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In vitro release of curcumin from alginate submicron particles at pH 2 and pH 6.8

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Alginate is a polysaccharide, a structural component of marine brown algae that has been used for slow or controlled delivery of incorporated materials in food research due to its biodegradability, biocompatibility and non-toxicity. Although a few studies of alginate nanoparticles encapsulating curcumin, which is a natural product with numerous bioactivities, have been reported, their release kinetics have not been evaluated. Thus, the aim of this study was to evaluate the release behaviour of free curcumin and encapsulated curcumin in gastric pH and intestinal pH for evaluating their suitability for oral delivery. Curcumin encapsulated submicron particles were prepared by using the ionic gelation method and the cross linker used was calcium chloride. The particles were characterized for encapsulation efficiency, loading capacity, size, polydispersity index and zeta-potential. The morphology of the particles were observed via Scanning Electron Microscopy (SEM) while the encapsulation of curcumin was identified via Fourier Transform Infrared Spectroscopy (FTIR). *In vitro* release studies were conducted at simulated gastro-intestinal pH conditions without enzymes by using the dialysis bag method at 37±2 °C for a period of eight hours. The encapsulation efficiency and loading capacity were 92.78±1.02 % and 0.464±0.005 %, respectively. Average particle size, polydispersity index and zeta potential were 522.9 nm, 114.0 % and -14.7±7.45 mV, respectively. FTIR indicated the encapsulation of curcumin in to the alginate matrix. SEM indicated the formation of spherical particles. Compared to the release of free curcumin, slow and controlled release of curcumin was observed from the submicron particles at both pH conditions, as revealed by UV-visible spectroscopy. At pH 2, maximum release of free curcumin was around 38 % at the eighth hour. However, free curcumin showed a burst release within two hours that approximated to 60 % which was followed by a gradual degradation indicating the inherent instability of curcumin at high pH conditions. However, cumulative release of encapsulated curcumin was less than 16 % throughout the release time period at pH 2 whereas it was 64 % at pH 6.8 by the end of the eight hour experimental period. This result indicates a possible protective role of the particles on encapsulated curcumin. Also, release of encapsulated curcumin was much slower in gastric pH than in intestinal pH, which indicates that alginate submicron particles may be excellent carriers for safe oral delivery of curcumin to the site of its absorption.

Keywords: Alginate, Curcumin, Encapsulation, *In vitro* release, Kinetics

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