Production of alginate microparticles to encapsulate soybean oil emulsions stabilized by whey protein aggregates using an airbrush atomization system

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The objective was to evaluate an encapsulation process of soybean oil emulsions stabilized by microgels entrapped in a sodium alginate (SA) matrix, using an airbrush atomization system.

Whey protein suspensions (4.3% w/w, pH 7.5) were thermally treated (80°C, 60 min) to produce soluble aggregates (WPAg), which were used to obtain stable microgel emulsions. These emulsions were mixed with SA suspensions to obtain different soybean oil volume fractions (?=0.17 and ?=0.26). These mixtures were atomized at a flow rate of 4 mL min^{-1} over a 100 mM $CaCl_2$ gelling bath, with an air pressure of 276 kPa and air flow rate of 5 L min^{-1}. Microparticles were left for 30 min under stirring to complete gelation. To analyse the stability of microparticles, samples were poured into graduated glass tubes and centrifuged at 1,467 g and 25 °C for 15 min. The tubes were analysed to evaluate oil release. This procedure was repeated during 2 months. The particle size distribution was determined with a static light scattering instrument (refractive index for aqueous phase: 1.33, refractive index for microparticle phase: 1.507, absorption index: 0.1). The oil phase encapsulated inside the microparticles was extracted and correlated with the total oil volume atomized to estimate the encapsulation efficiency. Confocal laser scanning microscopy (CLSM) was used to study the morphology of microparticles. Samples were prepared with Nile Red and Fast Green to stain the oil phase and WPAg, respectively.

The results showed no differences in the size distribution curves between microparticles obtained with different oil fractions. The average D[4,3] and span values were 508.68±56.53 µm, 1.14±0.08 (?=0.17) and 526.78±51.12 µm, 1.19±0.06 (?=0.26). CLSM images showed microgel stabilized emulsion droplets are packed tightly with minimal interstitial space in both types of microparticles. The encapsulation efficiency in both cases was acceptable (89.39±5.48% for ?=0.17 and 74.22±8.09% for ?=0.26). None of the microparticles presented oil release after 2 months.

Results showed that emulsion microgel particles obtained by an airbrush atomization system can be an effective solution for lipophilic compounds. This system is simple, low-cost, and does not require heating, making it appropriate for labile compounds in the food industry.