Polymer coated fat crystals as oil structuring agents: Fabrication and oil-structuring properties

ABSTRACT

Oleogel has attracted the interest of food scientists and the food industry as an interesting alternative for solid fat in food products. Certain hydrophilic polymers, such as gelatin (GTA), are known to form gel structures in water, but fail to structure apolar solvents due to incompatibility. The hydrophilic polymers can only be introduced into an apolar solvent using an indirect approach. In our approach, GTA acted as a stabilizer of oil-in-water emulsions. During emulsification, GTA adsorbed at the interface, forming a polymer protective layer. Upon cooling, crystallisation of fully hydrogenated rapeseed oil (FHRO), as the oil droplets, fixed the polymer layer onto the droplets. Subsequently, the crystallised fat droplets were separated from the continuous water phase through creaming, and then subjected to drying. The dried fat droplets, fat capsules, exhibited spherical shape with D(3,2) at 6.7 ± 3.3 μm based on the microscopy and laser light scattering analyses. Interestingly, confocal laser scanning microscopy (CLSM) confirmed the location of the GTA layer on the surface of the fat capsules. Moreover, diffraction and thermal analyses showed similar properties between FHRO and GTA fat capsules, thus indicating that FHRO independently crystallised without being affected by the fabrication techniques and GTA. Subsequently, the fat capsules were tested as an oil structuring agent by employing two different approaches to form composite oleogels and particle-based oleogels. The amplitude sweep test showed that all oleogels behaved in a solid-like manner. The shear modulus of oleogels prepared from fat capsules was higher than the reference oleogel, regardless of the preparation approach. Electron microscopy confirmed the formation of composite oleogel and particle-based oleogels by the fat capsules as the structuring building blocks in the respective oleogels. In the oleogels, GTA acted as a filler in GTA-oleogel (GTA1) and as a surface polymer that interconnected the fat capsules in particle-based oleogel (GTA2) and particle-based added water oleogel (GTA3). Ultimately, we have shown the formation of FHRO coated with hydrocolloid, which can potentially act as a functional material for structuration and delivery vehicles.