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ARTICLE

Comparative bioactive compounds in the leaves, petals, and hips of two wild rose species: Persian yellow rose (*Rosa foetida* Herrm.) and dog rose (*Rosa canina* L.)

Comparação dos compostos bioativos nas folhas, pétalas e frutos de duas espécies de roseiras silvestres: rosa amarela persa (*Rosa foetida* Herrm.) e rosa canina (*Rosa canina* L.)

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Abstract
It is crucial to seek new sources of natural bioactive compounds, especially as consumers prioritize food quality. In this context, this study compares the bioactive compounds of the Persian yellow rose (*Rosa foetida*), which has received less attention than the dog rose (*Rosa canina*). While extensive research has highlighted the valuable properties of *R. canina* hips, such as their vitamin C content, antioxidant capacity, and medicinal uses, this study indicates that other parts of the plant may also be rich in nutrients. The comparison of the bioactive properties of these two species in leaves, petals, and hips revealed distinct distribution patterns of the measured compounds throughout different parts of the plant. Total phenolic and flavonoid content were significantly higher in the leaves of both *R. foetida* and *R. canina* compared to petals and hips, with the leaves of *R. foetida* exhibiting the highest levels. Vitamin C was primarily concentrated in the hips of both species, with *R. foetida* hips showing 33.14% more vitamin C than *R. canina* hips. Additionally, the hips of *R. foetida* contained the highest anthocyanin levels with 65.43 mg/100 g of fresh weight. Antioxidant capacity had a distinct pattern, with the leaves of both species showing high levels. Overall, the study emphasizes the need for further research into the diverse uses of *R. foetida*, given its superior bioactive profile and distinct morphological traits.
Keywords: antioxidant, bioactive compounds, hips, wild rose.

Resumo
É fundamental buscar novas fontes de compostos bioativos naturais, especialmente à medida que os consumidores passam a priorizar a qualidade dos alimentos. Nesse contexto, este estudo compara os compostos bioativos da rosa amarela persa (*Rosa foetida*), que tem recebido menos atenção do que a rosa canina (*Rosa canina*). Embora diversas pesquisas já tenham destacado as valiosas propriedades dos frutos de *R. canina*, como o alto teor de vitamina C, a capacidade antioxidante e os usos medicinais, este estudo indica que outras partes da planta também podem ser ricas em nutrientes. A comparação das propriedades bioativas dessas duas espécies em folhas, pétalas e frutos revelou padrões distintos de distribuição dos compostos medidos ao longo das diferentes partes da planta. O teor total de fenólicos e flavonoides foi significativamente maior nas folhas de ambas as espécies, *R. foetida* e *R. canina*, em comparação com as pétalas e frutos, sendo que as folhas de *R. foetida* apresentaram os níveis mais elevados. A vitamina C concentrou-se principalmente nos frutos de ambas as espécies, com os frutos de *R. foetida* apresentando 33,14% mais vitamina C do que os de *R. canina*. Além disso, os frutos de *R. foetida* apresentaram o maior teor de antocianinas, com 65,43 mg/100 g de massa fresca. A capacidade antioxidante mostrou um padrão distinto, com as folhas de ambas as espécies exibindo altos níveis. De modo geral, o estudo enfatiza a necessidade de novas pesquisas sobre os múltiplos usos de *R. foetida*, considerando seu perfil bioativo superior e suas características morfológicas distintas.
Palavras-chave: antioxidante, compostos bioativos, frutos, rosa silvestre.

Introduction

The *Rosa* genus belongs to the Rosaceae family and includes 150 to 200 semi-evergreen to deciduous species. These species are found throughout Asia, the Middle East, Europe, and North America (Fayaz et al., 2024). Roses are commonly grown in gardens, as potted plants, and as cut flowers because of their attractive appearance and fragrant blooms (Gahlaut et al., 2021). In addition to being ornamental, the false fruits (hips) of certain rose species, like the dog rose (*Rosa canina* L.), and the petals of the Persian yellow rose (*Rosa foetida* Herrm.) have noteworthy nutritional and medicinal benefits. This is attributed to their rich content of antioxidants and other health-promoting compounds (Asghar et al., 2022; Shabani et al., 2022).

In addition to its aesthetic appeal as an ornamental shrub and hedge plant, *R. foetida* boasts a wealth of bioactive diversity in its leaves, petals, and hips. Traditional uses highlight the potential of various plant parts. For example, dried petals are known for their analgesic and anti-inflammatory effects, while hips are used to treat vitamin C deficiency and digestive disorders. Scientific studies support these properties and have also discovered additional benefits, including pain relief and antimicrobial activity (Shabani et al., 2022). Shameh et al., (2018) reported that *R. foetida* petals have a high level of caffeic acid content (64.18 µg g^{-1} DW) compared to other species. This suggests that *R. foetida* could serve as a source of this bioactive compound with antioxidant properties.

R. canina is a shrub that reaches a height of 1-4 meters and produces white to light pink flowers. Notably, the hips of this plant are known for their various potential health benefits. They have traditionally been used as antioxidants, anti-inflammatories, and digestive remedies (Miljković et al., 2024). Scientific studies have also shown that *R. canina* hips have promising cardiovascular and immune-modulatory properties (Bamne et al., 2024). Furthermore, they have been reported to be effective in treating type 2 diabetes and oxidative stress, which calls for further investigation (Mourabit et al., 2023). It has also been found that the hips of *R. canina* contain an abundance of polyphenolic compounds, such as anthocyanins, procyanidins, catechin, and quercetin (Miljković et al., 2024). In addition, *R. canina* hips are a valuable source of vitamin C, carotenoids such as lycopene, beta-carotene, and zeaxanthin, and tocopherols (Tejpal et al., 2025).

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Compared to the well-studied species *R. canina*, which has known valuable properties, research on *R. foetida* is significantly limited, despite its promising bioactive potential. A thorough literature review has confirmed this knowledge gap, in particular. The lack of comparative studies that explores the bioactive differences between these two rose species. Although there is established knowledge about *R. canina*, there is a lack of a comprehensive bioactive comparison with *R. foetida*. This study seeks to fill this gap by conducting the first comprehensive bioactive comparison of these two rose species. By analyzing the various constituents of their leaves, petals, and hips, we hope to reveal the unique properties of *R. foetida* and establish its potential as a valuable source. This newfound knowledge could contribute to developing novel functional foods, nutraceuticals, and pharmaceuticals.

Materials and Methods

Location and plant material

This study focused on two rose species: the Persian yellow rose (*R. foetida* Herrm.), locally known as "Gol-e zard," and the dog rose (*R. canina* L.), referred to as "Shilan" or "Delegh." Both species are naturally found in the Abidar Mountain range in the Kurdistan province of western Iran, specifically at a latitude of 46°58'31''N and longitude of 35°17'46''E, with an elevation of 1726 m.

In Fig. 1 the morphological characteristics of both species' leaves, flowers, hips, and seeds are displayed. Detailed weather data, including temperature and precipitation values, for the Abidar Mountain region are presented in Table 1 for two years. The soil had a loamy texture, with a pH of 8.13, an electrical conductivity of 0.49, and a percentage of organic matter of 1.37%.

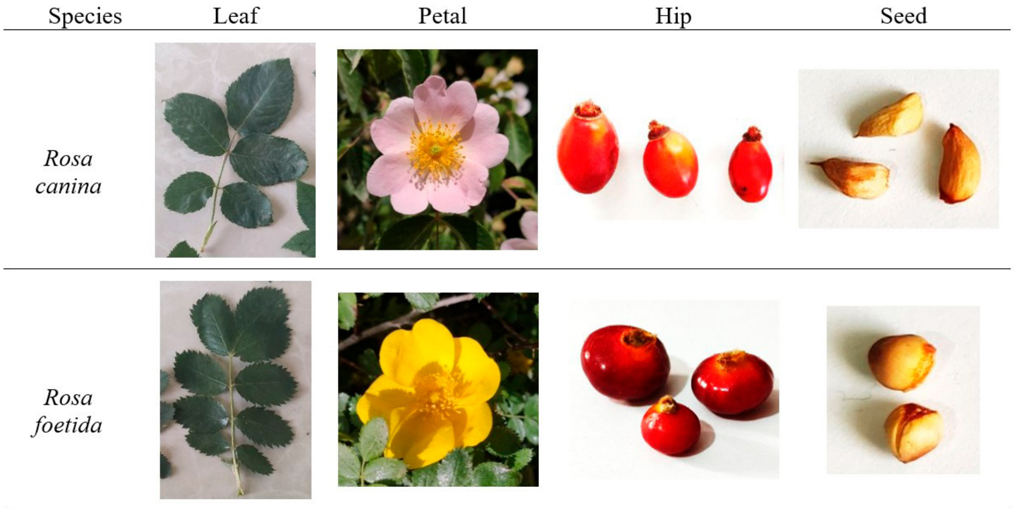

Fig. 1. Representative images of the leaves, flowers, hips, and seeds of *R. canina* and *R. foetida*.

Table 1. Climatic data from 2022 and 2023 for Abidar Mountain, located in the Kurdistan province of Iran, where the shrubs of the two evaluated rose species were growing.

Climatic data	Month												
	Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Minimum temperature (ºC)	2022	-24	-5	1	6	9	14	19	19	12	7	1	0
	2023	-4	-4	4	-2	2	9	14	11	8	3	-2	-4
Maximum temperature (ºC)	2022	15	18	14	24	26	35	38	38	34	27	16	9
	2023	4	18	18	25	30	37	41	40	38	28	23	19
Average temperature (ºC)	2022	0	5	8	15	18	26	29	29	23	17	8	4
	2023	0	2	10	13	17	23	29	27	23	16	11	6
Average precipitation (mm)	2022	60.31	56.22	32.44	23.25	19.03	0.02	0	0	0	4.4	37.82	11.24
	2023	47.85	24.05	113.56	100.26	84.42	0.81	0	0	0	4.02	49.74	11.65

Collection of plant samples

To ensure that samples (leaf, flower, and hip) were collected at comparable developmental stages, the growth and flowering times of the two rose species were monitored. As a result, leaf and petal samples from both species were collected in May 2022, coinciding with their flowering period. In August 2022, once fully ripe, hip samples were collected from *R. foetida*, and in late September 2022, ripe hips were collected from *R. canina*. Immediately after the collecting, all samples were transported to the laboratory using dry ice for preservation. Leaf and petal samples were pulverized in a mortar with liquid nitrogen to obtain a fine powder. Hip samples were also frozen using liquid nitrogen and subsequently ground into a fine powder with a grinding machine. The powdered materials were divided into aliquots and placed into 15 mL Falcon tubes, then stored at -80°C until they were analyzed. Measurements of bioactive parameters of leaves, petals, and hips from both rose species were performed at the Department of Horticultural Science and Engineering, University of Tehran, and the University of Kurdistan.

Bioactive compounds

Samples extract preparation

For each sample, 0.5 g of powder previously prepared by grinding with liquid nitrogen, was combined with 3 mL of 1% acidic methanol. The mixture was placed into 2 mL microtubes and centrifuged at 12,000 g for 10 min using a Hettich MIKRO 200 centrifuge (Tuttlingen, Germany). The supernatant obtained was collected and stored at -80 °C pending subsequent analyses for total phenolic content, antioxidant activity, and anthocyanin levels.

Total phenolic content

The total phenolic content was determined using the Folin-Ciocalteu reagent, following the method outlined by Alipanah et al. (2024). Each sample (0.5 g) was ground with 2 mL of ice-cold 85% methanol in a porcelain mortar to obtain a homogeneous extract. The mixture was then centrifuged at 4 °C for 15 min at 12,000 g. Subsequently, 25 µL of the supernatant was combined with 100 µL of the Folin-Ciocalteu reagent. After a 3-min incubation, 600 µL of 7.5% sodium carbonate (w v^{-1}) was added. The volume of each sample was brought to 2 mL with distilled water. The samples were incubated in the dark at room temperature for 2 h, after which their absorbance was measured at 750 nm using a spectrophotometer (Unico UV-2100, New Jersey, NJ, USA). The total phenolic content was calculated based on a standard curve of gallic acid and expressed as mg of gallic acid per 100 g of fresh weight (FW).

Total flavonoid content

The total flavonoid content was measured with the aluminum chloride colorimetric method as outlined by Toor and Savage (2005). For petal samples, 100 µL of the acidic methanol extract was diluted with 300 µL of acidic methanol. In the case of hip and leaf samples, 50 µL of extract was mixed with 350 µL of acidic methanol. Next, 100 µL of each prepared solution was combined with 1 mL of distilled water. Following this, 75 µL of 5% sodium nitrite ($NaNO_2$) and an equal volume of 10% aluminum chloride ($AlCl_3$) were added. After a 5-min incubation, 500 µL of 1 N sodium hydroxide (NaOH) was introduced. The total volume was then brought up to 2.5 mL with distilled water. Absorbance readings were taken at 510 nm using a spectrophotometer. Flavonoid concentrations were quantified using a quercetin calibration curve and reported as mg catechin equivalents per 100 g FW.

Vitamin C content

Vitamin C content was determined using the titration procedure outlined by AOAC (2000). Initially, 0.5 g of tissue sample, previously powdered in liquid nitrogen, was homogenized with 2.5 mL of 5% trichloroacetic acid (TCA) in a mortar. The homogenate was then placed into a microtube, sonicated for 20 min, and centrifuged at 12,000 g for 10 min. Subsequently, 1 mL of the clear supernatant was diluted with 20 mL of distilled water. The vitamin C level was assessed by titrating with a 1% solution of 2,6-dichlorophenolindophenol (DCIP) while stirring magnetically until a stable pink color persisted, indicating the endpoint. The volume of DCIP consumed was recorded and compared with a standard curve generated from known vitamin C standards. The final vitamin C concentration was quantified as mg per 100 g FW.

Total anthocyanin

Anthocyanin content was determined using the pH differential technique as outlined by Cheng and Breen (1991). Two buffer solutions were prepared: one at pH 1.0 (consisting of 0.2 M KCl and 0.2 M HCl) and another at pH 4.5 (made from 1 M sodium acetate, 1 N HCl, and deionized water). For leaf and petal samples, 0.5 g of dried powder was homogenized and extracted separately with 4 mL of each buffer using liquid nitrogen. For hip samples, 0.25 g of powder was extracted similarly with 4 mL of each buffer. Following homogenization, the mixtures were centrifuged at 6,000 g for 15 min. The collected supernatants were then utilized to measure anthocyanin content. Prior to absorbance measurements, the spectrophotometer was calibrated using the same buffer employed in the extraction of each sample. Absorbance readings were taken at wavelengths of 520 nm and 700 nm. Anthocyanin levels were calculated and reported as mg per 100 g FW.

Antioxidant capacity

The 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activity of the extracts was evaluated following the procedure described by Baliyan et al. (2022). A 25 µM DPPH solution was prepared by dissolving 0.0025 g of DPPH in 100 mL of 80% methanol. For each test, 25 µL of the extract was combined with 975 µL of the DPPH solution in a cuvette. The mixture was then incubated in the dark at room temperature for 30 min. Absorbance was recorded at 515 nm using a UV-2100 spectrophotometer. The percentage of DPPH radical scavenging activity was calculated with the formula:

$$\text{DPPH radical scavenging (\%)}(A_{Blank} - A_{Sample} / A_{Blank}) \times 100$$

A_{Blank} refers to the absorbance measured for the DPPH solution without any added sample, while A_{sample} denotes the absorbance observed when the extract is present.

Statistical analysis

In this study, evaluations of bioactive compounds were conducted using a factorial randomized complete block design (RCBD). In the RCBD, the two factors were species (two levels: *R. foetida* and *R. canina*) and organ type (three levels: leaf, petal, hip). A total of six treatment combinations were replicated three times per plant. After verifying the normality and homogeneity of variances, mean comparisons were conducted using the least significant difference (LSD) test with a significance level of $p \leq 0.05$. The analysis was carried out using SAS 9.4 software (SAS Institute Inc., Cary, NC, USA). To provide a clear and concise comparison of the bioactive compounds in the leaf, petal, and hip organs of *R. canina* and *R. foetida*, a heat map was generated using R software (version 3.6.3) (https://cran.r-project.org/).

Results

Heat-map analysis of bioactive compounds in two species

A heat map of bioactive compounds (Fig. 2) in the three organs (leaf, petal, and hip) of *R. canina* and *R. foetida* revealed three distinct groups based on their similarities. In the first group, the leaves of both species are clustered together. In the second group, the hips of *R. canina* form a separate cluster, while in the third group, the hips and petals of *R. foetida* are grouped together with the petals of *R. canina*. The analysis of the heat map indicates that the behavior of the leaves and petals of the two species is somewhat similar in terms of bioactive compounds; however,they differ when it comes to the hips (Fig. 2)

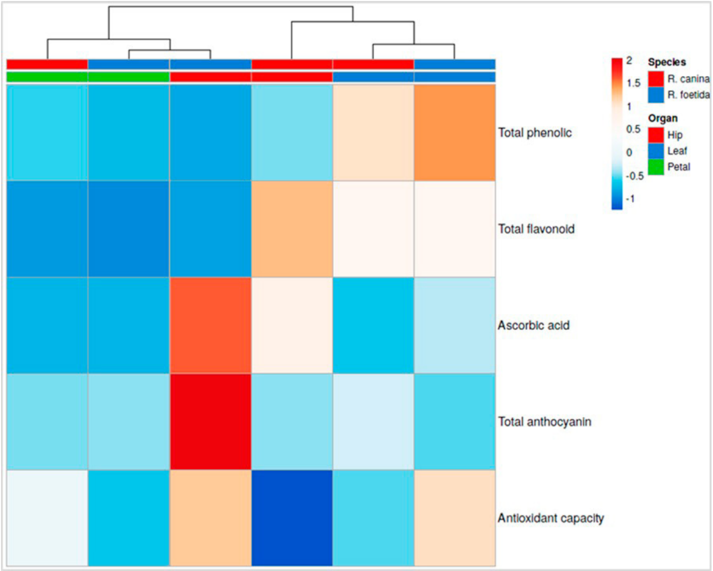

Fig. 2. Heat map comparison of bioactive compounds in the leaves, petals, and hips of *R. canina* and *R. foetida*.

Total phenolic content

The total phenolic content in the leaf tissues of both species (Fig. 3) was significantly higher than that in the petals and hips. Comparing the leaves, *R. foetida* had the highest total phenolic content (1193 mg/100 g FW), which was 12.58% higher than that of *R. canina*. Interestingly, the total phenolic content in the petals of *R. canina*, although not statistically different from that in *R. foetida* petals, was the highest among all the petal samples. Lastly, *R. canina* hips exhibited a greater total phenolic content compared to *R. foetida* hips, although this difference was not statistically significant (Fig. 3).

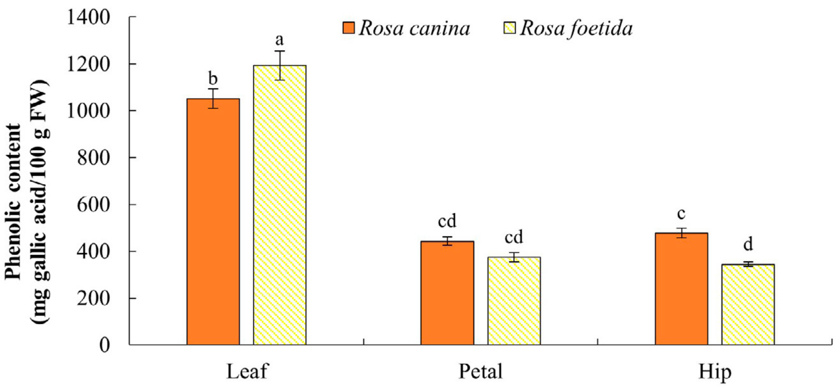

Fig. 3. Comparison of the phenolic content in the leaves, petals, and hips of R. canina and R. foetida. Different letter(s) above the bars signify significant differences at $p \leq 0.05$, as determined by the LSD test. Error bars represent the standard errors of the means (n = 3).

Total flavonoid content

Similar to the total phenolic content, the flavonoid content (Fig. 4) was significantly higher in the leaves (447.51 mg catechin/100 g FW) of both species compared to the hips (348.22 mg catechin/100 g FW) and petals (105.04 mg catechin/100 g FW). Interestingly, unlike the total phenolic content, there was no significant difference in the flavonoid content of the leaves between *R. foetida* and *R. canina*. However, *R. canina* hips had the highest flavonoid content (580.4 mg catechin/100 g FW), which was significantly greater than the content measured in *R. foetida* hips, representing an increase of 133.36% (Fig. 4).

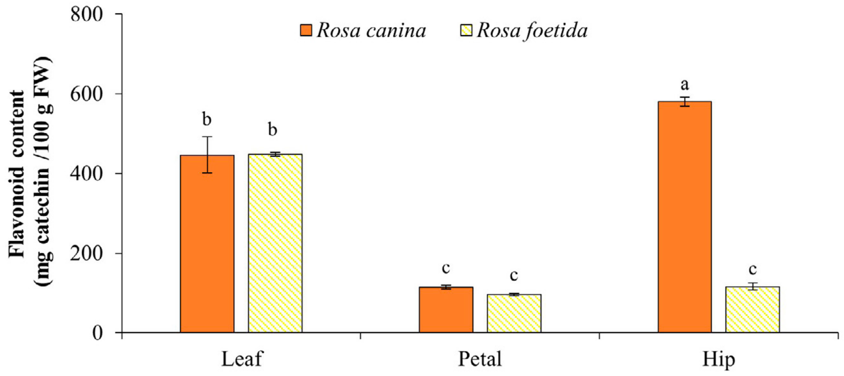

Fig. 4. Comparison of the flavonoid content in the leaves, petals, and hips of R. canina and R. foetida. Different letter(s) above the bars signify significant differences at $p \leq 0.05$, as determined by the LSD test. Error bars represent the standard errors of the means (n = 3).

Vitamin C

The vitamin C content in the hips of both species was significantly higher than in the petals and leaves. *R. foetida* hips displayed the highest vitamin C content, exceeding *R. canina* hips by 33.14%. Furthermore, the leaves of *R. foetida* exhibited significantly higher vitamin C content than those of *R. canina*, with an increase of 45.43%. However, no significant difference was observed in vitamin C content between the petal tissues of the two species (Fig. 5)

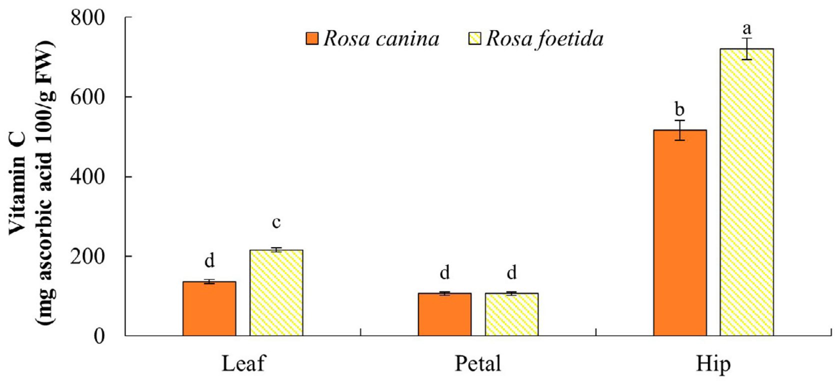

Fig. 5. Comparison of the vitamin C content in the leaves, petals, and hips of *R. canina* and *R. foetida*. Different letter(s) above the bars signify significant differences at $p \leq 0.05$, as determined by the LSD test. Error bars represent the standard errors of the means (n = 3).

Total anthocyanin

A significant difference in total anthocyanin content was observed between the two species. Specifically, the total anthocyanin content of *R. foetida* was found to be approximately five times higher than that of *R. canina* across all three organs. Among all analyzed organs and species, *R. foetida* hips exhibited the highest anthocyanin content (65.43 mg/100 g FW), significantly surpassing all other measurements. This value represents a 93.62% increase compared to *R. canina* hips (4.11 mg/100 g FW). Interestingly, *R. canina* leaves displayed a higher anthocyanin content (1.9 mg/100 g FW) compared to *R. foetida* leaves. Conversely, *R. foetida* petals exhibited a higher anthocyanin content (4.43 mg/100 g FW) than *R. canina* petals (Fig. 6)

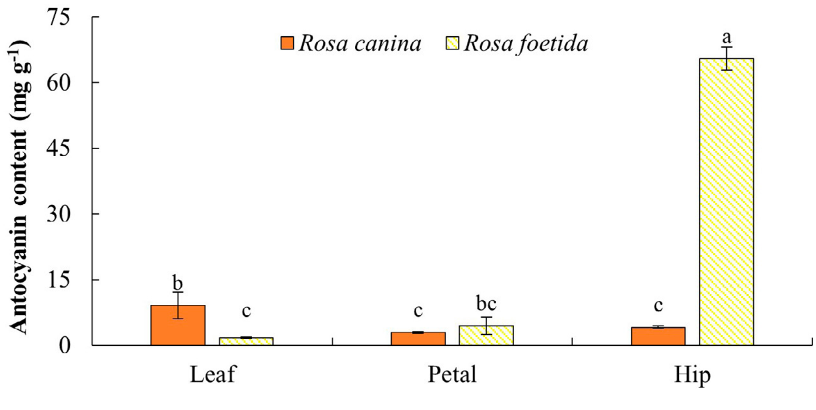

Fig. 6. Comparison of the total anthocyanin content in the leaves, petals, and hips of *R. canina* and *R. foetida*. Different letter(s) above the bars signify significant differences at $p \leq 0.05$, as determined by the LSD test. Error bars represent the standard errors of the means (n = 3).

Antioxidant capacity

As shown in Fig. 7, the two species do not exhibit a significant difference in antioxidant capacity in their leaves and petals; however, there is a notable difference in their hips. Interestingly, despite no significant species-level differences, the antioxidant capacity of *R. foetida* leaves (94.43%) and hips (95.44%) tended to be higher compared to *R. canina* (86.39% and 88.32%, respectively). Conversely, *R. canina* petals displayed slightly higher antioxidant capacity (89.76%) than *R. foetida* petals (88.12%), although this difference is not significant (Fig. 7).

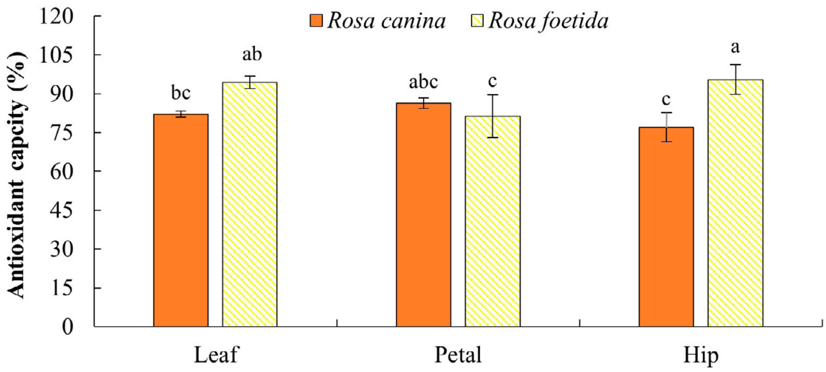

Fig. 7. Comparison of the antioxidant capacity in the leaves, petals, and hips of *R. canina* and *R. foetida*. Different letter(s) above the bars signify significant differences at $p \leq 0.05$, as determined by the LSD test. Error bars represent the standard errors of the means (n = 3).

Discussion

Despite extensive research on *R. canina* and its various applications, a significant knowledge gap remains regarding its close relative, *R. foetida*. This study aimed to address this gap by conducting a comparative analysis of the bioactive profiles of these two rose species. The findings have important implications, as identifying species with comparable or even higher levels of valuable compounds could lead to the development of new functional foods and nutraceuticals.

Phenolic compounds, the primary class of bioactive compounds in plants, act as natural antioxidants and provide various health benefits, including anti-tumor, anti-ulcer, and anti-inflammatory properties (Pekacar et al., 2021). Our findings on total phenolic content align with those of Aggarwal and Kaur (2017), who indicated that total phenol levels in rose petals are approximately 348 mg/100g. Additionally, studies on different *R. canina* ecotypes have reported values ranging from 398 to 511 mg/100g (Bozhuyuk et al., 2021). This demonstrates consistency between existing knowledge and our observations for both petals and hips. Our study revealed that total phenolic content was highest in the leaves of both *R. foetida* and *R. canina*, highlighting the potential of rose leaves as a valuable source of antioxidant agents. Furthermore, these results suggest that rose leaves, in addition to the commonly used hips, hold promise for various applications as a rich source of bioactive compounds, including potential uses in home products, the pharmaceutical industry, and the food industry.

Flavonoids, bioactive compounds found in plants, offer a wide range of health benefits, including anti-cancer, antimicrobial, antiviral, anti-inflammatory, anti-malarial, antioxidant, neuroprotective, anti-tumor, and anti-proliferative properties (Sarwar et al., 2025). Our findings regarding the flavonoid content in *R. foetida* and *R. canina* are generally consistent with previous research. Earlier studies reported flavonoid levels of approximately 1.13 mg g^{-1} in *R. canina* leaves (D'angiolillo et al., 2018) and 0.95 to 1.87 mg g^{-1} in the hip (Bozhuyuk et al., 2021). Our analysis revealed that both species had the highest levels of flavonoids in their leaves, which aligns with the observation that approximately 60% of the total phenolics in the leaves were flavonoids. Since the total phenolic content was also highest in the leaves, this explains the greater flavonoid content observed in the leaves compared to the petals and hips. Moreover, the measured flavonoid levels in the hips of both species fall within the previously reported range, indicating consistency with existing literature.

Vitamin C, a potent antioxidant, plays a vital role in various biological processes within plants. In humans, vitamin C has demonstrated potential therapeutic applications in treating various clinical disorders, including ascorbate deficiency, viral infections, neurological diseases, cardiovascular disease, anemia, and diabetes (Alberts et al., 2025). Our findings on vitamin C content in *R. foetida* and *R. canina* shed light on the variability of this important compound within the *Rosa* genus. Previous studies report diverse levels of vitamin C in different rose species and organs. For example, *R. damascena* petals exhibit approximately 293.37 mg/100 g (Kumar et al., 2017), while *R. canina* petals show lower vitamin C content, around 40.02 mg per 100 g (Aggarwal and Kaur, 2017). However, *R. canina* hips are known for their high vitamin C content, ranging from 430 to 1358 mg/100 g depending on habitat conditions (Bozhuyuk et al., 2021). Interestingly, our study revealed significantly higher vitamin C levels in *R. foetida* compared to *R. canina*. This finding highlights *R. foetida* as a wealthy source of vitamin C, with considerable potential for both raw consumption and use in processed products. Further research is warranted to explore optimal conditions for maximizing vitamin C content and investigate potential applications of *R. foetida* as a functional food source.

Anthocyanins, responsible for the red to blue colors in many plants, are powerful antioxidants that offer various potential health benefits. These benefits include improved eye health, cardiovascular protection, anti-obesity and anti-diabetic effects, antimicrobial activity, anti-cancer properties, and neuroprotection (Chen et al., 2024). The concentration of anthocyanins in hips is strongly influenced by factors such as species, variety, environment, and cultivation practices. Our findings indicate that *R. foetida* hips contain higher levels of anthocyanins compared to *R. canina* hips. The anthocyanin levels in *R. canina* hips align with previous studies, which report values ranging from 4.41 to 7.04 mg/kg FW (Bozhuyuk et al., 2021) and 2.45 to 3.72 mg/100 g FW (Murathan et al., 2016). However, there is limited data available on the anthocyanin content of *R. foetida*.

The significantly higher anthocyanin content in *R. foetida* hips calls for further investigation. If further research confirms these findings, *R. foetida* could be recognized as a significant source of anthocyanins, paving the way for its use in developing functional foods and natural health products.

Previous studies have shown that different parts of roses, such as leaves, petals, and hips, exhibit varying levels of antioxidant capacity. In this study, we investigate the antioxidant potential of *R. foetida* and *R. canina* by comparing our findings with existing literature. Our results indicate that the antioxidant capacity in the leaves of both species is comparable and potentially higher than previously reported for *R. canina* leaves (87.7%, Nowak and Gawlik-Dziki, 2007). This suggests that *R. foetida* leaves may be a valuable source of antioxidants. The antioxidant capacity observed in the petals of both species was generally lower than the values reported for *R. damascena* petals, 83.91% (Kumar et al., 2017). While both species show potential as sources of antioxidants in petals, further investigation may be needed to understand the factors influencing this variation. In contrast to petals, the antioxidant capacity of *R. foetida* hips was higher than that of *R. canina* hips (85.02%, Sallustio et al., 2022) and comparable to that of rose hips (76.9%, Xu et al., 2018). This suggests that *R. foetida* hips may have similar potential to *R. canina* hips in terms of antioxidant content. Overall, both *R. foetida* and *R. canina* demonstrate promising potential as sources of antioxidants across various plant parts. Further research is necessary to explore the specific types of antioxidants present and their potential health benefits.

Moreover, further research is needed to explore the specific biological activities and potential health benefits associated with the identified bioactive constituents in *R. foetida*. Investigating the environmental factors that influence the production of these compounds could help optimize cultivation strategies to maximize their content. This study specifically examined a restricted geographic area and particular plant genotypes. To gain a more thorough understanding of the bioactive variability of the species, future research should explore a wider range of geographical regions and diverse *R. foetida* genotypes. In summary, this study provides valuable insights into both the bioactive profile of *R. foetida* and *R. canina*. The comparable, and in some cases superior, bioactive profile of *R. foetida*, suggests its potential as a valuable source of bioactive compounds. Further research into the cultivation strategies and geographical variability of these species is warranted to optimize their use in functional foods, nutraceuticals, and pharmaceutical products.

Conclusion

This study presents a comprehensive comparison of both the bioactive comparison between two wild rose species: *R. foetida*, native to the Kurdistan region of Iran, and *R. canina*, a well-established medicinal plant. Our findings reveal that *R. foetida* contains comparable or even higher levels of various bioactive compounds compared to *R. canina*. Notably, *R. foetida* hips exhibited significantly higher concentrations of vitamin C and anthocyanins, while both species demonstrated high antioxidant capacity across all analyzed plant parts. This suggests that in addition to the traditionally valued hips, the leaves and petals of *R. foetida* hold potential as valuable sources of bioactive compounds.

Overall, the combined bioactive profiles highlight *R. foetida* as an under-explored but highly promising resource for the development of functional foods, nutraceuticals, and pharmaceuticals. Its abundance in the Kurdistan region makes it suitable for sustainable utilization, and its comparable or superior levels of bioactive compounds relative to *R. canina* further enhance its significance. This research establishes *R. foetida* as a valuable new bioactive and ecological resource, leading the way for future investigations into its specific applications, cultivation strategies, and health benefits.

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Author Contribution

NN: Conceptualization, Data Curation, Investigation, Writing – Original Draft, Writing – Review & Editing. **RN**: Methodology, Supervision, Writing – Review & Editing. **VN**: Project Administration, Supervision, Data Curation, Validation, Software, Writing – Review & Editing. **FN**: Project Administration, Supervision, Validation, Writing – Original Draft, Writing – Review & Editing.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability Statement

Data will be made available upon request to the authors.

Declaration of generative AI and AI-assisted technologies in the writing process

The authors declare that AI and AI-assisted technologies were not used in the writing process.

References

AGGARWAL, P.; KAUR, S. Technology development for the preparation, concentration and utilization of rose extract in different valuable products and by products with retention of color. **Pharmaceutical Innovations**, v.6, p.189, 2017.

ALBERTS, A.; MOLDOVEANU, E. T.; NICULESCU, A. G.; GRUMEZESCU, A. M. Vitamin C: a comprehensive review of its role in health, disease prevention, and therapeutic potential. **Molecules**, v.30, n.3, p.748, 2025. https://doi.org/10.3390/molecules30030748

ALIPANAH, S.; NAZARI, F.; KOUSHESH SABAA, M.; TEIXEIRA DA SILVA, J.A. Biochemical changes of autumn daffodil (*Sternbergia lutea*) during bulb dormancy and flowering. **Genetic Resources and Crop Evolution**, v.71, p.2355-2371, 2024. https://doi.org/10.1007/s10722-023-01787-2

AOAC. Association of Official Agricultural Chemists (17th ed.). 2000. https://www.sigmaaldrich.com/catalog/product/aldrich/z423645

ASGHAR, M.; SAJJAD, A.; HANIF, S.; ALI, J. S.; ZEESHAN, M.; ZIA, M. Comparative analysis of synthesis, characterization, antimicrobial, antioxidant, and enzyme inhibition potential of roses petal based synthesized copper oxide nanoparticles. **Materials Chemistry and Physics**, v.278, p.125724, 2022. https://doi.org/10.1016/j.matchemphys.2022.125724

BALIYAN, S.; MUKHERJEE, R.; PRIYADARSHINI, A.; VIBHUTI, A.; GUPTA, A.; PANDEY, R. P.; CHANG, C. M. Determination of antioxidants by DPPH radical scavenging activity and quantitative phytochemical analysis of *Ficus religiosa*. **Molecules**, v.27, n.4, p.1326, 2022. https://doi.org/10.3390/molecules27041326

BAMNE, F.; SHAIKH, N.; ALI, A.; MOMIN, M.; KHAN, T. Phytochemicals and overview of the evolving landscape in management of osteoarthritis. In: Izah, S.C., Ogwu, M.C., Akram, M. (eds) **Herbal Medicine Phytochemistry. Reference Series in Phytochemistry**. Springer, Cham. p.835-858, 2024. https://doi.org/10.1007/978-3-031-21973-3_55-1

BOZHUYUK, M. R.; ERCISLI, S.; KARATAS, N.; EKIERT, H.; ELANSARY, H. O.; SZOPA, A. Morphological and biochemical diversity in fruits of unsprayed *Rosa canina* and *Rosa dumalis* ecotypes found in different agroecological conditions. **Sustainability**, v.13, n.14, p.8060, 2021. https://doi.org/10.3390/su13148060

CHEN, S.; JIA, Y.; WU, Y.; REN, F. Anthocyanin and its bioavailability, health benefits, and applications: a comprehensive review. **Food Reviews International**, v.40, n.10, p.3666-3689, 2024. https://doi.org/10.1080/87559129.2024.2369696

CHENG, G. W.; BREEN, P. J. Activity of phenylalanine ammonia-lyase (PAL) and concentrations of anthocyanins and phenolics in developing strawberry fruit. **Journal of the American Society for Horticultural Science**, v.116, p.865-869, 1991. https://doi.org/10.21273/JASHS.116.5.865

D'ANGIOLILLO, F.; MAMMANO, M. M.; FASCELLA, G. Pigments, polyphenols and antioxidant capacity of leaf extracts from four wild rose species grown in Sicily. **Notulae Botanicae Horti Agrobotanici Cluj-Napoca**, v.46, n.2, p.402-409, 2018. https://doi.org/10.15835/nbha46211061

FAYAZ, F.; SINGH, K.; GAIROLA, S.; AHMED, Z.; SHAH, B. A. A comprehensive review on phytochemistry and pharmacology of *Rosa* species (Rosaceae). **Current Topics in Medicinal Chemistry**, v.24, n.4, p.364-378, 2024. https://doi.org/10.2174/0115680266274385231023075011

GAHLAUT, V.; KUMARI, P.; JAISWAL, V.; KUMAR, S. Genetics, genomics and breeding in *Rosa* species. **Journal of Horticultural Science and Biotechnology**, v.96, n.5, p.545-559, 2021. https://doi.org/10.1080/14620316.2021.1894078

KUMAR, A.; KAUR, A.; JOSHI, V.K.; KUMAR, V. *Rosa damascena*: quality evaluation and process optimization for the development of rose syrup. **International Journal of Food Fermentation Technology**, v.7, n.2, p.279-285, 2017. https://doi.org/10.5958/2321-5771.2017.00038.2

MILJKOVIĆ, V.M.; NIKOLIĆ, L.N.; MRMOŠANIN, J.; GAJIĆGAJIĆ, I.; MIHAJILOV-KRSTEV, T.; ZVEZDANOVIĆ, J.Z.; MILJKOVIĆ, M.M. Chemical profile and antioxidant and antimicrobial activity of *Rosa canina* L. dried fruit commercially available in Serbia. **International Journal of Molecular Sciences**, v.25, n.5, p.2518, 2024. https://doi.org/10.3390/ijms25052518

MOURABIT, Y.; EL HAJJAJI, S.; TAHA, D.; BADAOUI, B.; EL YADINI, M.; RUSU, M.E.; LEE, L.H.; BOUYAHYA, A.; BOURAIS, I. HPLC-DAD-ESI/MS phytochemical investigation, antioxidant, and antidiabetic activities of Moroccan *Rosa canina* L. extracts. **Biocatalysis and Agricultural Biotechnology**, v.52, p.102817, 2023. https://doi.org/10.1016/j.bcab.2023.102817

MURATHAN, Z.; ZARIFIKHOSROS, H.M.; KAFKAS, F.; SEVINDIK, E. Characterization of bioactive compounds in rosehip species from East Anatolia region of Turkey. **Italian Journal of Food Science**, v.28, n.2, 2016.

NOWAK, R.; GAWLIK-DZIKI, U. Polyphenols of Rosa L. leaves extracts and their radical scavenging activity. **Zeitschrift für Naturforschung C**, v.62, n.1-2, p.32–38, 2007. https://doi.org/10.1515/znc-2007-1-206

PEKACAR, S.; BULUT, S.; ÖZÜPEK, B.; ORHAN, D.D. Anti-inflammatory and analgesic effects of rosehip in inflammatory musculoskeletal disorders and its active molecules. **Current Molecular Pharmacology**, v.14, n.5, p.731-745, 2021. https://doi.org/10.2174/1874467214666210804154604

SALLUSTIO, V.; CHIOCCHIO, I.; MANDRONE, M.; CIRRINCIONE, M.; PROTTI, M.; FARRUGGIA, G.; ABRUZZO, A.; LUPPI, B.; BIGUCCI, F.; MERCOLINI, L.; POLI, F.; CERCHIARA, T. Extraction, encapsulation into lipid vesicular systems, and biological activity of *Rosa canina* L. bioactive compounds for dermocosmetic use. **Molecules**, v.27, n.9, p.3025, 2022. https://doi.org/10.3390/molecules27093025

SARWAR, R.; MAISAM, M.; KHAN, M. W.; XUE, Y.; HASSAN, S. Bioactive compounds in herbal remedies. In: **Herbal Pharmacopeia**. Boa Raton: CRC Press, 2025. p.89-121.

SHABANI, F.; OMIDVAR, S.; SAJADI KABOUDI, P.; PASHA, H.; KHAFRI, S.; NAJAFZADEHVARZI, H.; NASIRI AMIRI, F.; FARAMARZI, M.; BOUZARI, Z. The effects of *Rosa foetida* extract along with self-care education on primary dysmenorrhea: study protocol for a randomized clinical trial. **Trials**, v.23, n.1, p.1–7, 2022. https://doi.org/10.1186/s13063-022-06583-4

SHAMEH, S.; HOSSEINI, B.; ALIREZALU, A.; MALEKI, R. Phytochemical composition and antioxidant capacity of petals of six *Rosa* species from Iran. **Journal of AOAC International**, v.101, n.6, p.1788–1793, 2018. https://doi.org/10.5740/jaoacint.18-0111

TEJPAL, S.; DOGRA, S.; SHARMA, S. The role of *Rosa canina* in modulating NF-Kb and MAPK signaling pathways: a key to anti-inflammatory therapy. **Asian Journal of Pharmaceutical Research and Development**, v.13, n.1, p.128-137, 2025. https://doi.org/10.22270/ajprd.v13i1.1516

TOOR, R. K.; SAVAGE, G. P. Antioxidant capacity in different fractions of tomatoes. **International Food Research Journal**, v.38, p.487–494, 2005. https://doi.org/10.1016/j.foodres.2004.10.016

XU, J.; JÖNSSON, T.; PLAZA, M.; HÅKANSSON, Å.; ANTONSSON, M.; AHREN, I. L.; TURNER, C.; SPÉGEL, P.; GRANFELDT, Y. Probiotic fruit beverages with different polyphenol profiles attenuated early insulin response. **Nutrition Journal**, v.17, p.1-10, 2018. https://doi.org/10.1186/s12937-018-0335-0