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Evaluation of high-pressure homogenizer parameters in the production of nanoemulsions using three different surfactants

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Nanotechnology applied to food comes from the demand of the industry to new tools for the development of strategies to improve food products, improving the solubility and bioavailability of many functional ingredients. This worked aims the production and optimization of nanoemulsions using three different surfactants (tween 20, sodium dodecyl sulphate (SDS), and dodecyl(trimethyl)azanium bromide (DTAB)) based on a 23-level factorial design, through a high-pressure homogenizer. The homogenization pressure (10,000, 15,000, and 20,000 psi), surfactant concentration (0.5, 1.0, and 1.5% w/w), ratio between oily and water phase (O/W ratio) (0.5/9.5, 1/9, and 1.5/8.5 v/v) and the cycles between the each homogenization (10, 20, and 30) were evaluated. Moreover the stability of the nanoemulsions was determined at 4 ºC, in the absence of light, during 28 d. The hydrodynamic diameter (Hd) and the zeta potential (Zp) were evaluated for all samples. Results showed that the interaction between pressure and O/W ratio, surfactant concentration, pressure and number of cycles affect the Hd ($p<0.05$) of the nanoemulsions using tween 20 (values ranged between 171 and 323nm). For SDS nanoemulsions (values ranged between 129 and 177nm) Hd was not affected ($p>0.05$) by the evaluated parameters. While, for DTAB nanoemulsions statistical significant influence ($p<0.05$) was observed by the variation of the surfactant concentration, O/W ratio and pressure (values ranged between 121 and 198 nm). At 28 d the Hd of the nanoemulsions ranged between 166 to 245 nm, 126 to 165 nm, and 118 to 195 nm for Tween 20, SDS, and DTAB, respectively. Regarding Zp the results showed that the evaluated parameters did not influence significantly the values. However, depending on the class of the surfactant used the values can range between -19 and -27 mV, -45.4 to -78.7 mV, and 43 to 75.7 mV, for tween 20, SDS, and DTAB, respectively. In conclusion, this work shows that the nanoemulsions produced through high-pressure homogenizer can be tailored based being stable during storage.