



DETERMINATION OF THE ANTIMICROBIAL POTENTIAL OF NATURALLY GROWN ROSEHIP (*Rosa canina* L.) FRUIT IN THE GİRESUN REGION

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Abstract: The rise of antibiotic-resistant microorganisms has become a major global public health challenge, prompting the search for alternative antimicrobial agents. In this study, the antimicrobial activity of *Rosa canina* (rosehip) fruit extract, collected from the Alucra Plateau in Giresun, Türkiye, was evaluated under in vitro conditions. Methanolic extracts were tested against Gram-positive (*Bacillus subtilis*, *Staphylococcus aureus*) and Gram-negative (*Escherichia coli*, *Enterobacter aerogenes*) bacteria, as well as fungal strains (*Candida albicans*, *Candida glabrata*, *Candida tropicalis*) using the disk diffusion method. At a concentration of 30 mg/mL, the extract demonstrated significant inhibition zones against both bacterial and fungal pathogens. The most notable antifungal effects were observed against *C. glabrata* (20 mm) and *C. tropicalis* (16 mm). The absence of antimicrobial activity in the 25% DMSO control confirmed that the effects were solely attributable to the plant extract. These findings suggest that *R. canina* possesses promising natural antimicrobial properties and could serve as a complementary treatment option, particularly against multidrug-resistant pathogens.

Keywords: *Rosa canina*, Antimicrobial activity, Natural extract, *Candida*, Antibacterial effect

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1. Introduction

The emergence of bacterial resistance to commonly used antibiotics has become a significant global public health issue. The declining effectiveness of current antibiotics has rendered them insufficient for treating bacterial infections, prompting the scientific community to seek alternative antimicrobial agents. These alternatives include not only newly synthesized antibiotics but also natural antimicrobial compounds derived from plants (Monroe and Polk, 2000; Yılmaz and Ercişli, 2011). In this context, non-antibiotic bioactive compounds have recently become a major focus of scientific research (Taştekin and Çiftçi, 2023).

Antimicrobial resistance (AMR) has been identified by the World Health Organization (WHO) as one of the top ten global public health threats. It is estimated that AMR is directly responsible for over 1.27 million deaths annually, with projections indicating a rise to 10 million deaths per year by 2050 if urgent action is not taken (WHO, 2022).

This growing threat has accelerated the exploration of plant-based compounds as alternative antimicrobial agents, due to their chemical diversity, bioavailability, and lower tendency to induce resistance (Ashraf et al.,

2023; Jo et al., 2024).

Polyphenolic molecules play an important role in preventing cellular damage and the development of various chronic diseases due to their antioxidant properties (Taştekin and Çiftçi, 2023). Plants rich in phenolic compounds are considered valuable sources of natural antimicrobial agents. Among these, *Rosa canina* L. (rosehip), a perennial shrub belonging to the *Rosaceae* family, comprises approximately 200 species distributed worldwide, including Asia, the Middle East, Africa, and North America, and is widely recognized for its medicinal and nutritional properties (Blumenthal et al., 1998; Yılmaz and Ercişli, 2011; Polumackanycz et al., 2020). It naturally grows at forest edges, water puddles, shrubs, and pastures. *R. canina* has long been used worldwide as a source of vitamins, medicinal supplements, and food. It is especially rich in vitamin C and contains valuable compounds such as polyphenols, carotenoids, carbohydrates, and fatty acids. Scientific evidence also supports its anticancer, antidiabetic, anti-obesity, anti-inflammatory, hepatoprotective, anti-arthritis, neurological, and antibacterial properties (Yılmaz and Ercişli, 2011; Selahvarzian et al., 2018; Fayaz et al., 2024; Masnavi et al., 2024). Different parts of *R. canina* have traditionally been used to treat various ailments: the root



for cough, hemorrhoids, and heartburn; leaves for colds, cough, influenza, and urinary stones; fruit for asthma, bronchitis, and colds; and seeds for osteoarthritis, rheumatism, and gout (Erciřli, 2005; Tolekova et al., 2020).

Recent studies have shown that extracts of *Rosa canina* exhibit strong antibacterial activity against a range of Gram-positive and Gram-negative bacteria, including *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa* (Rovná et al., 2015).

In addition to their antimicrobial effects, *Rosa* species have been shown to possess antiviral and antifungal properties, further increasing their value in natural medicine and food preservation (Vilhelmova-Ilieva et al., 2021; Mařelienė et al., 2025).

Rosehip fruits are particularly rich in ascorbic acid (vitamin C), making them a potent source of antioxidants. They also contain significant amounts of tannins, flavonoids, phenolic acids, and anthocyanins (Ogah et al., 2014; Balta and Tekin, 2021; Tařtekin and ifti, 2023). These phenolic compounds have demonstrated antioxidant, antimutagenic, and anticancer effects. In the food industry, rosehip is commonly used in the production of fruit juice, tea, jam, jelly, and wine (Moerman, 2002).

Türkiye hosts a rich biodiversity of *Rosa* species, with approximately 25% of all known wild rose species naturally growing within its borders (Erciřli, 2005). This biological diversity highlights the importance of investigating the health-related potential of rosehip species at a local level.

The present study aims to investigate the antibacterial and antifungal activities of rosehip fruits collected from the Giresun region of Türkiye under in vitro conditions. By focusing on a locality not previously studied, this research is expected to make a significant contribution to the scientific literature and provide valuable insights into the potential health benefits of this species.

2. Materials and Methods

R. canina fruits utilized in this study were harvested from the Alucra Plateau region of Giresun Province during the autumn season. The collected fruits were subjected to drying under controlled conditions in a cool, dark environment to prevent degradation of bioactive compounds (Figure 1). Once thoroughly dried, the fruits were pulverized into fine powder using a laboratory-grade mechanical grinder. The powdered samples were subsequently stored in airtight containers at 4°C to maintain stability and prevent contamination until further analysis.

A total of seven pathogenic microorganisms were employed to assess the antimicrobial activity of the *Rosa canina* L. (rosehip) samples. The Gram-positive bacteria included *Bacillus subtilis* ATCC 6633 and *Staphylococcus aureus* ATCC 25923, while the Gram-negative bacteria comprised *Escherichia coli* ATCC 25922 and *Enterobacter aerogenes* CCU 2531.



Figure 1. Fruits of *R. canina*.

The fungal strains tested were *Candida albicans* ATCC 10231, *Candida glabrata* ATCC 15126, and *Candida tropicalis* ATCC 13803. All strains were obtained from recognized microbial culture collections and cultured under standardized laboratory conditions prior to antimicrobial susceptibility testing.

R. canina fruit extract was prepared using 96% methanol (Sigma-Aldrich). Fresh fruits were dried under controlled conditions and ground into a fine powder. About 20 g of the sample was extracted via Soxhlet for 8 h with 200 mL of methanol. The extract was then concentrated under reduced pressure at <40 °C using a rotary evaporator (Heidolph Hei-Vap) (Figure 2).

Subsequently, the crude extract was reconstituted in 25% dimethyl sulfoxide (DMSO) to yield two stock solutions at concentrations of 30 mg/mL and 15 mg/mL. Prior to antimicrobial susceptibility testing, the extract solutions were sterilized through 0.45 µm membrane filtration to ensure sterility. All prepared extracts were stored at 4°C until further use in antibacterial assays (Dulger and Dulger, 2018; Akkoyunlu and Dulger, 2024).

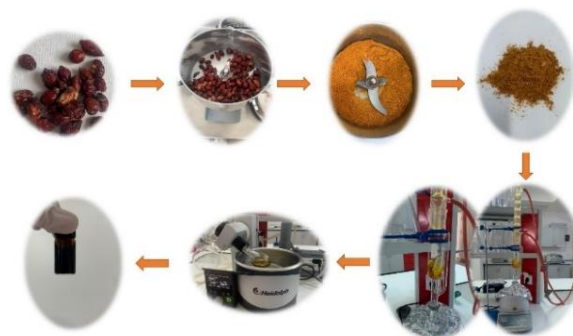


Figure 2. Extraction process of rosehip (*R. canina*) extract.

Pathogenic microorganisms used to evaluate the antimicrobial efficacy in this study were obtained from recognized national and international culture repositories. These strains were maintained as frozen

stock cultures at -80°C in the laboratory of the Department of Medical Services and Techniques, Vocational School of Health Services, Sinop University. A total of seven strains were selected, including two Gram-positive bacteria, two Gram-negative bacteria, and three yeast species. Detailed information regarding the microbial strains is summarized in Table 1.

Table 1. Pathogenic microorganisms used in the study

Microorganisms	
Gram-positive bacteria	<i>Bacillus subtilis</i> ATCC 6633 <i>Staphylococcus aureus</i> ATCC 25923
Gram-negative bacteria	<i>Escherichia coli</i> ATCC 25922 <i>Enterobacter aerogenes</i> CCU 2531
Fungus	<i>Candida albicans</i> ATCC 10231 <i>Candida glabrata</i> ATCC 15126 <i>Candida tropicalis</i> ATCC 13803

The antimicrobial potential of *R. canina* extracts was assessed via the disk diffusion technique (Collins et al., 1989; Taner Saraçoğlu, 2024; Veyisoğlu et al., 2024a, b). Mueller-Hinton Agar (MHA) served as the culture medium for bacterial strains, while Sabouraud Dextrose Agar (SDA) (Difco) was employed for fungal isolates. Microbial suspensions were adjusted to a turbidity equivalent to 0.5 McFarland standard, and 100 μL of each suspension was uniformly spread over the agar surface using sterile cotton swabs. The inoculated plates were subsequently left to dry for roughly 5 minutes within a laminar flow hood.

Methanol-based plant extracts were diluted to concentrations of 30 mg/mL and 15 mg/mL. For each concentration, 25 μL of the extract was pipetted onto sterile 6 mm diameter disks, which were then gently placed onto the agar surface. Following application, plates were once more allowed to dry for about 5 minutes under laminar flow conditions.

Incubation of bacterial cultures was carried out at 37°C for 24 hours, whereas fungal cultures were incubated at 28°C for an appropriate period. As controls, 25% dimethyl sulfoxide (DMSO) was used as a negative control, while ampicillin (AM10) and polymyxin B (PB300) served as positive controls against bacteria, and nystatin (NS100) was used for fungi. Post-incubation, inhibition zones generated by the extracts were measured in millimeters, including the diameter of the disks.

3. Results and Discussion

In this study, the antimicrobial activity of *R. canina* extract was evaluated against both Gram-positive and Gram-negative bacteria, as well as various *Candida* species. The findings revealed that *R. canina* extract exhibited broad-spectrum antimicrobial activity, particularly at a concentration of 30 mg/mL. Inhibition zones of 14 mm and 15 mm were observed against the Gram-positive strains *B. subtilis* and *S. aureus*, respectively. Similarly, inhibition zones of 15 mm and 13

mm were detected for the Gram-negative strains *E. aerogenes* and *E. coli*. Although these effects were lower compared to some standard antibiotics, they are considered significant for a natural extract. Notably, *R. canina* also demonstrated distinct antifungal activity against *C. glabrata* and *C. tropicalis*, with inhibition zones of 20 mm and 16 mm, respectively. This activity is particularly striking when compared to the response observed with Nystatin (Table 2; Figure 3).

Table 2. Antimicrobial activity of *R. canina* extract

<i>R. canina</i> extract	Gram-positive bacteria		Gram-negative bacteria		Fungus		
	BS	SA	EA	EC	CA	CG	CT
30 mg/mL	14	15	15	13	-	20	16
15 mg/mL	10	10	13	10	-	13	11
Ampicillin (AM10)	30	20	10	20	ND	ND	ND
Polymyxin B (PB300)	12	10	7	14	ND	ND	ND
Nystatin (NS100) %25	ND	ND	ND	ND	30	-	-
DMSO	-	-	-	-	-	-	-

BS= *B. subtilis* ATCC 6633, SA= *S. aureus* ATCC 25923, EA= *E. aerogenes* CCU 2531, EC= *E. coli* ATCC 25922, CA= *C. albicans* ATCC 10231, CG= *C. glabrata* ATCC 15126, CT= *C. tropicalis* ATCC 13803. ND= not determined; “-“= no inhibition zone was shown.

While antibiotics such as ampicillin showed stronger effects against Gram-positive bacteria (e.g., 30 mm inhibition zone for *B. subtilis*), *R. canina* extract presented a more moderate yet broad-spectrum activity profile. Polymyxin B was found to be especially effective against Gram-negative bacteria but showed no activity against fungal strains. In contrast, *R. canina* extract stood out as a promising plant-based source with antimicrobial potential against both bacterial and fungal pathogens. Furthermore, since the 25% DMSO solution alone produced no inhibition zones, it can be concluded that the observed antimicrobial activity originated directly from the plant extract, not the solvent (Table 2; Figure 3). These results are consistent with previous studies suggesting that *R. canina* is rich in bioactive compounds, including phenolics and flavonoids, which contribute to its antimicrobial properties.

The antimicrobial activity of *Rosa canina* has been increasingly investigated in the literature. Comlekcioglu et al. (2022) reported that different *Rosa* species are rich in phenolic compounds, which inhibit bacterial growth. Haghparasti et al. (2023) demonstrated the antibacterial activity of *Rosa canina* extracts against Gram-negative pathogens, supporting the potential of plant-based compounds in the development of alternative antimicrobial strategies.

For instance, Taştekin and Çiftçi (2023) reported that *R. canina* fruits collected from 10 different regions in Samsun, Türkiye, had high levels of ascorbic acid (0.781–1.120 g/100 g), total phenolics (4.700–8.347 g GAE/100 g), and flavonoids (29.5–36.3 mg quercetin/100 g), supporting its potent antioxidant and potential antimicrobial effects. Their study also highlighted strong antibacterial activity, particularly against *Enterococcus faecalis*, further confirming the therapeutic promise of this underutilized fruit.

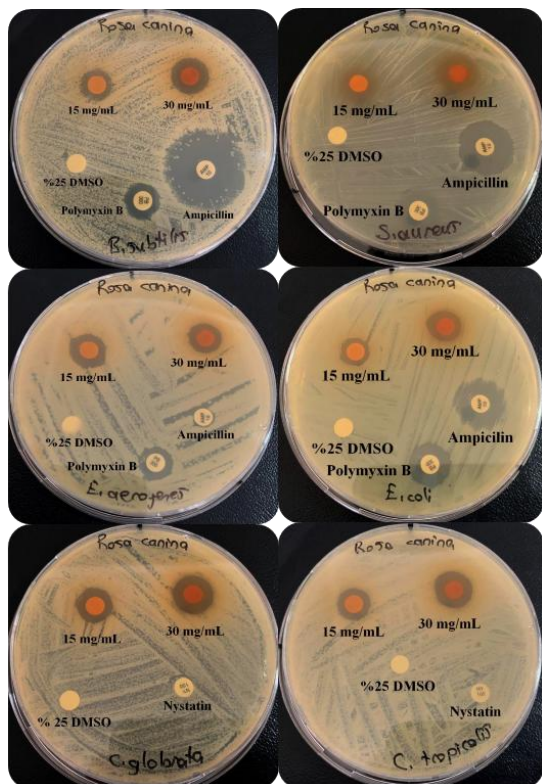


Figure 3. Evaluation of the antimicrobial activity of *R. canina* extract at concentrations of 15 mg/mL and 30 mg/mL against various pathogenic microorganisms using the disk diffusion method.

In a recent study, Miljković et al. (2024) conducted a comprehensive investigation on commercially available dried *R. canina* fruits from Serbia. The chemical composition of both polar and non-polar extracts, obtained using a solvent mixture of hexane, acetone, and ethanol (2:1:1, v/v/v) containing 0.05% (w/v) butylated hydroxytoluene (BHT), was analyzed by UHPLC-DAD-ESI-MS. Additionally, total lycopene, β -carotene, polyphenol, and flavonoid contents were quantified using UV-Vis spectrophotometry. Antioxidant activity was assessed through four complementary assays: ABTS, DPPH, FRAP, and CUPRAC. A total of nine compounds were identified in the extracts. These chemical composition data provided a basis for interpreting the antioxidant and antimicrobial activities observed. The dried *R. canina* fruit extract showed notable levels of bioactive compounds, including β -carotene (7.25 mg/100 g fresh weight), lycopene (2.34 mg/100 g FW), total

polyphenol content (2980 mg GAE/kg FW), and total flavonoid content (1454 mg CE/kg FW). Antioxidant activities measured by ABTS, DPPH, FRAP, and CUPRAC assays were 12.3 μ mol/100 g, 6.84, 52.04, and 15,425, respectively. Regarding antimicrobial activity, minimum inhibitory concentrations (MIC) and minimum microbicidal concentrations (MMC) were reported as follows: *Staphylococcus aureus* (4/0 mg/mL), *Enterococcus faecalis* (4/0), *Bacillus cereus* (4/0), *Escherichia coli* (4/0), *Salmonella enteritidis* (4/4), *Enterobacter aerogenes* (4/0), *Pseudomonas aeruginosa* (2/0), and *Candida albicans* (2/0).

Taken together, these findings reinforce the potential of *R. canina* extract as a promising plant-based candidate for complementary or alternative treatments, especially in the context of multidrug-resistant microorganisms. Nevertheless, further in vivo investigations, toxicological evaluations, and isolation of specific active compounds are essential to fully elucidate its mechanism of action and facilitate future clinical applications.

These results suggest that *R. canina* possesses both antibacterial and antifungal potential, making it a candidate for alternative or complementary treatment strategies, particularly in the fight against multidrug-resistant microorganisms. However, further in vivo studies are required to support these findings, elucidate the mechanisms of action, and identify the active constituents responsible for the observed effects.

4. Conclusion

This study demonstrated that *R. canina* extract exhibits notable antimicrobial activity against both bacterial and fungal pathogens. The findings indicate that the extract, particularly at a concentration of 30 mg/mL, possesses a broad-spectrum antimicrobial profile and shows remarkable antifungal effects against certain *Candida* species. The inhibition zones observed against Gram-positive and Gram-negative bacteria support the potential of plant-based natural products as alternative agents in the treatment of infectious diseases. Furthermore, the lack of antimicrobial activity from the solvent control confirms that the observed effects were due to the *R. canina* extract itself.

In conclusion, *R. canina* extract appears to be a promising natural antimicrobial candidate that could serve as a complementary or supportive treatment option, especially in the fight against multidrug-resistant microorganisms. However, further in vivo studies, toxicological assessments, and the isolation of active compounds are necessary to validate its therapeutic potential and enable its translation into clinical applications.

Author Contributions

The percentages of the authors' contributions are presented below. All authors reviewed and approved the final version of the manuscript.

	A.V.	D.T.
C	50	50
D	60	40
S	60	40
DCP	50	50
DAI	50	50
L	70	30
W	50	50
CR	70	30
SR	80	20
PM	90	10
FA	50	50

C=Concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

Conflict of Interest

The authors declared that there is no conflict of interest.

Ethical Consideration

Ethics committee approval was not required for this study because of there was no study on animals or humans.

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