Preparation of Chitosan Microcapsules by Using Microreactor

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Abstract

Chitosan microcapsules were prepared by microreactor method and conventional batch method using glutaraldehyde as a cross-linking agent and *L*-a-phosphatidylcholine as an emulsifier. The mean particle sizes of microcapsules prepared by microreactor and batch method were 1.10 and 1.96 mm, respectively. The former microcapsules showed narrower size distribution than those of the latter one.

1. Introduction

Microcapsules have found a wide range of application in liquid crystals, adhesives, cosmetics and insecticides. Recent research interest is focused in the reduction of the particle size of the micro-capsules. Chitosan is a naturally occurring polycationic polymer and has antifungal and bacteriostatic properties. Chitosan microcapsules have been prepared in the combination of alginate or glutaraldehyde for the purpose of pharmaceutical use[1,2)].

Microreactor system provides uniquecharacteristics such as short molecular diffusion distance, large specific interfacial area and small heat capacity, promoting the research of highly effective chemical reactions. Recently we have developed the preparation of melamine microcapsules using microreactor method, obtaining particle sizes much smaller than those prepared by batch method[3)]. We have applied the microreactor method for the preparation of chitosan microcapsule using SPAN 80 as emulsifier[4)]. In this work, we investigated the microreactor method for the preparation of chitosan microcapsule by using *L*-a-phosphatidylcholine as emulsifier. *L*-a-Phosphatidylcholineis available from natural resource and biocompatible like chitosan.

2. Experimental

2.1 Batch method

A mixture of 2.25 g of *L* - a - phosphatidylcholine, 10 ml of toluene, 10 mg chitosan and 1ml of 1 % aqueous acetic acid was stirred for 10 minutes by using homogenizer, giving w/o emulsion. To this emulsion 0.5 ml of aqueous glutaraldehyde in 5 % sulfuric acid was added and the mixture was stirred for 40 minutes by homogenizer. Solid polymeric materials formed were collected by filtration.

2.2 Microreactor method

The capillary microreactor system was composed of a microsyringe pump, a pair of gas-tight syringe, a Y-connector, deactivated fused silica capillary tubes with a diameter of 250 mm. The w/o emulsion prepared from a mixture of *L*-a-phosphatidylcholine, toluene, chitosan and 1% aqueous acetic acid as described in the batch method was placed in one of the syringe, while a mixture of aqueous gultaraldehyde in 5 % sulfuric acid was placed in another syringe. Both of the solution was injectedto the capillary system at a controlled rate. The solution eluted from the capillary tube gave polymeric solid including microcapsules.

3. Results and Discussion

Using SPAN 80 as an emulsifier we have prepared chitosan microcapsules with mean particle size of 3.9 and 2.0mm for batch and microreactor method, resectively.[5)]

(a) (b)

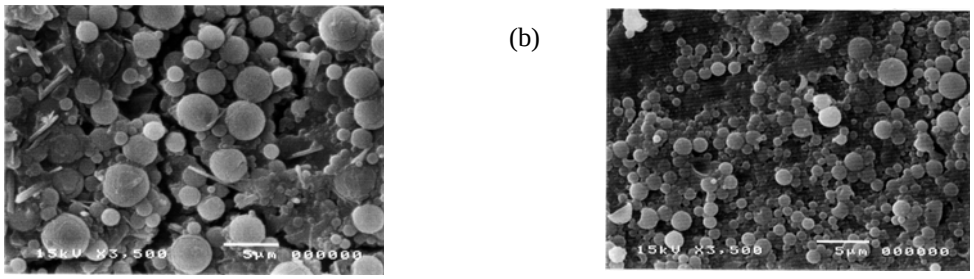

Fig. 1. SEM photographs of microcapsules prepared by (a) batch and (b) microreactor method.

In the present work Span 80 was replaced by *L*-a-phosphatidylcholine. As shown by the SEM photographs in Fig. 1, batch and microreactor method gave spherical microcapsules with smooth surfaces. The mean sizes of the microcapsules are 1.96 and 1.10 mmfor batch and microreactor method, respectively. *L*-a-Phosphatidylcholine reduced the particle sizes to 50-55% of those for SPAN 80.

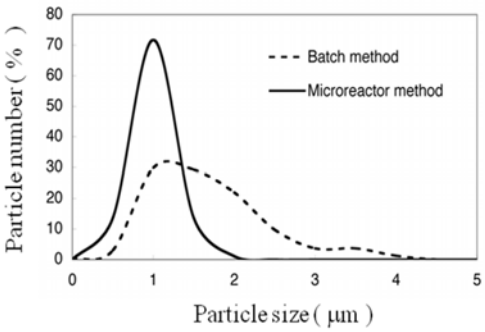

Fig. 2. The size distribution of microcapsules.

As shown by Fig. 2 the size distribution obtained by microreactor method was narrower than that of batch method. The emulsion is considered to be more stable in laminar flowof microreactor than in the vigorous mixing of the batch method.

References

1. X. Shin, T. Tan, *Biometerials,* **23,** 4469-4473 (2002).
2. C. Wang, W. Ye, *Int. J. Pharm*. **338**, 165-173 (2007).
3. T. Sawada, M. Korenori, K. Ito, Y. Kuwahara, H. Shosenji, Y. Taketomi and S. Park, *Macromol. Mater. Eng*., **288**, 920 (2003).
4. H. Shosenji, M. Korenori, Y. Kuwahara, T. Sawada, and S. Park, *Proc. of 2003 Internat. Conf. on Advanced Polym Mat*., Shanghai, China.

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