SHORT COMMUNICATION

Development of great burdock essence compounds

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Abstract The nanomicelle encapsulating the water-insoluble substances can solubilize in aqueous solution. In this study, we used nanomicelle technology to develop great burdock essence. Black semen oil extracts of Arnebia euchroma and Angelica sinensis, water extract of Arctium lappa, phospholipid, and glycerol were mixed and homogenized in a high-pressure homogenizer. The particle size of great burdock essence was 167.1 ± 0.96 nm. Concentrations of chlorogenic acid, shikonin, and ferulic acid of great burdock essence were 2.300 ± 0.605, 1.484 ± 0.009, and 1.463 ± 0.006 mg/g, respectively. The great burdock essence had nanoparticle-size molecules, which resulted in easy cellular uptake by endocytosis, and main components of three herbs. However, for more information on the health benefits of the great burdock essence, further studies are needed.

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Introduction

Nanomicelles, which are self-assembled from amphiphilic biomolecules, are useful as drug delivery system. These are amphiphilic biomolecules, such as phospholipid, that contain a hydrophilic phosphate and two hydrophobic aliphatic chains, and can self-assemble spontaneously into vesicles when dispersed in an aqueous solution.1 Nanomicelle is able to solubilize hydrophobic substance and form small particles, which helps in easy cellular uptake via endocytosis.

Arctium lappa, commonly known as great burdock, is a traditional Chinese medicinal herb and an edible perennial plant of the Asteraceae family. The root of A lappa has
also been cultivated as a vegetable for dietary use in Taiwan. The nutrients contained in *A lappa* include inulin, polyphenols, chlorogenic acid, proteins, carbohydrates, vitamins, amino acids, minerals, and unsaturated fatty acids.\(^2\) In folk medicine, *A lappa* had been used to treat throat pain, arthritis, rashes, and various skin problems, and also as a diuretic, depurative, and digestive stimulant.\(^3\)

Some studies indicated that *A lappa* roots have hepatoprotective, anti-inflammatory, and free radical scavenging activities.\(^4,5\) In our previous studies, we found that *A lappa* improved mucus protection in the stomach and intestines, and also prevented mucous injuries caused by alcohol.\(^6\)

*Arnebia euchroma*, a plant of Boraginacea family, is an important traditional Chinese medicinal herb, and has been widely used for its wound healing, anti-inflammation, and antibacterial properties. Shikonin, which is an important component of *Arnebia euchroma*, has been reported to induce hepatocellular carcinoma cells apoptosis,\(^7\) and shows anti-inflammatory, antibacterial,\(^8,9\) antioxidative,\(^10\) and antiviral activities.\(^11\) *Angelica sinensis*, a perennial plant of Apiaceae family, is widely used in traditional Chinese medicine to treat gynecological diseases such as dysmenorrhea, menoxenia, and pelvic pain.\(^12\) Ferulic acid, one main component of *A sinensis*, exhibits many bioactivities such as anti-inflammatory and immunostimulatory effects.\(^13\)

In this study, we combined the medicinal herbs described above and developed the great burdock essence for protecting the mucus coating of the stomach from bacteria. Because nanomicelle has the ability to solubilize water-insoluble substances in aqueous solution, we used this technology to encapsulate the oil extracts of *A euchroma* and *A sinensis* in the water extract of *A lappa*.

### Materials and methods

*Arnebia euchroma* root and *Angelica sinensis* were purchased from a Chinese herbal medicine store. *A lappa* was provided by Dong Yuan Biotechnology Pharmacy. *Arnebia euchroma* and *A sinensis* were extracted with black sesame oil, and *A lappa* was extracted with water. Oil extracts of *Arnebia euchroma* root and *Angelica sinensis*, water extract of *A lappa*, phospholipid, and glycerol were mixed. The mixture was homogenized in a high-pressure homogenizer, and the nanomicelle solution of great burdock essence was prepared by filtering through a 0.1 \(\mu\)m membrane. The particle size of the nanomicelle solution was evaluated by Particle Size Analyzer (Beckman Coulter, Fullerton, CA, USA). Chlorogenic acid of *A lappa*, shikonin of *Arnebia euchroma*, and ferulic acid of *A sinensis* were analyzed by high-performance liquid chromatography.

### Results

The mixtures of oil extracts, water extracts, phospholipid, and glycerol were homogenized in a high-pressure homogenizer, and then passed through a 0.1 \(\mu\)m membrane. The resulting particle size of great burdock essence was approximately 167.1 ± 0.96 nm (mean ± SD, Fig. 1). The concentrations of chlorogenic acid, shikonin, and ferulic acid in great burdock essence were 2.300 ± 0.605, 1.484 ± 0.009, and 1.463 ± 0.006 \(\mu\)g/g, respectively (Table 1).

### Discussion and conclusion

Nanomicelle is useful for solubilizing hydrophobic substances in hydrophilic solution. Because of this advantage, nanomicelle is wildly used in drug delivery system. The nanomicelle is subjected to cellular uptake via cell infusion, endocytosis, and phagocytosis. In this study, we extracted *Arnebia euchroma* and *Angelica sinensis* using black sesame oil, and *A lappa* using water. Using nanomicelle technology, the great burdock essence was prepared successfully, and the vesicle diameter of the micelle particle was approximately 167.1 ± 0.96 nm. Moreover, chlorogenic acid, shikonin, and ferulic acid contents in the great burdock essence were 2.300 ± 0.605, 1.484 ± 0.009, and 1.463 ± 0.006 \(\mu\)g/g, respectively. These results show that the main

![Figure 1](image.png)

**Figure 1** Particle size of the great burdock essence. The great burdock essence particle size was analyzed three times. The average particle size was 167.1 ± 0.96 nm.
components of herbs are actually present in the great burdock essence, indicating that the nanomicelle technology does not lead to the loss of the main components of the medicinal herbs. Our future studies will focus on further elucidating the effect of the great burdock essence on mucus protection and bacterial inhibition.

References


### Table 1 Main components of the great burdock essence and their concentrations.

<table>
<thead>
<tr>
<th>Main component</th>
<th>Concentration (µg/g)</th>
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<tbody>
<tr>
<td>Chlorogenic acid</td>
<td>2.300 ± 0.605</td>
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<tr>
<td>Shikonin</td>
<td>1.484 ± 0.009</td>
</tr>
<tr>
<td>Ferulic acid</td>
<td>1.463 ± 0.006</td>
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