Characterizations of oil-in-water (O/W) emulsions containing different types of milk fats prepared using rhamnolipids as emulsifiers

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Lu Lin

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Abstract

Emulsions containing three different types of milk fat fractions (MF13, MF27 and MF42) and anhydrous milk fat (AMF) were prepared at oil to water (O/W) ratios of 1:9, 3:7, 5:5 and 7:3 using rhamnolipids as emulsifiers. The prepared emulsions were analyzed for their storage stability and properties (colour, particle size, zeta potential and rheology). The effects of various factors (freezing/thawing, heating, pH, salts and ionic strength) on the stability of emulsions were also investigated. All emulsions prepared with an O/W ratio of 7:3, regardless of the type of milk fat, rendered a highly condensed, semi solid and cream-like substance whereas other emulsions containing less oil were in a liquid form. Among the four different O/W ratios tested, the highest emulsion stability during the storage of 12 weeks was observed from the emulsions containing 1:9 O/W ratios, due to a combine effect of smaller emulsion particle size and lower collision frequency between droplets. Interestingly, the emulsions with 7:3 O/W ratios were found to be more stable than the ones with 5:5 O/W ratios. This might be due to the limited movements of closely-packed emulsion droplets induced by the high oil concentration of 7:3 O/W ratios. The emulsion stability was significantly affected by low pH, especially at lower than pH 4, due to the loss of electrostatic repulsions between droplets leading to droplet coalescence and also possibly due to hydrolysis of rhamnolipid molecules. The presence of salts (NaCl, KCl and $CaCl_2$) also rendered the emulsion unstable. The degree of instability was gradually increased with increasing salt concentrations. $CaCl_2$ had the most significant effect even at a very low concentration. The viscosity of emulsions increased with increasing oil concentration but was not affected by the types of milk fats. Emulsions with 3:7, 5:5 and 7:3 O/W ratios exhibited non-Newtonian and shear thinning flow behaviour. At 7:3 O/W ratios, MF13 exhibited gel-like properties whereas both MF42 and AMF emulsions became more solid-like at higher frequency.

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