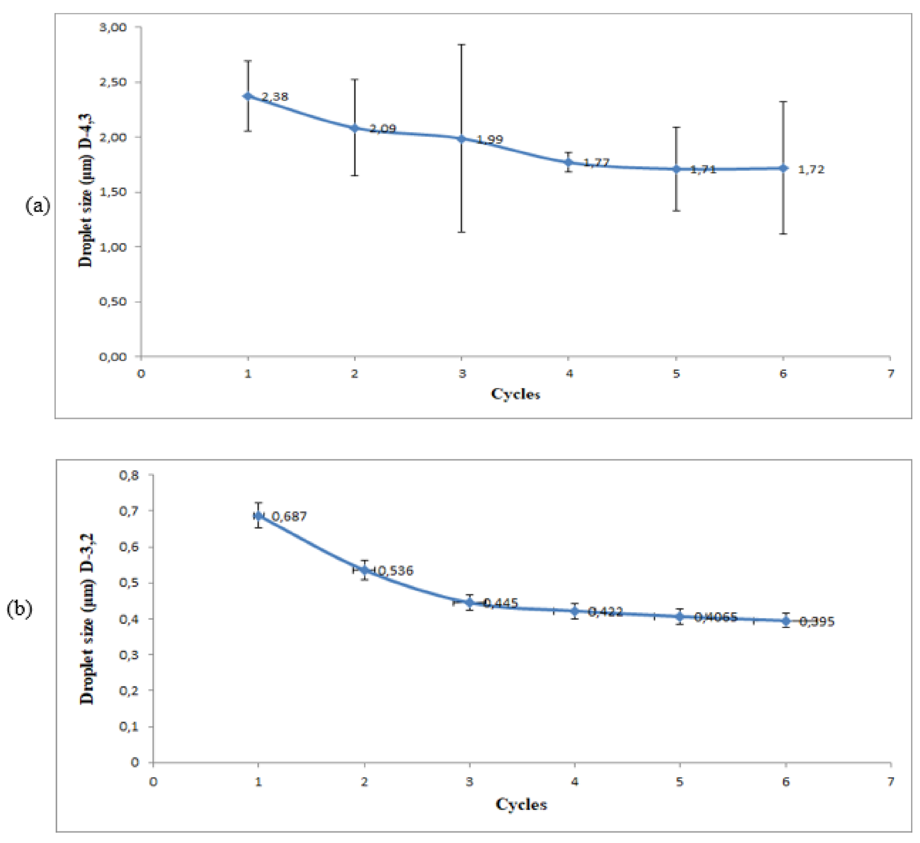


Figure 1. (a) volume weighted mean (d43) (b) surface average mean droplet diameter (d32) of ratio canola oil-in-water NE to FBPI of 5 wt% to 2 wt% FBPI.

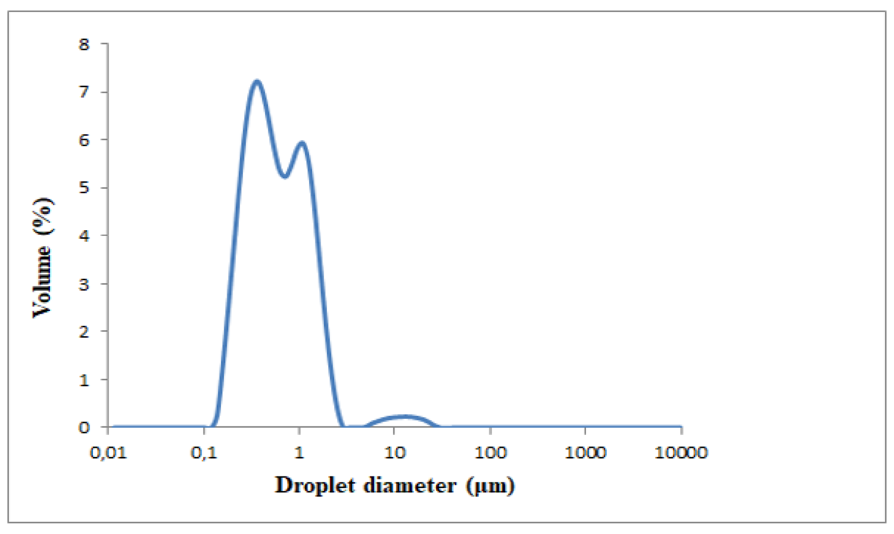


Figure 2. Droplet size distribution (volume-based frequency [%] as a function of particle size [µm]) of protein-stabilized emulsions at day 0 of nanoemulsions 5w% canola oil in water with 2w% faba bean protein.

ACCELERATED STORAGE STABILITY

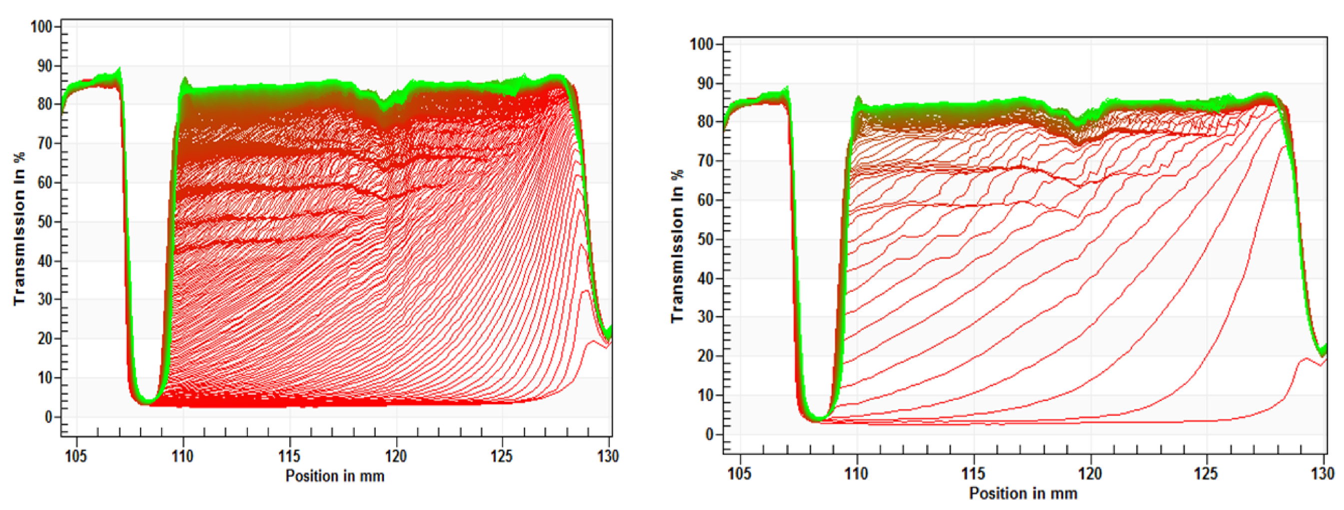


Figure 3. Photocentrifuge transmission profiles of nanoemulsions freshly prepared with 2 wt% faba bean protein. Red and green lines indicate initial and latest transmission profiles, respectively.

ZETA POTENTIAL (Z-POTENTIAL)

The zeta potential of nanoemulsions of 5w% canola oil in water with 2w% faba bean protein was +30 ± 1.46 mV at pH 2.

LUMISIZER

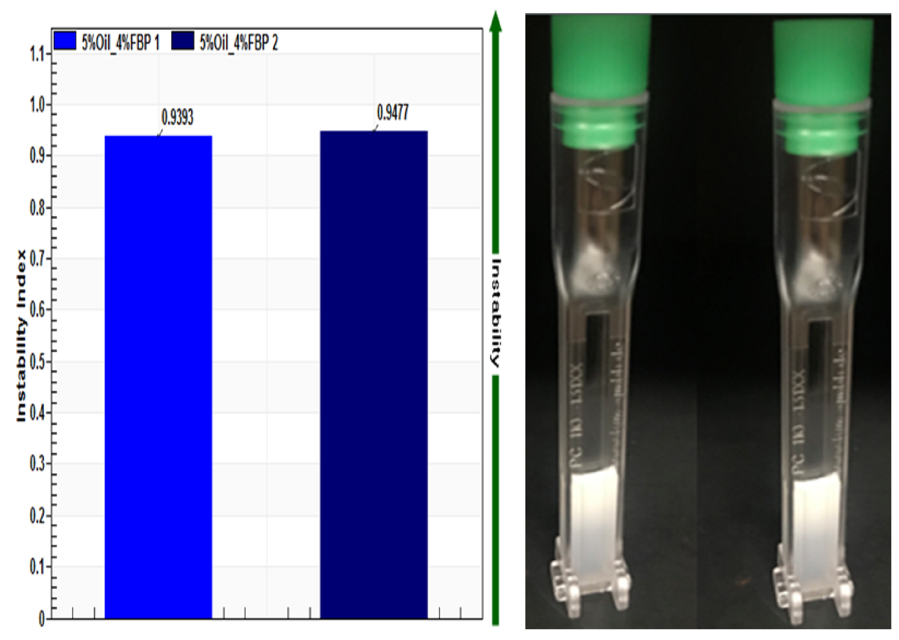
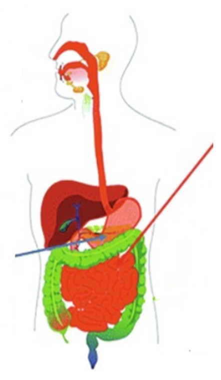


Figure 4. (a) Instability indices, calculated from transmission profiles, of the nanoemulsions prepared 2 wt% faba bean protein, (b) visual observation.

IN VITRO DIGESTION MODEL



The extent of lipid digestion from the nanoemulsions prepared with modified FBP was determined after 2h simulated stomachal digestion followed by 2h simulated intestinal digestion by titrating the released FFA with NaOH using a pH-STAT autotitrator. A rapid increase in FFA release was observed in intestinal digestion where more than 64.54 ± 3.52% of the lipid was digested.

CONFOCAL MICROSCOPY

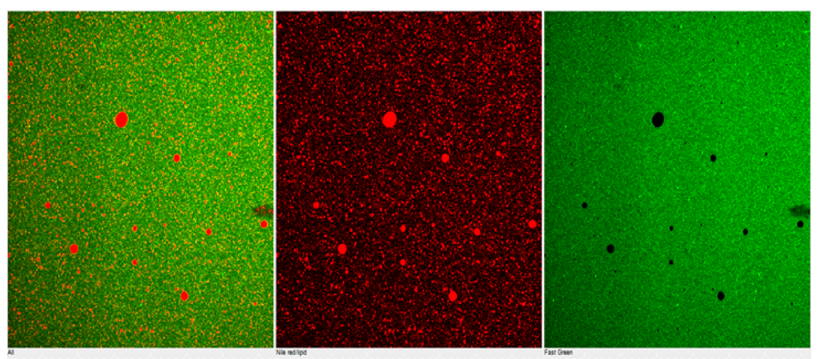


Figure 5. Confocal microscopy with Fast Green at 60x – 1x magnification for 2 wt% FBPI- stabilized nanoemulsion homogenized under high pressure (20,000 psi) in the continuous phase of the nanoemulsions. Oil droplets are red, and the FBPI is green.

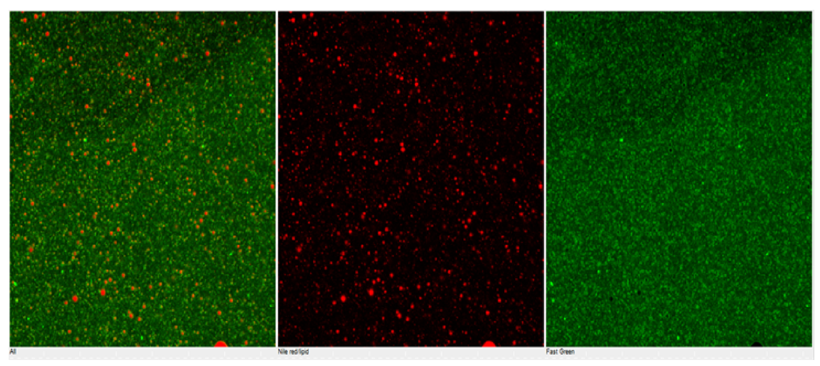


Figure 6. Confocal microscopy with Fast Green at 60x – 2.5x magnification for 2 wt% FBPI-stabilized nanoemulsion homogenized under high pressure (20,000 psi) in the continuous phase of the nanoemulsions. Oil droplets are red, and the FBPI is green.

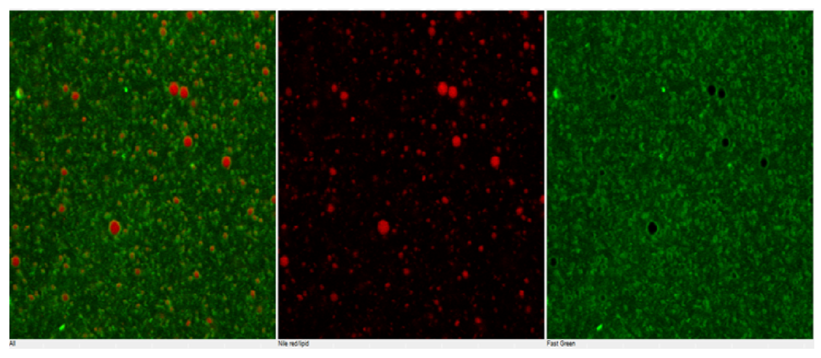


Figura 7. Confocal microscopy with Fast Green at 60x – 5x magnification for 2 wt% FBPI- stabilized nanoemulsion homogenized under high pressure (20,000 psi) in the continuous phase of the nanoemulsions. Oil droplets are red, and the FBPI is green.

INTERFACIAL TENSION OF FABA BEAN PROTEIN SOLUTIONS

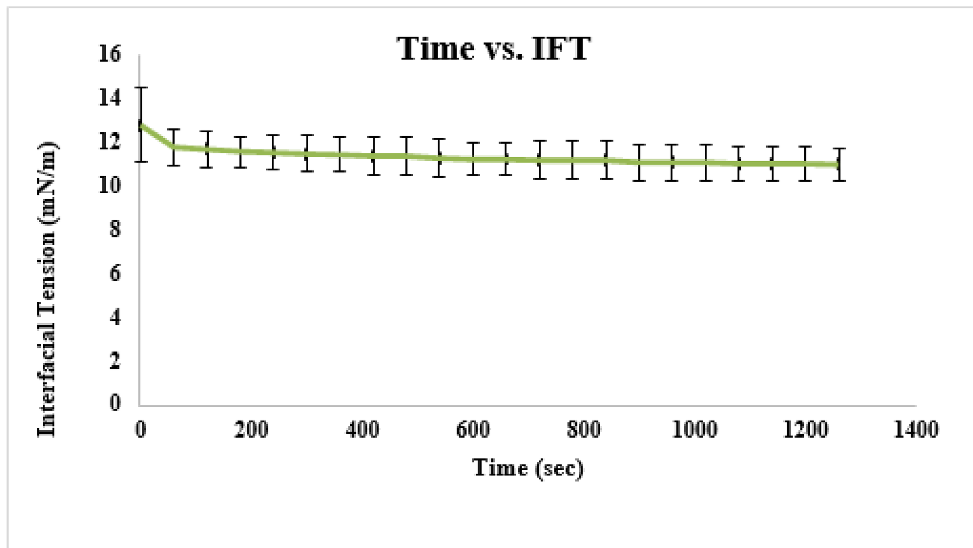


Figure 8. Interfacial tension of 2 wt% protein solution and canola oil.

CONCLUSION

A nanoemulsion from canola oil and FBPI without adjuncts was successfully created. These results have important applications for the production of functional foods and beverages containing faba bean protein-based ingredients. Reduced manufacturing costs for a nanoemulsion made from canola oil and FBPI using a relatively simple procedure makes this process a financially attractive means to take advantage of the many interesting and useful properties of this promising emulsifier in food production.

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