Pea protein-alginate hydrogel beads: Impact of bead composition and dimension on vitamin D bioaccessibility

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Encapsulating bioactive components within hydrogel beads provides an effective method of improving their stability and efficacy, thereby enhancing their potential health benefits. In this study, vitamin D3-loaded nanoemulsions were encapsulated within biopolymer-based hydrogel beads comprised of pea protein (heated or unheated) and calcium alginate. The impact of bead composition and dimensions on lipid digestibility and vitamin D bioaccessibility was then investigated. The hydrogel beads containing heated pea protein were more stable to simulated oral and stomach phases than those containing unheated pea protein. This effect was attributed to the formation of heat-induced pea protein aggregates that were better retained by the calcium alginate network. The bioaccessibility of vitamin D3 was improved when it was encapsulated inside the beads, which may have been due to their ability to protect the vitamin from chemical degradation, especially under acidic gastric conditions. The beads containing the heated protein provided the best protection during stomach digestion, leading to around 86% of the original vitamin D3 still being bioaccessible after the small intestine phase. The information contained in this manuscript may lead to the development of novel hydrogel delivery systems that can improve the efficacy of oil-soluble vitamins in plant-based foods.

**Keywords**:hydrogel beads; preheating; pea protein; particle size; vitamin D