
ETHNOBOTANICAL AND PHYTOCHEMICAL ACTIVITIES OF *Rosa canina* L. FROM R.N. MACEDONIA

ЕТНОБОТАНИЧКА И ФИТОХЕМИСКА АКТИВНОСТ НА *Rosa canina* L. ОД МАКЕДОНИЈА

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Abstract: *Rosa canina* L. has a significant ethnobotanical importance with a rich history of traditional uses across various cultures. The goal of this study was to determine the potential of *Rosa canina* L. as a source of bioactive compounds for use in the pharmaceutical, cosmetic and food industries. This study provides a comprehensive ethnobotanical analysis of the utilization of *Rosa canina* L. across different regions from R.N. Macedonia, especially in traditional medicine, food and for other purposes. The research methodology involved a review of ethnobotanical literature and interviews with local residents. Rosehip is a nutritionally valuable fruit containing substantial amounts of bioactive compounds. Fruits with a mass of 1.147 g, a length of 18.88 mm and a width of 11.00 mm contain 356 mg/100 g vitamin C, 38 799 mg/kg total phenols, 73 mg/kg total anthocyanins, 615 mg/kg flavan-3-ols and have high antioxidant activity (89.2% inhibition). In traditional medicine, *Rosa canina* L. is used as a remedy for colds, flu, inflammation and for improving immunity, against anemia, for better functioning of the heart and blood vessels, against diarrhea, for reducing high blood pressure, for stomach diseases and gastritis. This plant has antiviral and immune-boosting, antioxidant, anti-inflammatory, antibacterial, anti-aging, anticancer, antiproliferative, antidiabetic, cardioprotective, hepatoprotective and protective effect against kidney diseases. The fruits are used dried (for tea) and processed into syrups, juices, jams, liqueurs and wines. Roasted fruits and seeds are used as raw material for coffee. Teas, preparations and lotions are made from leaves and flowers. This research consolidates existing ethnobotanical knowledge and highlights the need for sustainable conservation efforts to ensure the continued availability of this valuable botanical resource.

Key words: *Rosa canina* L., rosehip, ethnobotanical, phytochemical activities.

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Апстракт: *Rosa canina* L. има значајно етноботаничко значење со богата историја на традиционална употреба во различни култури. Целта на оваа студија беше да се утврди потенцијалот на *Rosa canina* L. како извор на биоактивни соединенија за употреба во фармацевтската, козметичката и прехранбената индустрија. Оваа студија обезбедува сеопфатна етноботаничка анализа на употребата на *Rosa canina* L. во различни региони од Р.С. Македонија, особено во традиционалната медицина, храната и за други цели. Методологијата на истражување вклучуваше преглед на етноботаничката литература и интервјуа со локалните жители. Шипката е хранливо вредно овошје кое содржи значителни количини на биоактивни соединенија. Плодовите со маса од 1,147 g, должина од 18,88 mm и ширина од 11,00 mm содржат 356 mg/100 g витамин Ц, 38 799 mg/kg вкупни феноли, 73 mg/kg вкупни антоцијанини, 615 mg/kg флаван-3-оли и имаат висока антиоксидантна активност (89,2% инхибиција). Во традиционалната медицина, *Rosa canina* L. се користи како лек за настинки, грип, воспаленија и за подобрување на имунитетот, против слабокрвност, за подобра работа на срцето и крвните садови, против дијареа, за намалување на висок крвен притисок, за стомачни заболувања и гастритис. Ова растение има антивирусно и имуно-засилувачко, антиоксидативно, антиинфламаторно, антибактериско, антистареешко, антиканцерогено, антипролиферативно, антидијабетско, кардиопротективно, хепатопротективно и заштитен ефект против бубрежни заболувања. Плодовите се користат сушени (за чај) и преработени во сирупи, сокови, џемови, ликери и вина. Печеното овошје и семките се користат како сировина за кафе. Чаеви, препарати и лосиони се прават од лисја и цветови. Ова истражување ги консолидира постојните етноботанички знаења и ја истакнува потребата од одржливи напори за зачувување за да се обезбеди континуирана достапност на овој вреден ботанички ресурс.

Клучни зборови: *Rosa canina* L., шипка, етноботаничка, фитохемиска активност

1. INTRODUCTION

Rosehip (*Rosa canina* L.) commonly known as dog rose, wild rose, “ship” is a perennial deciduous ornamental plant of the *Rosaceae* family. It blooms in May and June, depending on climatic conditions and altitude. The fruits are small, red, with an ovoid or elliptical shape. Growing wildly around the globe in areas such as Asia, North America, Europe, Middle East. In R.N. Macedonia *Rosa canina* L. is found on all mountains up to 1600 m altitude. It is found in places exposed to the sun, most often on southern slopes, on hill and mountain pastures, forest clearings, along rivers and streams, along roads, fences, etc. It grows on all types of soils (Micevski, 1998).

Rosehip is a nutritionally valuable fruit containing substantial amounts of bioactive compounds, such as vitamins, minerals, antioxidants, and phenolic compounds, which contribute to its health-promoting properties. The main bioactive compounds of rosehip are phenolic acids, anthocyanins, tocopherols, tannins (Kubczak et al., 2020; Tabaszewska and Najgebauer-Lejko, 2020) and flavonoids (flavan-3-ols) (Dabic Zagorac et al., 2020). Phenolic acids, including ellagic acid and gallic acid, along with anthocyanins such as cyanidin-3-glucoside, further enrich this complex phytochemical profile (Butkeviciute et al., 2022). The main carotenoids found in rosehips are lutein, zeaxanthin, β -carotene and lycopene, also responsible for the characteristic red color (Winther et al., 2016; Medveckiene et al., 2020). Rosehip contains tocopherols and essential fatty acids, sterols (Grajzer et al., 2015; Topkafa, 2016).

The content of these bioactive compounds allows this plant to have antiviral and immune-enhancing, antioxidant, anti-inflammatory, antibacterial, anti-aging, anti-cancer, anti-

proliferative, anti-diabetic, cardioprotective, hepatoprotective and protective effects against kidney diseases. *Rosa Canina* have a rich ethnobotanical history. Its significance in traditional cultures spans various regions across the globe and it has been used for numerous purposes, including medicinal, culinary and cultural.

Due to the increasing pollution and industrialization on the one hand and the development of the concept of organic production and the new trends in nutrition aimed at so-called "healthy food" on the other hand, there has recently been an increased interest in wild fruit species and their use for the production of ecologically healthy food in many countries around the world. As such, they have great potential in the sustainable development of rural areas and their use and popularization are in line with sustainable resource management. Due to their adaptability and resilience, the promotion of wild fruit species can be considered as one of the most promising efforts to mitigate climate change. On the other hand, by collecting fruits and other plant parts and processing them, significant economic gains can be achieved, especially for people in rural areas. They are an important raw material for the cosmetic, pharmaceutical, chemical, food, wood, textile industries, etc.

2. MATERIAL AND METHODS

The results of the studies are part of the scientific research project "Ethnobotanical research of wild fruit species", which included an ethnobotanical and analysis of the polyphenolic composition of *Rosa canina* L.

The information about traditional knowledge of *Rosa canina* was gathered by direct interviews with 278 respondents from different regions of R.N. Macedonia. North Macedonia is situated in the central part of the Balkan Peninsula and is divided into eight statistical regions. The survey was conducted with the assistance of agricultural advisors of the National Extension Agency in the eight regions: 1-Skopje region (with the municipalities Saraj, Chucher Sandevo, Butel, Gjorce Petrov, Aerodrom, Petrovec, Kisela Voda, Gazi Baba, and Ilinden), 2-Northeastern region (with municipalities Kumanovo, Kriva Palanka, Rankovce, Lipkovo and Kratovo), 3-Eastern region (with municipalities Shtip, Vinica, Makedonska Kamenica, Pehchevo, Berovo, Karbinci and Kochani), 4-Southeastern region (with municipalities Strumica, Valandovo, Radovish and Konche), 5- Pelagonia region (with municipalities Bitola, Demir Hisar, Resen and Krushevo), 6-Southwestern region (with municipalities Ohrid, Kichevo, Centar Zhupa, Struga, Debarca and Debar), 7- Polog region (with municipalities Tetovo, Brvenica, Mavrovo-Rostushe and Gostivar) and 8-Vardar region (with municipalities Veles, Kavadarci, Negotino, Rosoman and Chaska), covering the entire territory of the R.N. Macedonia, in the period from January to March 2026. During the interview, respondents shared their knowledge and experience about using rose hips as food and medicine. The collected data were processed using descriptive statistical methods. Frequencies, percentages and mean values were calculated to summarize the socio-economic characteristics of respondents, the regional distribution of collectors, and the purposes of use and sale of *Rosa canina* fruits. The results were comparatively analyzed by regions and presented in tables.

The chemical analyses included determination of the content of vitamin C and selected phytochemicals (anthocyanins, flavan 3-ols, total phenols) and antioxidant activity of the fruits. The fruits were taken from rural areas in the Skopje region. The Skopje region is located at 41°57'N and 21°28'S and belongs to the continental-mediterranean climate-

vegetation-soil region. In recent decades, global climate changes have been observed in this area, expressed through reduced annual precipitation, increased aridity, altered pluviometric regime, reduced temperature, especially in winter and periodic occurrence of heavy frosts.

Chemical analyses were performed in the oenological laboratory of the Institute of Agriculture in Skopje. The content of vitamin C was examined by volumetric method (Sadasivam and Balasubramanian, 1987). Total phenols in the samples are determined according to the Folin-Ciocalteu method (Slinkard and Singleton, 1977). The content of total anthocyanins was determined according to the acid-ethanol method (Somers and Evans, 1977) and p-dimethylaminocinnamaldehyde (p-DMACA) is used for the quantification of flavan-3-ols in the samples (Di Stefano *et al.*, 1989). Determining of the antioxidant activity was performed as an anti-radical activity against the stable product DPPH (2,2-diphenyl-1-picrylhydrazil).

3. RESULTS AND DISCUSSION

Ethnobotanical survey and socio-economic characteristics of collectors: The study included a total of 278 respondents who are collectors of wild fruits from different regions in the R.N. Macedonia. The data presented in Table 1 on the socio-economic structure show that this activity is dominated by men (73.8%), while the participation of women is significantly lower (26.2%). The highest representation of men in the collection of wild fruits is recorded in the Vardar region (96.8%), while the most balanced gender structure is in the Southwestern region, where women participate with 44.7%. The largest share of older collectors is in the Polog region (90%) and the Southwestern region (89.5%).

According to age, the data show that the majority of collectors are older than 40 years (82.4%), while only 17.6% are younger than 40 years, which indicates that this activity is more often performed by people with greater life and work experience. According to employment status, more than half of the respondents are unemployed (57.3%), which also includes retirees, while 42.7% are employed, which shows that collecting wild fruits is a significant source of income, especially for the population that does not have permanent employment.

According to work experience, the majority of respondents have more than 10 years of experience in collecting wild fruits (52.8%), while 35.8% have 3 to 10 years of experience and 11.4% have less than 3 years of experience, indicating that this activity is often practiced long-term and it is a traditional practice in certain regions. The largest share of collectors with more than 10 years of experience is in the Pelagonia region (78%), as well as in the Eastern and Polog regions (70%), indicating a long-standing tradition of collecting wild fruits in these regions.

Table 1. Socio-economic characteristics of wild fruit collectors by regions according to gender, age, employment and work experience (Source: own research)

Regions	Gender (%)		Age (%)		Employment (%)		Years of experience (%)		
	Male	Female	Below 40	Above 40	Employed	Unemployed	1-3	3-10	Above 10
Skopje	66.7	33.3	20.5	79.5	56.4	43.6	25.6	17.9	56.4
Northeastern	67.4	32.6	19.6	80.4	43.5	56.5	8.7	41.3	50.0

Eastern	72.5	27.5	20.0	80.0	42.5	57.5	5.0	25.0	70.0
Southeastern	76.9	23.1	23.1	76.9	61.5	38.5	23.1	61.5	15.4
Pelagonia	87.8	12.2	14.6	85.4	29.3	70.7	2.5	19.5	78.0
Southwestern	55.3	44.7	10.5	89.5	42.1	57.9	13.1	39.5	47.4
Polog	66.7	33.3	10.0	90.0	46.7	53.3	6.7	23.3	70.0
Vardar	96.8	3.2	22.6	77.4	19.3	80.7	6.4	58.1	35.5
Total share	73.8	26.2	17.6	82.4	42.7	57.3	11.4	35.8	52.8

The respondents are collectors of various wild fruits present in the regions. Only 27.7% of them collect rosehip fruits (Table 2). The most rosehip fruits are collected in the North-East (58.7%) and Skopje (41.0%) and the least in the Vardar region (6.4%). Most of them collect rosehip fruits, while very few collect other plant parts. In some regions, such as the Skopje and Southeastern region, the flowers and leaves of the rosehip are collected and used, most often for tea. In the Southwestern region they use the root, most often for tea. 47.7% of the respondents use rosehip for their own use and 60.3% for sale. Some respondents reported both personal consumption and sale of collected fruits. They make various preparations from the fruits (juice, jam, marmalade and wine), from the dried fruits they make tea that is most often used in the prevention and treatment of colds, to improve immunity due to the high content of vitamin C, against anemia, for better functioning of the heart and blood vessels, against diarrhea, to reduce high blood pressure, for stomach diseases and gastritis. The leaves, flowers and root are used for tea. Regarding the placement of the collected fruits, respondents most often sell the fruits through buyers (60-70%), on local markets (40.2%), through buyers (38.1%) and through acquaintances (33.5%). The largest part of the fruit is sold in the Eastern (87.5%), Pelagonia (82.9%) and Northeastern regions (73.9%) (Table 2). The largest quantities of fruits are purchased in the Pelagonia (73.5%) and Eastern region (60.0%).

Table 2. Structure of forest fruit collectors by region, proportion of pickers and distribution methods (%)

Regions	Total number of wild fruit collectors by regions (%)	Rosehip collectors by regions (%)	Aim		Sale		
			Own use (%)	Sale (%)	Buyers (%)	Local market (%)	Acquaintances (%)
Skopje	14.0	41.0	66.7	56.4	9.1	36.4	54.5
Northeastern	16.5	58.7	34.8	73.9	55.9	32.3	23.5
Eastern	14.4	27.5	35.0	87.5	60.0	22.8	22.8
Southeastern	4.7	15.4	69.2	30.8	25.0	50.0	25.0
Pelagonia	14.8	17.1	26.8	82.9	73.5	8.8	17.6
Southwestern	13.7	28.9	73.7	26.3	20.0	50.0	30.0
Polog	10.8	26.7	33.3	66.7	45.0	55.0	50.0
Vardar	11.1	6.4	41.9	58.1	16.7	66.7	44.4
Total average	12.5	27.7	47.7	60.3	38.1	40.2	33.5

Phytochemistry properties: Rosehip is a nutritionally valuable fruit containing substantial amounts of bioactive compounds, such as vitamins, minerals, antioxidants, and phenolic compounds, which contribute to its health-promoting properties. The main bioactive compounds of rosehip are phenolic acids, anthocyanins, tocopherols, tannins (Kubczak et al., 2020; Tabaszewska and Najgebauer-Lejko, 2020) and flavonoids (flavan-3-ols) (Dabic Zagorac et al., 2020). Accordingly, an examination of the vitamin C content and content of select phytochemicals of *Rosa canina* L. fruits was performed.

According to our study, fruits with an average mass of 1.147 g, length 18.88 mm and width 11.00 mm, contain 356 mg/100 g vitamin C, 38 799 mg/kg total phenols, 73 mg/kg total anthocyanins, 615 mg/kg flavan-3-ols and have 89.2 % inhibition antioxidant activity. The percentage of vitamin C in total antioxidant activity is 399 % (Table 3).

Table 3. Content of selected phytochemicals of *Rosa canina* L. fruits

Fruit mass g	Fruit length Mm	Fruit width Mm	Vitamin C mg/100 g	Total phenols mg/kg	Total anthocyanins mg/kg	flavan-3-ols mg/kg	Antioxidant activity (% inhib)
1,147	18,88	11,00	356	38 799	73	615	89,2

The content of chemical materials of *Rosa canina* depends on different factors, such as genotype, species and cultivars, ripening stage, geographical location, altitude, climatic conditions and according Ghazghazi et al. (2010) depends on the methods which are used to store and extract it. The amount of vitamin C is 6.0 to 8.2 mg/g FW (fresh weight) (Peña et al., 2023).

Rose hips that grow in colder climates contain more vitamin C than those that grow in warmer climates. (Pyke and Melville, 1942; Stamberg, 1945). The highest concentration of vitamin C is typically found in mature, hardened rosehips ranging from 400 to 1500 mg/100 g (Bilgin et al., 2020; Harrison et al., 2014; Ermolaev and Fedorov, 2022). Ripe, red fruits contain a higher amount of vitamin C (417.5 mg/100 g), compared to the green fruits (18.0 mg/100 g) and orange fruits (175.0 mg/100 g) (Nojavan et al., 2008). Fruits of *Rosa canina* collected from higher altitudes contain more vitamin C than fruits collected from lower altitudes (Pyke and Melville, 1942). The amount of efficient compounds varies in different parts of rose hip. This plant contained a considerable amount of vitamin C, especially in the peel, while the seeds contained the greatest amount of oil (Georgieva et al., 2014).

The content of total polyphenols in rose hip fruits is from 10.89 mg GAE/g (gallic acid equivalent/g) to 26.49 mg GAE/g (Butkeviciute et al., 2022), 12.07 to 37.17 mg GAE/g DW (dry weight) (Mihaylova et al., 2015). According to Fascella et al. (2019) *Rosa canina* and *Rosa sempervirens* have the highest total polyphenol contents (6784.5 and 6241.2 mg GAE/100 g DW, respectively) and the highest antioxidant activities than *Rosa corymbifera*, *Rosa micrantha* species.

According to the content of anthocyanins, rosehip fruits have a lower content than some fruit species like blackberry 58.61 mg/100 g FW, red raspberry 14.69 mg/100 g FW, strawberry 16.03 mg/100 g FW, blueberry 29.72 mg/100 g FW, sweet cherry 26.72 mg/100 g FW (de Souza et al., 2014). In terms of flavanol content, rosehip fruits contain more flavanols than strawberry 38.17 mg CE/100 g FW (Catechin Equivalents/100 g), blueberry 47.53 mg CE/100 g FW, sweet cherry 59.92 mg CE/100 g FW (de Souza et al., 2014). Butkeviciute et al. (2020) in the fruits of *Rosa canina*, revealing the presence of flavan-3-ol group compounds such as catechin ranging from 26.30 to 522.48 µg/g, epicatechin ranging from 2.12 to 20.66 µg/g, procyanidin B1 ranging from 1.65 to 40.89 µg/g, and procyanidin B2 ranging from 5.54 to 86.95 µg/g.

Medical uses: Various parts of *Rosa canina* have been traditionally used for medicinal and culinary purposes for centuries. More than 2 000 years ago, people used rosehip for medicinal purposes. Pliny the Elder (23–79 AD) was the first person who described the medicinal properties of *Rosa canina* L. Its use in treating dog bites earned it the name dog rose. In the Canons of Medicine written by Avicenna, rosehip was suggested for treating headaches and some stomach ailments (Khazaei et al., 2020). In folk medicine, the fruits of *Rosa canina* are used as a universal remedy for colds and viral infections, fever (Lustrup and Winther, 2022), as well as exerting a positive influence on the osteoarthritis, anxiety, depression, recognition memory, urinary and reproductive systems disorders, and neutrophil respiratory burst (Khazaei et al., 2020), for reducing cholesterol and high blood pressure, for better appetite and strengthening the immune system (Selahvarzian et al., 2018). During World War II, rosehip syrup was used in the UK as a food and to prevent scurvy. In folk medicine, the oil is used to treat skin burns, treat wrinkles, remove scars and tone the skin. Fruit tea is recommended for women who have given birth, as well as for people who have kidney problems and whose body has a tendency to form kidney stones. It helps to excrete harmful substances from the body and against arthritic pain. In R.N. Macedonia, rosehip is most often used to improve immunity, against colds and flu.

With a rich ethnobotanical history and documented phytochemical profile, rosehip has garnered attention for its therapeutic potential across various health domains.

Antiviral and immune-boosting effect: One of the most well-known benefits of rosehips is their ability to boost the immune system. This is due to their high content of vitamin C, which has been shown to enhance immune function by increasing the production of white blood cells and antibodies (Medveckienė et al., 2021).

Rosehip fruits are rich in antioxidant compounds, especially vitamin C (30–1 300 mg/100 g), more than other fruits and vegetables (Ziegler et al., 1986). *Rosa canina* fruits contain more vitamin C than blackberry (52.41 mg/100 g FW), red raspberry (92.17 mg/100 g FW), strawberry (90.13 mg/100 g FW), blueberry (73.21 mg/100 g FW), sweet cherry (62.42 mg/100 g FW) (de Souza et al., 2014), black currant 216.0 mg/100 g, white mulberry 29.9 mg/100 g, black chokeberry 24.2 mg/100 g (Selamovska et al., 2024), some indigenous varieties of apple (*Malus domestica*) 9.37 mg/100 g, pomegranate (23.67 mg/100 g FW), cherry (12.83 mg/100 FW), grape 9.00 mg/100 g FW, tomato 38.25 mg/100 g FW and pepper 51.25 mg/100 g FW (Selamovska et al., 2021–2022).

Antioxidant activity: Rosehip is known to contain the highest amount of vitamin C among other fruits, which could be explanatory for their antioxidant activity. Furthermore, rosehip is rich in carotenoids (lycopene, β -carotene, zeaxanthin) (Pena et al., 2023], tannins, flavonoids, and phenolic acids, bioactive compounds bounded to the antioxidant activity (Kunc et al., 2023). Along the years, it was mentioned that the high antioxidant activity values of rosehip extracts are due to a strong interaction between polysaccharides and organic acids, and most important with phenolic antioxidants (flavonoids and phenolic acids) (Ognyanov et al., 2022). The authors Mihaylova et al. (2015), Butkevičiūtė et al. (2022), determined a positive correlation between total polyphenol and antioxidant activity in *Rosa canina* fruits. This indicates that in *Rosa canina* fruits, total phenols have a large share in the antioxidant activity.

Rosa canina L. fruits contain more total phenolics than blackberry (850.52 mg GAEs/100 g FW), red raspberry (357.83 mg GAEs/100 g FW), strawberry (621.92 mg GAEs/100 g FW), blueberry (305.38 mg GAEs/100 g FW and sweet cherry (314.45 mg GAEs/100 g FW) (de Souza et al., 2014).

Compared to the other fruit species, *Rosa canina* fruits have higher antioxidant activity than some indigenous fruit varieties of pomegranate 81.58%, indigenous varieties of apple 60.37%, indigenous varieties of cherry 43.36% (Selamovska et al., 2021–2022), *Ribes nigrum* 86.2 %, *Morus Alba* 71.6 %, *Aronia melanocarpa* 76.4 %, *Rubus fruticosus* 78.6 %, *Punica granatum* 86.3 % (Selamovska et al., 2024).

Anti-Inflammatory effect: The phenolic compounds present in rosehips have shown anti-inflammatory properties (Medveckiene et al., 2020; Ozdemir et al., 2022). Flavonoids are an example of a polyphenolic compounds that can block transcription factors or regulatory enzymes involved in the inflammatory process (Maleki et al., 2019). The presence of phenolic compounds in rosehip represents the main reason why rosehip has an anti-inflammatory effect. In our study, fruits with a mass of 1.147 g, length 18.88 mm and width 11.00 mm contained 615 mg/kg flavan-3-ols (Table 3). Some strawberry cultivars contain more flavanols 38.17 mg CE/100 g FW, blueberry 47.53 mg CE/100 g FW, sweet cherry 59.92 mg CE/100 g FW. (de Souza et al., 2014).

Antibacterial effect: The fruit ethanol extract of *Rosa canina* has antimicrobial activity against *E.coli*. Rose hip flower ethanol extract had the best antibacterial activity against *Pseudomonas aeruginosa* and against *Escherichia coli* (Rovná et al., 2015).

Anti-aging effect: The phenolic compounds present in rose hips have anti-aging effects on the skin. (Sallustio et al., 2023). Furthermore, the presence of antioxidants in rose hips confers protective effects against inflammation, a key factor implicated in the onset and progression of chronic diseases like cancer, diabetes, and cardiovascular ailments.

Anticancer and antiproliferative effect: The results of the study showed that the ethanol extract of rosehip had a cytotoxic effect on the MCF-7 and MDA-MB-468 cancer cell lines depending on the dose of exposure without affecting normal cells (Berkoz et al., 2019). Rosehip extracts have been shown to have antiproliferative and antioxidant properties in Caco-2 human colon cancer cells. Rosehip extracts are a potent antioxidant that inhibits cell proliferation in Caco-2 cells (Jiménez et al., 2016).

Antidiabetic and antihyperlipidemic effect: Rosehip extract's beneficial effects in diabetes management are linked to its ability to modulate cell signaling pathways involved in glucose metabolism and insulin sensitivity, ultimately influencing the overall metabolic state and reducing the risk of diabetes progression (Taghizadeh et al., 2016).

Protective effect against kidney diseases: In the traditional medicine rosehip extract could prevent and possibly eliminate preexisting kidney stones (Tayefi-Nasrabadi et al., 2012).

Cardioprotective effect: Rosehip is an effective dietary supplement for preventing the formation of atherosclerotic plaques by modulating systemic blood pressure and the expression of RCT and inflammatory genes (Cavalera et al., 2017). The conclusion of the study shows that they found that blood pressure and atherosclerotic plaques, as well as oxidized LDL, total cholesterol, and fibrinogen levels, are lower when consuming rosehip fruits. In the study by Nasrolahi et al. (2020), the cardioprotective effects of rosehip methanolic extract were evidenced by its ability to modulate the expression of critical markers related to ER (endoplasmic reticulum) stress.

Hepatoprotective effect: The rosehip qualifies as a hepatoprotective herb (Ghanbari-Niaki et al., 2022). The alcoholic extract of rosehip had a protective effect on liver tissue (Banan Khojasteh et al., 2017).

Culinary delights: Rosehip emerges as a potential candidate due to its wide- ranging functionalities. The increasing focus on sustainability and eco-friendly practices in industries has sparked interest in rose hip's potential in applications beyond traditional medicine. Rosehip is utilized in various culinary preparations. The fruits, leaves and flowers are useful for humans. The fruits are consumed raw, dried (for tea) and processed into syrups, juices, jam, marmalade, liqueur, wine, vitamin concentrates, etc. Roasted fruits and seeds are used as a raw material for coffee. The flowers are used as an additive in salads, for the preparation of sweets, etc. The potential applications of rosehips in the food industry make them a promising ingredient for the development of functional products that promote health and wellness. In this regard, both the rose hips and their by-products offer a wide range of potential applications in functional foods and dietary supplements, for obtaining probiotic drinks, yogurts and soups, in addition to the production of conventional products. Its inclusion in functional foods, nutraceuticals, cosmetics and pharmaceuticals has been explored, showcasing its versatility and economic potential. As a result, value-added foods, or functional foods with higher levels of dietary fiber and antioxidants have evolved, especially in bakery and cereal products like cookies, gingerbread or noodles. Moreover, by-products of rosehip are valorized in cereal products such as noodles. In Turkish noodles, flours from seed of rosehip, grape and pomegranate were added in concentrations of 10, 20 and 30 %. The addition of 10 % of these seed flours presented significant antioxidant activity (Koca et al., 2018). Substitution of flour in a standard cookie recipe with 15 % rosehip powder and 25 % hibiscus powder showed to increase total phenolic content, antioxidant capacity all along high acceptance when it comes to sensory evaluation (Antarkar et al., 2019). The incorporation of rosehip flour in bread dough has led to a significant increase in the bread's nutritional value and improved its rheological properties, with a positive correlation observed with the amount of rosehip flour used (Gül and Sen, 2017). The rosehip could be a potential substitute for synthetic ascorbic acid in the bakery industry (Vartolomei and Turtoi, 2021). By adding 5% and 10% rosehip puree, the physicochemical properties of the extrudates are improved and they are enriched with flavonols, carotenoids, vitamin C and folates (Igual et al., 2021). Moreover, rosehip presents applications in meat industry as well, where was most added to products such as sausages. Polyphenols extracted from rosehip added to pork sausages at a concentration of 0.005 %, along with 0.01 % sodium nitrite, can delay lipid oxidation, protein degradation, microbial growth, and preserve the bright red color, flavor, and taste of smoked pork sausages for up to 20 days of refrigeration storage (Nicorescu et al., 2018). Also, Armenteros et al. (2013) showed that natural antioxidants from strawberry and rosehip in frankfurter sausages in combination with traditional additives (sodium ascorbate and nitrite) enhanced the oxidative stability without modifying the color and texture properties of sausages. Rosehip can act as a natural antioxidant in meat sausages, but not as a full replacer for traditional additives (Vossen et al., 2012). The eggs that come from hens fed with rosehip and flaxseed presented high essential amino acids, antioxidant amino acids, and sulfur amino acids contents (Vlaicu et al., 2022).

The leaves and flowers are used to make teas, various preparations and lotions for skin treatment. Regarding rosehip, studies have primarily focused on the valorization of its seeds and pomace. Cold-pressed rosehip seed oil is a valuable source of bioactive compounds, including mono/polyunsaturated fatty acids (oleic and linoleic acids) (Franco et al., 2007).

Furthermore, the diverse bioactivities exhibited by rosehips render them a highly promising ingredient for the formulation and development of nutraceuticals, cosmetics, and pharmaceutical products (Negrean et al., 2024). Moreover, Darie-Nita et al. (2021) research focused on developing an ecological packaging PLA-based containing bio-plasticizers and chitosan modified with rosehip seed oil. Accordance with the obtained results, the elaborated formulations had tensile strength and flexibility depending on whether their composition is rigid or flexible, as well as antibacterial and antioxidant activity, which may allow for prolonged use for food packaging. The created biocomposites made of PLA, chitosan modified, and additives (rosehip seed oil) displayed enhanced processability as well as physical-mechanical, thermal, water vapor barrier, antioxidant and antibacterial characteristics suited for application in food packaging (Darie-Nița et al., 2021).

4. CONCLUSION

Rosehips is a widely distributed plant species in R.N. Macedonia. It is found in all regions. The fruits are used dried (for tea) and processed into syrups, juices, jams, liqueurs and wines. In the past, roasted fruits and seeds are used as raw material for coffee. Teas, preparations and lotions are made from leaves and flowers.

Rosehip is a nutritionally valuable fruit containing substantial amounts of bioactive compounds, vitamin C, total phenols, flavan-3-ols, total anthocyanins, and have high antioxidant activity (89.2% inhibition). In traditional medicine, *Rosa canina* L. is used as a remedy for colds, flu, inflammation and for improving immunity, against anemia, for better functioning of the heart and blood vessels, against diarrhea, for reducing high blood pressure, for stomach diseases and gastritis.

Rosehips and their by-products have gained significant attention in recent years due to their abundance of bioactive compounds which are linked to a wide array of health benefits. Despite the promising health benefits of rosehips, there is still a lack of research on their bioactive compounds and potential applications in functional products.

From the total number of respondents who collect fruits from wild fruit species, only 27.7% of them collect rosehip fruits. The most rosehip fruits are collected in the Northeastern (58.7%) and Skopje region (41.0%) and the least in the Vardar region (6.4%). 47.7% of the respondents use rosehip for their own use and 60.3% for sale. They most often sell the fruits in local markets (40.2%), through buyers (38.1%) and through acquaintances (33.5%).

Despite its high nutritional value, good adaptability to environmental conditions and climate change, as well as the possibilities for its use in various industries and for various purposes, we believe that there is not enough awareness of its importance, which is why more attention needs to be paid to this plant species.

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