In Vitro Digestion of Protein-Based Nanohydrogels Incorporating Curcumin as a Lipophilic Model Compound: Effect of a Chitosan Coating

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Introduction:
One of the challenges of food enrichment with lipophilic bioactive compounds is related with their poor solubility in food matrices and their instability during digestion, leading to a poor bioavailability. These challenges are promoting research efforts to find more effective delivery systems based on natural biopolymers. Protein nanohydrogels can be used as carriers of bioactive compounds in food products, however, during gastric digestion, proteins are denatured by environmental conditions and hydrolyzed by enzymes. One of the strategies to improve protein nanohydrogels' stability and the controlled release of active ingredients during gastrointestinal (GI) digestion is the addition of a coating (polysaccharide layer). The behavior of lactoferrin (Lf)–glycomacropeptide (GMP) nanohydrogels with and without a chitosan coating was evaluated during GI digestion.

Method:
A dynamic gastrointestinal system was used as in vitro digestion model to evaluate the stability and bioaccessibility of Lf and GMP during the digestion process. Proteins were evaluated by high performance liquid chromatography during GI digestion.

Significance:
These results have important implications for the design of effective protein-based delivery systems for lipophilic bioactive compounds.

Results:
Results showed that at the end of digestion, Lf and GMP were digested until levels of protein degradation of 76% and 53%, respectively, for the nanohydrogels with chitosan coating, whereas for nanohydrogels without coating the corresponding levels of protein degradation were around 86% and 71% for Lf and GMP, respectively. Protein bioaccessibility results showed that nanohydrogels with chitosan coating 23% of Lf and 40 % of GMP remained intact until absorption. Size distribution and transmission electron microscopy confirmed that nanohydrogels with chitosan coating were more stable during digestion than nanohydrogels without coating. Based on these results, the bioaccessibility of curcumin encapsulated in Lf-GMP nanohydrogels with chitosan coating was evaluated during gastrointestinal digestion. Curcumin in coated nanohydrogels presents a bioaccessibility of 72% while the corresponding value for curcumin in free form only reached a value of 66%. It was also observed that under simulated GI conditions, free curcumin lost around 68% of its antioxidant activity while when incorporated into Lf-GMP nanohydrogels, only 30% of this activity was lost.

Category:
Protein