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Release of curcumin from chickpea protein submicron particles at gastrointestinal pH values

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Activity of bioactive components such as curcumin, which is a natural polyphenolic compound, depends on their stability, solubility, absorption and bioavailability at specific sites. Development of natural polymer based oral delivery systems for controlled delivery of bioactives has become essential in order to improve the aforementioned characteristics of those compounds. Among the biopolymers used in the formation of delivery vehicles, protein holds a prominent place due to its high biocompatibility and biodegradability. Chickpea *(Cicer arietinum L.)* protein shows high protein bioavailability and it has been used successfully in drug encapsulation processes. Therefore, the purpose of the study was to develop curcumin-loaded submicron particles using chickpea protein, and to characterize, and to evaluate the release of curcumin via understanding its release kinetics from the protein matrix. To prepare chickpea protein isolates, alkaline extraction and subsequent precipitation of the proteins at the isoelectric point (4.5) was followed. Glyoxal was used as a cross-linker. *In vitro* release studies were carried out using the dialysis bag method, using UV-visible spectroscopy for quantification, at simulated gastric and intestinal pH buffers without enzymes. The release profiles were fitted in to eight different mathematical models namely Zero order, First order, Higuchi, Hixon-Crowell, Korsemeyer-Peppas, Baker-Lonsdale, Weibull and Gompertz, to determine and interpret the kinetics of the drug release from the protein matrix. Encapsulation efficiency showed a high value of 89 % and loading capacity approximated to 0.45 %. Average particle size, polydispersity index and zeta potential were found to be 466.9 nm, 290.5 % and -10.8 mV, respectively. Release of curcumin from the protein matrix showed a slower controlled release compared to the release of free curcumin at both pHs. Release of encapsulated curcumin at pH 2 showed a much higher release compared to the release at pH 6.8. In fact, maximum release at pH 2 and pH 6.8 were approximately 26 % and 16 % at the sixth hour, respectively. Release profiles of curcumin encapsulated protein fitted well with Higuchi and Weibull models at pH 2 and 6.8, respectively. At pH 6.8, release followed a Weibull sigmoidal pattern showing an asymptotic maximal release. At pH 2, release of encapsulated curcumin followed a diffusional release from the matrix. This study indicates differential release behaviour of curcumin from chickpea delivery vehicles at gastric and intestinal pH conditions.

Keywords: Chickpea protein, Curcumin, Encapsulation, *In vitro* release, Kinetics

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