Tracking fluid interfaces: Role of emulsifiers, oil phase composition and co-solvents

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Flavour emulsions are widely used in the food industry to facilitate uniform flavour dispersion across diverse food matrices, protect volatile compounds from acid, thermal, and oxidative degradation, and maintain stability upon dilution in beverage systems. Despite their ubiquity, flavour emulsions are often formulated empirically, and limited research has addressed the interfacial stabilization mechanisms of emulsifiers or the influence of complex polar oils (e.g., essential oils with weighting agents) and co-solvents (e.g., propylene glycol and glycerine). [1]

In this study, the interfacial stabilization (adsorption kinetics and interfacial rheology) of various emulsifiers (Acacia gum, OSA-starch, and quillaia saponin) have been characterized and compared using a pendant droplet tensiometer and an interfacial shear rheometer initially at the medium-chain triglyceride (MCT) oil-water interface as a model system. A phase exchange experiment was designed to simulate emulsion dilution in beverage applications. Gum Acacia, a macromolecular hydrocolloid, exhibits relatively slow adsorption and interfacial tension reduction, and forms a strong irreversibly adsorbed solid-like elastic interfacial layer. In contrast, OSA-starch shows fast surfactant-like adsorption, and develops a slightly elastic to nearly viscous interfacial multilayer, [2] which can be partially removed upon dilution. Quillaia saponin also demonstrates rapid interfacial tension reduction and forms a brittle solid-like elastic interfacial layer, which also partially desorbs when diluted.

Cold pressed single-fold orange oil is then characterized as a model flavour oil, and the effect of the weighting agents sucrose acetate isobutyrate (SAIB) and ester gum (EG) has been investigated. The orange oil shows high polarity and very low interfacial tension. Adding weighting agents to adjust the density to that of the aqueous phase increases the interfacial tension, facilitates emulsifier adsorption and thereby enhances flavour emulsion stability. The impact of the co-solvents propylene glycol (PG) and glycerin in the aqueous phase was also investigated. Although both co-solvents reduced interfacial tension, Acacia gum remained able to adsorb and further decreases the interfacial tension. However, co-solvent addition diminished interfacial viscoelasticity: PG reduced the elasticity of Gum Acacia films, while glycerine rendered the interface fully viscous. These results indicate that co-solvent inclusion may hinder interfacial stabilization and compromise flavour emulsion stability.

Keywords:
Interfacial stabilization mechanism, food hydrocolloid, flavour emulsion

References:

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