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VOLATILE SUBSTANCES AND ELEMENTAL COMPOSITION OF FRUITS OF SOPHORA JAPONICA L. FLORA OF UZBEKISTAN

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ABSTRACT. The article presents the results of identification of volatile substances, as well as macro and microelement composition of fruits "Sophorajaponica L.", cultivated in Tashkent using the method of chromatomass spectroscopy on an Agilent 7890 AGS gas chromatograph, as well as mass spectral analysis using a mass spectrometer inductively coupled plasma ICP MS (inductivelycoupledplasmamass-spectrometerAgilentTechnology 7500). As a result of the studies carried out in the fruits of Sophorajaponica L., the content of α-pinene (in hexane - 26.67%, in benzene - 12.93%), eucalyptol (in hexane - 17.23%, in benzene - 9.45%) and camphor (in hexane - 4.5%, in benzene - 2.49%), and the most significant macro- and microelements were found, among which potassium, sodium, magnesium, calcium, phosphorus, manganese, iron predominate in quantitative terms, chrome, copper and zinc.

KEYWORDS: Sophorajaponica L., ultrasonic extraction, extracts, chromatography-mass spectral analysis, macro and microelements

INTRODUCTION. Sophorajaponica L. (Japanese Sophora) from the legume family (Fabaceae) is widely distributed in the territory of the Republic of Uzbekistan as an ornamental and melliferous plant (Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No. 187 of 09/07/2007).

The fruits of Sophorajaponica L. are the raw material for the production of the only medicinal product - Sophora tincture.

Official tincture (1: 2) from the fruits of Japanese Sophora in our country is obtained with 48% ethyl alcohol, used as an antiseptic agent in the form of irrigation, rinsing or tampons for the treatment of eczema, acute and chronic

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purulent inflammatory processes (abscesses, wounds, burns, trophic ulcers, etc.). As noted above, the tincture is the only industrially significant domestic drug produced from the fruit of Sophora. As for the actual components of antimicrobial action as active substances of fruits and tincture of Japanese Sophora, flavones are positioned in their role, according to the presence of which the quality of the tincture is assessed. Meanwhile, the fruits of sophora are distinguished by a rich and varied chemical composition and, in all likelihood, other groups of biologically active substances can, to a greater extent than flavones, be able to play the role of active substances of this medicinal plant. In addition, there is no connection between the current standardization of the original medicinal plant raw materials - the fruits of Japanese Sophora and the product obtained from them - the tincture. In accordance with the current regulatory documentation (ND), fruits are not checked for the presence of flavones (unlike tinctures), they are not controlled by the content of "extractive substances", while the "dry residue" is determined in the tincture [1].

In folk medicine, a tincture is prepared from the fruits of Sophora in 70% ethyl alcohol in a ratio of 1: 5, as well as in 56% ethyl alcohol (from fresh fruits in a ratio of 1: 1, from dry fruits 1: 2), which is used to treat hypertension, sugar diabetes, kidney disease, ulcerative colitis, chronic pancreatitis, pulmonary tuberculosis, rheumatism, prevention of hemorrhage, nosebleeds [2], as well as osteparosis [3,4].

In China, Japan and Korea, a decoction of flowers and fruits of Sophora is used to combat bleeding, treat bloody vomiting, to lower blood pressure, prevent stroke and correct the effects of cerebral ischemia.

The chemical composition of the fruits of Sophorajaponica L. is rich in a complex of biologically active substances (BAS): flavonoid and isoflavonoid compounds, as well as phytoncides and triterpene saponins [5], coumarone-chromones [5,6], lectins [6, 7, 8], fatty oils (seeds - up to 10%) [9] and polysaccharides (16-17%) [5]. Literature data show that the chemical composition of fruits of Sophorajaponica L., mainly growing abroad, is well studied. At the same time, the greatest interest is given to the group of compounds of isoflavonoid nature.

It is known that the qualitative composition of flavonoids in Sophora fruits varies depending on the phase of development, climatic factors and the place of growth. In juicy ripe fruits in autumn, depending on climatic conditions, 7-8 flavonoid compounds can be contained, including rutin, sophoricoside, sophorabioside,

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genistein, isorhamnetin, nicotiflorin, quercetin. Sophoricoside and sophorabioside under favorable climatic conditions accumulate in the fruits of sophora in almost equal amounts, however, when the snap falls, sophorabioside disappears [2]. In fruits, as they ripen, kaempferol glycosides appear, among which kaempferol-3-sophoroside and genistein glycosides predominate. The content of kaempferol glycosides, while keeping fruits on the tree, gradually decreases, but in the harvested and dried ones, it does not change during the year [2].

According to P.M. Akhmedkhodzhaeva et al. In the fruits of Japanese Sophora is dominated by kaempferol-3,7-diglycoside [10]. Fruits contain a variety of flavonoid glycosides, including kaempferol-3-sophoroside and genistein glycoside (the sugar residue of sophorosis). Other flavonol and isoflavone tri- and tetraglycosides have also been found. Along with the indicated compounds, L-maakiain, daidzein, formononetin, di-O-methyldaidzein, apigenin, biochanin A, quercitrin, prunetin, irisolidone were also identified in the Japanese sophora. The structure of two isomers of the genistein glycoside: 'genistein-6' α-L-rhamnopyranosyl) -β-sophoroside-7β-D-glucopyranoside and genistein (6 " - O-α-L-rhamnopyranosyl) -β-sophoroside) - 7β-L-glucopyranoside [11,12].

The presented scientific literature data give reason to believe that isoflavonoids are leading in terms of pharmacological action and predominant in quantitative terms BAS of fruits of Sophorajaponica L. Along with this, it should be noted that little attention has been paid to the study of other groups of natural compounds of Sophora fruits, in particular, insufficiently studied are study of volatile substances and mineral compounds of this medicinal product. Meanwhile, the above groups of substances are able to quite actively influence the manifestation of the specific pharmacological action of the fruits of Sophora and, in this regard, are worthy of additional phytochemical study.

The purpose of this study was to study volatile substances and mineral composition of fruits of Sophorajaponica L. flora of Uzbekistan.

MATERIALS AND METHODS. Fruits of Sophorajaponica L., growing in Tashkent city, were used as an object. To study the volatile substances of the fruits, the seeds were separated from the peel, dried (within one day), and crushed. From 10.00 g of crushed sophora seeds using ultrasonic extraction, first hexane and then benzene extracts were obtained. The extraction was carried out three times for 15 minutes. The obtained extracts were studied on an Agilent 7890 AGS gas chromatography-mass spectrometer with an Agilent 5975 CinertMSD quadrupole

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mass spectrometer as a detector. Separation of the components of the studied extracts was carried out on a quartz capillary column HP-5MS (30 mx 250 µmx 0.25 µm) with a grafted stationary phase of helium at a temperature of 60 ° C (1 min.) –4 ° C / min. Up to 250 ° C (6 min.) –25 ° C / min. Up to 290 ° C (5 min.). The volume of the introduced sample is 1 µl, the flow rate of the mobile phase is 1.3 ml / min. The components were identified based on a comparison of the characteristics of mass spectra with data from electronic libraries (W8N05ST.L and NIST08.L). The results are shown in Figures 1-2 and Table 1.

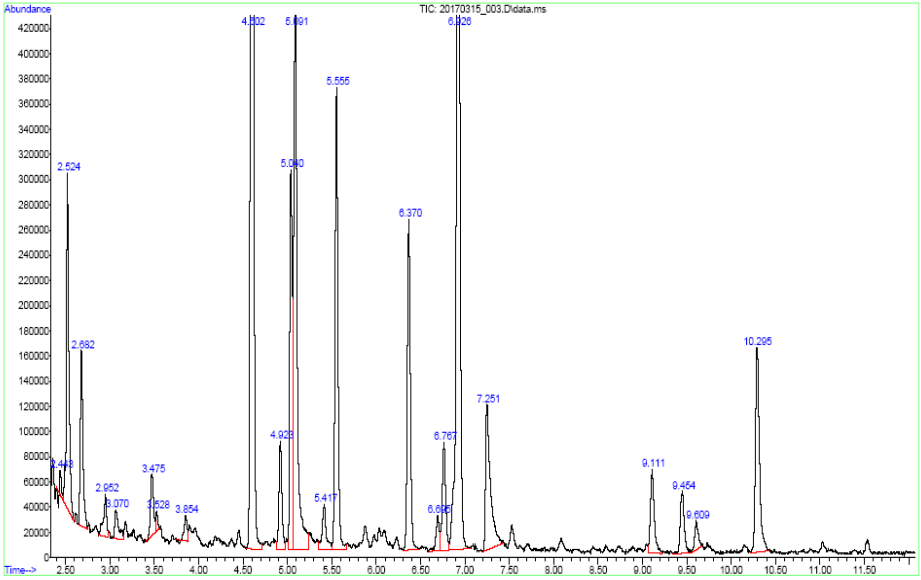

Fig. 1. Typical chromatogram of hexane extract

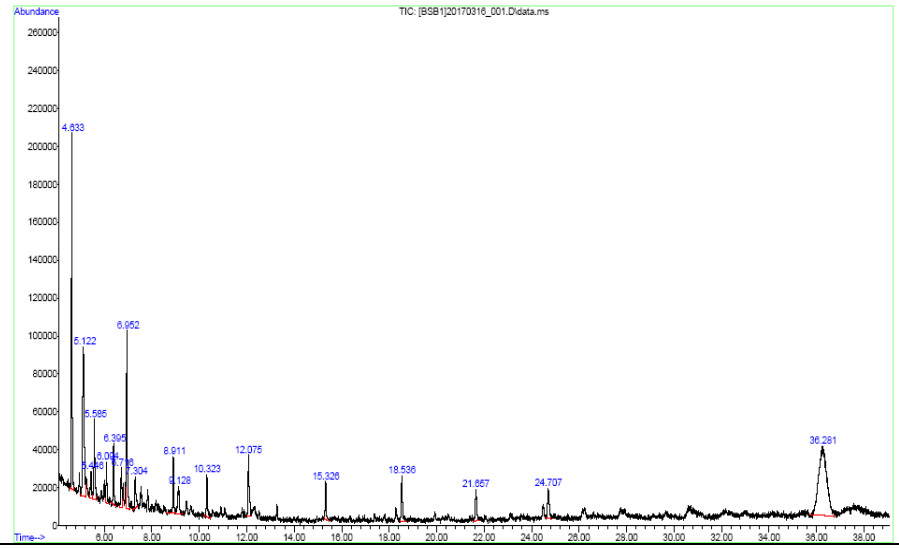

Fig. 2. Typical chromatogram of a benzene extract

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Table 1. Volatile substances of Japanese Sophora fruit extract

Name substance	RI (Retention Index)	Percentage,%	Retention time, min.
benzene extract			
α- pinen	933	12,93	4.634
Hexadiene -2,4	976	4,14	5.587
γ- terpinene	1012	2,68	6.393
Eucalyptol	1021	9,45	6.952
[6]- annullen	1052	1,88	7.303
н- undecane	1123	2,81	8.914
(+-)-camphor	1144	2,49	10.322
Dodecane	1199	4,00	12.074
Decane	1249	2,15	15.327
Tetradecane	1299	2,94	18.536
Octacosan	1501	2,22	21.660
H- nonadecan	1602	2,63	24.709
Diisobutyl phthalate	1889	29,66	36.281
hexane extract			
Octane	800	4,47	2.524
Ethylcyclohexane	831	0,71	2.954
M-Xilen	869	1,03	3.477
P-Xilen	896	0,37	3.852
α-pinene	931	26,97	4.602
2,2-dimethyl-L-3-methylene Bicyclo [2.2.1] heptane	946	1,72	4.922
5,5-dimethyl-2 (5H) - furanone	951	5,21	5.420
O-Zimen	968	0,99	5,420
(-) - β-pinene	974	7,22	5,555
(+ -) - 3-Karen	1011	5,43	6.373
P-Zimen	1025	0,59	6,692
Zimen	1028	2,04	6,776
Eucalyptol	1035	17,23	6.926
5-ethenyldihydro-5-methyl-2 (3H) - furanone	1049	3,85	7.525
(+-)-β- sujon	1105	1,78	9.109
(-) - β-sujon	1116	1,36	9.453
α-isophorone	1121	0,54	9,607
(+-)-camphor	1143	4,50	10.295

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Based on the analysis of the data presented in the figures and in the table, it was revealed that the hexane extract contains 18 compounds, and the benzene extract contains 13 compounds, in total 31 compounds, 90% of which were found in the composition of Sophorajaponica L. for the first time, 4 substances were identified as terpenoid compounds (benzene extract).

Macro- and microelement composition of Sophora fruits was investigated by mass spectral analysis using an inductively coupled plasma mass spectrometer ICP MS (inductivelycoupledplasmamass-spectrometerAgilentTechnology 7500). Device parameters: plasma power 1200 W, integration time 0.1 sec, rotation speed of the peristaltic pump - 0.1 rev / sec. The sample feed rate into the mass spectrometer is ~ 1 ml / min. The rest of the device parameters were set during the setup process and were unchanged between maintenance periods. A multi-element (27 component) standard solution from Agilent Technology with a target component content of 10.0 mg / l was used as a standard. A weighed portion of the crushed raw material was placed in a porcelain crucible, charred on an electric stove until smoke emission ceased, after which the crucible was kept in a muffle furnace at a temperature of 250 ° C, gradually increasing it to 450 ° C every 30 minutes. Combustion was stopped after receiving ash gray or white. The resulting ash was treated with a 5% solution of acetic acid at a temperature of 40-50 ° C and then evaporated to dryness on an electric stove. The operation was repeated twice. The dry residue was dissolved in a 5% acetic acid solution, the resulting solution was transferred through a paper filter using a funnel into a volumetric flask, and made up to the mark with bidistilled water. The found quantitative contents of individual, most significant in terms of biological activity, macro- and microelements in the fruits of Japanese Sophora are presented in table. 2.

Table 2.

The content of the most significant macro- and microelements in the fruits of Japanese Sophora

Name of macro- and microelements	Content, mg / l	Name of macro- and microelements	Content, mg / l
Li	2.500	Cr	0.770
B	7.500	Mn	0.150
Na	360.0	Fe	2.800

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Mg	4.800	Ca	6.000
Al	0.190	Cu	1.600
Si	68.00	Zn	0.570
P	5.700	Cs	0.610
S	3.600	Br	1.600
K	340.0	Ti	0.470

From the data given in Table 2, it can be seen that the fruits of Japanese Sophora contain macronutrients potassium, sodium, magnesium, calcium, phosphorus, as well as trace elements manganese, iron, chromium, copper and zinc. At the same time, it was revealed that, in quantitative terms, sodium prevails among the macroelements of the fruits of Japanese Sophora, and among the trace elements, iron.

It should be noted that information about the mineral compounds of domestic raw materials - the fruits of Japanese Sophora was obtained for the first time, and indicates that this medicinal plant is characterized by a variety and significant content of mineral compounds, which, both independently and in combination with other biologically active substances, are capable of determining the latitude and specificity of the pharmacotherapeutic action of Sophora fruits. Conclusion. The method of chromatography-mass-spectral analysis was used to study the qualitative composition and quantitative content of volatile substances in the fruits of Japanese Sophora growing in Tashkent. As a result of the studies carried out, the extracts revealed such compounds as α-pinene (in hexane - 26.67%, in benzene - 12.93%), eucalyptol (in hexane - 17.23%, in benzene - 9.45%) and camphor (in hexane - 4.5%, in benzene -2.49%). The data obtained on the study of the qualitative and quantitative composition of macro- and microelements will expand the general information on the phytochemical composition of Japanese Sophora fruits. The results of the study as a whole show that along with flavonoids, traditionally and reasonably recognized as active ingredients of Japanese Sophora fruits, the presence of other biologically active substances has been established that can contribute to the manifestation of the specific activity of this medicinal plant. The data obtained can be used for the development of new dosage forms based on the fruits of Japanese Sophora in the future.

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