Encapsulation of sesame oil by microemulsion technique: Study of phase diagram

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INTRODUCTION

Microemulsion is a system composes of water, oil, surfactant and/or cosurfactant. It is a transparent, low viscosity, and spontaneous formation system with an internal droplet size ranging of about 10-100 nm (1-2). It has an advantage over a traditional emulsion since it is thermodynamically stable. Hence, microemulsion is promising for efficient drug carrier (3). Sesame oil, a fixed plant oil of *Sesamum indicum*, comprises many active substances with high activity for health promotion such as antioxidant (4) and antitumor (5) actions. The oil has been used for a long time by Thai people as food additives so this is a proof for its safety to human. Because of its high antioxidant property, transdermal delivery of sesame oil via microemulsion system could prevent the skin from oxidative stress. The purpose of this work was to investigate a suitable surfactant and cosurfactant for microemulsion of sesame oil and to study the influence of ionic strength and pH on microemulsion formation.

EXPERIMENTAL

Materials

Polyoxyethylene (10) oleyl ether (Brij 97) was purchased from Aldrich (Steinheim, Garmany). Octylphenol-polyethylene glycolether (Triton X-114) and polyethylene glycol sorbitan trioleate (Tween 85) were obtained from Acros Organics (New Jersy, USA). Hexan-1-ol was purchased from Unilab – APS (Asia Pacific Specialty Chemical Limited ABN, Australia). Ethanol, sodium dihydrogen orthophosphate dehydrate, sodium chloride and calcium chloride were obtained from Fisher Chemicals (Loughborough, UK). Di-Sodium hydrogen orthophosphate dehydrate was obtained from Ajax Finechem. (NSW, Australia). These reagents were of analytical grade. Polyoxyethylene sorbitan monolaurate (Tween 20) was purchased from Namsiang Co., Ltd. (Bangkok, Thailand). Sesame Oil was a generous gift from Thai Flower & Herbs Co., Ltd. (Petchaboon, Thailand).

Construction of phase diagrams

Pseudoternary phase diagrams were constructed using a water titration method. Surfactants including Brij 97, Triton X 114, Tween 20 and Tween 85 were separately mixed with a cosurfactant, ethanol or hexanol at a weight ratio of 1:2, 1:1 and 2:1 to obtain a surfactant mixture. Sesame oil and the surfactant mixture were then mixed at the weight ratios of 1:9, 2:8, 3:7, 4:6, 5:5, 6:4, 7:3, 8:2, and 9:1. These mixtures were titrated with water, under moderate agitation. The samples were classified as microemulsions when they appeared as a clear liquid. The water was replaced by phosphate buffer pH 4.0, 6.0 and 8.0 to investigate pH effect and by 0.1 M, 0.5 M and 1.0 M monovalent salt (NaCl) and divalent salt ($CaCl_2$) to investigate the effect of electrolyte and ionic strength. The pseudoternary phase diagram was drawn by SigmaPlot for Windows version 10.0 software.

RESULTS AND DISCUSSION

Effect of surfactant type and cosurfactant

Pseudoternary phase diagrams of 4-component system (sesame oil/ water / surfactant and cosurfactant) were constructed to determine the area of microemulsion. It is found that among 4 surfactants used (Tween 85, Brij 97, Triton X-114 and Tween 20), only Tween 85 gave the microemulsion area. The result shows that Tween 85 has an ability to form microemulsion of w/o type as shown in Fig. 1. The addition of ethanol as a cosurfactant affected the microemulsion. The results reveals that more water can be added to the microemulsion with cosurfactant as shown in Fig. 2.

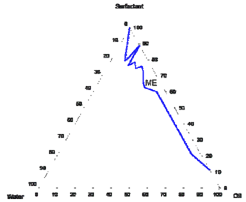

Fig. 1. Ternary phase diagram of sesame oil / water / Tween 85 (ME = microemulsion area)**.**

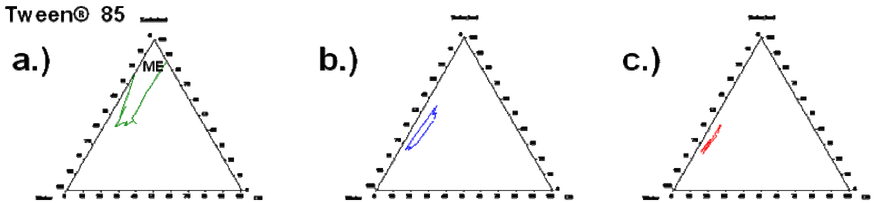

Fig.2. Effect of ratio of surfactant to ethanol of 2: 1 (a), 1: 1 (b), and 1: 2 (c).

Effect of alcohol type

In this experiment, two alcohols (ethanol and hexanol) were used as cosurfactant of the system. The results demonstrate that microemulsion type obtained from each alcohol is different. Microemulsion area obtained from ethanol is of o/w type whereas that of heaxanol is w/o type as shown in Fig. 3. It is more obvious when the ratio of surfactant to cosurfactant is high.

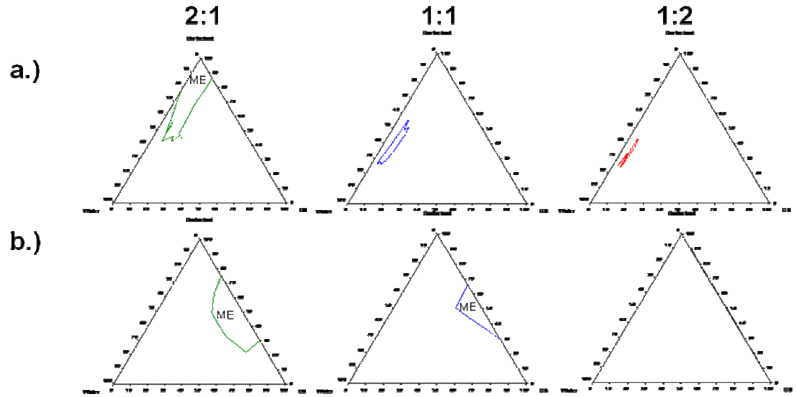

Fig. 3. Effect of ethanol (a) and hexanol (b) on microemulsion area in pseudoternary phase diagram.

Effect of pH and electrolyte

Results in Fig. 4 shows that the presence of electrolyte could affect microemulsion by increasing polarity of microemulsion system. However, the differences in type of electrolyte and ionic strength give similar results. The effect of pH on microemulsion area is shown in Fig. 5. It is found that the area of microemulsion is similar in the system with pH of 4 and 6. However it was changed when the pH was changed to 8.

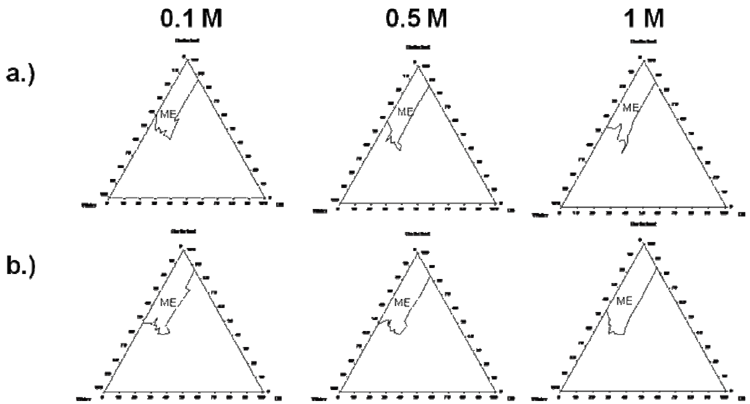

Fig. 4. Effect of NaCl (a) and $CaCl_2$.(b) on microemulsion area in the phase diagrams.

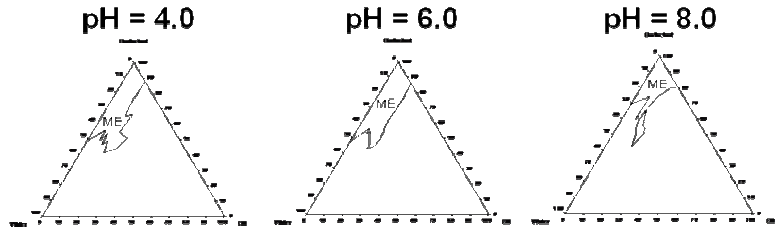

Fig. 5. Effect of pH on microemulsion area in ternary phase diagram.

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