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Curcumin-Loaded Pickering Emulsion Stabilized by pH-Induced Self-Aggregated Chitosan Particles for Encapsulating Bioactive Compounds for Food, Flavor/Fragrance, Cosmetics, and Medicine

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Abstract : Curcumin, a natural polyphenolic compound, boasts numerous health benefits; however, its industrial applications are hindered by instabilities and poor solubility. Encapsulating curcumin in Pickering emulsion presents a promising strategy to enhance its bioavailability. Yet, the development of an efficient and straightforward method to fabricate a natural emulsifier for Pickering emulsion poses a significant challenge. Chitosan has garnered attention due to its non-toxicity and excellent emulsifying properties. This study aimed to prepare four distinct types of self-aggregated chitosan particles using a pH-responsive self-assembling approach. The properties of the aggregated particles were adjusted by pH, degree of deacetylation (DDA), and molecular weight (MW), thereby controlling surface charge, size (ranging from nano to micro and floc), and contact angle. Pickering emulsions were then formulated using these various aggregated particles. As MW and pH increased and DDA decreased, the networked structures of the aggregated particles formed, resulting in highly elastic gels that were more resistant to the breakdown of Pickering emulsion at ambient temperature. With elevated temperatures, the kinetic energy of the aggregated particles increased, disrupting hydrogen bonds and potentially transforming the systems from fluids to gels. The Pickering emulsion based on aggregated particles served as a carrier for curcumin encapsulation. It was observed that DDA and MW played crucial roles in regulating drug loading, encapsulation efficiency, and release profile. This research sheds light on selecting suitable chitosan for controlling the release of bioactive compounds in Pickering emulsions, considering factors such as adjustable rheological properties, microstructure, and macrostructure. Furthermore, this study introduces an environmentally friendly and cost-effective synthesis of pH-responsive aggregate particles without the need for high-pressure homogenizers. It underscores the potential of aggregate particles with various MWs and DDAs for encapsulating other bioactive compounds, offering valuable applications in industries including food, flavor/fragrance, cosmetics, and medicine.

Keywords : chitosan, molecular weight, rheological properties, curcumin encapsulation
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