UDC 615.32+581.5

QUANTITATIVE CONTENT OF MINERAL ELEMENTS IN HERBAL COLLECTION WITH HEPATOPROTECTIVE ACTIVITY

Zafarova Mukhtabar Zohidjon kizi

3rd year student of the Pharmaceutical Biotechnology Faculty of the Tashkent Pharmaceutical Institute

Khalilova Shakhnoza Ravshanovna

PhD, Associate Professor, Department of Pharmacognosy, Tashkent Pharmaceutical Institute

xalilova.shaxnoza@mail.ru

Abstract. The ICP-MS method was used to determine the elemental composition of the herbal collection with hepatoprotective activity, including raw materials of domestic medicinal plants: red clover herb, milk thistle fruits, sandy immortelle flowers and corn silks with stigmas. The analysis revealed the presence of 61 mineral elements. The content of such essential elements as potassium, calcium, phosphorus, magnesium, sodium, etc., which have a positive effect on the vital functions of the body, was also noted. It was ascertained that the analyzed medicinal herbal collection is environmentally safe, since the content of toxic elements in it does not exceed permissible values.

Keywords: herbal collection, hepatoprotector, elemental composition, ICP-MS method, micro- and macroelements, environmental safety.

INTRODUCTION

It is known that the therapeutic effectiveness of plants is due to the content of a complex of diverse and complex in their chemical composition and pharmacological action biologically active compounds. Important components of this complex - mineral elements in the plant are often associated with other biologically active substances. At the same time, the therapeutic effect of the latter can be successfully combined with the action of mineral elements. Being in plants in optimal "biological" concentrations, mineral elements are of great importance for the vital activity of the organism, are better absorbed by it [1].

The problem of determining the elemental composition of medicinal plants depends on the specific environmental conditions of the region of procurement.

Considering that herbal remedies are in demand on the pharmaceutical market, and their range and prospects for use are expanding every year, we, with the aim of creating an effective, import-substituting herbal medicine, have proposed a herbal collection with hepatoprotective activity.

The objective of this research is to study the elemental composition of a collection based on local medicinal plants, which we recommend for the treatment of the liver.

LITERATURE AND METHOD

The object of the study was serial samples of herbal collection, harvested in the territory of the Republic of Uzbekistan in 2023-2024 and prepared in accordance with the requirements of the article "Collections" of the State Pharmacopoeia of the Republic of Uzbekistan.

The collection includes ecologically clean raw materials of red clover herb, milk thistle fruits, sandy immortelle flowers and corn silks with stigmas. When selecting the components of the collection, we proceeded from literary data on the pharmacological properties, chemical composition and practice of their use in folk and scientific medicine, as well as the sufficiency of the raw material base in the territory of our republic for the organization of industrial production [2-7].

The elemental composition of the collection was determined by the inductively coupled plasma method on an ICP-MS mass spectrometer, i.e. a method of studying a substance based on determining the mass-to-charge ratio of ions formed during ionization of components [8-9].

In the ICP-MS method, the source of excited ions is also argon plasma, but each chemical element of the periodic table has a unique series of stable isotopes, which allows for the precise identification of the presence of a given element in a sample [10].

The raw material sample was prepared according to the method specified in IND Ph 16.1:2.3:3.11-98. A 0.5 g sample of the preparation was placed in Teflon autoclaves and a mixture of purified concentrated mineral acids (nitric acid and hydrogen peroxide) was added. Then the autoclaves were closed and placed on a Berghof microwave decomposition device with MWS-3 software, observing all safety precautions. The decomposition program was determined based on the type of the substance being studied, the degree of decomposition and the number of autoclaves (up to 12 pcs) was indicated.

The following heating mode was used: raising the temperature to 210°C for 25 min, holding for 10 min at 210°C, cooling to 45°C. The cooled autoclave was shaken to mix the contents and the lid was slightly opened to equalize the pressure (a well-decomposed sample after distillation of nitrogen oxides should be a colorless or yellowish transparent solution, without undissolved particles on the bottom and on the walls of the fluoroplastic liner). The solution cooled to room temperature was quantitatively transferred into a 50 or 100 ml volumetric flask depending on the expected element content in the sample, the walls of the insert were washed with small portions of 0.5% nitric acid, brought to the mark and mixed thoroughly. The "blank sample" was prepared in parallel with the batch of analyzed samples, performing all the above operations.

DISCUSSION

To measure mass concentrations of an element in solutions, the analyzed sample solutions were fed into the spray chamber of the mass spectrometer using a peristaltic pump, and the resulting aerosol entered the burner in a stream of argon (99.995% pure gas), where the ionization of atoms occurred. After receiving the data, the device automatically calculated the true quantitative content of the substance in the sample under study as mg/kg or μg/g with error limits - RSD in %.

RESULTS

As a result of the analysis, it was ascertained that the herbal collection contains 61 chemical elements (Table 1).

Table 1

Elemental composition in herbal collection

№	Element	Content, mg/kg	№	Element	Content, mg/kg
1.	Li_{7}	22.9	32.	Sn_{119}	0.145
2.	Be_{9}	0.067	33.	Sb_{122}	0.119
3.	B_{11}	82.1	34.	Te_{128}	0.10
4.	Na_{23}	3519	35.	Cs_{133}	1.04
5.	Mg_{24}	5494	36.	Ba_{137}	150
6.	Al_{27}	30464	37.	La_{139}	18.8
7.	P_{31}	4267	38.	Ce_{140}	32.3
8.	K_{39}	37025	39.	Pr_{141}	3.27
9.	Ca_{40}	15957	40.	Nd_{144}	6.71
10.	Sc_{45}	3.16	41.	Sm_{150}	1.88
11.	Ti_{48}	107	42.	Eu_{152}	0.499
12.	V_{51}	2.03	43.	Gd_{157}	1.49
13.	Cr_{52}	4.04	44.	Tb_{159}	0.180

14.	Mn_{55}	52.6	45.	Dy_{163}	0.833
15.	Fe_{56}	552	46.	Ho_{165}	0.172
16.	Co_{59}	0.408	47.	Er_{167}	0.402
17.	Ni_{59}	3.69	48.	Tm_{169}	0.051
18.	Cu_{64}	23.7	49.	Yb_{173}	0.358
19.	Zn_{65}	31.4	50.	Lu_{175}	0.085
20.	Ga_{70}	1.29	51.	Hf_{178}	0.01
21.	As_{75}	0.308	52.	Ta_{181}	0.139
22.	Se_{79}	0.639	53.	W_{184}	0.01
23.	Rb_{85}	33.0	54.	Re_{186}	0.139
24.	Sr_{88}	80.4	55.	Pt_{195}	0.01
25.	Y_{89}	5.14	56.	Au_{197}	0.05
26.	Zr_{91}	3.89	57.	TI_{204}	0.002
27.	Nb_{93}	0.300	58.	Pb_{207}	3.28
28.	Mo_{96}	2.46	59.	Bi_{209}	0.028
29.	Ag_{108}	1.62	60.	Th_{232}	5.75
30.	Cd_{112}	0.055	61.	U_{238}	0.191
31.	In_{115}	0.002			

From Table 1 it is evident that 3 elements (K, Al, Ca) are in concentration more than 10000 mg/kg, 3 elements (Na, Mg, P) in content are in the range from 1000 to 10000 mg/kg, 3 elements (Ti, Fe, Ba) are in the range from 100 to 1000 mg/kg, 9 elements (Li, B, Mn, Cu, Zn, Rb, Sr, La, Ce) - from 10 to 100 mg/kg, 15 elements (Sc, V, Cr, Ni, Ga, Y, Zr, Mo, Cs, Pr, Nd, Sm, Gd, Pb, Th) - from 10 to 1 mg/kg and less than one mg/kg - 28 elements (Be, Co, As, Se, Nb, Ag, Cd, In, Sn, Sb, Te, Eu, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, W, Re, Pt, Au, TI, Bi, U).

Thus, in the studied collection of 61 elements, 4 are macroelements.

In decreasing order of quantity, the mineral elements found in the collection can be arranged in the following sequence: K>Al>Ca>Mg>P>Na>Fe>Ba>Ti>B>Sr>Mn>Rb>Ce>Zn>Cu>Li>La>Nd>Th>Y>Cr>Zr>Ni>Pb>Pr>Sc>Mo>V>Sm>Ag>Gd>Ga>Cs>Dy>Se>Eu>Co>Er>Yb>As>Nb>U>Tb>Ho>Sn>W>Sb>Te>Hf>Be>Cd>Lu> Tm>Pt=Au>Bi>Ta=Re>In=TI.

The detected elements can be divided into: those of vital biological importance (K, Ca, P, Mg, Na, Fe, S, Co, Mn, Cu, Mo, Cr, Zn, V, Si, Li, Ni, As, Se), conditionally essential elements (B, Sr, Ti), toxic elements (Ba, Bi, Cd, Pb, Hg) and little-studied microelements (Al, Be, Ga, Ge, Sn, Re, Ag, Sc, Rb, Th, U, Cs, Zr, etc.).

The quantitative content of mineral elements in the collection in percentage terms is 61%

vital, 39% poorly studied microelements, conditionally vital and toxic elements are almost 0%.

As can be seen from the data in Table 1, among the vital elements in quantitative ratio, the dominant ones are K, Al, Ca, P, Mg. The content of Ca, Mn, Cu, Mo, Cr and Zn in the collection, which have a positive effect on the vital activity of the organism, increases the pharmacological value. The concentration of heavy metals in the collection practically corresponds to the concentrations of unpolluted territories. Toxic heavy metals (Pb, Hg, Cd) in the collection are practically equal to zero, i.e. environmentally safe in accordance with SanPiN 1.10.7.

As a result of the analysis, it was ascertained that the herbal collection, in terms of heavy metal content, generally complies with accepted international standards.

CONCLUSION

The ICP-MS (inductively coupled plasma mass spectrometer) method determined the content of 61 mineral elements in the anti-sclerotic collection, including 4 macroelements. The concentration level of toxic elements is within the background values, which allows us to classify the recommended collection as environmentally friendly. The studied collection can be used as a medicinal raw material enriched with potassium, calcium, magnesium, phosphorus, sodium, iron, aluminum, manganese and other elements that have a positive effect on the vital activity of the body.

The level of heavy metals ascertained for the plant collection can be adopted as an indicative criterion for the purity of the collection in further environmental studies.

REFERENCES

1. Dementieva T.M., Kompantseva E.V., Sannikova E.G., Frolova O.O. Macro- and microelements of the bark and shoots of some willow species growing in the North Caucasus // Far Eastern Medical Journal. - 2017. - No. 3. - P. 56-59.
2. Khalilova Sh.R., Urmanova F.F. Hepatoprotective effect of dry extract of red clover // Current achievements of pharmaceutical technology and biotechnology: collection of scientific works, issue 3. - Kh.: University University, 2017. pp. 308-310.
3. Ramazanov A.Sh., Balaeva Sh.A., Shakhbanov K.Sh. Chemical composition of fruits and oil of milk thistle growing in the Republic of Dagestan // Chemistry of plant raw materials. 2019. No. 2. P. 113-118. doi:10.14258/jcprm.2019024441.
4. Smirnov S.O., Fazullina O.F. Milk thistle fruits as a promising raw material of plant origin in the technology of production of biologically active food additives // Food industry. 2018. No. 9. P. 8-12.
5. Durnova N.A., Afanasyeva G.A., Kurchatova M.N., Zarayeva N.V., Golikov A.G., Bucharskaya A.B., Plastun V.O., Andreeva N.V. The content of oxidative stress markers in

blood plasma under the influence of extracts of common aurantium, sandy everlasting, anthocyanin form of common corn under conditions of induced oxidative stress - // Exp. and clinical pharmacology 2015, 78, 7, 36-40.
6. On the issue of standardization of medicinal plant materials in the creation of phyto preparations. Message 1. Evaluation of immortelle flowers for the content of biologically active compounds / V.P. Georgievskiy [et al.] // Pharmacom. - 2017. - No. 3, - P. 34-57.
7. Sandy Everlasting (Helichrysum arenarium (L.) Moench): Botanical, Chemical and Biological Properties / D. Pljevljakusi [et al.] // Frontiers in Plant Science. - 2018. - Vol. 9. - P. 1123-1135.
8. Khalilova Sh.R., Pulatova D.K., Urmanova F.F. Study of the elemental composition of the above-ground part of red clover // Pharmaceutical journal. - Tashkent, 2012.-№4. - P.26-28.
9. Khalilova Sh.R. Elemental composition of herbal collection with anti-sclerotic activity // Ecological Bulletin of Uzbekistan. - 2023. - No. 4 (8). - P. 65-69.
10. Slivkin A.I., Trineeva O.V. Study of the elemental composition of medicinal plant materials by mass spectrometry (using stinging nettle leaves and sea buckthorn fruits as an example) // Bulletin of the Voronezh State University. Series: Chemistry. Biology. Pharmacy. - 2016.-No.1.-P.152-155.