STUDY OF THE MINERAL COMPOSITION OF HUNGARIAN LILAC (*SYRINGA JOSIKAEA*) BUDS

Popyk Andriy, Kyslychenko Victoriia, Iosypenko Olena, Novosel Olena, Skrebtsova Kateryna, Tartynska Ganna

National University of Pharmacy, Kharkiv, Ukraine

Introduction. Plants of the Lilac genus (*Syringa* L.) of the Olive family (*Oleaceae* Lindl.) are extremely decorative plants that are widely cultivated in various European countries and in Ukraine.

The Carpathian or Hungarian Lilac (*Syringa josikaea* J. Jacq. ex Rchb.) is especially famous, it is used to create late spring and early summer flowering displays in decorative gardening in various countries. Hungarian Lilac is a highly decorative plant, as it has beautiful flowers of pale pink color, collected in a small, fluffy upright panicle, and has a strong pleasant smell. The plant grows naturally in the Ukrainian Carpathians, Romania, Bulgaria, and Hungary. Hungarian Lilac contains a variety of biologically active substances, in particular polysaccharides, iridoids, lignans, flavonoids, essential oils, it exhibits diaphoretic, broncholytic effects and is promising for further phytochemical research [15].

Among the various classes of biologically active compounds, macro- and microelements that affect the activity of many enzymes, are part of various vitamins, hormones and thus support the homeostasis of the body are of no less importance. Microelements are the most important catalysts of metabolic processes and play an important role in the adaptation of the body in normal and pathological conditions. Despite the fact that mineral substances do not have energy value like proteins, fats and carbohydrates, many enzymatic processes in the body are impossible without the participation of certain elements [4, 5, 8, 9, 13].

Macro- and microelements that plants absorb from the soil and accumulate have a significant impact on physiological and biochemical processes, ensuring the synthesis of certain substances. They participate in the construction of tissues, maintenance of constant osmotic pressure, ionic and acid-base composition [1, 2, 4, 5, 6]. That is why it is important to study the elemental composition of plants, in particular Hungarian lilac, which can be used to treat elemental diseases common in the modern world.

The purpose of the research is to conduct a quantitative analysis and qualitative composition of macro- and microelements in the buds of Hungarian Lilac, which is growing on the territory of Ukraine.

Materials and methods. Buds of Hungarian Lilac harvested in May 2023 in the botanical garden of the National University of Pharmacy were used for the study. The raw material was dried in the shade in the open air, with occasional stirring, and ground.

The raw material was dried in the shade in the open air, with occasional stirring, and ground. The study of the mineral composition was carried out on the basis of State Scientific Institution “Institute for Single Crystals” of National Academy of Sciences of Ukraine (Kharkiv) in the Department of Analytical Chemistry named after A.B. Blank.

The tests were carried out using the atomic absorption spectrographic method with atomization in an air-acetylene flame according to State Pharmacopoeia of Ukraine (SPhU) 2.0, vol. 1, general article 2.2.23 "Atomic absorption spectrometry" [11].

2.0 g of dried plant material (precisely weighed) was ground to a powdery state. It was placed in a quartz crucible, 10 ml of a 5% solution of sulfuric acid was added, and dried (t = 105 °C) to a constant mass. The crucibles were placed in a muffle furnace for 5 hours (t = 500 °C), cooled, and weighed. Dissolved in 5% sulfuric acid, introduced in cuvettes to the electrothermal atomizer of the device. Atomization of samples was carried out on graphite electrodes of the IVS-28 device in an alternating current arc discharge (I = 16 A, U = 220 v, t = 60 c, P = 0.04 MPa, t flame = 2250 °C). Spectra were recorded using a DFS-8 spectrograph (diffraction grating 600 pcs/mm with a three-lens slit illumination system). The intensity of the emission lines in the spectra was recorded with a MF-1 microphotometer (ignition phase 60 °C, spectrograph slit width 0.015 mm, λ= 196 – 706.5 nm). For identification and quantitative determination of the elemental composition of the studied plant material, the corresponding absorption bands according to standard samples were used (nm): 213.9 (Zn); 228.8 (Cd); 232.0 (Ni); 240.7 (Co); 248.3 (Fe); 251.6 (Si); 257.0 (Hg); 279.5 (Mn); 283.3 (Pb); 285.2 (Mg); 309.3 (Al); 313.3 (Mo); 324.7 (Cu); 357.9 (P); 365.0 (As); 422.6 (Ca); 460.0 (Sr); 589.0 (Na); 706.5 (K).

Photographic lamella were developed, dried, photometer lines (in nm) of the spectra of samples, calibration samples, as well as the background near them. Then a calibration graph was constructed in coordinates: the average value of the difference between the blackening of the line and the background is the logarithm of the content of the element in the grading samples, by which the percentage content of the element in the ash was found and its quantitative content in the studied raw material was calculated according to the formula:

$$X = a\, m_1/m,$$

where m_1 is the mass of ash, g; m – mass of raw material, g; a – element content in ash, % [1, 2, 10, 11].

Determination of total ash content was carried out according to the methodology of SPhU 2.0, vol. 1, general article 2.4.16 "Total ash" [11]. The results were processed by the method of mathematical statistics in accordance with the requirements of SPhU 2.0, vol. 1 (general articles 5.3 "Statistical analysis of the results of biological tests and quantitative determinations" and 5.3.N.1 "Statistical analysis of the results of chemical experiment N") using the program Statistica 8 (StatSoft inc., USA) and a package of statistical functions of the Microsoft Excel program [11]. The probability of differences in concentration values was assessed by Student's t-test (p > 95%) [11].

Results and discussion. By the method of atomic absorption spectrography, the presence of 19 mineral elements in the buds of Hungarian lilac was established, of which 10 (Ca, Cu, Fe, K, Co, Mg, Mn, Zn, P, Mo) are essential [3, 8 9, 12]. The results of the research are shown in Table 1.

DOI: 10.5281/zenodo.11634272

Table 1. The content of mineral elements in buds of Hungarian Lilac, mg/100 g (x ± Δx), n = 5

Element name	λ, nm	Element content, mg/100 g
Zinc (Zn)	213,9	1,25 ± 0,03
Nickel (Ni)	232,0	0,03 ± 0,04
Iron (Fe)	248,3	15,00 ± 1,55
Silicon (Si)	251,6	75,00 ± 7,56
Manganese (Mn)	279,5	5,60 ± 1,02
Magnesium (Mg)	285,2	112,00 ± 10,85
Lead (Pb)	283,3	<0,03
Aluminum (Al)	309,3	12,50 ± 0,86
Molybdenum (Mo)	313,3	<0,03
Copper (Cu)	324,7	0,31 ± 0,03
Phosphorus (P)	357,9	127,00 ± 11,18
Calcium (Ca)	422,6	250,00 ± 20,80
Strontium (Sr)	460,0	5,00 ± 0,98
Sodium (Na)	589,0	16,20 ± 0,86
Potassium (K)	706,5	700,00 ± 410,60
Cobalt (Co)	240,7	<0,03
Cadmium (Cd)	228,8	<0,01
Arsenic (As)	365,0	<0,01
Mercury (Hg)	257,0	<0,01
Ash content, g	0,09 ± 0,01	

Among the identified compounds, 6 are attributed to macroelements (K, Ca, Mg, Na, Si, P), 9 to microelements (Fe, Al, Mn, Pl, Ni, Mo, Cu, Zn, Sr), and 4 to ultra-microelements (Co, Cd, As, Hg). The total content of macro- and microelements was 1320,42 mg/100 g. The content of mineral elements in the buds of Hungarian Lilac gradually decreased in the order K > Ca > P > Mg > Si > Na > Fe > Al > Mn > Sr > Zn > Cu > Ni > Mo > Pb.

The content of macroelements in the studied raw materials was equal to 1280,2 mg/100 g. In the predominant concentrations accumulated (mg/100 g): K (700,00 ± 410,60), Ca (250,00 ± 20,80), P (127,00 ± 11,18) and Mg (112,00 ± 10,85).

The total content of trace elements was 39,75 mg/100 g. Fe (15,00 ± 1,55) and Al (12,50 ± 0,86) dominated among trace elements (mg/100 g).

The presence of various elements in Hungarian lilac has a positive effect on the human body. Thus, in particular, potassium is the main intracellular cation, activates various enzymes, accelerates the hydration of protoplasm, participates in the transport of various ions, potassium participates in the maintenance of homeostasis, osmoregulation and water exchange, iron is part of cytochromes, catalase, metallocyanine complexes, is of great importance in the oxidation processes, is indispensable in the functioning of the main redox systems of photosynthesis and respiration, plays an important role in enzymatic reactions. Equally important is calcium, which is responsible for the strength and cohesion of plant cell walls, increases the activation of various enzymes and the transmission of signals that coordinate various processes in cells, participates in the regulation of intracellular processes and the permeability of cell membranes; aluminum is an integral component of tissues and intercellular solutions, increasing their colloidal properties [3, 4, 8, 9, 13]. Magnesium is the most important intracellular element. It participates in metabolic processes closely interacting with potassium, sodium, calcium; is an activator for many enzymatic reactions [12, 13]. Phosphorus is present in all tissues, is part of proteins, nucleic acids, nucleotides, and phospholipids. Phosphorus compounds ADP and ATP are a universal source of energy for all living cells. Silicon in the form of various compounds is part of most tissues, affects lipid metabolism, promotes the formation of collagen and bone tissue. The role of silicon as a structural element of connective tissue is especially important. Sodium plays a very important role in the regulation of osmotic pressure and water exchange, participates in the hydration of proteins and the solubilization of organic acids.

As a result of the analysis, it was established that the ash content in the buds of the Hungarian Lilac is 0,09 ± 0,01g.

Heavy metals, entering the human body, are able to remain and accumulate, and when the appropriate concentration is reached, they can cause a harmful effect, causing poisoning and mutations [7, 8, 12, 14]. According to the requirements of SPhU 2.0, vol. 1, the maximum content of toxic elements in medicinal raw materials is for Zn – 30,00 mg/kg, Cr – 1,50 mg/kg, Cu – 10,00 mg/kg, Ni – 1,50 mg/kg, Mn – 200,00 mg/kg, Cd – 0,30 mg/kg, Pb – 10,00 mg/kg, As – 1,00 mg/kg [7, 11].

According to the results of the study of the raw materials of the Hungarian Lilac, it was established that the content of such elements as cobalt (Co), cadmium (Cd), mercury (Hg), arsenic (As) is equal to: Co<0,03 mg/100g; Cd, As, Hg<0,01 mg/100g, which are within the permissible limits for medicinal raw materials, which are set by the SPhU.

Conclusions. For the first time, the quantitative content of 19 mineral compounds was identified and quantified in Hungarian Lilac buds using atomic absorption spectrometry. Potassium, calcium, phosphorus and magnesium are dominant. Heavy metals are identified within the permitted limits, so buds of Hungarian Lilac are a fairly safe raw material for use. The conducted studies confirm that the buds of the Hungarian Lilac contain a significant amount of vital mineral compounds, primarily essential elements. When combined with other biologically active substances of Hungarian Lilac, this indicates the therapeutic value and perspective of the plant

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for the creation of new drugs of various pharmacological effects based on the studied plant material.

Study of the mineral composition of Hungarian lilac (*Syringa josikaea*) buds

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Keywords: Carpathian or Hungarian Lilac, *Syringa josikaea* J. Jacq. ex Rchb., buds, mineral compounds, qualitative composition, quantitative content.

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DOI: 10.5281/zenodo.11634272