Extraction of Nonionic Natural Surfactants (saponin) From Ginseng Medical Plant

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Abstract:

In this study, nonionic surfactants were extracted from ginseng. The extraction of these surfactants from the plant was done by soxhlet. After the extraction, we used FT-IR spectroscopy for characterization of extracted saponin. Rates of change of water surface tension in terms of these surfactants concentration were obtained at 25℃. It shows that saponin as a surfactant decreased the surface tension of water. After that, the critical micelle concentration of these surfactants was obtained by curve of change of water surface tension in terms of change of these surfactants concentration.

Keywords: ginseng, nonionic surfactant, surface tension, critical micelle concentration

Introduction:

So far, many efforts to replace natural surfactants have been conducted in various processes. However due to the low efficiency of some products, this products are not economically. So replacing plant surfactants is further used due to having chemical surfactants and other natural advantages and high production efficiency. Saponin is a kind of these natural surfactants.

Saponin is a kind of nonionic natural surfactant that can be found in many plant species. Saponins are a major group of plant secondary metabolite. They are glycosides with high molecular weight. Figure 1 shows two group of saponin chemical structure that include triterpenoids and steroids [1-2].

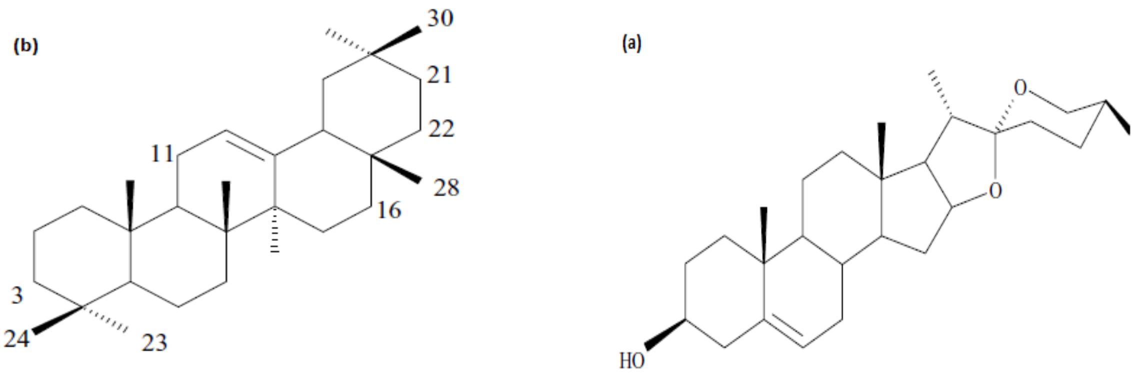

Fig1. a) Structures of steroide saponin b) triterpenoide saponin

Saponins in addition to having the capability of chemical surfactants can also be self-decomposable [3].

There are more than 500 medicine plants in the world that they are having these nonionic surfactants. Figure 2 shows the picture of one of the most common of this plants that is Asian ginseng or Korean ginseng.

The main components of ginseng are triterpenoid saponins that they have been identified as an agent with more versatile and useful effects including anti-inflammatory, antioxidant and anticancer properties [4-5]. Figure 3 shows structure of these triterpenoid saponins.

Fig2. Picture of Asian ginseng

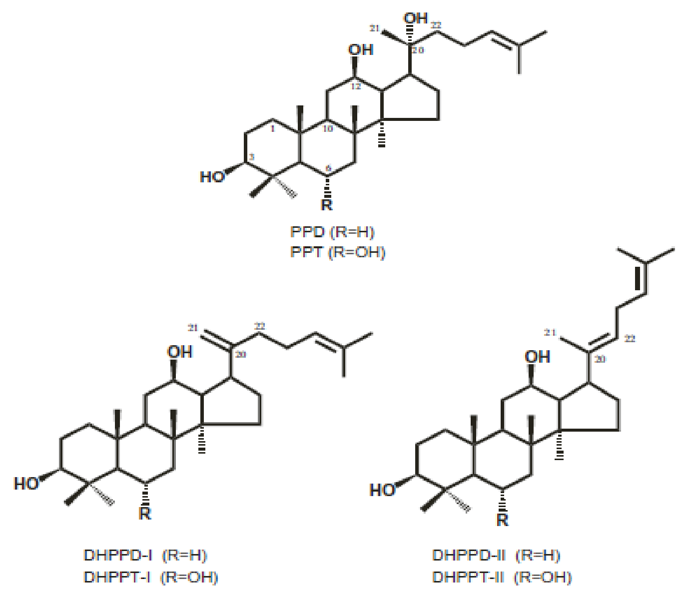

Fig3. Structure of triterpenoid saponins

Experimental:

Materials:

First, roots of Korean ginseng were purchased. Methanol as solvent and acetone as degreasing were purchased from Merck Company and used as received.

Method of extraction:

First, certain amount of chopped roots of ginseng were put into the soxhlet in other to degreasing by acetone for 4 hours. Then the residuum was placed into the oven at 40 ℃ for a day. The degreased dry residuum was solved to mixture of methanol and water (3:2) at 70 ℃. After that, the mixture was placed to the sonicator for 45 min. The obtained sample was spin off and the residuum was placed into the soxhlet with mixture of methanol and water (3:2) as solvent in other to complete extraction. The fluid obtained of centrifuges and soxhlet was poured rotary evaporator in other to concentrate for 3 hours at 55 ℃. Finally, the crude saponin were put to the fridge for future use [6]. Figure 4 shows the soxhlet system.

For characterization of extracted saponin, FT-IR shimadzu S8400 fourier transform infrared spectrometer was used.

Surface tension measurement:

We measured the changes of surface tension of water with adding these saponins to the water. For this work we used tensiometer sigma 700.

Fig4. Soxhlet system

Result and discussion:

Figure 5 shows the FT-IR spectra of the gel and powder form of extracted saponin. The IR spectra shows important absorption bands at 3354 cm^{-1}(attributed to OH stretching) , 2935 cm^{-1} (assigned to C–C overtone) and 1633-1662 cm^{-1} (assigned to C=C stretching).Those peaks clearly shows that saponin have been extracted from ginseng.

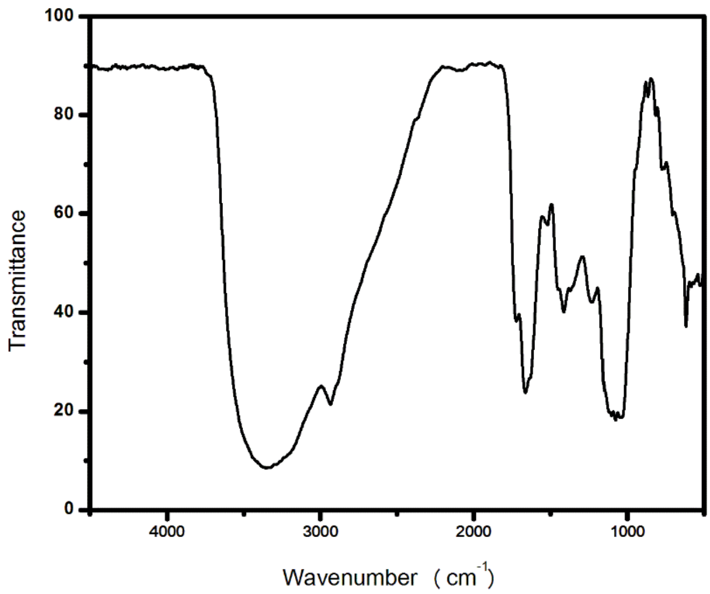

Fig5. FT-IR spectra of extracted saponin

Figure 6 indicates changes in surface tension of deionized water by adding extracted saponins at 25℃. By adding these kind of nonionic surfactants into the DI water, surface tension decreased from 72.689 $\frac{mN}{m}$ to 38.921$\frac{mN}{m}$. When we are not added saponins into the DI water, the molecules of water are imposed hydrogen bond with their maximum capacity, so this causes that the surface tension of DI water be 72.689$\frac{mN}{m}$. But by adding the saponins into the DI water, these surfactants are placed on the water surface from their hydrophilic head and this event breaks the hydrogen bonds between water molecules, so the surface tension of water decrease to 38.921$\frac{mN}{m}$ [7]. The surface tension reduction continues until the surface is saturated by the surfactants. After that the surfactants forms micelles with entrance to the bulk [8]. Critical micelle concentration (CMC) is the lowest concentration of surfactants for micelle forming. The value of CMC of saponin was 830 ppm.

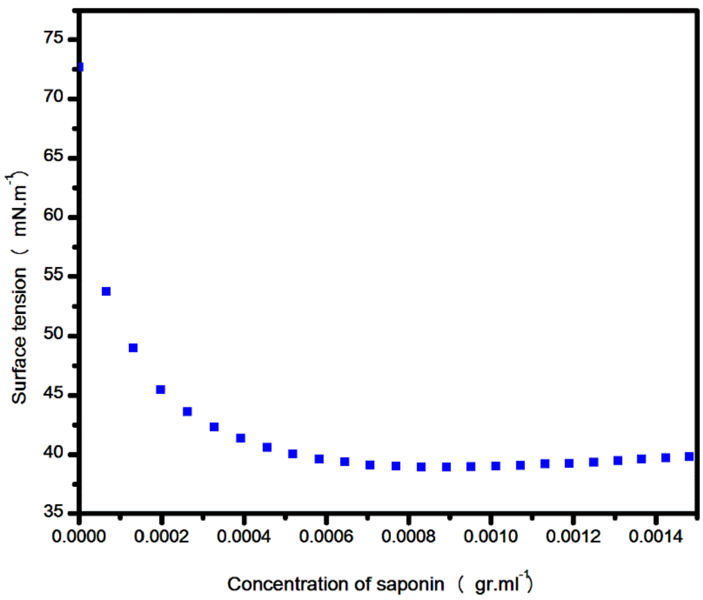

fig6. The curve of changes in surface tension of water

Conclusions:

In this study nonionic surfactants were extracted from a kind of medical plant that called ginseng. The surface tension of water significantly reduced by adding saponin .This project improved using this surfactant in future projects. These natural surfactants can significantly reduce pollutions and environmental risks that caused by chemical surfactants. Plant saponins have mainly medical applications but we can use them in another industries due to their surface properties.

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