

Nanoemulsion Formation and Characterization of Neutraceutical Component with the Sonication and Self-Assembly Methods

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ABSTRACT

In this research, we investigated the optimum condition for the preparation of O/W nanoemulsion containing surfactants, neutraceutical ingredients extracted from *Angelica gigas* Nakai and oil phase in ternary phase diagrams of systems, and characterized the stability and formation of nanoemulsions. O/W nanoemulsions of neutraceutical ingredients could be prepared by the ultra-sonication process and by self-assembly method with a particle size of 20-100nm and having a good stability during storage. The self-assembly method have an advantage with using low energy, but have a defect of using with many amounts of synthetic surfactants. Therefore the ultra-sonication method may be more powerful tool to prepare the nanoemulsion than the self-assembly method, it might be due to the formation capacity of nanoemulsion phase.

Keywords: nanoemulsion, *Angelica gigas* Nakai, neutraceutical ingredients self-assembly, ultra-sonication

INTRODUCTION

Nanotechnology focuses on the characterization, fabrication, and manipulation of biological and nonbiological structures smaller than 100nm. Structures on this scale have been shown to have unique and novel functional properties[1]. In recent years, much attention has focused on lipid-based formulations to improved the oral bioavailability of lipophilic functional components. In fact, the most popular approach is the incorporation of the active lipophilic component into inert lipid vehicles such as oil, surfactant dispersions, microemulsions, nanoemulsions, and liposomes[2-4]. One of the promising nanotechnologies is nanoemulsions, which have also potential advantages over macroemulsions offering sustained controlled release, improved bioavailability and high stability for neutraceutical components[5]. *Angelica gigas* Nakai (also known as Cham-Danggui in Korea) is a perennial plant belonging to the Umbelliferae family, and the root has been traditionally used in Korean folk medicine containing neutraceutical components such as decursin and decursinol angelate[6].

MATERIALS AND METHODS

1. Materials

Polyoxyethylene sorbitan monooleate (Tween 80) was supplied from IlshinWells (Seoul, Korea, commercially available as Almax-9080). Medium chain triglyceride(MCT) supplied from Wellga (Yangsan, Korea).

2. Preparation of *Angelica gigas* Nakai Extracts

Neutraceutical ingredients such as decursin and decursinol angelate was extracted from *Angelica gigas* Nakai, medicinal herb in Korea. The neutraceutical ingredients of *Angelica gigas* Nakai was extracted with 100% MeOH (5% w/v) for 2hr at room temperature. The extracts was concentrated with evaporation at 50 °C.

3. Preparation of nanoemulsion

The composition of three-component nanoemulsion system included *Angelica gigas* Nakai Extracts(AE)+MCT, Tween 80 and water. An oil-in-water emulsion was prepared by self-assembly or ultra-sonication method[7].

4. Particle size measurements

The mean droplet size and size distribution were determined by laser light scattering (Nanotrac TM250, Microtrac Inc., PA, U.S.A) at 25°C.

RESULTS AND DISCUSSIONS

1. Ternary phase diagram

The phase diagrams indicating the behavior of the systems composed of AE+MCT, Tween 80 and water with self-assembly and ultra-sonication method, respectively, and area of nanoemulsion existence are shown Fig. 1 and 2. Area enclosed within the solid line represents the extent of nanoemulsion formation, which was a white region and below 100nm. In place of a gray region, was formed with microemulsion, above 100nm and an extensive region, 2-phase regions were formed at high surfactant (degree of 60-

80 wt %), low AE concentrations, together with very large, cloudy and separation.

not stable during storage, and had phase separation and flocculation.

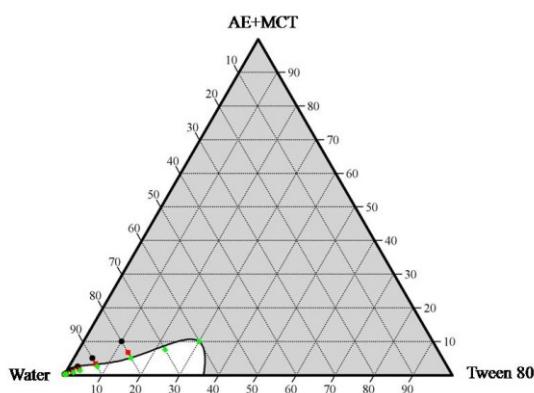


Fig. 1. Pseudo-ternary phase diagram of nanoemulsions formed by self-assembly method on the system AE+MCT/Tween 80/Water
(AE; *Angelica gigas* Nakai Extracts, White region;
Nanoemulsion <100nm)

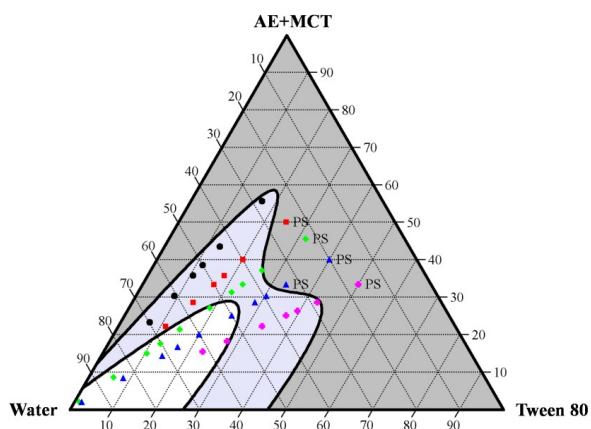


Fig. 2. Pseudo-ternary phase diagram of nanoemulsions formed by ultra-sonication method on the system AE+MCT/Tween 80/Water
(AE; *Angelica gigas* Nakai Extracts, PS; phase separation,
White region; Nanoemulsion <100nm, Gray region;
Microemulsion >100nm)

2. Stability of nanoemulsions during storage

The stability of nanoemulsion measured by particle size over 14 days period of storage at 25 °C. The nanoemulsions prepared in this study maintained stable form having particle size, below 100nm. However, microemulsions were

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