

Egg yolk lipoproteins as natural stabilizers and emulsifiers to prepare Pickering emulsions as solid fat replacer

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Egg has been a major food in the world due to its well-rounded nutritional values and functional properties. Lipoproteins from egg yolk are of particular importance as natural stabilizers and emulsifiers among food ingredients, which have been engineered to develop functional foods with innovative applications. Our groups have exploited egg yolk low (LDL) and high (HDL) density lipoproteins to prepare high internal phase Pickering emulsions (HIPEs) and comprehensively studied their roles as a stabilizer. Both LDL and HDL exist as homogenous nanoparticles with an average size of 50-70 nm and amphiphilic nature, having a contact angle close to 90°. HIPEs were studied by varying compositions of 75%–90% oil phase and 25%–10% aqueous phase containing 0.5%–2% LDL or HDL, under various pH conditions. Rheological measurement, confocal laser scanning and optical microscopes imaging together with digital photos revealed the solid gel network, the strength of which was dependent upon oil volume fraction and LDL concentration. Likewise, as expected, the emulsifying ability showed a strong correlation with the pH conditions, too. HIPE that was prepared at pH 5 exhibited small droplet size, high viscosity and gel stability. The optimal formulation of HIPEs was found as 80% oil and 2% LDL or DL concentration, which exhibited small droplets under 10 µm with negligible aggregations, even after four weeks of storage under refrigeration or heating at 90 °C for 30 min. After three freeze-thawing cycles, the HIPEs were demulsified losing their gel structure, but a simple re-homogenization was able to reconstitute the gel network identical to the original microstructure. Encapsulation of curcumin into Pickering HIPEs provided exceptional photostability (around 80% retention rate) against ultraviolet radiation and improved its bioaccessibility from 10% to 50% during in vitro digestion. Our findings have demonstrated the promising potential of egg lipoproteins-stabilized HIPEs as a delivery system for lipophilic compounds and meanwhile as a substitute to saturated/trans fats for modulating the texture of semi-solid foods with added health benefits.