Studies on the Microencapsulaton of Curcumin with γ-Polyglutamic Acid by Using Response Surface Methodology and Release

張兆凱、柯文慶 ; 謝昌衛

E-mail: 9806849@mail.dyu.edu.tw

ABSTRACT

Poly-γ-glutamic acid (γ-PGA) is biosynthesized from D-glutamic acid and L-glutamic acid through amide linkages between α-amino and γ-carbonxylic acid groups. Because of water soluble, bio-degradable, edible and non-toxic toward humans, furthermore, applicable as surfactant, γ-PGA is potent to be used as shell material for microencapsulation.

In this study, the encapsulation effect of alcohol-borne colorant curcumin by γ-PGA was investigated by response surface methodology (RSM). The effects of γ-PGA on drug control release and stability by combining with alginate, poly-l-lysine (PLL) and microbial transglutaminase (MTGase) were also determined. The purpose was to improve the value of γ-PGA as a shell material in microencapsulation. The results obtained were as follows.

1.The optimum encapsulation condition was shown at γ-PGA 6%:core (curcumin) 15%:surfactant (Span 80) 0.6% by RSM. About 78.7% curcumin was encapsulated under the condition.

2.The encapsulation efficiency of the mixtures individually combined γ-PGA with alginate, PLL, and MTGase were 78.0%, 72.4% and 63.2%, respectively. Addition of alginate showed the less faulty on microencapsulation of γ-PGA.

3.The release rate of curcumin microencapsulated in γ-PGA at pH 1.3 and pH 7 were 12% and 42%, respectively, while decreased to 5% and 8% at pH 1.3 and increased to 60% and 78% at pH 7 for that microencapsulated in γ-PGA combined with alginate and PLL, respectively. The phenomena indicated that both alginate and PLL improved the pH sensitive response.

4.The kinetic analysis of drug release in simulate gastric juices for 2 hr showed only the profile of γ-PGA combined with alginate fit to zero-order and first-order release kinetics. According to Higuchi kinetic module, the state for the obtained microcapsules was estimated as an ideal sphere and the core components were uniformly distributed. On the other hand, no module was applicable to the drug release kinetics in simulate intestinal juice for the four microencapsulated systems.

5.Retained rate of core material (curcumin) microencapsulated in γ-PGA was decreased from 96% to 55% after hydrolyzed by pepsin as a simulate gastric fluid treatment for 2 hr. The curcumin retained rate was increased to higher than 70% by combined with alginate, PLL and MTGase.

6.On thermal stability, core material (curcumin) retained in γ-PGA microcapsules were 51.6%, 28.8%, and 22.9%, respectively, after treatment at 35°C, 55°C, and 75°C for 1 hr. The curcumin retained rate could be increased to 79.3%, 79.8%, 68.4% for that combined with alginate; 75.9%, 60.6%, 51.5% for that combined with PLL; and 60.9%, 55.4%, 39.7% for that combined with MTGase. Addition of the three polymers enhanced the resistance to heat, and the effect of alginate appeared most obviously.

In summary, γ-PGA was a potential shell material for microencapsulation to prevent core materials microencapsulated from destruction. Moreover, the drug control release characteristics and stability could be improved by means of addition of alginate, PLL and MTGase. We anticipate a practical application of γ-PGA as a safe and protective delivery vehicle for drug administering and food industry.

Keywords : γ-PGA、Curcumin、Alginate、Poly-L-lysine、Microbial transglutaminase、Microencapsulation、Drug release kinetics

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