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ELEMENTAL COMPOSITION OF *CYCLORIUM INTYBUS* L. AND *URTICA DIOICA* L.

Abstract. This experiment was conducted to establish mineral accumulation in different parts of Kazakh samples of *Cichorium intybus* L. (flowers, stems, leaves, roots) and *Urtica dioica* L. (stems, leaves, roots). Mineral concentration was determined by atomic emission semiconductor spectral method. As a result, 39 macro, micro and trace nutrients were identified in *Cichorium intybus* L. and 20 – in *Urtica dioica* L. High levels of Ca, Mg and Al were found in all parts of *Cichorium intybus* L and of Ca, K, Zn, Si and P in all parts of *Urtica dioica* L. The levels of elements not significantly differ between parts of plants. Flowers of *Cichorium intybus* L. contained low percentage ($\leq 1.0 \cdot 10^{-6}$ %) of Bi, In, Nb, Ta, V, Ge; stems – As, Bi, In, Nb, V, Ge, Sb; leaves – Bi, Nb, Ta, V, Ge, Sb, Se; roots – As, Bi, In, Ta, V, Sb, Se. Stems of *Urtica dioica* L. contained low percentage ($\leq 1.0 \cdot 10^{-3}$ %) of Mo, Cu, Pb; leaves ($\leq 5.0 \cdot 10^{-3}$ %) – of Mo, B, Ni, Cu; roots ($\leq 7.0 \cdot 10^{-3}$ %) of Cr, Cu, Mo, V, Ni.

Key words: *Cichorium intybus* L., *Urtica dioica* L., macro-and microelements, trace elements, atom-adsorption method, atomic-emission semiconductor spectral analysis.

Introduction. *Cichorium intybus L.*, commonly known as chicory, is an erect fairly woody perennial herb, around 1 m in height with a fleshy taproot of up to 75 cm in length and large basal leaves having blue or white flowers. It has major distribution areas in South Africa, North and South America, Australia and New Zealand [1]. *C. intybus* is grown for the production of inulin which has a negligible impact on blood sugar and thus is suitable for diabetics [2, 3]. It is a medicinally important plant worldwide due to its long historic experience of use in traditional medicines [4]. The folk medicine the roots and leaves are used for various purposes. The roasted roots of the plant are used as a substitute of coffee in Turkey.

The aqueous root extract is used against malaria in Afghanistan [5]; for the treatment of eupeptic, stomachic, depurative, choleretic, laxative, hypotension, tonic, and antipyretic diseases in Iran [6]; against liver diseases and lack of appetite in Poland [7]; as laxative and blood purification in Italy and Serbia [8, 9]; whole plant is used for internal hemorrhage, sedative in typhoid in Jordan [10]; for jaundice and rheumatism in India [10, 11]

Research for evaluation of the biological activity have revealed that whole plant aqueous extract, leaf and seed extracts of *C. intybus* exhibits activities: antibacterial and antifungal [12-14], anthelmintic [15], anti-inflammatory [16], analgesic [17], antioxidant [18], tumor-inhibitory [19], remedy for malarial fevers [5]. On the other hand, the aqueous-methanolic extract of the seeds and aqueous extracts of the roots of *C. intybus* has been showed for the hepatoprotective activity [20, 21]. The antidiabetic effect of the aqueous seed extract of it has also been researched [22].

Urtica dioica L., often called common nettle, stinging nettle or nettle leaf, is a herbaceous perennial flowering plant in the family *Urticaceae*. Originally native to Europe, much of temperate Asia and western North Africa but it is distributed nearly worldwide [23]. The research of plant used as remedies in traditional folk medicine to treat rheumatic pain and for colds and cough [24] and also is used against liver insufficiency [25], and aqueous methanolic extract from roots used in the treatment of prostatic hyperplasia [26]. *U. dioica* is well known as hypoglycaemic [27]. Crude extract of the plant produces a hypotensive, antioxidant, antimicrobial, antiulcer, analgesic and immunomodulatory actions [28, 29].

The role of these elements in various metabolic processes and their impact on human health have an increased interest due to environmental pollution. Consequently the elemental composition of the herbs is very important for dietary. The elements are present at varying concentrations in different parts of the plants which are used as ingredient in the medicinal preparation. Moreover with increasing industrialization and environmental pollution it is necessary to check the content of toxic elements such as Ar, Hg, Sn and Se. Heavy metals that are considered essential for at least some forms of life include V, Cr, Mn, Fe, Co, Ni, Cu, Zn, and Mo. Heavy metals required by plants include Mn, Fe, Cu, Zn, Mo, and Ni. The phytotoxicity of such relatively common heavy metals as Cd, Cu, Hg, and Ni is substantially greater than that of Pb and Zn. In order to establish a direct link between elemental content and its curative capability, the monitoring of the elemental composition of the leaves has become essential [30].

Therefore, the aim of the present work was to determine mineral accumulation in different parts of *Cichorium intybus* L. (flowers, stems, leaves, roots) and *Urtica dioica* L. (stems, leaves, roots) which growing in Kazakhstan.

Materials and methods. Plant raw material *C. intybus* L. (common spray) and *U. dioica* L. (duplex nettle) were collected from Medeo mountain range in Almaty, Kazakhstan.

The quantitative analysis of elements contained in plant *C. intybus* L. (flowers, stems, leaves, roots) at atomic-adsorption method in the «AA 7000» Shimadzu instrument and the size of the plant *U. dioica* L. (stems, leaves, roots) are determined at A-Analyst 400 device by atomic-emission semi-quantitative spectral analysis [31].

RESULTS AND DISCUSSION

According to the research data, 39 elements from the plant *C. intybus* L. (flowers, stems, leaves, roots), 20 elements from the plant (stems, leaves, roots) were identified. The elemental levels of different parts of analyzed plants are presented in table.

The Gd element is equal to <0.001 % in the flowers, stems, leaves, roots and the elements V, Bi in all parts of *C. intybus* L.**,** is <0.000001 %, the Sb plant

Elemental composition of *Cichorium intybus* L. and *Urtica dioica* L.

No	Element	*Cichorium intybus* L., %				*Urtica dioica* L., %		
		Flowers	**Stems**	**Leaves**	**Roots**	**Stems**	**Leaves**	**Roots**
1	Al	0.62	1.00	0.64	2.33	3.50	1.43	1.00
2	As	$4.0\cdot10^{-3}$	$1.0\cdot10^{-6}$	$3{,}7\cdot10^{-3}$	$<1.0\cdot10^{-6}$	–	–	–
3	Bi	$<1.0\cdot10^{-6}$	$<1.0\cdot10^{-6}$	$<1.0\cdot10^{-6}$	$<1.0\cdot10^{-6}$	–	–	–
4	Ca	12.58	14.83	21.08	7.59	22.6	22	9.50
5	Cd	$2.1\cdot10^{-4}$	$2.2\cdot10^{-4}$	$3.1\cdot10^{-4}$	$4.9\cdot10^{-4}$	–	–	–
6	Cr	$4.1\cdot10^{-4}$	$6.2\cdot10^{-4}$	$5.0\cdot10^{-3}$	$2.0\cdot10^{-3}$	$3.5\cdot10^{-3}$	$7.5\cdot10^{-3}$	$3.0\cdot10^{-3}$
7	Cu	$1.4\cdot10^{-2}$	$7.9\cdot10^{-3}$	$4.5\cdot10^{-3}$	0.01	$1.0\cdot10^{-3}$	$1.5\cdot10^{-3}$	$7.0\cdot10^{-3}$
8	Fe	0.16	0.21	0.16	0.10	–	–	–
9	In	$<1.0\cdot10^{-6}$	$<1.0\cdot10^{-6}$	$8.6\cdot10^{-4}$	$<1.0\cdot10^{-6}$	–	–	–
10	Li	$9.0\cdot10^{-4}$	$3.6\cdot10^{-3}$	$2.1\cdot10^{-3}$	$1.7\cdot10^{-3}$	–	–	–
11	Mg	2.30	1.58	1.91	1.77	0.21	2.65	3.06
12	Mn	0.031	0.024	0.022	0.027	0.03	0.05	0.15
13	Mo	$1.1\cdot10^{-3}$	$2.1\cdot10^{-3}$	$4.6\cdot10^{-3}$	$5.2\cdot10^{-3}$	$3.0\cdot10^{-4}$	$9.0\cdot10^{-4}$	$4.0\cdot10^{-3}$
14	Nb	$<1.0\cdot10^{-6}$	$<1.0\cdot10^{-6}$	$<1.0\cdot10^{-6}$	$3.6\cdot10^{-4}$	–	–	–
15	Pb	$3.2\cdot10^{-3}$	$6.4\cdot10^{-3}$	$3.8\cdot10^{-3}$	$4.3\cdot10^{-3}$	$1.0\cdot10^{-3}$	$7.0\cdot10^{-3}$	–
16	Rb	0.028	0.016	0.020	0.017	–	–	–
17	Si	0.028	0.038	0.030	0.100	2.59	6.97	1.00
18	Sn	$2.8\cdot10^{-3}$	$5.7\cdot10^{-3}$	$2.4\cdot10^{-3}$	$4.4\cdot10^{-3}$	–	–	–
19	Ta	$<1.0\cdot10^{-6}$	$7.7\cdot10^{-3}$	$<1.0\cdot10^{-6}$	$<1.0\cdot10^{-6}$	–	–	–
20	Te	$1.7\cdot10^{-3}$	$8.4\cdot10^{-3}$	$6.4\cdot10^{-3}$	$6.4\cdot10^{-3}$	–	–	–
21	Ti	0.035	0.075	0.038	0.100	–	–	–
22	V	$<1.0\cdot10^{-6}$	$<1.0\cdot10^{-6}$	$<1.0\cdot10^{-6}$	$<1.0\cdot10^{-6}$	$3.0\cdot10^{-3}$	0,015	$7.0\cdot10^{-3}$
23	W	$3.8\cdot10^{-3}$	$1.7\cdot10^{-3}$	$4.4\cdot10^{-3}$	$2.8\cdot10^{-3}$	–	–	–
24	Zr	$1.9\cdot10^{-3}$	$1.9\cdot10^{-3}$	$1.2\cdot10^{-3}$	$5.6\cdot10^{-3}$	–	–	–
25	Ge	$<1.0\cdot10^{-6}$	$<1.0\cdot10^{-6}$	$<1.0\cdot10^{-6}$	0,13	–	–	–
26	Sb	$1.3\cdot10^{-3}$	$<1.0\cdot10^{-6}$	$<1.0\cdot10^{-6}$	$<1.0\cdot10^{-6}$	–	–	–
27	Se	$1.9\cdot10^{-3}$	$2.6\cdot10^{-3}$	$<1.0\cdot10^{-6}$	$<1.0\cdot10^{-6}$	–	–	–
28	Tl	0.019	0.018	0,024	$5.0\cdot10^{-3}$	0.01	0.03	0.40
29	Zn	0.044	0.028	0.036	0.027	6.31	6.80	0.015
30	P	–	–	–	–	2.17	2.31	6.96
31	K	–	–	–	–	15.83	9.81	23.98
32	Ba	–	–	–	–	0.01	0.01	0.05
33	B	–	–	–	–	$3.0\cdot10^{-3}$	$5.0\cdot10^{-3}$	–
34	Sr	–	–	–	–	0.05	0.05	0.03
35	Ni	–	–	–	–	$2.0\cdot10^{-3}$	$5.0\cdot10^{-3}$	$3.0\cdot10^{-3}$
36	S	–	–	–	–	1.53	2.0	–

members were $<1.0\cdot10^{-6}$-$1.3\cdot10^{-3}$ %. By the roots < stems < flowers < leaves (Ho, Fe, Zn, Tl, In, Si, Ti) was increased between <0.000001- 7.46 % respectively. One of the most important microelement for the plant and the metabolism is Sa 7,59-21,08 % in leaves.

Level of Zn, Si, Pb, B, Sr in the roots of *U. dioica* L. stem < flower < leaf was changed between the range from 0.003 to 6.97%, elemental concentration of Mg, Ba, Ti, Mn, Mo, Cr was increased from 0.0003 to 3.06% respectively. Moreover, concentration of the elements P, Ca, K is particularly important. The level of P in the roots is more (6,96%) than in stems and leaves. Concentration of Ca is higher in leaves and stems than in the roots with 22, 22.6, 9.50% respectively. Concentration of K is higher in roots than in stems and leaves 23.98, 15.83, 9.81 % respectively.

High levels of Ca, Mg and Al were found in all parts of *Cichorium intybus* L and of Ca, K, Zn, Si and P in all parts of *Urtica dioica* L. The levels of elements not significantly differ between parts of plants. Flowers of *Cichorium intybus* L. contained low percentage ($\leq1.0\cdot10^{-6}$ %) of Bi, In, Nb, Ta, V, Ge; stems – As, Bi, In, Nb, V, Ge, Sb; leaves – Bi, Nb, Ta, V, Ge, Sb, Se; roots – As, Bi, In, Ta, V, Sb, Se. Stems of *Urtica dioica* L. contained low percentage ($\leq1.0\cdot10^{-3}$ %) of Mo, Cu, Pb; leaves ($\leq5.0\cdot10^{-3}$ %) – of Mo, B, Ni, Cu; roots ($\leq7.0\cdot10^{-3}$ %) of Cr, Cu, Mo, V, Ni.

Conclusion. Based on the results of the study, medicinal herbs *Cichorium intybus* L. and *Urtica dioica L.* were the most important source of macro- and micronutrients. 39 elements were identified in the flowers, stems, leaves and roots of *Cichorium intybus* L. and 20 elements were found in the flowers, stems, leaves and roots of the *Urtica dioica* L. plant. In the future, the plants can be recommended for medical and pharmacological experiments.

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Резюме

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CICHORIUM INTYBUS L. ЖӘНЕ *URTICA DIOICA* L. ӨСІМДІКТЕРІНІҢ ЭЛЕМЕНТТІК МӨЛШЕРІ

Бұл мақалада күрделі гүлділер тұқымдасына жататын Cichorium intybus L. (гүлі, сабағы, жапырағы, тамыры) және Urtica Dioica L. (сабағы, жапырағы, тамыры) өсімдіктерінің элементтік мөлшері анықталып, зерттелді. Өсімдіктердің құрамындағы макро-микро элементтердің мөлшері атом-эмиссионды жартылай сандық спектрлік анализ әдісімен зерттеліп, мәліметтері көрсетілді. Нәтижесінде Cichorium intybus L. өсімдігінің құрамында 39 элемент, Urtica Dioica L. өсімдігінің құрамында 20 элемент анықталды. Cichorium intybus L. өсімдігінің барлық мүшесінде Ca, Mg и Al элементтері жоғары мәнді көрсетсе және Ca, K, Zn. Si и P элементтері Urtica Dioica L. өсімдігінің де барлық мүшесінде кездесті. *Cichorium intybus* L. өсімдігінң гүлінде Bi, In, Nb, Ta, V, Ge элементтері, сабағында - As, Bi, In, Nb, V, Ge, Sb; жапырағында – Bi, Nb, Ta, V, Ge, Sb, Se; тамырында - As, Bi, In, Ta, V, Sb, Se төмен пайыздық көрсеткішті көрсетті ($\leq 1,0 \cdot 10^{-6}$ %). Ал, *Urtica dioica* L. өсімдігінің сабағында Mo, Cu, Pb элементтері ($\leq 1,0 \cdot 10^{-3}$ %) аз мөлшерді көрсетсе, жапырағында Mo, B, Ni, Cu ($\leq 5,0 \cdot 10^{-3}$ %), тамырында Cr, Cu, Mo, V, Ni элементтері ($\leq 7,0 \cdot 10^{-3}$ %) мәнге ие.

Түйін сөздер: Cichorium intybus L., Urtica dioica L., макро- және микроэлементтер, трансэлементтер, атом-адсорбциялық әдс, атом-эмиссионды жартылай сандық спектрометр.

Резюме

М. Б. Ахтаева, Г. Е. Азимбаева

ЭЛЕМЕНТНЫЙ СОСТАВ
CYCLORIUM INTYBUS L. И *URTICA DIOICA* L.

Данный эксперимент был проведен для установления накопления минералов в разных частях казахстанских образцов *Cichorium intybus* L. (цветки, стебли, листья, корни) и *Urtica dioica* L. (стебли, листья, корни). Концентрация минералов определялась атомно-эмиссионным полупроводниковым спектральным методом. В результате было выявлено 39 макро- и микроэлементов в *Cichorium intybus* L. и 20 - в *Urtica dioica* L. Высокие уровни Ca, Mg и Al были обнаружены во всех частях *Cichorium intybus* L и Ca, K, Zn. Si и P во всех частях *Urtica dioica* L. Концентрация элементов в различных частях исследуемых растений различается не существенно. Цветки *Cichorium intybus* L. содержали низкий процент ($\leq 1{,}0 \cdot 10^{-6}$ %) Bi, In, Nb, Ta, V, Ge; стебли - As, Bi, In, Nb, V, Ge, Sb; листья - Bi, Nb, Ta, V, Ge, Sb, Se; корни - As, Bi, In, Ta, V, Sb, Se. Стебли *Urtica dioica* L. содержали низкий процент ($\leq 1{,}0 \cdot 10^{-3}$ %) Mo, Cu, Pb; листья ($\leq 5{,}0 \cdot 10^{-3}$ %) - из Mo, B, Ni, Cu; корни ($\leq 7{,}0 \cdot 10^{-3}$ %) Cr, Cu, Mo, V, Ni.

Ключевые слова: Cichorium intybus L., Urtica dioica L., макро- и микроэлементы, трансэлементы, атом-адсорбционный метод, атомно-эмиссионный полупроводниковый спектрометр.