일반강연 A-2

Preparation of Alginate Microspheres Using the Membrane Emusification Method and Release Characteristics of BSA

Choi Yong Han, Youm Kyung Ho
School of Chemical Engineering, Chungbuk National University

막유화법을 이용한 Alginate Microsphere의 제조 및 BSA 방출 특성

최용한, 염경호
충북대학교 공과대학 화학공학부

1. Introduction

Emulsion manufacturing is a very important process in the food, chemical, mineral processing, cosmetics and pharmaceutical industries. To produce emulsion, many emulsification equipments such as high-speed rotor systems, colloid mills, homogenizers and ultrasonicators are being used in various industrial fields. However, it is well known that a number of problems may be associated with such conventional methods: The droplet size and size distribution cannot easily be controlled. The energy utilization for large scale production of emulsions using conventional methods is very poor and gets worse as vessel size increases [1-3].

Over the last 10 years or so, there has been an increasing interest in a technique for making emulsions known as membrane emulsification. This method involves using a low pressure to force the disperse phase to permeate through a microporous membrane having a uniform pore-size distribution into the continuous phase. This technique is highly attractive to give its simplicity, potentially lower energy demands and the resulting narrow droplet-size distribution. Since the pioneering work on preparation of monodispersed microspheres using Shirasu-porous-glass (SPG) membrane by Nakasima and Shimizu et al [4], various kinds of monodispersed microemulsions and microspheres with a narrow size distribution have been developed.

In this paper, we prepared uniform microspheres of a natural polymer, Ca-alginate, for controlling various conditions of emulsification procedure using a lab-scale membrane emulsification system and observed the effects of various parameters of membrane emulsification procedure to prepare Ca-alginate microspheres as antigen delivery systems. we also studied characteristics of bovine serum albumin(BSA) release from prepared microspheres.

2. Experimental

2-1. Membrane emulsification apparatus

A schematic diagram of the membrane emulsification apparatus is shown in Fig. 1. The continuous phase containing a emulsifier is stirred outside Microporous glass (MPG) membrane tube in the vessel and the disperse phase in the disperse phase reservoir is permeated through the membrane into the continuous phase under N_2 gas pressure.

Pressure is monitored by a pressure gauge connected between the disperse phase reservoir and the membrane module. The disperse phase

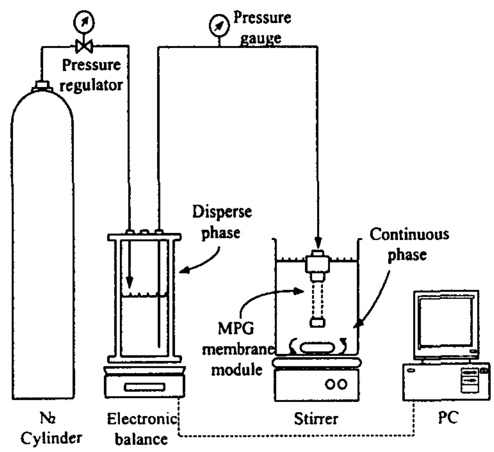

Fig. 1. Schematic diagram of membrane emulsification apparatus.

flux is calculated on the basis of the data obtained from the weight change of the disperse phase reservoir with a balance and a computer.

2-2. Preparation of alginate microspheres

A typical experiment was carried out as follows: Before emulsification, the membrane tube was immersed in the oil for 10min prior to use so that its surface was entirely wetted by the continuous phase. The membrane tube immersed in the oil was installed in the membrane system. The dispersed phase was permeated through the membrane under nitrogen gas pressure in the continuous phase and suspended. A calcium chloride solution was added and the dispersion was mixed for 20min. Ethanol was then used to dehydrate and further harden the formed microspheres. The microspheres were collected by filtration, washed three times with acetone and finally dried 24h at 37℃.

3. Results and discussion

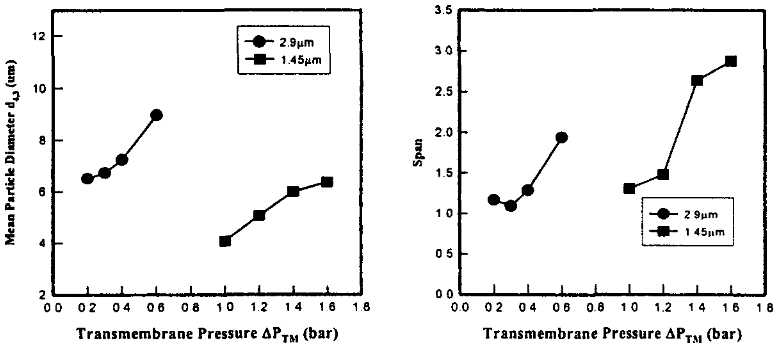

Fig. 2. Mean size and size distribution of alginate microspheres on transmembrane pressures.

Fig. 2 shows the effect of sizes and size distribution of prepared microspheres on various transmembrane pressures. when transmembrane pressure was increased, mean size of prepared microspheres was increased and size distribution was broadened. Although size distribution of prepared microspheres became narrow at the low pressure, emulsion-prepared time became more slow than at the high pressure due to the reduction of the flux of the disperse phase permeated through a microporous membrane.

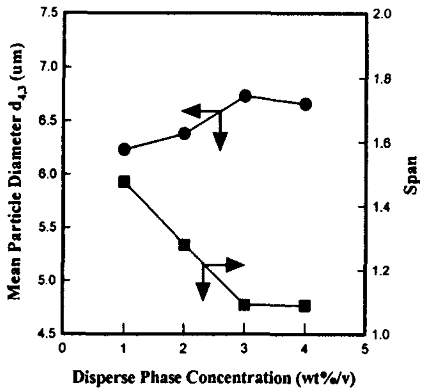

Fig. 3. Mean size and size distribution of alginate microspheres on the concentrations of the disperse phase.

Fig, 3 shows the effect of size and size distribution of prepared microspheres on various concentrations of the disperse phase. when the concentration of the disperse phase was increased, we could observe that mean sizes of prepared microspheres was increased and their size distribution narrowed due to the increase of the viscosity of the disperse phase.

4. References

1. D. J. McClements, Food Emulsions: Principles, Practice, and Techniques, CRC Press, **Ch. 1**, 1(1999).
2. V. Schröder, O. Behrend, H. Schubert, *J. Colloid and Interface Science*, **202**, 334(1998).
3. R. A. Williams, S. J. Peng, D. A. Wheeler, N. C. Morley, D. Taylor, M. Whalley, D. W. Houldsworth, *Trans IchemE*, **76**, Part A, 902(1998).
4. T. Nakahima, M. Shimizu, M. Kukizaki, *Key Engineering Materials*, **61-62**, 513(1991).