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Ruguzova A.I. Female reproductive structures formation in *Torreya grandis* Fortune ex Lindl. under the conditions of the Southern coast of Crimea // Bull. of the State Nikit. Botan. Gard. – 2015. – № 117. – P. 47 – 54.

Data about calendar terms of *Torreya grandis* female reproductive structures formation in the conditions of the introduction have been presented in the article. It is demonstrated that in this species normally developed ovules are formed to the time of pollination. They carry megasporocyte. Further development of female generative sphere was noticed only in successfully pollinated ovules. It takes 16 – 17 months between pollination and fertilization and 11 months from fertilization to mature seeds. Mature seeds carry undeveloped embryo and they need the period of stratification.

Key words: *Torreya grandis*, female reproductive structures, ovules, female gametophyte, seeds.

BIOCHEMISTRY OF PLANTS

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BIOLOGICALLY ACTIVE SUBSTANCES OF *SCUTELLARIA BAICALENSIS* GEORGI OF NIKITA BOTANICAL GARDENS COLLECTION

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Introduction

Scutellaria baicalensis Georgi is a valuable compendial medicine plant of Lamiaceae family. Its habitat is Eastern Transbaikalia (Chita district), Middle Priamurye (Amur district) and southwest Primorye (Primorsky krai). This perennial herbaceous plant is typically used in eastern medicine due to its broad-spectrum activity.

Medicine based on *Scutellaria baicalensis* Georgi has hypotensive, antivirus, anti-inflammatory, antitumoral, blood vessel strengthening, sedative and anticonvulsive properties, P-vitamin and antioxidant activity [10, 13-15]. Such preparations are prescribed to treat hypertension, functional disorder of nervous system, cardiovascular neuroses, myocardium, acute articular rheumatism, pneumonia, whooping cough and various types of bleeding [3,16].

Broad-spectrum of biologically active compounds, such as coumarin, tanning agents, essential oils, flavonoids and others cause pharmacological effects of this plant. A group of phenol compounds should be emphasized due to its high concentration and considerable structural variety.

Flavones takes the leading position among phenol substances of *Scutellaria baicalensis* Georgi. The following substances were found in its raw materials: chrysin, apigenin, scutellareine, isoscutellareine and luteolin [7, 12]. Nevertheless root materials are mainly applied in medicine, such substances as luteolin, apigenin and their glucuronids were discovered in overground plant parts [7]. Besides that overground part of *Scutellaria baicalensis* Georgi is notable for high concentration of carotinoides that reaches 74,6 mg per 100 g of air-dry raw material [15]. Chemical researches of vegetative changeability of overground materials reveals that the highest concentration of biologically active substances in raw materials of *Scutellaria baicalensis* Georgi is registered during mass flowering.

Chemical composition of *Scutellaria baicalensis* crude drug is determined by soil and climatic conditions of its cultivation. According to data of some authors concentration of phosphorus in soil favors deposit of all polysaccharide groups, while content of organic matter in soil (humus) determines content of carotinoids [8].

Allowing for pharmacological importance of this plant and correlation between concentration of biologically active substances in *Scutellaria baicalensis* and growing conditions [3], study of this plant biochemical composition under conditions of South Coast of the Crimea is current.

Objective of this work is to investigate qualitative and quantitative composition of biologically active substances (phenol matters, volatile compounds, vitamins) in a promising specimen, cultivated in Nikita Botanical Gardens being practically useful in production of medioprophyllactic goods.

Objects and methods of the research

Research object was overground part of the promising *Scutellaria baicalensis* Georgi. specimen. Seeds of the starting material were ordered from German delectus. Raw material was obtained from introduction area of aromatic and medicinal plants of Nikita botanical gardens during mass flowering.

Scutellaria baicalensis Georgi. is a perennial herbaceous plant with not so large rhizome and pulpy main root. Height of plant growing on South Coast of the Crimea gets 73,0-74,5 sm, reproductive shoots are tetrahedral, branching from the bottom. Leaves are narrow lanceolate – 5,0-5,5 sm, opposite, sessile, smooth-edged. Flowers grow in one-sided bunch, 9-13 sm long. The bell is bilabiate, villous and campaniform on the top with special cup-shaped emergence (corymb) on the upper labium. Corolla is bilabiate, glandulosous from the outside, purple, 2,5-2,8 cm, with concave entire upper labium (helmet) and three-lobed lower labium. Crop capacity of the overground mass makes 1,67 kg/m² during mass flowering.

Concentration of biologically active substances was determined in aqueous ethanol extract consisted of air-dry raw material. Extraction was carried out by means of 50%-solution of ethanol having proportion of raw material and leach 1:10, preparing for 10 days at room temperature.

Component composition of phenol matters was determined applying chromatograph Agilent Technologies (model 1100), supplied with running vacuum degasifier G1378A, 4-ported low-pressure gradient pump G13111A, automatic injector G1313A, thermostat of columns G3116A, diode matrix detector G1316A. Chromatographic column 2,1-150 mm, filled with octadecyl sorbet “ZORBAX-SB C-18 with granulating 3,5 mkm was applied for analysis. Gradient regime of chromatography, specifying changes in eluting mixture of components A (0,1% orthophosphoric acid; 0,3% tetrahydrofuran; 0,018% trietilamine) and B (methanol) ratio were applied for analysis as well. Advance speed of mobile phase made 0,25 sm³/min; working pressure of eluent was 240-300 kPa; sample size was 2 mkl, scan time – 0,5 sec; scale of measurements 0,1. Identification of phenol substances was carried out following the time of standard retention and spectrum characteristics (parameters of spectrum – each peak is 190-600 nm; waves length are 280, 313, 350, 37 nm) [11].

Component composition of volatile substances was determined by means of chromatograph Agilent Technology 6890 with mass-spectrometric detector 5973. Water heater HP-1 – 30 m, inside diameter – 0,25 mm. Thermostat temperature was programmed from 50 till 250°C with speed rate of 4°C/min. Injector temperature was 250°C. Gas carrier was Helium, stream velocity – 1 sm³/min. During transformation from gas chromatograph to mass-spectrometric detector temperature was risen up to 230°C. Source temperature was kept as 200°C. Electric ionization was carried out under conditions of 70 eV with mass

ranging m/z from 29 till 450. Identification was conducted basing on comparison of found mass-spectrums with data of combined library NIST05-WILEY2007 (about 500000 mass-spectrums) [4].

Results and discussion

As a result of conducted researches it was found out that extract of that *Scutellaria baicalensis* Georgi. specimen contains 18,5g of phenol substances per 100 g of air-dry material (fig.1, table 1). The study case contains 12 components as well, 10 of them were indentified. Exclusively flavanoids (flavones and flavanones) represented identified phenol compounds.

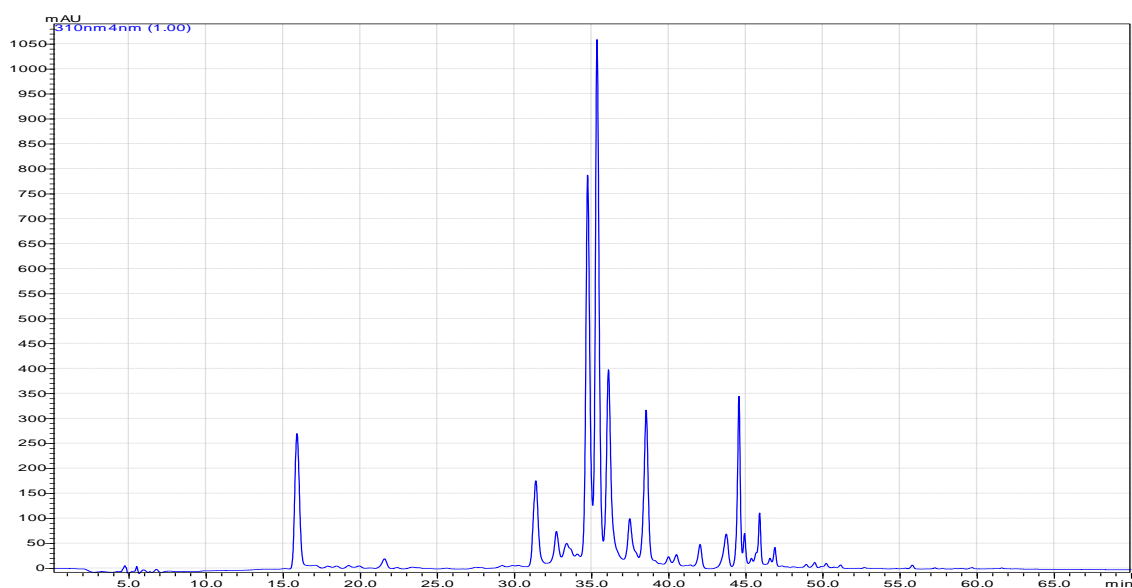


Fig.1 Chromatogram of phenol substances of water-ethanol *Scutellaria baicalensis* extract

Table 1

Phenol substances of water-ethanol *Scutellaria baicalensis* extract

№	Time of emission, min	Component	Concentration, mg/100 g of raw materials
1	15.88	Non-identified	1127,70
2	31.39	Dihydroscutellarine	998,16
3	32.71	Skutellarine-7- Glicozide	227,17
4	33.37	Dihydroscutellarine	427,91
5	34.56	Dihydroscutellarine	7646,20
6	35.34	Skutellarine -4- Glicozide	2164,96
7	36.08	Dihydroscutellarine	3424,39
8	37.46	Isoscutellarine -7- glucuronide	249,16
9	38.49	Apigenin -7- glucuronide	787,20
10	42.02	Baikaline	127,07
11	43.72	Apigenin	141,57
12	44.54	Skutellarine	515,19
13	44.91	Dihydrobaikaline	415,47
14	45.88	Non-identified	165,56
15	46.87	Dihydrobaikaline	93,01

By present most aspects of flavonoids biological activity have been identified, their P-vitamin activity has been known for a long time [1]. Flavonoids possess hepatoprotective,

antitumoral and antimicrobial effect, stimulate heart work and decrease blood tension for awhile [6]. In study case flavones prevails due to their various qualitative composition, but as to quantitative content flavanones do. Concentration of flavanones (70,3%) exceeds a lot concentration of other phenol compounds. Dominant component of phenol compounds (62,1% from the total content) is dihydroscutellarine what rather corresponds literary data [5].

Researching volatile compounds it was found out their concentration in water-ethanol extract of study case made 10,2 mg per 100 g of air-dry raw material. 25 components were identified in the extract (fig.2, table 2).

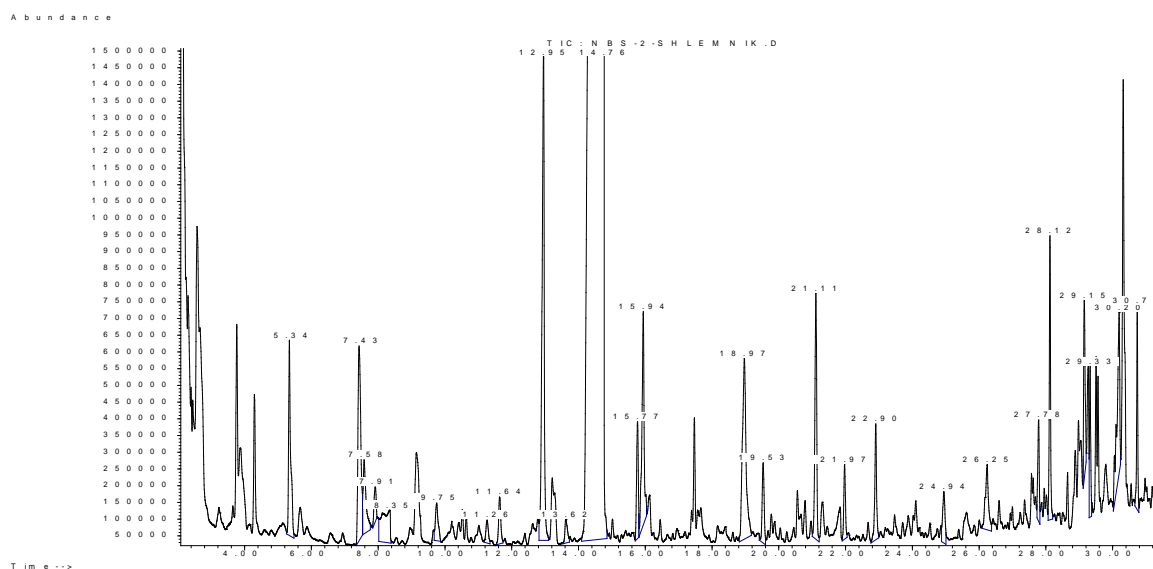


Fig.2 Chromatogram of volatile compounds in water-ethanol extract of *Scutellaria baicalensis*

Table 2

Volatile compounds in water-ethanol extract of *Scutellaria baicalensis*

№	Time of emission, min	Components	Mass fraction, %
1	2	3	4
1	5.34	Trans-2-Hexenal	5,41
2	7.43	1-octen-3-ol	7,78
3	7.57	Octanol-3	3,05
4	7.91	Trans-2-Heptenal	0,98
5	8.35	Capronic acid	3,84
6	9.75	2,4-heptadienal	1,48
7	11.25	linalool	0,79
8	11.63	nonanal	1,48
9	12.95	Phenylacetaldehyde	15,16
10	13.62	acetophenone	0,89
11	15.76	Para-vinyl-anisole	2,66
12	15.94	Ethyl Acetopyruvate	6,69
13	18.96	4- vinylphenol	9,25
14	19.53	β -bourbonene	2,17
15	21.11	β - caryophyllene	6,3
16	21.97	4-vinyl-2-methoxy-phenol	1,77
17	22.9	eugenol	2,95
18	24.94	δ -cadinene	1,67

19	26.24	lauric acid	2,85
20	27.78	caryophyllene	2,07
21	28.12	caryophylla-2(12),5-dien-13-al	5,22
22	29.15	caryophylla-4(12),8(13)-dien-5-ol	3,84
23	29.32	α -cadinol	2,46
24	30.19	myristinic acid	6,1
25	30.73	hexahydro farnesyl acetone	3,15

In total concentration of the study extract aromatic compounds prevail (39,37%). Considerable number of components in the extract are aliphatic compounds (32,97%): alcohols, aldehydes and acids. Concentration of terpenic compounds makes 27,67% of total amount of volatile substances. Terpenoids are represented by sesquiterpenoids (16,74%), sesquiterpenes (10,14%) and the only monoterpenoid – linalool, what is not considerable (0,79%). The dominant component of extract is phenylacetaldehyde (15,2%), 4-vinylphenol (9,2%), 1-octen-3-ol (7,8%). Phenylacetaldehyde possesses strong hyacinth aroma and in case of 2% dosage is possible to use in perfume compositions and various odorants, but 1-octen-3-ol has pronounced fungal smell and analogous appliance in case of 1% dosage [2].

Concentration of ascorbic acid in *Scutellaria baicalensis* extract made 115 mg/100g. Carotinoids content is 2,5mg/100g.

Content and composition research of biologically active substances revealed the study pattern of *Scutellaria baicalensis* is a promising source of flavonols (flavonones and flavones).

Conclusions

Quantitative and qualitative composition of biologically active substances (phenol substances, volatile) in aqueous-ethanol extract of *Scutellaria baicalensis* pattern cultivated on South Coast of the Crimea, was investigated in terms of this research.

At the same time it was determined that flavanons prevail among phenol substances. Dominant component is dihydroscutelarine.

Among volatile substances aromatic compounds dominate. The principal extract components were found phenilacetaldehyde, 4-vinylphenol and 1-octen-3-ol.

In extract of *Scutellaria baicalensis* concentration of vitamin (ascorbic acid and carotinoids) was identified as well.

Raw material of this *Scutellaria baicalensis* pattern is a valuable source of biologically active substances in the field of medioprophyllactic production.

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The article covers study of qualitative and quantitative composition of aqueous-alcoholic extract of the *Scutellaria baicalensis* promising pattern. It was determined that content of phenol substances in this extract reaches 18,5 g/100g. Dominate phenol substances are flavanones (dihydroscutelarine). As to volatile substances aroma compounds prevail. Dominant extract components are phenylacetaldehyde (15,2 %), 4-vinylphenol (9,2%) and 1-octen-3-ol (7,8%). It was found out the extract contains ascorbic acid and carotinoids. In general, the study pattern can be considered as a source of biologically active substances, first and foremost, source of phenol compounds.

Key words: *Scutellaria baicalensis* Georgi, aqueous-alcohol extract, phenol combinations, volatile compounds, vitamins.