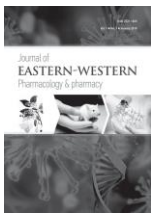

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STUDY ON SYNTHESIZING SILVER NANOPARTICLES USING RAW MATERIALS OF *SCUTELLARIA BAICALENSIS* GEORGI

Suvd Gantulga[1], Byambasuren Gerelt-Od[1], Tserentsoo Byambaa[2], Altansukh Tsend-Ayush[3], Tserendolgor Batsukh[1]*

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

[2] *International School of Mongolian Medicine, Mongolian National University of Medical Sciences, Ulaanbaatar, Mongolia*

[3] *School of Bio-Medicine, Mongolian National University of Medical Sciences, Ulaanbaatar, Mongolia*

KEYWORDS

Plant extract, Nanoparticle, Synthesis, Silver, Maceration

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ABSTRACT

Background: Scientists have found that *Scutellaria baicalensis* Georgi has liver protection, antibacterial, and anti-tumor effects. 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. Hence, we aimed to synthesize silver nanoparticles from *Scutellaria baicalensis* Georgi extracts.

Methods: Raw material of *Scutellaria baicalensis* Georgi was used in this study. The upper part of the plant was extracted by circulation, remaceration, and repercolation in 70% ethanol and distilled water (1:10). The quality analysis of total alkaloids and flavonoids, which are the biologically active substances of the extract, was determined by thin layer chromatography, and the concentration was determined by spectrophotometry. Silver nanoparticles were synthesized using silver nitrate solution and the plant extract.

Results: The raw material of *Scutellaria baicalensis* Georgi was extracted by maceration with 70% ethanol. A change in color from light to deep brown was observed when silver nanoparticles were synthesized from the extract of *Scutellaria baicalensis* Georgi. As assessed by spectral analysis, the light absorption value increases with increasing reaction time, indicating the formation of silver nanoparticles. The average size of the silver nanoparticles was 27.98 nm.

Conclusion: Our study suggested that the extracting technique of plant raw material by maceration with 70% ethanol was suitable. Based on these results, we successfully prepared silver nanoparticles using the plant extract.

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

E-mail address: tserendolgor.bat@gmail. (Tserendolgor Batsukh)

1. INTRODUCTION

The World Health Organization (WHO) reports that 80% of the world's population uses herbal medicines and preparations.[1-2] *Scutellaria baicalensis* Georgi is widely distributed in Mongolia, Russia, China, North Korea, and other countries. In Mongolian and Tibetan Medicine, *Scutellaria baicalensis* Georgi has been used under the name "Honlen" to relieve fever that dries up the blood and fever.[3-4] Recent pharmacological studies have shown that *Scutellaria baicalensis* Georgi improves cardiovascular and central nervous system functions, protects the liver, and has anti-bacterial and anti-tumor effects. Scientists have determined that the main biologically active compounds of this plant are flavonoids.[4-5]

As of 2022, 5,981 new cancer cases were diagnosed in our country, of which 1,956 new cases were diagnosed with liver cancer. Liver cancer alone accounts for 33% of all cancers. The research of natural drugs and preparations with less harmful side effects and anti-tumor effects continues to attract the attention of scientists.[6]

In recent years, pharmaceutical engineering has rapidly developed and been applied as a promising diagnostic and therapeutic tool in clinical medicine.[7-8] Therefore, in this research, we conducted research on the quality of raw materials of *Scutellaria baicalensis* Georgi plant, extracting the plant's raw materials, identifying some biologically active substances, and extracting silver nanoparticles.

2. MATERIALS AND METHODS

2.1. The raw material of *Scutellaria baicalensis* Georgi was used in this study.

The upper part of the plant was extracted by circulation, remaceration, and repercolation in 70% ethanol and distilled water (1:10). The quality analysis of total alkaloids and flavonoids, which are the biologically active substances of the extract, was determined by thin layer chromatography, and the concentration was determined by spectrophotometry. Silver nanoparticles were synthesized using silver nitrate solution and the plant extract.

3. RESULTS

3.1. The results of quality analysis of alkaloids and flavonoids in *Scutellaria baicalensis* Georgi

The qualitative analysis of flavonoids in distilled water and 70% ethanol extract of *Scutellaria baicalensis* Georgi was carried out by thin layer chromatography using a system of ethyl acetate-formic acid-glacial acetic acid-water (100:11:11:26) solvent system (**Figure 1**).

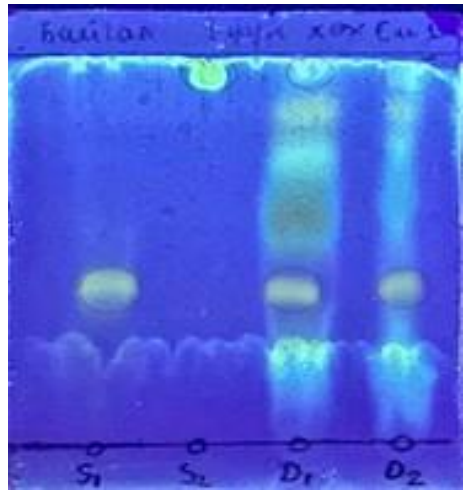

Figure 1. Thin layer chromatogram for an extract of *Scutellaria baicalensis* Georgi A flavonoid was detected as a brown color spot at the same level as the standard quercetin (Rf=0.9) in a thin layer chromatogram.

3.2. Results of quantitative analysis of plant extracts

The raw materials of *Scutellaria baicalensis* Georgi were extracted using remaceration, repercolation, and circulation methods with distilled water and 70% ethanol, and the total flavonoid content was determined by spectrophotometry in Table 1.

Table 1. Results of research on an extract from *Scutellaria baicalensis* Georgi

Extraction liquid	Method of extraction	Total flavonoids
Distilled water	Circulation	2.0±0.01*
	Remaceration	1.01±0.03*
	Repercolation	0.23±0.09*
70% alcohol	Circulation	2.3±0.02*
	Remaceration	1.16±0.04*
	Repercolation	0.41±0.1*

The upper part of *Scutellaria baicalensis* Georgi was extracted in 70% ethanol by circulating method and the total flavonoid content was 1.1±0.01% (n=3, p<0.001). The total flavonoids of the extract extracted in 70% ethanol by repercolation were 0.47±0.14% (n=3, p<0.02), and the total flavonoids of the extract extracted in 70% ethanol by remaceration were 1.56±0.09% (n=3, p<0.001).

3.3. Results of Silver Nanoparticle Extraction

The color change of the reaction changed from light yellow to brownish red during the synthesis of silver nanoparticles from the extract of *Scutellaria baicalensis* Georgi.

3.4. Spectral characteristics of obtained silver nanoparticles

When looking at the absorption of light in the range of 433 nm of the silver nanoparticle, the values of 0.815 at 0 minutes, 1.281 at 30 minutes, 1.595 at 60 minutes, 2.001 at 90 minutes, 2.328 at 120 minutes, and 2.688 at 24 hours were shown.

3.5. Determination of the size of nanoparticles

The size of silver nanoparticles obtained from the plant extract was determined using the Atomic Force Microscope (AFM) microscope (Figure 2).

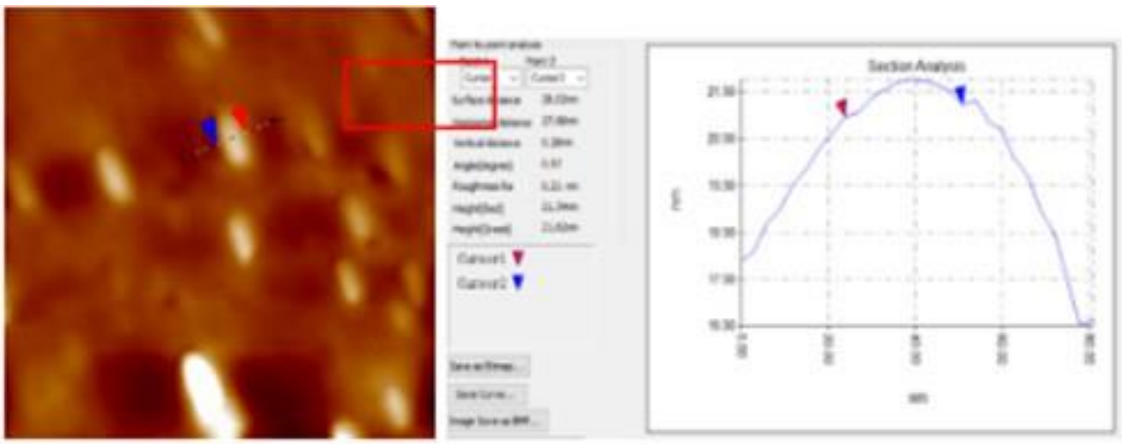

Figure 2. Size determination of silver nanoparticles: In determining the size of nanoparticles of *Scutellaria baicalensis* Georgi, a total of fifteen nanoparticles with sizes of 27 nm to 107 nm were detected.

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.

In 2005, Tserentogtokh et al revealed that the flavonoid composition of *Scutellaria baicalensis* Georgi had 4 types of flavonoids in the ethyl acetate fraction by thin-layer chromatography. The raw material of *Scutellaria baicalensis* Georgi was extracted by circulation method with 70% ethanol.[9]

In our study, brown spots were detected by thin-layer chromatography at the same level as standard quercetin and rutin and it was considered a flavonoid. This result was similar to the research results of the above researchers. In conclusion, after obtaining the silver nanoparticles from the plant extract, the color change of reaction, spectral properties, and size of newly obtained nanoparticles indicated that silver nanoparticles were successfully synthesized using the herbal plant.

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

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