CHARACTERISATION OF DIFFERENT BLACK SOLDIER FLY (HERMETIA ILLUCENS) PROTEIN EXTRACTS AND POTENTIAL APPLICATION AS AN EMULSIFIER IN OIL-IN-WATER EMULSIONS

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INTRODUCTION

According to the UN Food and Agriculture Organization (FAO) the global population is expected to reach 9 billion in 2050. However, current agricultural systems are not prepared, in terms of sustainability, to address such a huge demand on the food supply –something that was made 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, which must provide good nutritional value and functionality and must be sustainable. Edible insects have drawn interest from the FAO and the scientific community, being reported as a promising protein source with potential technological applications. Recently, the European Union has authorised the placing on the market of the first insect as a novel food (2015/2283). Black soldier fly larvae (BSFL) has largely been utilised for animal feed. Due to its interesting composition, BSFL shows great potential for being further implemented in the human diet. In addition, sustainable methods can be applied to optimise protein extraction from insects and improve their techno-functional properties, such as the emulsifying properties.

METHODOLOGY

In this study, defatted BSFL 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 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 analysed during 10 days of storage. The emulsion stability was evaluated by Turbiscan, considering the TSI value. In addition, droplet size and z-size were also evaluated. The oxidative stability of each emulsion was analysed by the peroxide value (PV) method for primary oxidative stability, tocopherol content and secondary oxidation products by dynamic headspace GC-MS.

RESULTS

A clear difference in the secondary structure was observed between BSFL and the treated samples, considering mainly the amide I region and the qualitative analysis of the presence of b-sheets, a-helices, random coils and b-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 samples treated with ohmic heating and then ultrasound was observed, when compared to untreated BSFL samples. 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. z-potential had values higher than -30 mV and was similar for all emulsions including CAS. Among the insect samples, BSFL-OH was shown to 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.

DISCUSSION

The secondary structure of BSFL-OH showed a unique pattern and the b-turns region was shown to be more affected by ultrasound treatment. For DSC, an increase in enthalpy was observed for the BSF-UOH sample, probably due to protein aggregation and bond formation after treatment. An increase in enthalpy and decrease in temperature is observed for BSFL-UOH, which might be due to the long exposure time of samples to ultrasound treatment causing protein aggregation. Considering emulsion stability by TSI, the more uniform heating and higher protein content provided by ohmic heating treatment was shown to be more interesting for emulsifying stability. The increase in particle size noted more evidently for BSFL-UOH can directly impact the emulsion stability, due to the presence of aggregates. The lowest particle size observed in BSFL-OH could also contribute to a more interesting decrease in the interfacial tension of the oil-in-water interface. All insect emulsions showed a high PV and volatile value after 10 days of storage. Therefore, as this was a pioneering study using BSFL for oxidative stability tests, further treatments might bring promising results in the future.