Pickering emulsions stabilized by colloidal lipid particles: Potential for high chemical stability?

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Many food, pharmaceutical, cosmetic, and agrochemical products exist as dispersions of immiscible liquids (typically, oil and water), i.e., are emulsions. These emulsion products may undergo a range of physical and chemical destabilization events over their production, storage and end-use. Pickering emulsions have shown to provide definite advantages with respect to physical stability of emulsions compared to conventional emulsifiers, and are emerging in the food area. In addition to controlling the physical stability of food emulsions, preventing adverse chemical degradation is also a challenge, and in particular, oxidation of the unsaturated lipids. Often, lipid oxidation in emulsions is tentatively prevented by using oil-soluble antioxidants (e.g., tocopherols). These components are highly hydrophobic and therefore located inside the oil droplets. However, lipid oxidation is initiated at the oil-water interface, so the efficiency of these antioxidants is far from optimal and could be enhanced when present at the interface [1]. A way to achieve this could be to entrap antioxidants within Pickering particles, thus locating them at the droplet surface. In the present work, we study lipid oxidation in two Pickering emulsions stabilized by colloidal lipid particles (CLPs) [2], with the exact same composition, but with a different physical location of the antioxidant α-tocopherol: either within the CLPs (Figure 1, left), or in the core of the oil droplets (Figure 1, right). Pickering emulsions containing the antioxidant in the CLPs oxidize slower and to a lesser extent compared to Pickering emulsions containing the antioxidant in the core of the droplet [3]. Although, according to our initial hypothesis, the interfacial localization of CLP-entrapped antioxidant may explain these results, other possible mechanisms are currently under consideration, such as the possibility that antioxidant-loaded CLPs would behave as an antioxidant reservoir with progressive release in time. This work opens up new perspectives to develop physically and chemically stable food emulsions with high levels of unsaturated lipids, and optimized levels of antioxidants.

 

Figure 1: Schematic representation of CLP-stabilized Pickering oil-in-water emulsions: (left) with α-tocopherol incorporated in the particles and (right) with α-tocopherol in the liquid oil droplets.

References

[1] M. Laguerre, C. Bayrasy, A. Panya, J. Weiss, D. J. McClements, J. Lecomte, E. a Decker, and P. Villeneuve, “What makes good antioxidants in lipid-based systems? The next theories beyond the polar paradox,” *Crit. Rev. Food Sci. Nutr.*, vol. 55, no. 2, pp. 183–201, 2015.

[2] A. Schröder, J. Sprakel, K. Schroën, and C. Berton-Carabin, “Tailored Microstructure of Colloidal Lipid Particles for Pickering Emulsions with Tunable Properties,” *Soft Matter*, pp. 3190–3198, 2017.

[3] A.J. Schröder, M. Laguerre, J.H.B. Sprakel, S. Birtic, C.G.P.H. Schroën, C. Berton-Carabin, “Patent Application Number 1810850.6 UK.”