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Title: Caseinate-Laponite Nanocomposites as Potential Nutrient Delivery Vehicles
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Abstract:
Curcumin has been recognized for its significance in human health with anti-oxidant, anti-cancer, and anti-inflammatory activities. However, poor solubility and bioactivity of curcumin are obstacles for its application, which can be potentially improved by delivery systems. In this study, a low-cost, low-energy, and organic solvent-free encapsulation technology was studied by utilizing the pH-dependent solubility properties of curcumin and self-assembly properties of protein-nanoclay system. In this study, sodium caseinate (NaCas)-laponite (LAP) nanocomposite was dissociated at pH 12. Various amount of curcumin (0.2, 0.5 and 1 mg/mL) were dissolved and deprotonated in NaCas-LAP dispersion at pH 12.0 for 30 min. The subsequent neutralization enabled the encapsulation of curcumin in self-assembled NaCas-LAP nanoparticles. The degradation of curcumin under encapsulation conditions was negligible based on UV-vis spectroscopy. The encapsulation and delivery potentials of curcumin loaded NaCas-LAP nanoparticle were then explored, including particle size, zeta potential, encapsulation efficiency, release profile in simulated gastrointestinal track, as well as morphological study based on TEM. The bioactivity of curcumin after encapsulation was evaluated for antioxidant capacity. The results indicated that upon neutralization, NaCas-LAP nanocomposites were re-associated into smaller particles which were packed more efficiently by the bound curcumin. The curcumin encapsulated in NaCas-LAP nanoparticles showed improved antioxidant activity based on ABTS assay. In particular, the addition of LAP played an essential role in reducing particle size, elevating encapsulation efficiency, and providing sustained release under gastric condition. The low-cost, low-energy, and organic solvent free encapsulation technology utilizing food proteins-clay nanocomposite can be used to incorporate lipophilic bioactive compounds such as phytochemicals in nutrient delivery system.