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Composition of three plant species of the genus *Climacoptera C. subcrassa, C. korshinsky and C. ambylostegio* on phases of vegetation

Abstract. The research results on the chemical composition of the aerial parts of three species of the genus Climacoptera: C. ambylostegia, C. subcrassa and C. korshinskyi of the goosefoot family (Chenopodiaceae), collected during flowering and budding in Ili district of Almaty region are presented. It is determined that a qualitative chemical composition of the plant species are identical to investigated genus Climacoptera. Results of the qualitative and quantitative analysis of the studied species Climacoptera subcrassa, C. korshinskyi and C. ambylostegio allow to suggest the general scheme of separation and isolation of different classes of compounds such as triterpenoids, flavonoids, saponins.
Keywords: *Climacoptera*, mineral composition, biologically active complex, amino acids, fatty acid, vegetation**.**

Introduction

One of the most productive ways of obtaining new biologically active substances is the isolation of compounds from plants. On this path necessary challenges are great obtaining and deep cleaning of complex multicomponent biological sufficiently labile target substances, unequivocal identification of structures.

Chemical studies of plants - halophytes, are of great scientific and practical interest. These include plants of Climacoptera, Chenopodiaceae family is widely growing in Kazakhstan.

By conventional methods XI edition, GOST 24027.1-80; 2407.1-80; 2237-75 in the study raw materials are defined: loss on drying, extractives, total ash. [1,2]

Currently recognized by necessary for the life of 14 of microelements: iron, cuprum, manganese, zinc, cobalt, iodine, fluorine, molybdenum, vanadium, nickel, strontium, silicon and selenium. They enhance the activity of enzymes that catalyze biochemical processes that promote the synthesis of carbohydrates, proteins and vitamins, and are also involved in metabolism. [3-5]

There is a relationship between the content of microelements in the soil by plants and the production of certain classes of biologically active substances. Plants that produce the cardiac glycosides, absorbs manganese, molybdenum, chromium; producing alkaloids - cuprum, manganese and cobalt; Saponins - molybdenum and vanadium, terpenes - manganese; vitamins, coumarins and polyphenolic compounds - copper, zinc, manganese; polysaccharides - manganese, chromium; carbohydrates - zinc [6-7].

Apparently, plants of the family Chenopodiaceae, the active principle which are alkaloids in a large amount of soil extracted from the calcium, iron, manganese, magnesium, potassium and sodium, which agrees well with literature data on the properties and the biosynthesis of alkaloids, polyphenols, vitamins, coumarin, carbohydrates and polysaccharides and is also typical of plants found in highly saline soils. [8]

Experiment results and discussion

The object of study - the aerial parts of three species of the genus *Climacoptera: C. subcrassa, C. korshinskyi and C. ambylostegia* of the goosefoot family (*Chenopodiaceae*), collected during flowering and budding in Ili district of Almaty region.

Revealed that the amount of heavy metals does not exceed allowable norms of their presence in medicinal raw material.

Comparing the data shown in Table 1, we can conclude that the quantitative iron content dominates the aerial part, *Climacoptera subcrassa* during flowering.

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A heavy metal content of cadmium does not exceed the maximum permissible norms. Apparently, in the plant genus *Climacoptera* active principle are polyphenolic compounds, coumarin, vitamins, carbohydrates, polysaccharides, alkaloids as they are of a large amount of soil extracted cuprum, zinc, manganese and iron, which agrees well with literature data on the properties of the biosynthesis and polyphenols [9,10]. High same content of magnesium, calcium, sodium and potassium in both samples can be explained by growing areal that is strongly saline clay soils.

The electoral accumulating capacity defined of microelements may become specific character of the plant.

The data quantitative determination of are shown in Table 2. From Table 2 that the quantitative content of such groups of compounds as phenols, amino acids, organic acids there is no particular differences. But it should be noted the predominance of saponins and flavonoids in *Climacoptera subcrassa*, *C.korshinskyi. and Climacoptera ambylstegio concede on carbohydrate composition* [11,12].

Table 1 - The quantitative of basic groups of biologically active substances and indicators benign raw materials in aerial parts of the genus *Climacoptera* (flowering and budding)

Name plants	Vegetation	Indicators benign raw materials			The quantitative of basic groups of biologically active substances, (%)							
		Moisture	Total ash	Extractives substance 50% - aqueous alcohol	Saponins	Favonoids	Phenols	Amino Acids	Carbohydrates	Organic acid	Coumarins	Alkaloids
C. subcrassa	flowering	6,02	12.87	28.82	2.42	1.29	1.52	1.87	1.7	1.09	0.80	0.026
C. subcrassa	budding	6,78	14.33	30.23	2.25	1.64	1.34	1.67	1.3	1.13	0.75	0.043
C.korshinskyi	flowering	7.37	19.53	36.23	2.76	1.1	0.94	1.40	1.1	1.54	0.13	0.075
C.korshinskyi	budding	8,51	21,67	38,02	3,90	0,98	0,68	1,42	0,8	1,06	0,6	0,091
C.ambylostegio	flowering	7.36	21.12	35.65	1.21	0,8	0.73	1.23	1.9	1.07	1.03	0.027
C.ambylstegio	budding	6.82	26.54	40.30	1.52	0,53	0.89	1.28	1.7	1.11	0.61	0.033

Table 2 - Mineral composition of plants of the genus *Climacoptera*

Macro-and micronutrients	Content mass %					
	C. subcrassa (budding)	*C. subcrassa (flowering)*	*C. korshinskyi (budding)*	*C. korshinskyi (flowering)*	*C. ambylostegi (budding)*	*C. ambylostegi (flowering)*
Potassium	46.15	39.56	36.40	28.67	25.43	12.36
Sodium	22.37	11.49	19.85	19.56	13.56	14.37
Calcium	499.77	404,71	366,5	287,6	164,6	112,8
Iron	21.43	16.70	19.80	14.50	15.45	16.51
Manganese	1.5×10^{-2}	2.3×10^{-2}	1.0×10^{-2}	1.6×10^{-2}	6.2×10^{-2}	3.1×10^{-2}
Nickel	-	6.8×10^{-2}	-	2.3×10^{-2}	4.1×10^{-2}	1.7×10^{-2}
Cuprum	4.4×10^{-2}	5.8×10^{-2}	3.1×10^{-2}	3.2×10^{-2}	5.3×10^{-2}	1.4×10^{-2}
Zinc	7.2×10^{-3}	3.1×10^{-3}	6.5×10^{-3}	9.8×10^{-3}	2.7×10^{-3}	1.5×10^{-3}
Cadmium	6.3×10^{-5}	5.2×10^{-5}	-	-	4.5×10^{-5}	-

Table 3 - Amino acid composition of plants of the genus *Climacoptera*

Amino acid	Content,%					
	C. subcrassa (budding)	*C.subcrassa (flowering)*	*C.korzhinskyi (budding)*	*C.korzhinskyi (flowering)*	*C.ambulastegio (budding)*	*C.ambulastegio (flowering)*
Alanine	8.82	6,71	7.67	6.02	6.53	4.21
Glycine	4.82	2.96	3.54	1.56	1.82	0.89
Valine	2.56	4.05	1.50	2.05	1.06	2.25
Leucine	3.15	6.12	2.15	4.16	1.67	2.15
Isoleucine	2.86	4.15	1.88	2.25	0.86	1.17
Threonine	2.44	4.38	1.94	2.32	0.45	1.38
Serine	5.15	4.94	3.19	2.94	3.10	1.92
Proline	9.56	9.15	7.46	6.95	5.56	6.75
Methionine	0.74	2.06	0.4	1.86	0.31	1.02
Asparagine	12.46	11.20	10.54	09.43	08.46	09.20
Cysteine	0.24	0.72	0.16	0.42	0.02	0.1
Phenylalanine	3.18	4.25	1.88	2.25	0.98	1.25
Glutamine	38.92	26.54	29.92	22.54	25.92	18.54
Ornithine	0.05	0.03	0.03	0.02	0.02	0.01
Tyrosine	2.85	5.14	1.65	3.24	0.85	1.14
Histidine	3.02	3.05	2.05	1.98	1.99	1.55
Arginine	4.48	6.12	2.68	5.12	3.48	2.12
Lysine	3.10	3.13	2.95	2.73	1.10	2.13
Tryptophan	1.82	2.05	1.42	1.95	0.82	1.05

Results Table 3 testifies about what mass of the aerial parts plant species investigated amino identical qualitative composition are defined near 20 free amino acids. Differences were observed in their flowering time. In plants collected during budding detected alanine, serine, methionine, glutamate in sufficient quantity, but plants collected during the flowering amount of these amino acids decreased sharply. A quantity of methionine, valine, leucine, threonine, cysteine, tyrosine, arginine, tryptophan increased during flowering. It should be noted that the quantitative composition of amino acids is highly dependent on the phase of vegetation.

In addition, we carried out the work on a comparative analysis of fatty acid plant of the genus *Climacoptera subcrassa, C.korshinskyi and C.ambylostegio* two phases of vegetation.

Table 4 - Fatty acid composition of plants of the genus *Climacoptera*

Name fatty acid	Symbol acid	Content %					
		C.subcrassa (flowering)	*C.subcrassa (budding).*	*C.korshinskyi (flowering)*	*C.korshinskyi (budding)*	*C.fmbulostegio (flowering)*	*C.ambulostegio (budding)*
Myristic	$C_{14:0}$	0,6	1,2	0,5	0,9	0,3	0,2
Pendakenov	$C_{15:0}$	0,8	2,1	0,6	1,8	0,3	1,4
Palmitic	$C_{16:0}$	11,2	6,2	9,2	2,2	4,7	1,2
Palmitoleic	$C_{16:1}$	1,1	1,9	1,01	1,4	0,6	0,7
Stearic	$C_{18:0}$	3,2	3,5	2,1	2,5	1,2	1,5
Oleic	$C_{18:1}$	3,6	2,6	1,6	1,2	1,06	1,01
Linoleic	$C_{18:2}$	8,5	6,8	3,5	2,8	2,8	2,6
Linolenic	$C_{18:3}$	0,4	0,3	0,3	0,2	0,1	0,07
Arachic	$C_{20:0}$	-	-	-	-	-	-

From the table 4 that all the investigated species of the genus *Climacopter,* have identical quantitative composition of fatty acids which identified nine components. Differences were observed only in the quantitative content of individual fatty acids. The saturated fatty acids are represented palmitic (C 16:0), stearic (C 18:0) acids than when the content of these acids in the plant genus *Climacoptera subcrassa* during flowering amount of fatty acid increased.

The main components of the unsaturated acids are oleic (C18: 1) and linoleic (C18: 2) acid. Large amount of content of unsaturated fatty acids in the plant genus *Climacoptera* detected during flowering.

Chromatographic study of phenolic complex phases showed that at the beginning of budding characterized by the appearance of tri-, di-, and aglycone monoglycoside: quercetin. Next phase in the flowering phase chromatography detected an increase in the density of aglycone.

Methods of two-dimensional paper chromatography and thin layer chromatography in various solvent systems using specific developers determined that the major groups of biologically active substances aerial parts mass of the investigation plants are saponins, flavonoids, amino acids, mono-, oligo-and polysaccharides, phenolic [12,13]

For the isolation of biologically active compounds conducted selection of solvents optimized technological regime. In order to optimize the extraction process of biologically active substances, studied the influence of relations, raw-solvent extraction time and temperature. The most appropriate 50% ethyl alcohol (in a ratio of raw materials: extractant 1:6-8, 3 days, room temperature) extracted in these conditions up to 60% of biologically active substances. [14]

Is established that a qualitative chemical composition of the investigated different time allow offering the general scheme of separation and isolation of different classes of compounds such as triterpenoids, flavonoids, saponins. [15,16]

Using silica gel column chromatography of the chloroform the concentrate elution using chloroform-ethyl acetate (8:2) allocated substance 1, and from the ethyl acetate fraction (eluent: chloroform - ethyl acetate 1:1, 1:2) were obtained from 2, 3 and 4. [17]

On the basis of physico-chemical data and comparison with literature selected compounds were identified as follows:

1. Substance 1- $C_{17}H_{14}O_7$, mp 212-214°Carried out a comparative analysis of the mineral, amino, phenolic and fatty acid composition of three species of the genus *Climacoptera*:*: C.subcrassa, C.korshinskyi and ambylostegio* two phases of vegetation.

2. In plants of the genus C. Subcrassa, collected during budding and flowering, flavonoids detected within 1.52% amounts than the flavonoid content in subcrassa higher than other types of plants *Climacoptera*.

3. As a result of component analysis established that *Climacoptera korshynski* contains 3.90% saponin in other than *Climacoptera*.

4. *Plants Climacoptera ambylostegio concedes on carbohydrate content 1.9%.*

5. Is established that a qualitative chemical composition of the plant species investigation genus *Climacoptera* are identical. Results of the qualitative and quantitative analysis of the studied species *Climacoptera subcrassa, C. korshinskyi and C. ambylostegio* allow offering the general scheme of separation and isolation of different classes of compounds such as triterpenoids, flavonoids, saponins.

6. For the isolation of biologically active compounds conducted selection of solvents optimized technological regime; suggested for the extraction of plant raw materials: 50% ethyl alcohol (in a ratio of raw materials: 1:6-8 extractant, extraction with two time 72 hours, room temperature

7. Using silica gel column chromatography of the chloroform the concentrate elution using chloroform-ethyl acetate (8:2) allocated substance 1, and from the ethyl acetate fraction (eluent: chloroform - ethyl acetate 1:1, 1:2) were obtained from 2, 3 and 4.

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