Oleogelation using dried protein particles

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Solid fats, such as palm oil or butter, are important ingredients in food products, as they play an essential role in providing texture and mouthfeel. However, the use of such fats is not desired from a health and sustainability perspective. Liquid oils, extracted from easily accessible oilseeds, are preferred, but oils cannot be used as a structuring and texturising agent in foods due to their liquid nature. Over recent years, research has shown the possibility of structuring liquid oil with protein particles to gain solid properties, these systems are called protein oleogels [1]. Protein oleogels are promising substitutes for solid fats, but the current oleogelation methods, such as the emulsion-templated and solvent exchange method, are indirect and require multiple steps [2]. Depending on the method used, it is also difficult to control the specific properties of the oleogels, as the protein content and structure cannot always be controlled. A simpler and adaptable method is the use of dried protein particles that can be directly dispersed in oil to create protein oleogels. Such a direct method requires a well-flowing particulate powder with small protein particles. When particles are small, more surface area is available for protein-protein interactions, and a more efficient network formation can be obtained. In contrast, when particles are large, as in current protein powders, no 3D protein network can be formed to create a stable protein oleogel. In our work, we explore a novel drying method, aimed at altering the properties and flowability of the obtained dry protein powder. This drying method included different solvents with low polarity, such as isopropanol and hexane, aiming to reduce attractive forces between proteins during the drying process by adjusting the solvent wettability and accompanying capillary forces. We found that the drying solvent affected the protein size, since particle agglomeration was prevented by drying from apolar solvents. The dried protein particles were directly dispersed in oil, resulting in protein oleogels. The stability of the oleogels created using this direct-dispersion method depended not only on the size of the particles, but also on other properties that were influenced by the drying procedure. Using confocal microscopy and rheology, we show the microstructure and properties of oleogels and discuss how the network formed is affected by the drying solvents used. The use of the direct-dispersion method simplifies the process of oleogelation and provides potential to adjust the properties of protein oleogels.

Keywords:
Protein oleogel, oil structuring, protein drying, organic solvents, oscillatory rheology

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