Biopolymer Stabilized Emulsions Improved Storage Stability and In Vitro Bioaccessibility of Lutein

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Objectives: Lutein plays a critical role in the visual and cognitive development of infants. However, the application of lutein as a potential nutraceutical is limited by its low stability and poor water solubility. While various encapsulation systems have been developed for lutein to enhance its stability and bioavailability, few utilized bio-based polymers that are safe to use in infant foods. The aim of the study was to develop a novel emulsion system for lutein using food-grade colloids, octenylsuccinylated (OS) starch and gum Arabic (GA), as emulsifiers, which could improve the stability and bioaccessibility of lutein.

Methods: Lutein oil-in-water emulsions were prepared using two types of OS starch, capsule TA® (CTA) and HI-CAP®100 (HC), and one type of GA, TICAmulsion® 3020 (TM). Lutein was dissolved in olive oil and mixed with the aqueous biopolymer dispersions at 70% oil volume fraction using a homogenizer. The stabilities of the emulsion were assessed by measuring droplet size and distribution, changes of droplet size, and lutein retention at 25 and 45°C after a week of storage. The *in vitro* bioaccessibility of lutein was measured using a simulated *in vitro* gastrointestinal model. Free lutein was used as control.

Results: The mean droplet size of lutein emulsions stabilized by CTA, HC, and TM were 1.19 ± 0.75, 1.45 ± 0.80, and 1.18 ± 0.8 μm, respectively. After a week of storage at 25°C, the particle size stabilized by OS starches did not change significantly, while GA-stabilized emulsion showed 1.58-fold larger droplet size than fresh sample ($P < 0.05$). Lutein retention in the control and emulsions stabilized by CTA, HC, and TM were 79%, 88%, 89%, and 86% at day 7, respectively. After a week of storage at 45°C, the emulsions stabilized by CTA, HC, and TM showed 1.34-, 2.38-, and 1.55- fold larger particle size compared to fresh samples ($P < 0.05$). The retention of lutein in free lutein and emulsions were 78%, 86%, 46%, and 63%, respectively. The *in vitro* bioaccessibility of lutein emulsions were 1.95-, 1.46-, and 1.27- fold higher than that of free lutein ($P < 0.05$).

Conclusions: Lutein emulsion stabilized by OS starch CTA had the best overall stability in droplet aggregation, color retention, and *in vitro* release. The oil-in-water emulsion stabilized by biopolymers could be promising carriers for lutein to expand their application in infant foods.

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