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COMPARATIVE ANALYSIS OF POLYSACCHARIDES OF *ROSA×DAMASCENA* MILL. BUDS AND FLOWER PETALS

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The aim. *The aim of the work was a comparative study of polysaccharides of Rosa×damascena buds and flower petals after obtaining essential oils.*

Materials and methods. *The water distillation technique was used to determine the essential oils (EO) content in buds and flower petals of R.×damascena. The content of water-soluble polysaccharides (WSPS) and pectins (PC) from buds and flower petals of R.×damascena was obtained using the fractionation method after EO were isolated. Free and bound monosaccharides in WSPS from R.×damascena buds and flower petals were determined by gas chromatography-mass spectrometry (GC/MS) method. Agilent 6890N/5973 inert gas chromato-mass spectrometric system (Agilent Technologies, USA) was used for the chromatographic separation with HP-5ms capillary column (30 m×0.25 mm×0.25 μm, Agilent Technologies, USA). The filtrates obtained after WSPS precipitation of buds and flower petals were analyzed by chemical reactions.*

Results. *The results showed that the EO concentration in buds and flower petals of R.×damascena was 0.033±0.005 % and 0.015±0.002 %, respectively. The WSPS content was 10.33±0.31 % in buds and 9.69±0.25 % in flower petals. In addition, the PC content in buds was 4.35±0.14 % and in flower petals 7.88±0.15 %. GC/MS analysis revealed that WSPS from buds of R.×damascena composed of monosaccharides arabinose, fucose, mannose, glucose, galactose, and inositol. WSPS of R. damascena flower petals consist of arabinose, fucose, glucose, galactose, and inositol. Glucose is present in a higher amount. Analysis of the filtrate of buds and flower petals obtained after WSPS precipitation by chemical reactions shows the presence of flavonoids, tannins and triterpene saponins.*

Conclusions. *The total content of WSPS in flower buds did not significantly exceed the content of these compounds in flower petals of R.×damascena. The PC content in flower buds was significantly lower (4.35±0.14 %) than in flower petals (7.88±0.15 %). It can be assumed that WSPS and PCS could be responsible for the high swelling index.*

The study of WSPS by GC/MS indicates the predominance of glucose and galactose in both types of raw materials, as well as differences in the qualitative and quantitative content of monosaccharides in the composition of WSPS of flower buds and flower petals.

The study of the filtrate of flower buds and petals of R.×damascena, obtained after precipitating WSPS by chemical reactions, indicates the presence of phenolic compounds and triterpene saponins.

The results obtained indicate the possibility of obtaining WSPS, PC, and an extract rich in phenolic compounds and triterpene saponins after extraction of EO from buds and flower petals of R.×damascena by hydrodistillation

Keywords: *Rosa×damascena, essential oils, water-soluble polysaccharides, pectins, fractionation, gas chromatography/mass spectrometry*

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1. Introduction

Nearly all living organisms include polysaccharides, which are common natural polymers with extraordinary qualities and critical roles in the biological processes of anti-tumour, immunomodulatory, antibacterial, antioxidant, anticoagulant, antidiabetic, antiviral, and hypoglycemic actions [1–3]. Additionally, polysaccharides are renowned for their great nutritional value, as well as their beneficial benefits on our immune, digestive, and detoxifying systems [4]. Polysaccharides are used in vaccinations, cosmetics, and nutraceuticals [4, 5]. They also form the skeletal system of various animals and plants, serving as both energy sources and stores [4, 5]. Vegetable biomass, which is currently used to produce chemicals, materials, and energy, primarily consists of polysaccharides [5].

Slavov A. et al. revealed that the periodate compound's carbohydrate moiety directly affects the in vitro immune system's modulating capability [6]. Another study revealed that polysaccharides and other biomolecules like proteins and nucleotides are vital components and have several biological functions, including cell-cell communication, adhesion, and molecular recognition in the immune system [1, 7]. Additionally, a number of investigations have suggested that certain types of complex molecular polysaccharides have pharmacological and immunopharmacological effects on the immune system, gastrointestinal system, etc. [8].

Pectins, cellulose, and hemicellulose, which are components of polysaccharides, are human nutrition that have positive effects on the body and are frequently employed in the food industry to increase the viscosity, texture, and shelf life of foods [5, 9]. Several biotechnological methods for converting agro-waste polysaccharides can be used to make biomaterials, enzymes, prebiotics, anticancer agents, value-added chemicals, renewable energy, and food additives [5].

Renewable sources of polysaccharides include algae, plants, bacteria, fungi, and other microbes [4, 5].

Recently, it was suggested that wasted *Rosa×damascena* petals, so abundant in the scent industry, might be utilized to extract polysaccharides [6]. The isolation of a polysaccharide-peptide complex with antioxidant characteristics has been described despite the paucity of information on the polysaccharide molecules found in rose flowers [6]. Depending on the biorefinery method, the utilization of agro-wastes as abundant sources of valuable polysaccharides could provide both a strategy for waste minimization and a more sustainable generation of energy and chemicals [5]. Xyloglucans, pectic polysaccharides, and arabino-3,6-galactans have all been reported to be produced by rose suspension culture [6]; it is reasonable to assume that waste rose petals are a good source for these macromolecular substances. Furthermore, polyphenol compounds have been identified in the wasted rose petals [6], and they are employed to stabilize strawberry beverages and as antioxidant supplements. Waste rose petals are expected to include immune-stimulating polysaccharides since arabino- 3,6-galactans with a specific structural feature have been shown to express significant immunopharmacological activity [6].

We are aware of no attempts to date to utilize waste rose buds and flower petals as a source of bioactive macromolecular water-soluble polysaccharides (WSPS) and pectins (PC), despite descriptions in the literature that the rose hips and petals contain considerable amounts of polysaccharides [6].

Damask rose oil is widely used in food, medicine, pharmacy, perfumery, aromatherapy, and cosmetology. It is one of the most expensive EO around the world. To obtain high-quality Damask rose oil, fresh flower petals are used and collected at the stage of full opening. The time of collection is also important - early in the morning. At other times of collection, drying significantly reduces the quantitative content of EO in the raw material. The temperature for distillation of high-quality rose oil should be low at 35–45 °C to prevent the entry of stearoptene (a more solid component of the oil) – a part of EO, which is released as a solid substance upon cooling or standing. Stearoptene is composed of saturated acyclic hydrocarbons, also called paraffins. *R.×damascena* raw material is known for its high content of saturated hydrocarbons. The most valuable rose oil – oleoptene – contains monoterpene alcohols (a more volatile oil component) [10].

The choice of flower petals as a raw material on an industrial scale for obtaining high-quality EO is explained by the chemical composition of volatile compounds of buds and flower petals [10]. In a previous study, we also found that the highest content of saturated acyclic hydrocarbons was in flower buds. For example, the content of nonadecane in flower buds was 256.89±5.31 mg/g, and in flower petals 89.62±1.79 mg/g [11].

However, the raw material of R.×damascena is used not only fresh. Two types of dried raw materials – buds and petals – are used for export for further use in food. Another reason for drying the petals is to store them when distilleries can no longer accept all the flower petals that have been produced. They are later used for distillation [10, 11].

We set the task to propose using flower petals or bud wastes after obtaining EO for dried raw materials. The yield of volatile compounds in this study is not the aim. The percentage of EO in dried raw materials is smaller than for fresh ones. However, we need to reproduce the process of obtaining EO to use the wastes after steam distillation to obtain polysaccharides.

The aim of our work was a comparative study of polysaccharides of *Rosa×damascena* dried buds and flower petals after obtaining essential oils.

2. Planning (methodology) of research

Analysis of scientific publications indicates that research on the chemical composition of *R.×damascena* medicinal plant material (MPM) is mainly devoted to studying volatile compounds. The polysaccharides of *R.×damascena* raw material have not been studied enough; although they also determine the pharmacological activity, they can be markers for its standardization. The information in scientific and regulatory sources does not have a single phase of *R.×damascena* MPM collection and drying requirements. *R.×damascena* needs Quality Control Methods (QCM) for each type of MPM to use in medicine and pharmacy.

Buds and flower petals require an in-depth phytochemical study of carbohydrates. The study includes the following steps shown in Fig. 1.

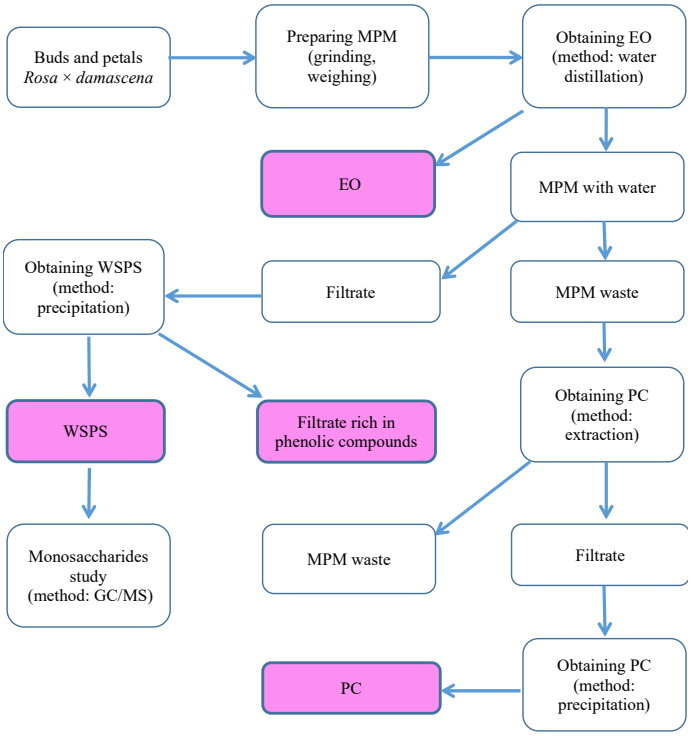

Fig. 1. Scheme of research of *R. ×damascena*

3. Materials and methods

Between late April and May 2020, *R.×damascena* flower buds and petals were manually collected in Amman, Jordan. Petals were gathered during flowering, while buds were harvested before flowering (budding stage). Under the direction of DrBiolSc, Professor Minarchenko V. M. (M. G. Kholodny Institute of Botany, Kyiv, Ukraine), plant material verification was carried out (verification voucher RD/DPB 2020/05/12). The MPM samples were ground (3.5 mm sieve size) after being air-shadow dried.

Determination of essential oils content.

Determination of essential oils content of *Rosa×damascena* dried buds and flower petals was carried out by the method of water distillation (2.8.12), according to the State Pharmacopoeia of Ukraine (SPhU) [12]. The method of quantitative determination of EO according to the SPhU by steam distillation does not aim to obtain high-quality EO or a certain fraction (oleoptene). This method obtains the sum of substances that are distilled with steam at high temperature – the liquid in the flask is heated to boiling, and unless otherwise stated, the distillation rate should be 2–3 ml/min. The SPhU does not have a monograph on the raw material of *R.×damascena*. We considered the ratio used in industry when obtaining rose oil – 500 kg of flowers and 1500 litres of water to obtain the essential oil. Distillation was carried out for 1.5 h [10].

Determination of WSPS *and PC content from R.×damascena buds and flower petals.*

Isolation, purification, and analysis of polysaccharides were performed by the fractionation method [13]. After collecting essential oils, the water extract was filtered. The extraction process was then repeated using purified water for two hours at a consistent temperature of 90 to 100 °C and a plant raw material to extract ratio of 1:20. The filtrates were mixed and evaporated to the lowest volume while under vacuum. A five-fold amount of 96 % ethanol was used to precipitate WSPS. The precipitate was dried to constant weight in a drying cabinet at 95–100 °C after being filtered and repeatedly rinsed with hot 96 % ethanol and acetone. After extraction, the plant material was dried.

PC were extracted from the input material using WSPS extraction. A heated mixture containing a 1:1 ratio of 0.5 % oxalic acid solution and 0.5 % ammonium oxalate solution was used for extraction. Two extractions were carried out using a 1:20 ratio of raw plant material to extract at a steady temperature of between 30 and 35 °C for two hours while stirring continuously. After being isolated from the original material, the extracts were mixed, concentrated, and precipitated using five times the volume of 96 % ethanol. The precipitate of PC was produced, filtered, and then dried to constant weight in a drying cabinet using hot 96 % ethanol and acetone in succession. After extraction, the plant material was dried. Five determinations were used in each analysis.

Determination of monosaccharides in WSPS from buds and flower petals of R.×damascena by GC/MS.

The method is based on the extraction of free monosaccharides and complete acid hydrolysis of raw materials to determine the total monosaccharide composition and to obtain acetates of their aldonitrile derivatives, followed by analysis by gas-liquid chromato-mass spectrometry (GC/MS) [14, 15].

Free monosaccharides preparation.

WSPS was ground to a powder state in a glass mortar. A portion of the powder (1.0 g) was placed in a vial, and 10 ml of 80 % ethanol solution was added. Extraction of the free monosaccharides was performed on an ultrasonic bath at 80 °C for 4 h. The extract was taken, evaporated to dryness, and resuspended by adding an aqueous solution of the internal standard – sorbitol – at a rate of 250 μg per sample.

Obtaining total monosaccharide composition.

A portion of the WSPS powder (1.0 g) was added to 2 ml of 2M trifluoroacetic acid. Hydrolysis was performed at 100 °C for 6 h. 2 ml of the hydrolyzate was collected, evaporated and washed with water to remove trifluoroacetic acid. It was resuspended by adding an aqueous solution of the internal standard – sorbitol – at the rate of 250 μg per sample.

Getting aldonitrile derivatives.

To obtain aldonitrile derivatives of monosaccharide extract, the hydrolyzate was evaporated to dryness on a rotary evaporator, and 0.3 ml of derivatizing reagent (32 mg/ml hydroxylamine hydrochloric acid in a mixture of pyridine/methanol (4: 1 v/v)) was added. The dissolved extract was kept for 25 min at 75 °C. Acetylation of aldonitrile derivatives of monosaccharides was performed for 15 min at 75 °C. To the reaction mixture, 1 ml of dichloroethane was added, and the excess derivatization reagents were removed by double extraction with 1N hydrochloric acid and water. The dichloroethane layer was dried to dryness and dissolved in 300 μl of heptane/ethyl acetate (1:1 v/v).

Chromatographic separation.

Agilent 6890N/5973 inert gas chromato-mass spectrometric system (Agilent technologies, USA) was used for the chromatographic separation. HP-5ms capillary column (30 m×0.25 mm×0.25 μm, Agilent Technologies, USA). The temperature was 250 °C for the evaporator and 280 °C for the interface. The separation was carried out in the temperature programming mode, whereby a gradient of 5 °C per minute was used to raise the starting temperature from 160 °C to 240 °C for 8 minutes. For six minutes, the ultimate temperature was kept constant. In a 1:50 flow divider mode, 1 μl of the sample was given.

Detection.

Detection was performed by Agilent 6890N/5973 inert gas chromato-mass spectrometric system (Agilent technologies, USA) in SCAN mode in the range (38–400 m/z). The carrier gas flow rate through the column was 1.2 ml/min. The identification was performed by the retention time of the monosaccharide standards

arabinose, fucose, mannose, glucose, galactose, inositol, rhamnose, the disaccharide standard sucrose and using the NIST 02 mass spectrum library. Quantitative analysis was performed by adding a solution of the internal standard (sorbitol) to the test samples and with calibration curves of monosaccharide standards. Quantification was performed with MS detection in scan mode (electron impact ionization with single quadrupole detection). The results were the mean±SD of three parallel measurements.

Statistical analysis.

Statistical processing of the obtained results was carried out by the method of least squares in accordance with the monograph of the SPhU "5. 3. N. 1. Statistical analysis of the results of a chemical experiment" [16].

Identification of BAS in filtrate after obtaining WSPS from buds and flower petals of R.×damascena by chemical reactions. Identification of BAS in filtrate received after WSPS precipitation from buds and flower petals of *R.×damascena* was conducted by chemical reactions [17–22].

Reaction with 10 % sodium hydroxide solution. 1.0 ml of obtained extract was placed in a test tube, 2 drops of 10 % sodium hydroxide alcohol solution was added to the test tube.

Reaction with iron (III) chloride solution. 1.0 ml of obtained extract was placed in a test tube, 2 drops of iron (III) chloride were added to the test tube.

Reaction with 2 % aluminium chloride alcohol solution. 1.0 ml of obtained extract was placed in a test tube, 2 drops of 2 % aluminium chloride alcohol solution was added to the test tube.

Bryant's modification of cyanidin formation test. 1.0 ml of obtained extract was placed in a test tube; 5 drops of hydrochloric acid and powder of metallic magnesium were added to the test tube. Colouring appeared. To the coloured product from the reaction of cyanidin formation, 1/3 parts on the volume of butanol were added, and diluted by water to get 2 layers; with shaking, we noted passing of pigments to the water or organic layers.

Reaction with vanillin in concentrated hydrochloric acid: 1.0 ml of obtained extract was placed in a test tube, and few drops of 1 % solution of vanillin in concentrated hydrochloric acid were added.

Reaction with gelatin. 2.0 ml of obtained extract were placed in a test tube, 1 % gelatin solution was added to the test tube by drops. If cloudiness formed, excess gelatin solution was added.

Reaction with alkaloids. 2.0 ml of obtained extract was placed in a test tube, and 1 % quinine chloride solution was added to the test tube by drops.

Reaction with iron ammonium alum solution. 2.0 ml of obtained extract were placed in a test tube; 4 drops of iron ammonium alum solution were added to the test tube.

Reaction with $NaNO_2$. 2 ml of obtained extract was placed in each of 2 test tubes; a few drops of $NaNO_2$ and hydrochloric acid were added to test tube #1 and few drops of $NaNO_2$ and acetic acid were added to test tube #2.

Foam test: 2.0 ml of obtained extract was placed in a test tube, vigorously shaken for 1 min.

Reaction with 1 % cholesterol alcoholic solution: 2.0 ml of obtained extracts were placed in a test tube; 1.0 ml of 1 % cholesterol alcoholic solution was added.

4. Results

Determination of essential oils content.

The hydrodistillation technique was used to determine the EO of *R.×damascena* buds and flower petals. Rose oil is a transparent, oily liquid or a heterogeneous mass that has a distinct aroma and a colour ranging from light yellow to yellow. The findings indicated that the EO concentration in buds is approximately 0.033±0.005 % and that in flower petals, it is 0.015±0.002 %.

Determination of water-soluble polysaccharides and pectins content from R.×damascena buds and flower petals.

The data presented in Table 1 show that the total WSPS content was almost the same in buds and in flower petals. Furthermore, the content of PC was twice as high in flower petals compared to buds.

Table 1

The content of polysaccharide fractions in MPM of *R.×damascena,* per dry weight

Compounds/MPM	Buds, %	Flower petals, %
WSPS	10.33±0.31	9.69±0.25
PC	4.35±0.14	7.88±0.15

Determination of monosaccharides in water-soluble polysaccharides from buds and flower petals of R.×damascena by GC/MS.

The results of identifying monosaccharides by GC/MS are shown in Table 2. The results showed that different polysaccharides, such as bound and free sugars, are present in *R.×damascena* MPM. Also, the percentage of each of them varies in buds and petals.

Free sugars of WSPS in *R.×damascena* buds and flower petals are present in small amounts. Fucose, glucose, galactose inositol, and sucrose are present in both MPMs. Mannose and galactose were identified only for buds as free sugars (Table 2).

After hydrolysis by GC/MS method, the presence of arabinose, fucose, glucose, galactose and inositol has been confirmed for *R.×damascena* buds and flower petals. Mannose was identified only for buds after hydrolysis. (Table 2). Arabinose was found in small amounts in bud and flower petals. Fucose, glucose and galactose are found in higher amounts in buds. Glucose, galactose, and inositol prevail in flower petals.

The total amount of free sugars in the buds and flower petals of *R.×damascena* is 7.19 mg/g and 3.35 mg/g, respectively. The total amount of free and bound sugars in the buds and flower petals of *R.×damascena* is 43.14 mg/g and 37.12 mg/g.

Table 2

The content of Free and Bound Sugars in WSPS from MPM of *R.×damascena*

Standard	RT		Library ID	Content, mg/g			
				Free sugars		Free and bound sugars	
	Buds	Flower petals		Buds	Flower petals	Buds	Flower petals
1	2		3	4			
Arabinose	8.61	8.46	1,3-Propanediol,2-hydroxymethyl-2--nitro-, triacetate	–	–	3.15±0.094	2.07±0.041
Fucose	9.05	9.05	D-Arabinononitrile, 2,3,4,5-tetraacetate	0.13±0.002	0.32±0.009	11.77±0.470	5.12±0.153
Mannose	15.25	15.33	2,3,4,5,6-Penta-O-acetyl-D-manonitrile	0.42±0.008	–	1.33±0.066	–
Glucose	15.57	15.46	2,3,4,5,6-Penta-O-acetyl-D-gluconitrile	3.42±0.010	1.89±0.075	10.92±0.436	12.18±0.487
Galactose	16.70	15.90	2,3,4,5,6-Penta-O-acetyl-D-galactonitrile	0.30±0.006	–	10.31±0.206	10.51±0.420
Inositol	18.40	18.32	Inositol	1.45±0.029	0.70±0.028	1.99±0.099	7.24±0.289
Sorbitol	18.82	18.77	Sorbitol	Inner. Stan.	Inner. Stan.	Inner. Stan.	Inner. Stan.
Sucrose	34.11	34.03	Sucrose Octaacetate	0.96±0.028	0.35±0.007	–	–
Σ free sugars				7.19	3.35	–	–
Σ free and bound sugars				–	–	43.14	37.12

Identification of BAS in filtrate after obtaining WSPS from buds and flower petals of R.×damascena by chemical reactions.

The results of chemical reactions are presented in Table 3.

Table 3

The results of Identification of BAS in filtrate after obtaining WSPS from buds and flower petals of *R.×damascena* by chemical reactions

No.	Reaction/reagent	Observation of colour in MRM filtrate		Identified BAS group
		Buds	Flower petals	
1	With 10 % sodium hydroxide solution	Yellow		Phenolic compounds
2	With iron (III) chloride solution	Blue-black	Green-black	
3	Bryant's modification of cyanidin formation test	Pink colour, at the same time, in the water layer the colour was brighter		Flavonoids and glycosides are prevalent
4	With 2 % aluminium chloride alcohol solution	Yellow (lemon)		Flavonoids
5	With vanillin in concentrated hydrochloric acid	Cherry-red		
6	With gelatin	Yellow precipitate formation		Tannins
7	With alkaloids	Light brown flocculent sediment		
8	With iron ammonium alum solution	Blue-black	Green-black	Tannins: in buds – hydrolyzable; in flower petals – condensed
9	With $NaNO_2$	Cherry red colouring using hydrochloric and acetic acids		Free and bound ellagic acid
10	Foam test	Formation of a thin layer of foam appears		Saponins
11	With 1 % cholesterol alcoholic solution	Formation of a light-coloured precipitate		

5. Discussions

We obtained WSPS, extract rich in phenolics, and PC from *R.×damascena* dried buds and flower petals, which have been used for extracting EO. After obtaining EO by hydrodistillation method, the MPM could just be thrown out as waste. The water extract remaining after obtaining EO by the hydrodistillation method can be used to further obtain WSPS by precipitation with ethanol. After filtration of the precipitate, we obtained WSPS and alcohol filtrate, which contains phenolic compounds and saponins, which are proved by the study of chemical reactions. Further studies indicate that the raw material can be used to obtain PC as well. Furthermore, the PC content in flower petals exceeds that in buds by twice.

According to the previous studies [11] of *R.×damascena* buds and flower petals by microchemical reactions and swelling index, the existence of pectins was revealed, the swelling index of buds was 5, for flower petals it was 15. Additionally, a swelling index supported by the results of PC content in buds (4.35±0.14 %) and flower petals (7.88±0.15 %)

The study of the monomer composition of WSPS from buds and flower petals by GC/MS method after hydrolysis indicates some similarities and differences; it could help to pro-

pose the composition of WSPS and its pharmacological action. Glucose and galactose are the main compounds in WSPS from *R.×damascena* buds and flower petals. arabinose was found in both WSPS only after 10.92±0.436 (buds – 3.15±0.094 mg/g, flower petals – 2.07±0.041 mg/g). Mannose is present only in WSPS from *R.×damascena* buds in a free (0.42±0.008 mg/g) and bound form (1.33±0.066 mg/g) and only in small amounts. Mannose has an anti-adhesive effect on causative agents of infection diseases of the urinary tract [23]. In WSPS from flower petals mannose is not found. Glucose is present in a higher amount. There are 10.92±0.436 mg/g in buds and 12.18±0.487 mg/g in flower petals after hydrolysis. Galactose was found after hydrolysis in *R.×damascena* buds (10.31±0.206 mg/g) and flower petals (10.51±0.420 mg/g) WSPS and as free sugar in trace amount in WSPS from buds. Inositol was found in free and bound forms; in flower petals, the amount increases significantly after hydrolysis (7.24±0.289 mg/g). Inositol is a sugar with several important functions, involved in several biochemical and metabolic functions of human organisms such as cellular growth, membrane biogenesis, signal transmission of hormones and neurotransmitters, etc. Several studies show the therapeutic efficacy of inositol in polycystic ovary syndrome treatment and support both female and male reproduction [24]. Sucrose was found in both WSPS from *R.×damascena* MPM as a free sugar (buds – 0.96±0.028 mg/g, flower petals – 0.35±0.007 mg/g). The results do not indicate the presence of fructose. The methodology chosen for the study of raw material monosaccharides has a drawback because ketoses give two peaks before hydrolysis and cannot react after derivatization [14].

Practical relevance. Dried flower petals or buds of *R.×damascena* can be used as a source of polysaccharides – WSPS and PC. It can find the application for the wastes after obtaining EO for dried raw materials and for the flower petals when distilleries can no longer accept the whole produced raw materials anymore.

The data we obtained can be used to estimate the content of substances that are distilled by water vapour in accordance with the requirements of the SPhU and for the development of QCMs.

Study limitations. The method chosen for the study of raw material monosaccharides involves the derivatization of carbohydrates with the formation of their aldonitrile acetates, but during sample preparation after hydrolysis, ketoses cannot react, which is the main drawback of this method and does not provide a full understanding of the composition of glycosides, polysaccharides.

Prospects for further research. Further research can be directed to the study of the pharmacological activity of obtained polysaccharides.

6. Conclusions

1. The waste-free recycling potential of *R.×damascena* buds and flower petals indicates that the EO concentration in buds is approximately 0.033 % and that in flower petals it is 0.015 %; the total WSPS content was 10.33±0.31 % in buds and 9.69±0.25 % in flower petals; the content of PC was quite high: in buds – 4.35±0.14 % and in flower petals 7.88±0.15 %. We can suppose that WSPS and PC are responsible for the high swelling index.

2. The study of *R.×damascena* buds and flower petals filtrate obtained after WSPS precipitation by chemical reactions shows the presence of flavonoids, tannins, and saponins.

3. The study of buds and flower petals WSPS by GC/MS indicated the differences in monosaccharides qualitative and quantitative content. Glusoce and galactose prevail in both.

4. It could be proposed to obtain WSPS, extract rich in phenolics and saponins, and PC after extracting essential oils from *R.×damascena* buds and flower petals by the hydrodistillation method. We can also predict the prospect of research on filtrates after obtaining WSPS from buds and flower petals of *R.×damascena*.

Conflict of interest

The authors declare that they have no conflict of interest in relation to this research, including financial, personal, authorship or other nature, which could affect the research and its results presented in this article.

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Availability of data

The manuscript has no associated data.

Use of artificial intelligence

The authors confirm that they did not use artificial intelligence technologies when creating the current work.

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