**Pickering Water-in-oil Emulsions Stabilized Solely Fat Crystals**

Elizabeth Tenorio-Garcia1, Elena Simone2, Michael Rappolt1 and Anwesha Sarkar1\*

*1Food Colloids and Bioprocessing Group, School of Food Science and Nutrition, University of Leeds, Leeds LS2 9JT, UK*

*2Department of Applied Science and Technology (DISAT), Politecnico di Torino, Torino 10129, Italy*

In recent years, Pickering stabilization has gained significant research attention in the food industry, because of the ultrastability it provides to an emulsion system. However, finding food-grade particles to replace the classic surfactant *i.e.* polyglycerol polyricinoleate (PGPR), E476, whilst providing good stability has been challenging[1]. Fat crystals can be a promising alternative, as they are shown to stabilise water-in-oil emulsions (W/O) emulsions by Pickering stabilization, network stabilization or a combination of both[2]. This study aimed to use solely fat crystals to create particle-stabilized W/O emulsions with increased volume fractions and measure their storage stability. Water-in-oil (W/O) emulsions were stabilized by using cocoa butter crystals (CB) dispersed in high oleic sunflower oil (HOSFO). The capability of the CB crystals (10-20 wt% CB) to form W/O emulsions (30-60 vol% water) was characterized using cross-polarized light microscopy, cryogenic scanning electron microscopy, and confocal light microscopy. Meanwhile, the characterization of CB polymorphism was evaluated by small angle (SAXS) and wide angle X-ray scattering (WAXS). In addition, the rheological properties of the emulsions were examined. Results showed that CB crystals could stabilize W/O emulsion where the droplets' size remained constant (0.281 μm) for a period of one month without any phase separation. The use of 15 vol% of CB provided remarkable stability to the water droplets. Microstructural analyses of W/O emulsions at multiple length scales revealed that platelet-like CB crystals not only surrounded the droplet surface but also the CB fat crystals formed a network in the bulk phase further contributing to stabilization. The increment in the water content increased the viscosity of the emulsions, showing shear-thinning behaviour which further demonstrated droplet aggregation. However, after one month all the emulsions behave similarly, with no change in viscosity, which might be associated with the growth of new crystals and crystal-crystal aggregation in the bulk phase contributing to locking the water droplets during storage, with rheological properties being largely governed by the CB crystals rather that the water droplet content. New findings from this study show that CB crystals can be used to stabilize the water-oil interface with an increased volume fraction of water in a W/O emulsion without any surfactant. Such stable clean-label Pickering systems offer promise for designing healthy low-fat confectionery products where biocompatibility is a key necessity.

***References:***

1 Tenorio-Garcia, E., Araiza-Calahorra, A., Simone, E., & Sarkar, A. (2022). Recent advances in design and stability of double emulsions: Trends in Pickering stabilization. *Food Hydrocolloids, 128*, 107601.

2 Rafanan, R., & Rousseau, D. (2019). Dispersed droplets as tunable fillers in water-in-oil emulsions stabilized with fat crystals. *Journal of Food Engineering, 244*, 192-201.