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Development of a waste-free technology for comprehensive processing of *Cornus mas* (dogwood) fruits: Production of natural viscous extract and medical suppositories with potential anti-hemorrhoidal activity

Slavik Dadayan[1], Artavazd Poghosyan[1], Lilit Arstamyan[1], Ani Chakhoyan[2], Gohar Mkrtchyan[2], Anahit Hovhannisyan[2], Narine Hovhannisyan[3], Ani Dadayan[1,2].

[1]Scientific and Production Center (SPC) "Armbiotechnology," National Academy of Sciences of the Republic of Armenia Yerevan, Armenia; [2]Yerevan State University, Institute of Pharmacy, 0025 Yerevan, Armenia; [3]Armenian National Agrarian University, Scientific and Research Institute of Biotechnology and Nutrition, 0009 Yerevan, Armenia.

***Corresponding Author**: Ani Dadayan[2], Yerevan State University, Institute of Pharmacy, 1 Alex Manoogian, 0025 Yerevan, Armenia

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ABSTRACT

Background: Cornus mas (dogwood) is well known for its anti-inflammatory and analgesic properties, making it a promising candidate for hemorrhoid treatment. Traditional medicine recommends consuming dogwood with seeds due to their oil content, which provides lubrication and alleviates symptoms such as pain, itching, and bleeding. Scientific medicine shows particular interest in ripe fruits and dogwood seeds for their ability to strengthen local immunity and aid in treating early-stage hemorrhoids. This growing interest has increased demand for multifunctional products such as biologically enriched nutraceuticals that combine therapeutic and preventive effects, necessitating precise qualitative and quantitative enrichment with bioactive compounds.

Objective: The development of an advanced technology designed to fulfill the criteria for the isolation and preservation of biologically active substances in their native form, as well as for the production of medicinal formulations based on them, remains relevant. Highly efficient methods for isolating fatty acids and anthocyanins without changing native structures and with high chemical yields (≥ 90%) and purified from mineral salts will be developed. Optimal conditions for obtaining medical suppositories based on isolated native BAS will be selected.

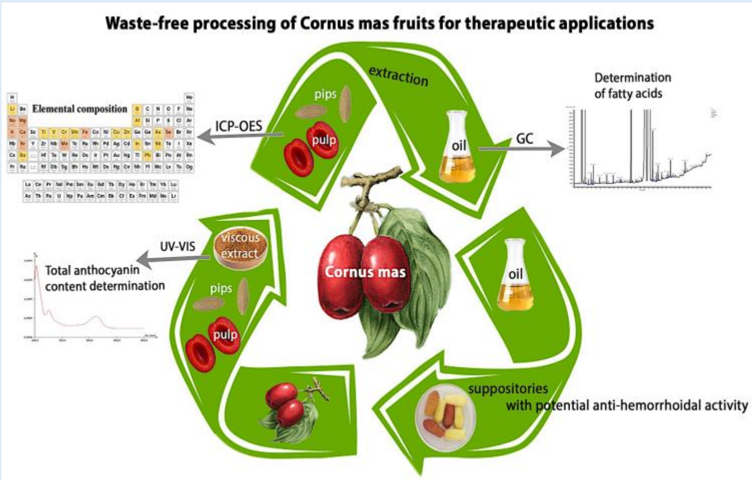
Methods: The qualitative and quantitative determination of fatty acid composition via gas chromatography was conducted. The elemental analysis of the seeds and pulp was performed using an inductively coupled plasma optical emission spectrometer (Agilent 5800 VDV ICP-OES) and the total anthocyanins content in the viscous extract was estimated by spectrophotometric method. The production of medicinal suppositories was carried out using the fusion-molding method.

Results: A waste-free technology for complex utilization of dogwood fruits has been formulated, allowing the production of natural dogwood viscous extract, as well as mixtures of anthocyanins and fatty acids from primary production meals (pits and peel of pulp). Using fatty acid mixture, laboratory samples of medical suppositories with potential antihemorrhoidal activity have been obtained.

Novelty: The novelty of this study lies in the development of a method that preserves the integrity of bioactive compounds (BACs) and enables their use in medicinal products, particularly in suppositories with potential antimicrobial and antihemorrhoidal effects.

Conclusion: The development of a waste-free technology for the comprehensive processing of *Cornus mas* fruits presents a promising, eco-friendly alternative to conventional synthetic methods for producing agents with potential antimicrobial and antihemorrhoidal activity. This natural-based approach not only reduces environmental impact and production costs but also offers considerable social benefits by providing sustainable and accessible medicines.

Keywords: *Cornus mas*, anthocyanins, fatty acids, hemorrhoidal disease, natural extracts, bioactive compounds, functional foods, therapeutic potential.



Graphical Abstract: Development of a waste-free technology for comprehensive processing of *Cornus mas* (dogwood) fruits: Production of natural viscous extract and medical suppositories with potential anti-hemorrhoidal activity

INTRODUCTION

The application of herbal medicine spans centuries and has played a significant role in managing various health conditions. Medicinal plants have been integral to the development of traditional medical systems over time. [1]. Today, their use goes beyond such practices.

The pharmaceutical and biotechnology industries incorporate plant-derived compounds in the development of new drugs and therapeutic approaches. Additionally, medicinal plants hold a significant function within the emerging area of complementary and alternative medicine, where they are used as supplements or alternatives to conventional treatments. [1,2].

The advancement of phytotherapy, aromatherapy, and the expanding market for plant-based dietary supplements all indicate a significant shift in public perception, with more people turning to natural remedies for health and wellness. In this context, functional foods containing biologically active compounds are gaining increasing recognition. [3-5].

Among naturally reproducing species that have both nutritional and medicinal value, the cornelian cherry stands out, traditionally considered a symbol of endurance and prosperity. The flora of Armenia is rich in medicinal plants, particularly cornelian cherry, which is used in both cooking and pharmaceuticals [6,7].

Dogwood fruits are rich in biologically active substances, such us phenolic constituents and vitamins with diverse pharmacological properties, attracting growing scientific interest [7].

Extracts and biologically active substances obtained from cornelian cherry exhibit antioxidant, antimicrobial, tonic, and anti-inflammatory effects, and recent studies confirm their effectiveness in modulating key enzymes involved in metabolic and inflammatory disorders [8–10]. Considering the antioxidant and antimicrobial potential of Cornus mas, its use in phytopharmacy is increasingly recognized [10–14].

Hemorrhoidal illness is characterized by rectal bleeding, swelling, discomfort, microbial invasion, and tissue prolapse. There is no universally accepted gold standard among existing therapeutic approaches; treatment methods are selected depending on the severity of the disease. [15,16].

Given the potential adverse effects, drug interactions, and substantial costs associated with synthetic pharmacotherapies, there is a growing interest in phytotherapeutic agents [17]. Clinical guidelines increasingly recommend natural therapies such as dietary fibers and flavonoids for symptom relief [18,19]. Traditional Iranian medicine and Chinese medicine have long applied plants for hemorrhoid management [20,21].

Collectively, these examples underscore the therapeutic potential of natural compounds in the management of hemorrhoidal disease.

Researchers from the Pyatigorsk State Pharmaceutical Academy in Russia have developed a method for producing an ointment exhibiting anti-inflammatory and antimicrobial activities. The method involves extraction of crushed cornelian cherry seeds with chloroform for a specified duration, followed by solvent removal and isolation of the lipophilic fraction.

However, the existing method for producing cornelian cherry-based ointments is technically complex and may degrade biologically active substances, limiting its practical application [22].

Therefore, there is a need for a technology that allows efficient extraction of biologically active compounds (BACs), preserves their natural composition, and incorporates them into pharmaceutical formulations. The novelty of this research lies in the development of a method that maintains BAC integrity and enables their use in medicinal products. The aim of this work is to establish a process for *Cornus mas* fruits to obtain juice rich in anthocyanins and vitamins, as well as seed oil, which can serve as bioactive substances for the production of dosage forms, particularly suppositories with potential antimicrobial and anti-hemorrhoidal activity.

MATERIALS AND METHODS

Plant materials: Primary Processing of Cornelian Cherry Fruits: Naturally grown Cornelian cherry fruits (Cornus mas L.), gathered in 2024 from the foothills of Alaverdi, Armenia, were selected as the study material. Initially, 3 kg of accurately weighed fresh Cornelian cherry fruits were thoroughly washed in a sanitized production area. The seeds were then mechanically separated from the pulp by pressing, and the residual pulp was removed by rinsing with running water [22]. The raw seeds were initially dried at room temperature, followed by drying in a drying oven at a temperature not exceeding 70 °C for 4 hours. The pulp samples were dried using the same method.

Grinding of Dogwood Pips and Dried Pulp to a Particle Size of 0.2–0.3 mm: Dried dogwood pips (0.8 kg) and pulp (1.4 kg) were ground using a laboratory grinder until the particles passed through a sieve with 0.3 mm diameter openings, achieving a final particle size of 0.2–0.3 mm.

Extraction of Fatty Acid Mixture from the dogwood pips and dried pulp: For this purpose, 0.2 kg of dogwood pips and dried pulp were placed into a 3-liter Erlenmeyer flask equipped with a reversed cooler and a magnetic stirrer. Then, 1.6 L of freshly distilled hexane was introduced, followed by intensive stirring of the mixture at 60 °C over a period of 16 hours. To purify the fatty acid mixture from dogwood seed meal, the obtained mixture was filtered twice through a paper filter and hexane was removed on a rotary evaporator in shad mode.

The resulting dogwood oil sample was stored for 24 hours in a refrigerator and subsequently filtered again through paper filters. Highly purified oils with a yellowish and bright red tint were obtained. The yield of the light-yellow and bright red oils amounted to 9 g (4.5%) and 10.4 g (5.2%), respectively [22].

Preparation of a concentrated extract rich in anthocyanins: To extract the anthocyanin mixture, 1.6 L of absolute ethanol (98%) was introduced into the cornelian cherry pomace, followed by continuous stirring at 60 °C over a 16-hour period. The resulting burgundy anthocyanin solution was then separated from the insoluble residue, and the solvent mixture was removed under mild conditions using a Rotavapor R-210 rotary evaporator. This process yielded a highly viscous burgundy liquid - a concentrated extract [23, 24]. The extract yield was 48.0 g (24%).

Assessment of Total Anthocyanin Concentration in the Viscous Extract from Common Dogwood [23]: Approximately 1 g of the viscous extract was transferred into a 100 mL conical flask with a side arm. Then, 50 mL of 60% ethanol containing 1% hydrochloric acid was added. The flask was sealed with a stopper and weighed on an electronic balance with an accuracy of ± 0.001 g. Subsequently, the flask was connected to a reflux condenser and heated in a boiling water bath for 90 minutes.

Then, the flask was allowed to cool to room temperature for 30 minutes, resealed with the original stopper, weighed once more, and the lost volume of extractant was compensated with 70% ethanol containing 1% hydrochloric acid. The extract was subsequently filtered through a paper filter. 1 mL of the resulting extract was transferred into a 25 mL volumetric flask and diluted to the mark with 1% hydrochloric acid in 95% ethanol. The optical density was determined using a cuvette with a layer thickness of 1 cm at a wavelength of 546 nm. A 95% ethanol alcohol solution served as the reference. The total anthocyanin content in the viscous extract of common dogwood, expressed as a percentage (X) relative to absolutely dry raw material and calculated as cyanidin-3-O-glycoside, was determined using the following formula:

$$X = \frac{A \times 25 \times 50 \times 100}{\mathrm{m} \times 1 \times 100 \times (100 - \mathrm{w})}$$

where *A* is the optical density of the test solution; *m* is the mass of raw material, *g*; *W* is the weight loss on drying in percent; 100 is the specific absorption rate of cyanidin-3-O-glucoside [23].

Determination of Fatty Acids (FA) by GC: In GC experiments with the studied oils from dogwood seeds and pulp, a Thermo Scientific TRACE 1300 gas chromatograph (USA) with a flame ionization detector (FID) was used [22]. To separate the components, a Thermo Scientific TR 5MS column with dimensions of 30 m 0.25 mm (inner diameter), 0.25 m (film thickness) was used. N2 was used as carrier gas at a flow rate of 1.2 mL/min in constant flow mode. A sample volume of 2 µL was injected in "splitless" mode. The injection port was set to 270 °C, and the oven temperature was initially set to 40 °C for 1 min. The oven temperature was increased to 70 °C at a rate of 5 °C/min for 5 min, to 140 °C at 5 °C/min for 5 min, to 200 °C at 5 °C/min for 5 min, to 250 °C at 5 °C/min for 5 min, and finally to 270 °C at a rate of 5 °C/min for 5 min. The maximum oven temperature was set to 270 °C.

Preliminary Treatment of Extracted Oil Samples: For sample preparation, 10 µL of each oil was dissolved in 1 mL of a methanol/water mixture (4:1, v/v), stored at 4 °C, and utilized as required.

Preparation of Reference Standards: To prepare standard solutions for analysis, 10 µg of each ester—derived from myristic, palmitic, linoleic, oleic, and stearic acids, as well as a tocopherol mixture—was accurately weighed and dissolved in 50 mL of a methanol/water solvent system (4:1, v/v) [22, 25].

Determination of organoleptic and basic physicochemical properties of the extracted lipophilic compounds from the pips and pulp of common cornelian cherry (*Cornus mas*): The organoleptic properties of the extracted lipophilic compounds from the studied Cornelian cherry seeds, as well as their basic physicochemical properties, were determined according to the following methods [26-30].

Elemental Composition Analysis of Common Dogwood (*Cornus mas*) Pip and Pulp Samples: Quantitative elemental analysis of the samples was conducted using an inductively coupled plasma optical emission spectrometer (ICP-OES, Agilent 5800 VDV) [31-33].

Spectrometry was performed in the analytical testing laboratory of the Educational Center for Drug Quality Control and Monitoring of Yerevan State University. The equipment, reagents, and standards used are listed in Table 1.

Table 1. Equipment, reagents, standards

Equipment	
ICP-OES	Agilent 5800 VDV
Microwave Digestion System	Anton Paar, Microwave Digestion System: Multiwave GO Plus
Analytical balance	Shimadzu AP225W
Mixer	Vortex Stuart, BioCote, UK
Reagent	
69% HNO_3	Carlo Erba
Deionized water	Milli-Q quality, Millipore
Standard	
Multielement standard for ICP OES № 504311 (500 ml Plastic bottle 33 elements: Al, Ag, As, B, Ba, Be, Bi, Ca, Cd, Co, Cs, Cr, Cu, Fe, In, K, Li, Mg, Mn, Mo, Na, Ni, Nb, Pb, Rb, Sb, Se, Sr, Ti, Tl, U, V, Zn 100ppm each - Matrix: Nitric acid (5%))	CARLO ERBA Reagents

Preparation of Samples: Samples were prepared through mineralization using a Multiwave GO Plus microwave oven.

Each sample was weighed into microwave reaction tubes using an analytical balance and 10 ml of concentrated HNO_3 (69%) was added to each. The reaction tubes were hermetically sealed, then placed in the oven rotor according to the loading program, the rotor was placed in the oven, closed with a lid, and the appropriate parameters for mineralization were given: heating to 180 ^{o}C for 10 minutes and holding at that temperature for 10 minutes.

Table 2. Microwave digestion parameters

Ramp (mm:ss)	Temp. (°C)	Hold (mm:ss)
10:00	180	10:00

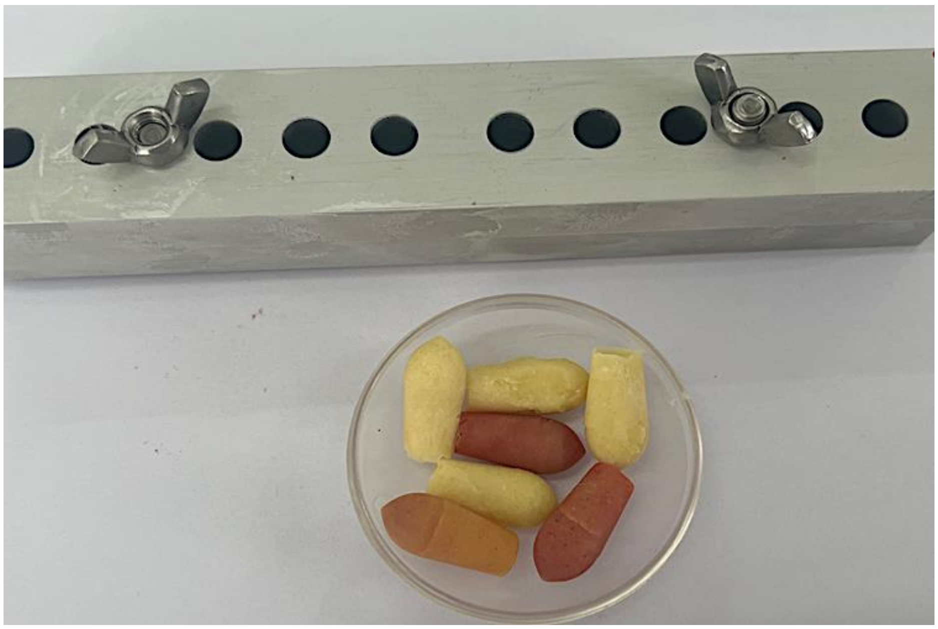
The mineralization of the samples was successful, the resulting clear, transparent solutions were transferred from the reaction tubes (washed with deionized water) into volumetric flasks, the volume was brought to 50 ml with deionized water and mixed with a Vortex mixer.

Measurements of elemental content in the samples was conducted using an inductively coupled plasma optical emission spectrometer, with the parameters presented in Table 3. [31, 32].

Table 3. 5800 VDV ICP-OES instrument and method parameters

Parameters	Adjustments
RF Power	1.2 KW
Pump Speed	12 rpm
Nebulizer Flow	0.7 L/min
Plasma Flow	12 L/min
Aux Flow	1 L/min
Spray Chamber	Borosilicate glass cyclonic double pass
Viewing Mode	Radial
Correlation Coefficient	0.999
Replicate Count	3
Sample Uptake Time	25 s
Rinse Time	30 s
Stabilization Time	15 s
Read time	5 s

Formulation of medicinal suppositories containing oils from cornelian pulp with potential anti-hemorrhoidal activity: Suppositories incorporating oils derived from the seeds and pulp of *Cornus mas* (dogwood) fruits were formulated using the fusion method [34]. In separate vessels, pre-weighed portions of a melted hydrophobic base (cocoa butter) were combined with oil from dogwood pips and pulp under continuous stirring using a magnetic stirrer. To prevent the formation of eutectic mixtures, paraffin was added to the total mass at a concentration of 0.1 gram per suppository. The homogeneous mixture was dispensed into metal molds using a syringe. Prior to filling, the molds were treated with ethanol to facilitate demolding. Throughout the process, constant temperature and continuous stirring were maintained to prevent sedimentation and ensure uniform distribution of the oils within each dosage unit. After solidifying at room temperature, the suppositories were further cooled in a refrigerator for 30 minutes to ensure complete hardening. Due to the favorable contraction properties of the excipients, the suppositories were easily removed from the molds. Uniformity of mass was assessed on ten individual units, each of which was weighed separately. The mean weight and percentage deviation were subsequently calculated. The obtained results complied with the US/FDA requirements [35].



RESULTS AND DISCUSSION

Organoleptic and main physicochemical properties of the studied oils: The results of sensory evaluation and determination of digital quality indicators of oils obtained from Cornelian cherry seeds and pulp are presented in Table 4.

Table 4. Organoleptic and main physicochemical properties of the studied Cornelian cherry oils

Parameter Name	Cornelian Cherry (dogwood) pips oil	Cornelian Cherry (dogwood) pulp oil
Acidic value	12.5707	15. 9410
Peroxide value	47. 3294	46. 6294
Iodine value	90. 2074	88. 6193
Saponification value	194. 93	194. 87
Refractive index	1. 469	1. 475
Total carotenoids	14.84	14.76
Color	Light yellow	Bright red
Taste	Moderately sweet	Sour
Smell	Moderate natural flavor	Moderate natural flavor
Transparency	Transparent, free of sediment	Transparent, free of sediment

Qualitative analysis of fatty acid composition: The qualitative composition of fatty acids in the studied dogwood pip and pulp oil samples is illustrated in Figures 2 and 3. The findings of gas chiral analysis, including Apex retention time (RT), Start RT, End RT, Area, and the quantitative content of FA esters, are summarized in Tables 5 and 6.

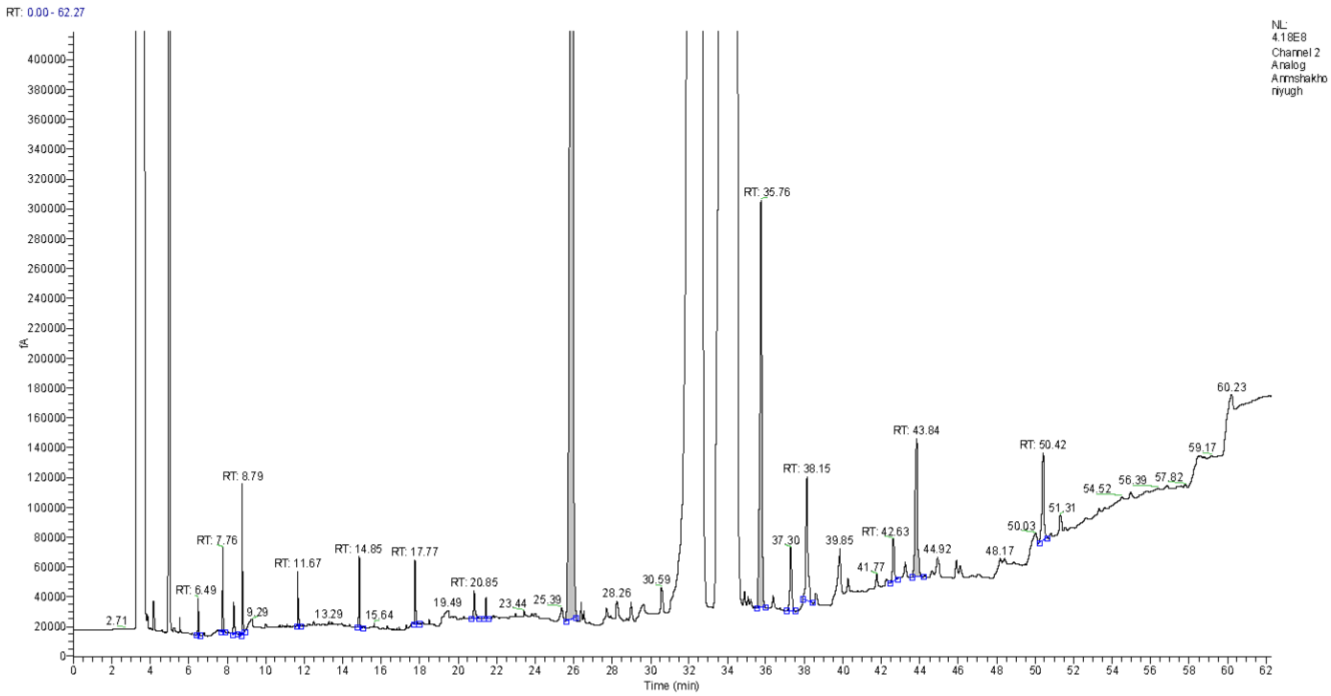


Figure. 2. GC Chromatogram of Dogwood Pip Oil Sample

Table 5. Quantitative content of fatty acids in the studied sample of oil from dogwood pips

Name	Apex RT	Start RT	End RT	Area	%Area	Amount (µg/ml) ±5%
	6.49	6.38	6.62	70908.16	0.46	
	7.76	7.7	7.9	186514.4	1.2	
	8.34	8.29	8.5	64399.81	0.41	
	8.79	8.72	8.92	271450.6	1.75	
	11.67	11.61	11.83	112387.5	0.72	
	14.85	14.78	15.04	136568.6	0.88	
	17.77	17.67	17.95	137748.9	0.89	
	20.85	20.67	21.08	99526.22	0.64	
	21.45	21.34	21.61	49360.06	0.32	
Methyl pentadecanoate (C15:0)	25.99	25.59	26.14	10023826	64.58	6,559
Methyl linoleate (C18:2)	35.76	35.53	35.98	1982432	12.77	4,362
Methyl arachidiate (C20:0)	37.3	37.08	37.49	278546.6	1.79	497
	38.15	37.93	38.39	645167.8	4.16	
	42.63	42.43	42.87	198582.4	1.28	
Methyl behenate (C22:0)	43.84	43.57	44.18	796815.9	5.13	1,029
Methyl cis-13, 16- docosadienoate (C22:2)	50.42	50.19	50.62	466133.3	3	107

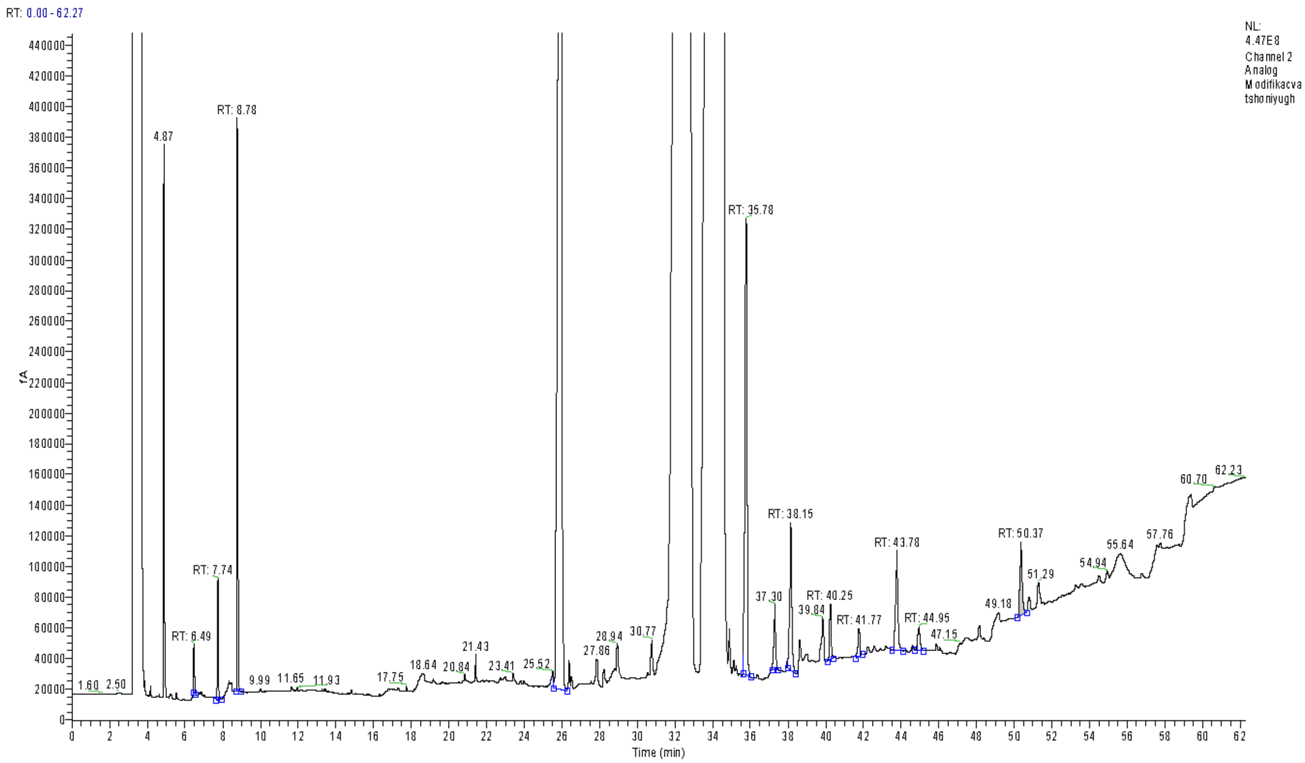


Figure. 3. GC Chromatogram of Dogwood Pulp Oil Sample

Table 6. Quantitative Composition of Fatty Acids in Dogwood Pulp Oil

Name	Apex RT	Start RT	End RT	Area	%Area	Amount(µg/ml) ±5%
	6.49	6.44	6.56	76395.2	0.43	
	7.74	7.66	7.92	287464	1.61	
Methyl hexanoate (C6:0)	8.78	8.68	8.94	1034584	5.79	105090.1
	26	25.56	26.28	11847758	66.28	
Methyl linoleate (C18:2)	35.78	35.62	36.01	2140558	11.98	4709.546
Methyl arachidiate (C20:0)	37.3	37.13	37.47	272600.5	1.53	486.4552
Methyl-gamma-linolenate (C18:3)	38.15	37.96	38.4	765045.1	4.28	1277811
	40.25	40.09	40.42	238469	1.33	
	41.77	41.6	41.95	145438.8	0.81	
Methyl behenate (C22:0)	43.78	43.5	44.08	524567.6	2.93	6771829
	44.95	44.73	45.16	139850.1	0.78	
Methyl cis-13, 16- docosadienoate (C22:2)	50.37	50.15	50.65	401653.2	2.25	9241879

As can be seen from Tabs. 5 and 6, both oils from the pips and pulp of the common dogwood contain methyl linoleate (C18:2), methyl arachidate (C20:0), methyl behenate (C22:0) and methyl cis-13, 16-docosadienoate (C22:2) (four identical FAs) in almost equal quantities**.** Only, the amount of methyl behenate (C22:0) in the oil from the kernels is 1.5 times greater than in the oil from the pulp of the dogwood.

The tested oil samples differ in the content of the following fatty acids: the oil from the kernels is rich in methyl pentadecanoate (C15:0), the oil from the pulp is rich in methyl hexanoate (C6:0) and methyl-gamma-linolenate (C18:3).

Oils extracted from cornelian cherry (*Cornus mas*) seeds and pulp, rich in a mixture of fatty acids, were used to produce suppositories with potential anti-hemorrhoidal properties.

Assessment of Total Anthocyanin Content: The quantitative analysis was performed by direct spectrophotometry in an acidic environment, measuring absorbance at a wavelength of 546 nm. (Fig. 4).

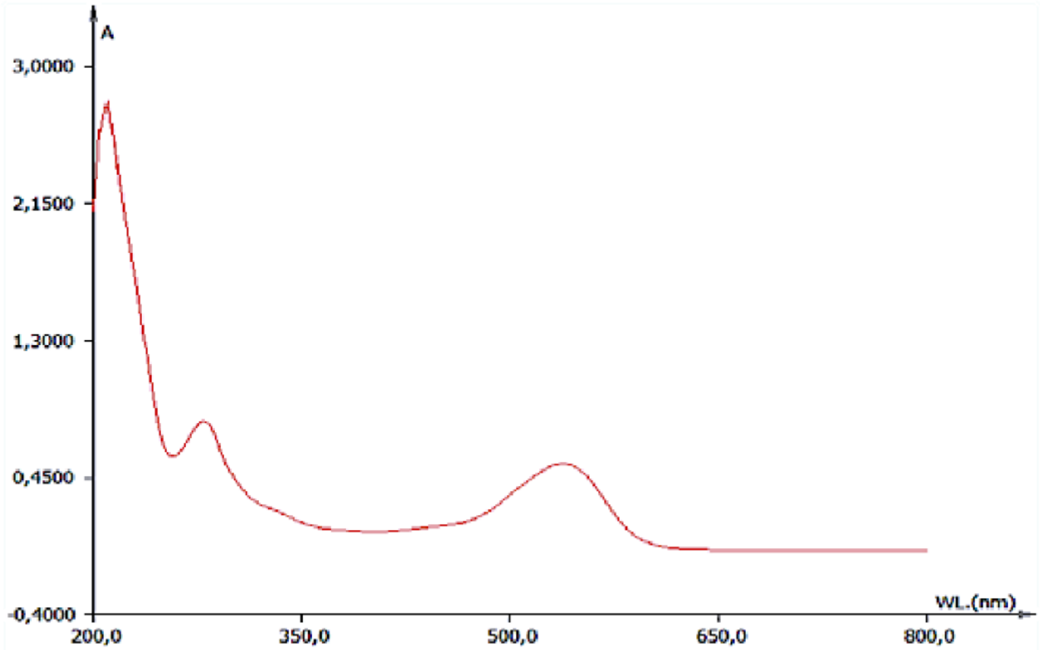


Figure. 4. Spectrum of the total anthocyanins in viscous extract of common dogwood

As a result of determining the total anthocyanin content in the viscous extract obtained from the cornelian cherry pomace, it was found to be rich in anthocyanins (4.25 %), expressed in terms of cyanidin-3-O-glucoside equivalents [23, 24].

Elemental composition of common dogwood pips and pulp: The analysis results of the elemental composition of the examined samples are presented in Table 7 (element concentrations are expressed in ppm (= mg/kg = µg/g = mg/l)). Calibration curves were previously constructed for each element.

Table 7. Quantitative content of elements in samples

Element (nm)	Sample 1 (dogwood pips)	Sample 2 (dogwood pulp)
Al (308.215 nm)	0. 32	2.41
As (188.980 nm)	0.61	0.18
B (249.772 nm)	5.85	6.09
Ba (455.403 nm)	1.65	1.99
Ca (396.847 nm)	3975.42	4893.06
Cd (214.439 nm)	_	-
Co (230.786 nm)	-	-
Cr (284.325 nm)	0.6	0.77
Cu (324.754 nm)	4.06	4.41
Fe (238.204 nm)	35.94	41.07

Element (nm)	Sample 1 (dogwood pips)	Sample 2 (dogwood pulp)
In (410.176 nm)	22.45	10.28
K (766.491 nm)	2386.40	2494.07
Li (670.783 nm)	-	4.01
Mg (279.553 nm)	704.99	700.11
Mn (257.610 nm)	2.74	3.2
Mo (379.825 nm)	20.8	20.75
Na (589.592 nm)	53.49	37.38
Ni (231.604 nm)	-	-
Pb (220.353 nm)	0.16	0.07
Sb (217.582 nm)	10.85	12.14
Se (196.026 nm)	15.57	14.51
Sr (407.771 nm)	18.66	27.38
Ti (334.941 nm)	0.33	0.48
V (309.310 nm)	1.61	1.48
Zn (213.857 nm)	6.78	7.58

The analysis was performed using the ICP-OES methodology described in USP 233.

The analysis of the elemental composition of dogwood pulp and pips revealed the presence of over 20 elements, including both macro- (Fe, Cu, Zn, Ca, Mg, etc.) and microelements (Mn, Co, Cd, V, Se, Cr, As, Pb, etc.) The ICP-OES analysis of cornelian cherry samples revealed that the concentrations of hazardous elements were within the permissible limits established by USP 2232.

Table 8. Permissible limits of hazardous elements according to USP 2232

Element	Permissible limit concentration (ppm = mg/kg)
Cd	3
Pb	10.0
As	10.0
Hg	1.0

The determination of permissible limit concentrations for heavy metals (Cd, Pb, Hg) and the toxic element arsenic (As) was carried out according to the relevant article of the United States Pharmacopeia, which specifies the permissible limits for heavy metals Cd, Pb, and Hg in plants (Table 8). Firstly, the maximum content of lead (Pb) detected in dogwood pips was 0.16 ppm, which is significantly lower than the USP permissible limit of 10 ppm. Similarly, the arsenic (As) content did not exceed 1 ppm in any sample, with the highest concentration of 0.61 ppm found in the pulp, which is within the USP standard limit (≤10 ppm). Cadmium (Cd) and mercury (Hg) were not detected.

At the same time, the analysis indicates that the content of biologically valuable elements is not only significant but may also contribute to the high nutritional value of the samples. Notably, potassium (K) and calcium (Ca) are present in high concentrations. The samples are also rich in magnesium (Mg), iron (Fe), and zinc (Zn)."

Considering these findings, it can be concluded that the analyzed samples comply with the USP 2232 standards for hazardous element contamination levels."

At the same time, due to the high content of essential elements, particularly potassium, iron, and magnesium the samples can be regarded as nutritionally valuable raw materials.

The results obtained in this study provide valuable insight into the capacity of *Cornus mas* (dogwood) as a raw material of bioactive compounds, particularly for the development of natural health products, such as oils and extracts with antimicrobial and anti-inflammatory properties.

The *Cornus mas* (dogwood) fruits, both pulp and seeds, were found to contain substantial amounts of bioactive compounds, including anthocyanins and fatty acids, which contribute to their therapeutic potential. For example, the total anthocyanin content in the viscous extract was 4.25%, expressed as cyanidin-3-O-glucoside equivalents. This high anthocyanin concentration underscores the potential of dogwood as a valuable source of antioxidants, which have well-documented anti-inflammatory and antioxidant effects. These properties are particularly significant for the treatment of conditions like hemorrhoidal disease, which is primarily characterized by inflammation.

The extraction of oils from both the pulp and seeds revealed interesting differences in their fatty acid profiles. The oil extracted from the seeds was rich in methyl pentadecanoate (C15:0), while the oil from the pulp contained higher concentrations of methyl hexanoate (C6:0) and methyl-gamma-linolenate (C18:3). These fatty acids are known for their ability to reduce inflammation and promote skin health. These findings suggest that dogwood oils could be effectively used in topical formulations for the management of hemorrhoidal symptoms.

Furthermore, the elemental profile of the dogwood specimens indicated the presence of macro- and micro-elements essential for human health. High levels of potassium (K), calcium (Ca), and magnesium (Mg) were observed in both pulp and seed samples. These minerals are vital for various physiological functions, including muscle function and bone health, adding further value to dogwood as a nutritionally rich plant. Importantly, the analysis of heavy metals (cadmium, lead, and arsenic) showed that the concentrations of these harmful elements were well below the permissible limits, indicating the safety of *Cornus mas* for human use.

Despite these promising results, additional research is necessary to validate the clinical applications of *Cornus mas* extracts and oils in humans. Clinical trials should be conducted to assess the efficacy and safety of these compounds in treating hemorrhoidal disease, as well as to determine the optimal concentrations and formulations for therapeutic use.

Scientific innovations: This study presents a method for the comprehensive processing of male cornelian cherry (*Cornus mas*) fruits, which preserves the integrity of biologically active compounds (BACs) in their native form. Unlike traditional methods, this waste-free technology preserves key biologically active compounds, such as anthocyanins and fatty acids, which are crucial for the therapeutic properties of the product. The novelty lies in the possibility of using these compounds in pharmaceutical compositions, in particular in suppositories with potential antimicrobial and antihemorrhoidal properties.

Practical Implications: The findings of this study have significant practical applications. The developed technology provides an eco-friendly, cost-efficient, and sustainable alternative to traditional synthetic methods. By extracting and utilizing bioactive compounds from *Cornus mas*, this approach not only offers a natural source of therapeutic agents but also addresses the environmental concerns associated with chemical production processes. Furthermore, the potential application of these bioactive substances in drug development—particularly for hemorrhoidal treatment—could lead to the creation of safer, more affordable treatment options, benefiting both individuals and the healthcare system.

CONCLUSIONS

The concentrated viscous extract from *Cornus mas* pulp contained 4.25% anthocyanins, calculated as cyanidin-3-O-glucoside equivalents. This indicates that the fruit is a good raw material of these potent antioxidant constituents.

The oils from the pips and pulp of *Cornus mas* were characterized by distinct organoleptic properties. The seed oil was light yellow in color, while the pulp oil was bright red. Both oils were transparent and free of sediment, indicating high purity and suitability for pharmaceutical and cosmetic applications.

The oil extracted from *Cornus mas* pips and pulp contained various fatty acids. The oil from the seeds was particularly rich in methyl pentadecanoate (C15:0), while the oil from the pulp contained higher levels of methyl hexanoate (C6:0) and methyl-gamma-linolenate (C18:3). These fatty acids are recognized for their anti-inflammatory and antimicrobial properties, which are beneficial for the management of hemorrhoidal conditions.

Elemental analysis confirmed that both seed and pulp samples contained high levels of essential elements, among which potassium (K), calcium (Ca), and magnesium (Mg) are vital for human health. The concentrations of these minerals confirm the nutritional value of *Cornus mas* fruits. The analysis of heavy metals showed that the concentrations of lead (Pb), arsenic (As), and cadmium (Cd) in both the pulp and seed samples were below the permissible limits defined by USP 2232. This indicates that the dogwood samples are safe for use in medicinal and food products.

The results highlight the significant bioactive potential of *Cornus mas* and its value as both a medicinal and nutritional plant. The oils and extracts derived from this plant may serve as effective natural treatments for conditions such as hemorrhoidal disease, due to their demonstrated anti-inflammatory, antioxidative, and antibacterial properties.

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