Emulsions of Hydrophobic Deep Eutectic Solvents Stabilised with Poloxamer Surfactants and Stearate Salts

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Deep eutectic solvents (DES) are novel solvents which have been applauded for their environmentally friendly nature and tunable behaviour. [1] They feature a range of properties, depending on the molecules of which they are comprised, which allows them to have a wide range of applications. [2] Despite many of the separate DES components being solid at room temperature, all DES form a room temperature liquid phase when mixed at their eutectic ratio.
This work explores a hydrophobic 'Type V' DES emulsion system, where a menthol : dodecanoic acid DES acts as the oil phase in an oil in water emulsion. These emulsions are stabilised through steric interactions of non-ionic block copolymer surfactants, namely poloxamer surfactants, at the droplet interface. The stability of these emulsion systems were found to be improved upon addition of the stearate salts of sodium, calcium and magnesium to the DES phase. This increased stabilisation is first quantified using droplet size analysis, then rationalised through the use of small angle neutron scattering techniques.
Type V DES are a subclass of these solvents, comprising of a simple mixture non-ionic hydrogen bond donors and acceptor pairs. At least one of the DES components is usually a terpene such as menthol or thymol, which can be extracted from mint and thyme respectively. [2] As these terpenes can be naturally produced as secondary metabolites of plants, this could allow the DES formed from them to be feasibly produced on a large scale and to be considered a truly sustainable replacement solvent for the petrochemical-derived solvents commonly used today.
These mixtures are naturally hydrophobic, similarly to their parent molecules. They have much lower viscosity than other DES types and also feature low vapour pressure paired with high thermal stability, allowing them a large scope of potential application. Their inherent hydrophobicity has led to these solvents being explored as extractants for several species, from heavy metals to pharmaceutical actives. [3, 4] As these solvents can comprise of natural 'essential oils', this allows these solvents to also deliver their therapeutic or antibacterial properties if used in products which are to be applied to the skin, such as in medical or personal care products. [5, 6]

Keywords:
Emulsion, Surfactant, Interface, DES, Nonionic, Polymer

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