Letter to the Editor

STUDY OF CARBOHYDRATES IN THE LEAVES OF THE POLTAVA VARIETY OF COMMON LILAC

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Introduction

In the plant world, the most common natural compounds are carbohydrates, which have a wide range of medicinal properties. Because of their chemical structure, carbohydrates can absorb radionuclides and heavy metals, improve lipid metabolism, activate the secretory and motor functions of the intestine, regulate immune and endocrine functions, and exhibit emollient, anti-inflammatory, anticoagulant, antiulcer, antitumor, and antiviral effects [4, 6].

The advantage of carbohydrates is their low toxicity and the presence of antigenic and pyrogenic properties, which has become the key reason for their use in medical practice. Additionally, they are among the most essential nutrients that supply the human body with energy—primarily glucose, fructose, sucrose, along with starch and glycogen [4, 6, 21]. That is why, finding new plant sources of carbohydrates is highly significant for modern medicine. One promising plant source of carbohydrates is the common lilac variety Poltava, widely cultivated in Ukraine. Lilac plants, besides their ornamental value, are also recognized for their medicinal properties [11]. In traditional medicine across many countries, the leaves, flowers, fruits, buds, and bark of the plant are used to treat malaria, rheumatoid arthritis, gout, headaches, and to enhance immunity [3,5,7-9,18,19,20]. Experimental studies confirm the anti-inflammatory, immunomodulatory, antioxidant, antipyretic, antitumor, and antiallergic properties of raw materials derived from plants of the genus Lilac [10,11,13-17].

The purpose of the study was to isolate fractions, determine the qualitative composition, and measure the quantitative content of carbohydrates in the leaves of the common lilac of the Poltava variety.

Materials and methods

The object of the study was leaves of the common lilac of the Poltava variety, harvested from the Botanical Garden (Kharkiv) in May 2025. Extraction of biologically active substances from the raw materials was performed with purified water. Preliminary identification of carbohydrates was conducted using paper chromatography by the descending method, with the mobile phase n-butanol-acetic acid-water (4:1:2), and compared with standard sugar samples. Acid hydrolysis was carried out to examine bound sugars. To do this, 5 ml of the extract was placed into a 10 ml glass vial, and 5 ml of a 5% sulphuric acid solution was added. The vial was hermetically sealed and kept for 24 hours in a thermal oven at 100 ºC.

The analysis of carbohydrates in the leaves of the common lilac of the Poltava variety was performed using high-performance liquid chromatography. To do this, 5.0 g (exact weight) of the studied raw material, degreased with petroleum ether, was extracted twice with 25 ml of a 1% sodium acetate solution for 1 hour at a temperature not exceeding 45 ºC. The resulting solution was filtered into a 50 ml volumetric flask and diluted with sodium acetate solution to the mark. A set of different carbohydrates—sucrose, maltose, glucose, and fructose—was used as standards to calibrate the chromatograph, with sodium acetate serving as the internal standard. Standard carbohydrate solutions were prepared in sodium acetate solution at 10 mg/ml. These solutions were filtered through a Chromafil GF/PET-45/25 membrane filter, and the carbohydrate content was identified and quantified using the Smartline high-resolution liquid chromatograph system (Knauer, Germany) equipped with a direct-phase column (300 x 8 mm) packed with Erokat H material (10 µm particles). A 0.01 N sulfuric acid solution served as the mobile phase, flowing at 1.0 ml/min, with an injection volume of 20 µl. Quantitative analysis of carbohydrates in the raw materials was performed using a RI Detector 2300 refractometer (Knauer, Germany). The column pressure was maintained at 6.3 MPa, and the temperature was set at 50 ºC. Chromatographic control, chromatogram analysis, and result calculation were conducted using ClarityChrom software [13].

The quantitative content of polysaccharides in the leaves of the common lilac of the Poltava variety was determined using the gravimetric method according to DFU 2.0, volume 3, monograph "Large Plantain Leaves^{N}" [1].

5.0 g (accurately weighed) of powdered raw materials was placed into a 250 mL flask fitted with a ground-glass stopper. Then, 100 mL of purified water was added, and the mixture was refluxed for 30 minutes using a reflux condenser. After cooling, the mixture was centrifuged at 5000 rpm for 10 minutes and decanted into a 250 ml volumetric flask through a glass funnel lined with 5 layers of moistened gauze. Extraction was repeated in two portions: first with 100 ml of purified water, then with 50 ml, each time boiling with a reflux condenser for 30 minutes.

Next, 25.0 ml of the obtained solution was transferred to a centrifuge tube. To it, 75 ml of 96% ethanol was added, mixed well, and then heated in a water bath at 30°C for 5 minutes. The mixture was kept at this temperature for 1 hour, then centrifuged at 5000 rpm for 30 minutes. The supernatant was filtered under vacuum at a residual pressure of 13–16 kPa through a POR16 glass filter that was pre-dried at 100–105°C to constant weight. The precipitate was transferred quantitatively to the filter using 15 ml of a mixture of purified water and 96% ethanol (1:3), then washed with another 15 ml of 96% ethanol. The filter with the sediment was air-dried and then dried to a constant weight at 100–105°C.The isolation of polysaccharide fractions from raw materials was performed using a modified method of M. K. Kochetkov, which involves sequentially extracting

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polysaccharide fractions with different solvents and then precipitating them with ethanol [2].

The content of polysaccharides (X, %) was calculated by the formula:

$$X = \frac{(m_1 - m_2) \times 100 \times 100}{m \times (100 - W)}$$

where:
m_1 is the mass of the filter with sediment, g;
m_2 is the mass of the filter, g;
m is the weight of the tested raw materials, g;
W is the loss in mass during drying of raw materials, %.

From the meal left after removing the lipophilic fraction, separate polysaccharide fractions were sequentially isolated: water-soluble polysaccharides (WSPS), pectin substances (PS), hemicellulose A (HC A), and hemicellulose B (HC B). The WSPS fraction was separated by extraction with purified water at a raw material-to-extractant ratio of 1:10, heating in a water bath for 1 hour, followed by precipitation with three times the volume of 96% ethanol. The PS fraction was obtained by extracting raw materials with a mixture of 0.5% oxalic acid and ammonium oxalate (1:1) at a 1:20 (raw materials to extractant) ratio at 80-85 ºC for 2 hours, then precipitating with five times the volume of 96% ethanol. The HC fraction was extracted with a 7% sodium hydroxide solution at a 1:5 (raw materials to extractant) ratio at room temperature for 12 hours. Before precipitating the HC B fraction, acetic acid was added to the alkaline extract. The percentage content of each polysaccharide fraction (WSPS, PS, HC A, and HC B) was calculated using the following formula:

$$X = \frac{(m_1 - m_2) \times 100}{m}$$

where:
m1 is the mass of the filter with sediment, g;
m2 is the mass of the filter, g;
m is the weight of the meal weight, g [1].

Statistical processing of the results was carried out in accordance with the monograph of the State Pharmacopoeia of Ukraine 2.0 "Statistical analysis of the results of a chemical experiment" using Microsoft Excel 2016 for Windows.

Results and discussion

Following a study of the carbohydrate composition of leaves of the common lilac of the Poltava variety, the presence of free sugars—glucose, maltose, and sucrose—as well as bound glucose and fructose was confirmed by paper chromatography. The chromatogram illustrating the carbohydrate composition of the lilac leaf extract is shown in Fig. 1. The results of measuring the carbohydrate content in the extract using high-performance liquid chromatography are presented in Table 1.

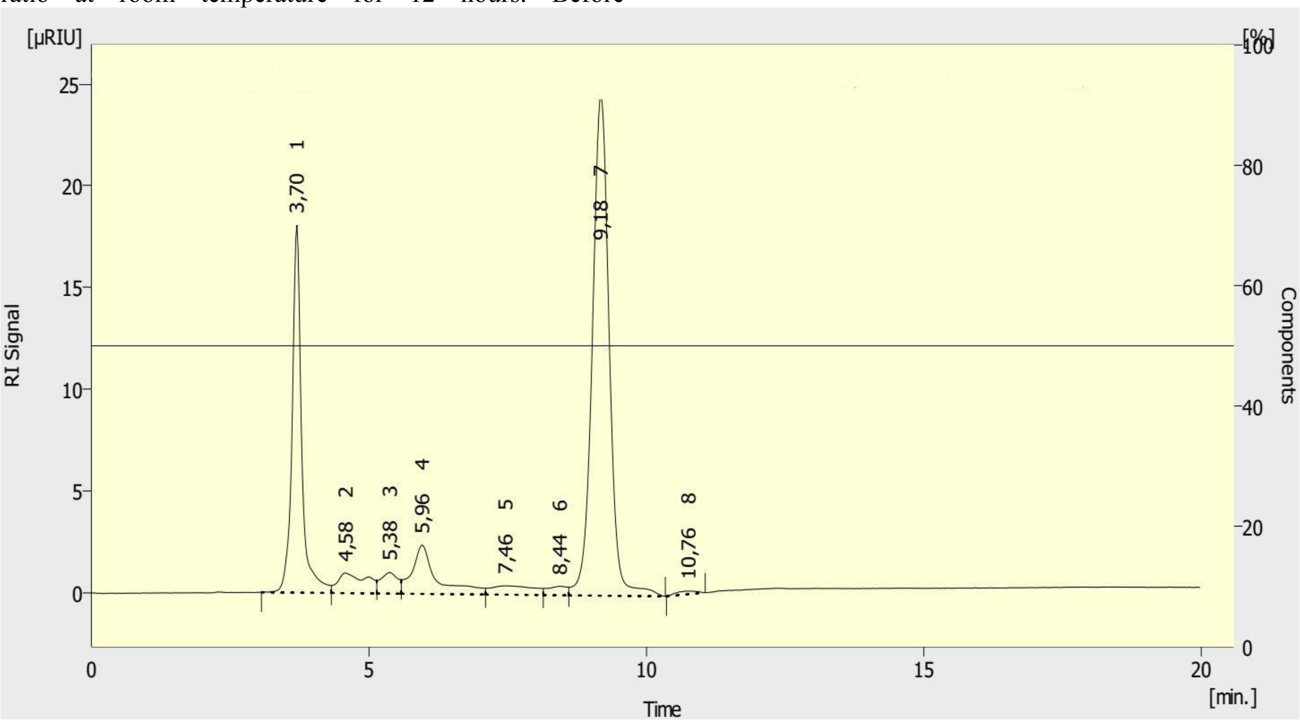

Fig 1. Chromatogram for detecting the composition of carbohydrates of leaf extract of the common lilac of the Poltava variety

Table 1. Quantitative content of carbohydrates in the leaves of the common lilac of the Poltava variety

Compound name	Holding time, min	Quantitative content, mg/ml
Glucose	5,38	0,11±0,03
Fructose	5,96	0,35±0,02
Sucrose + Maltose	4,58	0,12±0,06

As shown in Fig. 1 and Table 1, the leaves of the common lilac of the Poltava variety contained the following carbohydrates: glucose, fructose, and a mixture of sucrose and maltose. Among the sugars detected, fructose had the highest concentration at 0.35±0.02 mg/ml. Fructose is a well-known natural sugar substitute and is classified as a

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non-insulin-dependent carbohydrate, meaning it does not overload or thin the pancreas, as it participates in glycolytic reactions that do not require insulin to accelerate metabolism further. For this reason, it is recommended for consumption by people with diabetes mellitus [21]. Therefore, these studies indicate a significant fructose concentration in the leaves of the common lilac of the Poltava variety, which could serve as a promising raw material for treating type II diabetes mellitus. The total content of water-soluble polysaccharides, determined gravimetrically, in the leaves of the common lilac of the Poltava variety was 9.35±0.27%. The results of analyzing the fractional composition of polysaccharides in these lilac leaves are presented in Table 2.

Table 2. Results for determining the content of polysaccharides by fractions in the leaves of the common lilac of the Poltava variety

Polysaccharide fraction	Quantitative content of the fraction in lilac leaves, %
WSPS	11,25±6,98
PS	12,38±7,63
HC A	7,43±4,61
HC B	4,81±2,98

As shown in Table 2, the PS fraction was predominant, comprising 12.38±7.63 %. The WSPS fractions were slightly lower at 11.25±6.98 %. The total content of HC A and B was 12.24±7.59 %, with HC A being the most prevalent at 7.43±4.61 %.

Conclusions

Using paper chromatography and high-performance liquid chromatography, the quantitative content of carbohydrates in the leaves of the common lilac of the Poltava variety was identified and established — glucose, fructose, and a mixture of sucrose and maltose. In these lilac leaves, fructose was the most abundant sugar, with a quantitative content of 0.35±0.02 mg/ml. The total water-soluble polysaccharides in the leaves of the common lilac of the Poltava variety were found to be 9.35±0.27%. Fractionation of the polysaccharides was performed, and the quantitative content of the isolated fractions was determined, with pectin substances being the predominant fraction. These studies highlight the potential for further detailed investigation of the carbohydrates in the leaves of the common lilac of the Poltava variety, and the results can be used to standardize the raw materials.

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Conflict of interest: The author of the article, Victoriia Kyslychenko, is a member of the editorial board of this journal.

Research on carbohydrates in leaves of common lilac of the Poltava variety

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Introduction. Carbohydrates are the most common natural compounds in the plant world and have a wide range of medicinal properties. Due to their chemical structure, carbohydrates are capable of adsorbing radionuclides and heavy metals, improving lipid metabolism, activate the secretory and motor functions of the intestine, regulate the functions of the immune and endocrine systems, and exhibit emollient, anti-inflammatory, anticoagulant, antiulcer, antitumour, and antiviral effects. The advantage of carbohydrates is their low toxicity and antigenic and pyrogenic properties, which has led to their use in medical practice. That is why the search for new plant sources of carbohydrates is of great importance for modern medicine. One promising plant source of carbohydrates may be the common lilac, which grows widely in Ukraine. In traditional medicine, the leaves, flowers, fruits, buds, and bark of the plant are used to treat malaria, rheumatoid arthritis, gout, headaches, and to boost immunity. Experimental studies confirm the anti-inflammatory, immunomodulatory, antioxidant, antipyretic, antitumour and antiallergic properties of raw materials from plants of the *Syringa* genus. The study **aimed** to fractionally isolate, determine the qualitative composition, and quantify the content of carbohydrates in the leaves of the common lilac of the Poltava variety. **Materials and methods.** The study focused on the leaves of the common lilac (Poltava variety), harvested in the botanical garden (Kharkiv) in May 2025. Carbohydrates were identified using paper chromatography in comparison with standard sugar samples and high-performance liquid chromatography. The quantitative content of polysaccharides and polysaccharide fractions in the leaves of common lilac was determined by the gravimetric method. **Results and discussion**. As a result of studying the carbohydrate composition of leaves of the common lilac of the Poltava variety using paper and high-performance liquid chromatography, the presence of glucose, fructose, a mixture of maltose and sucrose was established. Among the identified sugars, fructose had the highest concentration – 0.35±0.02 mg/ml. The content of water-soluble polysaccharides, determined by the gravimetric method, in the leaves of the common lilac of the Poltava variety was 9.35±0.27 %. Fractionation of polysaccharides in the leaves of the common lilac of the Poltava variety indicates a significant concentration of pectin substances. **Conclusions**. Using paper and high-performance liquid chromatography methods, the quantitative content of carbohydrates – glucose, fructose, a mixture of sucrose and maltose – was identified and determined in the leaves of the common lilac variety Poltava. Among the identified sugars in the leaves of the common lilac of the Poltava variety, fructose dominated in terms of quantitative content – 0.35±0.02 mg/ml. The polysaccharides in the leaves of the common lilac of the Poltava variety were fractionated and the quantitative

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content of the isolated fractions was determined, among which the fraction of pectin substances predominated in terms of content. The studies conducted indicate the promise of further in-depth investigation of the carbohydrates in the leaves of the common lilac variety Poltava, and the results obtained can be used to standardize the raw materials studied.

Keywords: common lilac, Poltava variety, carbohydrates, high-performance liquid chromatography, fractionation, quantitative content.

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