Lucas Sales Queiroz, Federico Casanova, Aberham Hailu Feyissa, Flemming Jessen, Fatemeh Ajalloueian, Italo Tuler Perrone, Antonio Fernandes de Carvalho, Mohammad Amin Mohammadifar, Charlotte Jacobsen and Betül Yesiltas

Physical and oxidative stability of low-fat fish oil-in-water emulsions stabilized with Black Soldier Fly (*Hermetia illucens*) protein extract.

Introduction

According to the Food and Agricultural Organization (FAO) the global population is expected to reach 9 billion people in 2050. However, the actual agricultural systems are not prepared, in terms of sustainability, to address such huge demand in food supply, and that was more evident during the COVID-19 pandemic, when there was reduced meat supply on the market. Hence, there is an urgent need to explore alternative protein sources that must provide good nutritional value, functionality and be sustainable. Edible insects have drawn an interesting attention by the FAO and the scientific community, being reported as a promising protein source with potential technological applications. Recently, the European Union have authorized the placing on the market of the first insect as a novel food (2015/2283). The black soldier fly larvae (BSFL) has been largely utilized for animal feed. Due to its interesting composition, BSFL has great potential to be further implemented in the human diet. In addition, sustainable methods can be applied to optimize the protein extraction of insects and improve their techno-functional properties such as the emulsifying properties

Methodology

Herein, BSFL defatted powder was treated by ohmic heating (BSFL-OH), ohmic heating and ultrasound (BSFL-UOH) and compared to sodium caseinate (CAS) for their emulsifying properties. To have a wide knowledge on the protein structure and profile, Fourier-transformed infrared spectroscopy (FTIR), differential scanning calorimetry (DSC) and the interfacial properties for oil-in-water emulsion were evaluated. Emulsions were produced with cod liver oil-in-water using a microfluidizer system and analyzed during 10 days of storage. The emulsion stability was evaluated by Turbiscan considering the TSI value. In addition, droplet size and z-sizer were also evaluated. The oxidative stability of each emulsion was analyzed by peroxide value (PV) method for primary oxidative stability, tocopherol content and secondary oxidation products by dynamic head space GC-MS.

Results

Clear difference in the secondary structure could be noticed between BSFL and the treated samples considering mainly the amide I region and the qualitative analysis of the presence of β-sheets, α-helices, random coils and β-turns. The protein extraction was conducted by the alkaline method for all the samples and the yield of protein content was 62%,67% and 66% for BSFL,BSFL-OH and BSFL-UOH. A decrease in the denaturation temperature for sample treated with ohmic heating and then ultrasound was observed, when compared to untreated BSFL sample. The best stability was reported by BSFL-OH emulsion according to TSI value. CAS showed the smallest droplet size followed by BSFL-OH,BSFL and BSFL-UOH. ζ-potential had values higher than -30 mV and were similar for all emulsions including CAS. Among the insect samples, BSFL-OH could reduce the interfacial tension more efficiently compared to the other samples. CAS showed the lowest oxidation after 10 days, followed by BSFL,BSFL-OH and BSFL-UOH. The secondary volatile compounds were higher for the emulsions prepared with insect protein as emulsifier with BSFL-OH and BSFL-UOH showing the highest values over 10 days of storage.

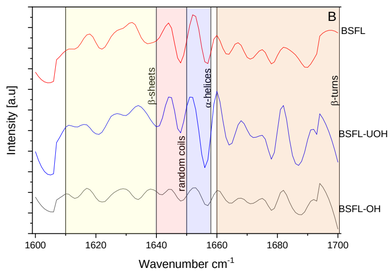

Figure 1- FTIR spectra of BSFL, BSFL-OH and BSFL-UOH

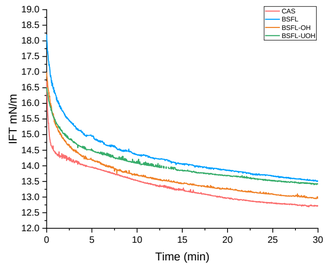

Figure 2- Interfacial tension oil and water of CAS, BSFL, BSFL-OH and BSFL-UOH

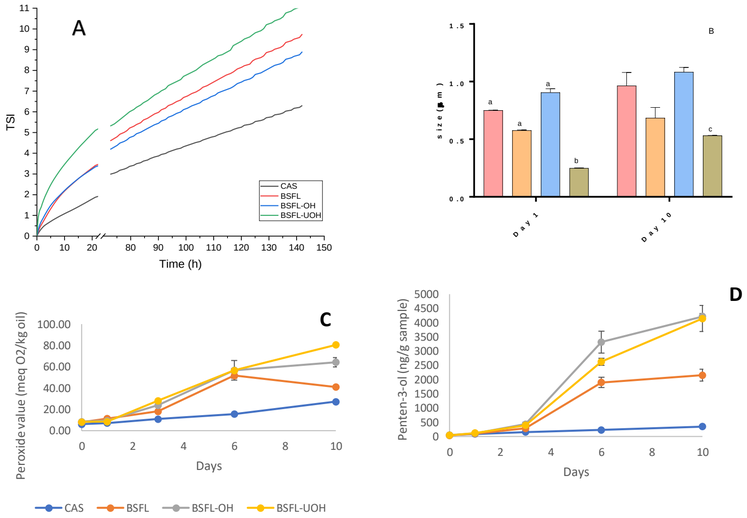

Fig 3- (A) Physical stability TSI value. (B) Emulsion droplet size for all samples. (C) Peroxide Value. (D) Secondary oxidation for all samples

Conclusions

Proteins from BSFL can be potentially applied as emulsifier and, alternative treatments such as ohmic-heating can enhance this functionality. The oxidative stability should be further explored under different treatments and from other insects in order to replace the conventional and non-sustainable protein sources.

Literature cited and aknowledgments

Queiroz, L.S.; Regnard, M.; Jessen,et al. Physico-chemical and colloidal properties of protein extracted from black soldier fly (Hermetia illucens) larvae. Int. J. Biol. Macromol. 2021, 186, 714–723.

Mintah, B.K.; He, R.; Agyekum, A.A.; et al. Edible insect protein for food applications: Extraction, composition, and functional properties. J. Food Process Eng. 2020, 43, e13362.

Wang, J.; Jousse, M.; Jayakumar, J.; Fernández-Arteaga, et al.. Black Soldier Fly (Hermetia illucens) Protein Concentrates as a Sustainable Source to Stabilize O/W Emulsions Produced by a Low-Energy High-Throughput Emulsification Technology. Foods 2021, 10, 1048.

Further information

email- lusaqu@food.dtu.dk