



SYNTHESIS OF SILVER NANOPARTICLES USING EXTRACT OBTAINED FROM *SAUSSUREA AMARA* L.

Byambasuren Gerelt-Od¹, Enkhsaikhan Munkhnasan¹, Tsetsemaa Sanjjav¹,
Altansukh Tsend-Ayush², Tserendolgor Batsukh^{1*}

¹ Department of Pharmaceutical Management and Organization, Mongolian University of Pharmaceutical Sciences, Ulaanbaatar, Mongolia

² School of Bio-Medicine, Mongolian National University of Medical Sciences, Ulaanbaatar, Mongolia

KEYWORDS

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ABSTRACT

Background: Cancer, especially liver cancer, is the second leading cause of death and morbidity among the population of Mongolia. In recent years, the development of bio-compatible, bio-safe, and ecologically friendly nanoparticles using medicinal plants with high therapeutic activity has become an urgent need for research in the field of nanotechnology. Therefore, we aimed to obtain an extract from *Saussurea amara* L., to conduct a qualitative study and to synthesize silver nanoparticles based on the extract. **Methods:** Raw material of *Saussurea amara* L. was used in the research. The aerial part of the medicinal plant was extracted by circulation, remaceration, and repercolation techniques with 70% ethanol and distilled water (1:10). The qualitative analysis of total flavonoids, which are biologically active substances of the extract, was determined

by thin layer chromatography, and the quantitative content was determined by spectrophotometry. After preparation of alcoholic extract from raw materials of *Saussurea amara* L., nanoparticles were synthesized using silver nitrate solution.

Results: The raw material of *Saussurea amara* L. was extracted by circulation method with 70% ethanol.

A color change from light to deep brown color was observed when observing the synthesis of silver nanoparticles based on the extract of the medicinal plant.

As assessed by spectral analysis, the light absorption value increases with increasing reaction time, indicating the formation of silver nanoparticles. The silver nanoparticles synthesized from *Saussurea amara* L. extract had a size of 32.02 nm. Based on these results, we successfully

*Corresponding author: Department of Pharmaceutical Management and Organization, Mongolian University of Pharmaceutical Sciences, Songolon's road 4/A, Songinokhairkhan District 20th khoroo, Ulaanbaatar, Mongolia

E-mail address: tserendolgor@monos.mn (Tserendolgor Batsukh)

synthesized silver nanoparticles from the medicinal plant extracts.

Conclusions: The results showed that the circulation method with 70% ethanol was more suitable for extracting the raw

materials of *Saussurea amara* L. The average size of silver nanoparticles synthesized from *Saussurea amara* L. extract was detected around 32.02 nm.

1. INTRODUCTION

As of 2021, 5,981 new cancer cases were diagnosed in Mongolia, of which 1,956 new cases were diagnosed with liver cancer. Liver cancer alone accounts for 33% of all cancers.¹ Therefore, the research of natural drugs and preparations with low side effects and anti-tumor effects continues to attract the attention of scientists. *Saussurea amara* L. is a perennial herb in the Compositae family. *Saussurea amara* L. has been used in traditional medicine since ancient times for killing bacteria, treating pneumonia, detoxification, and as a fever reducer. *Saussurea amara* L. is widespread in our country and has been used in the treatment of various diseases.²⁻⁴ In accordance with modern pharmaceutical trends, standardization of traditional medicinal ingredients and herbal raw materials, determination of the content of some biologically active substances, and purification of some biologically active compounds in the medicinal herbs have attracted more attention in the field of pharmacy and pharmacology.⁵⁻⁶ Therefore, the basis of this research is to conduct qualitative research on the raw materials of *Saussurea amara* L., which is widely used in traditional medicine in the composition of Hepaclin 4, to obtain suitable extracts, to identify some biologically active substances, and to obtain silver nanoparticles.

2. MATERIALS AND METHODS

2.1. The raw material of *Saussurea amara* L. was used in the research.

The aerial part of the medicinal plant was extracted by circulation, remaceration, and repercolation techniques with 70% ethanol and distilled water (1:10). The qualitative analysis of total flavonoids, which are biologically active substances of the extract, was determined by thin layer chromatography, and the quantitative content was determined by spectrophotometry. After the preparation of alcoholic extract from raw materials of *Saussurea amara* L., nanoparticles were synthesized using silver nitrate solution.

3. RESULTS

3.1. The qualitative analysis of flavonoids of water and 70% ethanol extracts of *Saussurea amara* L.

Was carried out by thin-layer chromatography using several solvent systems. According to the qualitative analysis for *Saussurea amara* L., the most suitable solvent system was a combination of ethyl acetate-formic acid-acetic acid-water (a ratio of 100:11:11:26) solvent system.

In the thin layer chromatography of medicinal plant, brown spots were detected at the same position as standard quercetin ($R_f=0.94$) and rutin ($R_f=0.18$), which indicates that flavonoids were contained in an extract from *Saussurea amara* L. As for the results of investigating the appropriate extractor solvent, the raw materials of *Saussurea amara* L. were extracted using remaceration, repercolation, and circulation methods with distilled water and 70% ethanol. The total flavonoid content was determined by spectrophotometry in Table 1.

Table 1. Results of obtaining an extract from *Saussurea amara* L.

Plant raw material	Extractor solvent	Extracting techniques	Total flavonoid
Aerial part of <i>Saussurea amara</i> L.	Distilled water	Circulation	0.83±0.03
		remaceration	0.21±0.01
		repercolation	0.92±0.01
	70% ethanol	Circulation	2.3±0.02
		remaceration	1.16±0.04
		repercolation	0.57±0.1

As displayed in Table 1, the total flavonoid content was detected at $1.03 \pm 0.05\%$ in 70% ethanol extraction of the aerial part of *Saussurea amara* L. by circulation method, which indicated that the circulation method was more suitable.

3.2. According to the results of synthesizing the silver nanoparticle, the reaction color changed from light gray to deep gray-brown during the synthesis of silver nanoparticles from *Saussurea amara* L. extract.

As regards to spectral characteristics of the newly synthesized silver nanoparticles based on *Saussurea amara* L., the light absorbance changes during the reaction were also checked by a spectrophotometer at 433 nm to confirm the reaction process. According to the result, the light absorbance from the silver nanoparticles was detected at values of 1.524 at 0 minutes, 1.776 at 30 minutes, 1.922 at 60 minutes, 2.176 at 90 minutes, 2.295 at 120 minutes, and 2.477 at 24 hours, indicating that yield of silver nanoparticles from the plant extract was time-dependent.

The size of silver nanoparticles synthesized from the extract of *Saussurea amara* L. was determined using the Atomic Force Microscope (AFM) microscope (Figure 1).

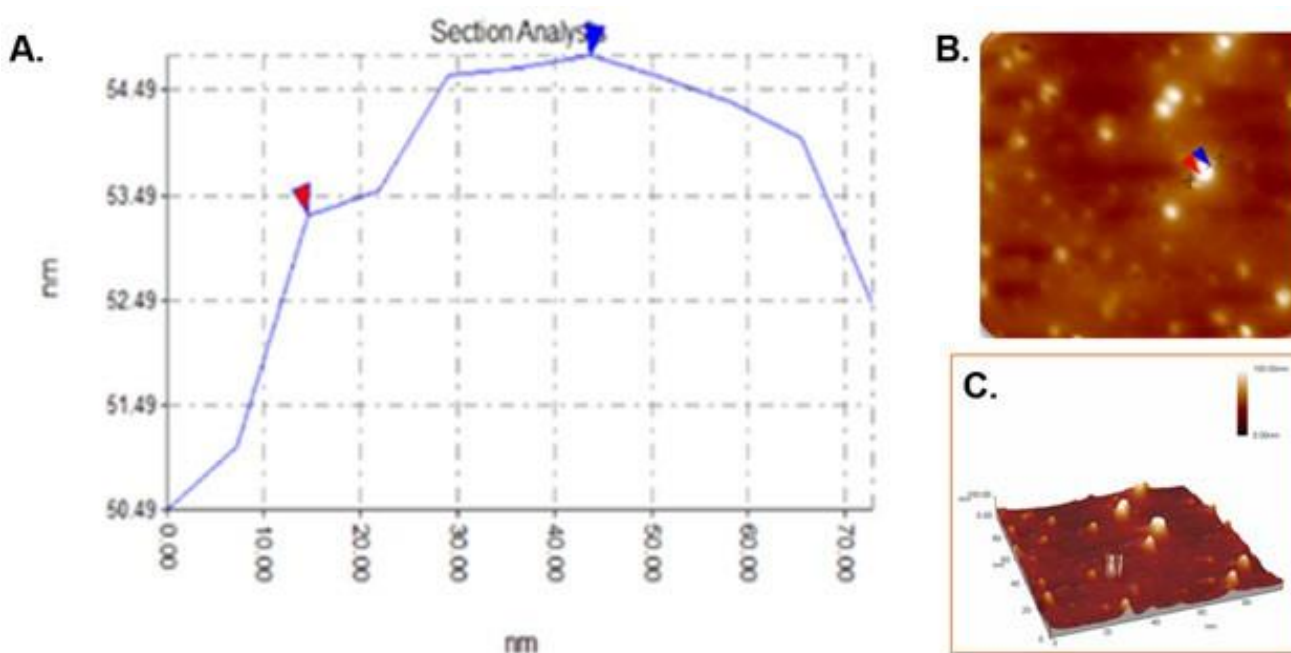


Figure 1. Representative images for the size of silver nanoparticles obtained from *Saussurea amara* L. A. Size of silver nanoparticle by AFM, B. 2D image of silver nanoparticle, C. 3D image of silver nanoparticle.

As detected by AFM, the average size of silver nanoparticles synthesized from *Saussurea amara* L. was 32.02 nm.

4. DISCUSSION

Our research was aimed at conducting qualitative research for raw materials in Hepaclin-4 prescription with preventive effects against liver diseases and complications, obtaining suitable extracts, and determining the qualitative and quantitative content of some biologically active substances.

Daariimaa Kh et al (2006) found terpenoid cinnaropicrin, taraxasterol, flavonoid apigenin, genquatin, sesquiterpenoids, monosaccharides, sucrose, and carbohydrates, rubber, alkaloids 0.1% in the above-ground part of *Saussurea amara* L. It was determined that the medicinal plant contains 0.7% anthraglycosides, 5.6% γ -linolenic acid, 0.2% essential oils, 1.96% flavonoids, and 0.09% coumarins.⁶ According to our study, the qualitative analysis of the raw material of *Saussurea amara* L. showed that flavonoids appeared in the chromatogram, which is similar to the results of the above researchers.

In a study by Musarat Amina et al. (2020), MgO nanoparticles were synthesized by green synthesis using native biomasses of *Saussurea costus* (Falc.) and MgO. The research team used a scanning electron microscope (SEM) and transmission electron microscopy (TEM) to check the surface morphology of extracted nanoparticles, and the size of nanoparticles was 30 and 34 nm.⁷⁻⁹

In our study, 2D and 3D topography of the surface morphology of silver nanoparticles synthesized from *Saussurea amara* L. extract using a microscope (AFM) was used to determine the size of the nanoparticles in a 2x2 μm area, and the silver nanoparticles with an average size of 32.02 nm were found, which is similar to the results of the above researchers.

Taken together with these results, the circulation method with 70% ethanol was more appropriate for extracting the raw materials of *Saussurea amara* L. Moreover,

total flavonoids were detected in the medicinal plant extract. The average size of silver nanoparticles synthesized from *Saussurea amara* L. extract was detected around 32.02 nm.

Conflicts of Interest: The authors declare no conflict of interest.

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