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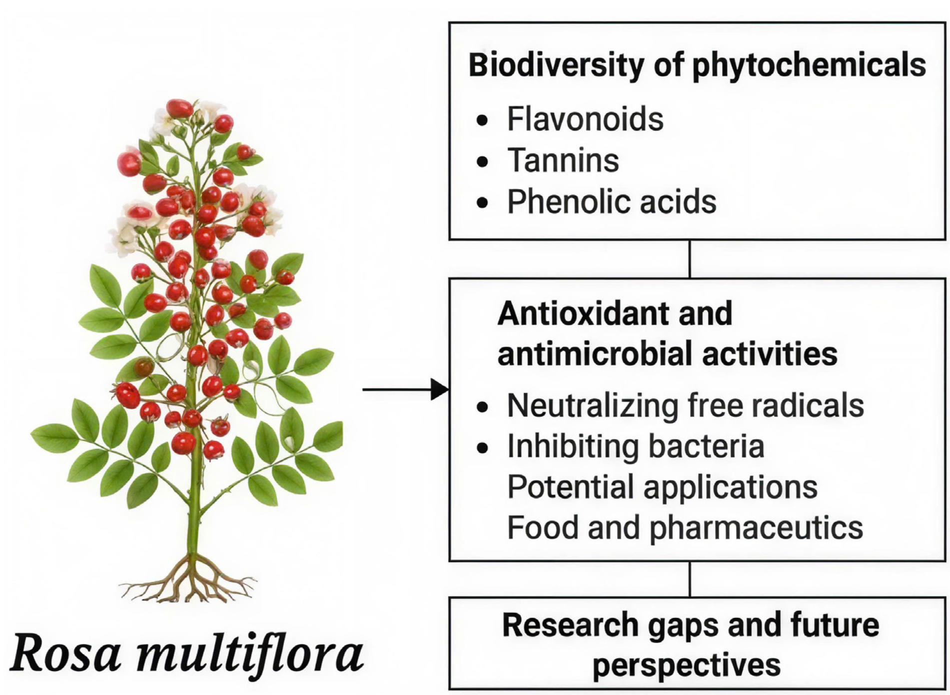
Rosa multiflora Thunb.: Chemical composition and potential pharmaceutical applications

Le Pham Tan Quoc, Pham My Hao, Pham Thi Quyen, Lam Bach Bao Phuong

Institute of Biotechnology and Food Technology, Industrial University of Ho Chi Minh City, Viet Nam

ABSTRACT: *Rosa multiflora* Thunb., is a widely distributed plant species of the Rosaceae family and used in traditional medicine in many Asian countries. In recent years, this species has attracted increasing attention in the field of medicinal research due to its high content of bioactive compounds. This article aims to systematically evaluate the morphological characteristics, secondary chemical constituents, and major biological activities of *R. multiflora*, such as antioxidant, antibacterial, and anti-inflammatory properties. Studies have shown that this species contains significant amounts of flavonoids, phenolic acids, tannins, triterpenoids, and carotenoids, which contribute to its potential biological effects. However, most of the studies have only been conducted at the *in vitro* level, lacking clinical studies and *in vivo* trials to determine the actual efficacy and safety. Therefore, further in-depth studies are needed to optimally exploit the value of *R. multiflora* in pharmaceutical applications and the functional food industry.

GRAPHICAL ABSTRACT



1. INTRODUCTION

Rosa multiflora Thunb., is a climbing shrub, originated from East Asian regions such as China, Japan and Korea. The plant often grows in the wild in mountainous areas; has stout thorny stem with pinnate compound leaves; and small, five-petaled white or light pink flowers arranged in clusters (Nakamura et al., 2018). In Vietnam, *R. multiflora* is recorded in folklore and traditional medicine, with the popular name "Tam xuan". Accordingly, the flowers, fruits and roots of the plant are used to treat blood stasis, abdominal pain, rheumatism, weakness, or processed into a traditional medicinal wine called "Mai que lo", used as a tonic and to enhance circulation (Lợi, 2004).

In recent years, many modern studies have contributed to clarifying the chemical composition and biological activities of *R. multiflora*, thereby consolidating and expanding the scientific basis for the application of this species. Extracts from the fruit and flowers of the plant have been identified as rich in phenolic compounds and flavonoids, which are substances with strong antioxidant properties (Park et al., 2022). Specifically, according to research by Cho (2013), HPLC analysis identified six major phenolic compounds: rosmarinic acid, caffeic acid, chlorogenic acid, coumaric acid, protocatechuic acid and quercetin. Of these, rosmarinic acid exhibited the highest content at about 15.04 mg/g DW (dry weight) in ethanol extract, significantly higher than that in water extract (8.53 mg/g). Not only has antioxidant properties, ethanol extract from fruit *R. multiflora* also exhibited marked antibacterial activity against bacteria such as *Staphylococcus epidermidis* (25 mm), *Staphylococcus aureus* (14 mm), *Escherichia coli* (13 mm), and *Helicobacter pylori* (14 mm) when using phenolic content of about 200 μg/mL (Cho, 2013).

Research by Kim et al. (2022) also extended the analysis to the flowers and fruits of *R. multiflora*, and found that the ethanol extract and ethyl acetate fractions had high flavonoid contents, especially glycosides of kaempferol and quercetin. The 2,2-Diphenyl-1-picrylhydrazyl (DPPH) and superoxide scavenging activities of these samples were high, corresponding to their potential to protect cells from oxidative stress damage.

Remarkably, Kitahiro et al. (2019) discovered two different chemotypes in *R. multiflora*. Type I contained multiflorin A—a saponin with laxative effects and a major component of the traditional Japanese medicinal herb *Rosae fructus*. In contrast, Type II did not contain multiflorin A but was rich in flavonoid glycosides such as quercitrin and hyperin, indicating differences in chemical structure depending on genetic origin and growth conditions. This finding opens up further research directions on the intrinsic chemical diversity of the species as well as the influence on pharmacological effects.

In general, *R. multiflora* is a plant species that has both a long-standing traditional value and contains many highly biologically active natural compounds. Owing to its strong antioxidant and antibacterial properties, this species is attracting attention in the development of pharmaceuticals, functional foods and cosmetics of natural origin. However, there is still a lack of a comprehensive review that focuses on the chemical composition and biological activities of this species from a modern perspective.

Therefore, this article aims to synthesize, analyze and evaluate studies related to the phytochemical composition, antioxidant and antibacterial activities and application potential of *R. multiflora* Thunb., contributing to clarifying the scientific value and application of this plant in the field of natural medicine and pharmacy.

2. METHODOLOGY

To serve the study of chemical composition, potential pharmaceutical applications, and future directions of *R. multiflora* Thunb., a systematic literature review was conducted. Leading academic databases including Web of Science, Springer, Nature, Science Direct, Scopus, and PubMed were researched.

The selected literature included preclinical and clinical studies published from 1976 to 2025. In addition, we also consulted the monograph Vietnamese Medicinal Plants to supplement the data and traditional usage experiences. The main search terms used were "*Rosa multiflora*", "chemical composition", "pharmaceutical applications", "anti-inflammatory", "antioxidant", and "traditional medicine". Articles that did not directly focus on the identified aspects of *R. multiflora* Thunb. were excluded to ensure the depth of the study.

3. PLANT MORPHOLOGY OF *R. MULTIFLORA*

R. multiflora is a climbing shrub, reaching heights of 1.5 to 4.6 meters, sometimes reaching a maximum of ~4.6 m when growing well in favorable conditions (Dlugos et al., 2015). The stem is woody and has many curved spines (prickles) about 4–6 mm long, which are characteristic for climbing and spreading; the spines are usually scattered and not in pairs (Hung and Wang, 2022).

Leaves are alternate and odd-pinnate, usually with seven to nine leaflets (range 5–11), each leaflet elliptic to obovate, 12–45 mm long, 12–25 mm broad, usually glabrous above, finely hairy or glandular below, margins regularly serrated (Maitra et al., 2016). The most recognizable feature is the stipule at the base of the petiole with a fringed or hairy margin—a unique feature that distinguishes *R. multiflora* from other wild roses (Hindal and Wong, 1988).

The flowers of *R. multiflora* are borne in corymb or cyme clusters, each cluster containing 25 to more than 100 small flowers, each flower measuring 1.9–3.8 cm (0.75–1.5 in) in diameter, usually white or pale pink, with a structure consisting of five petals, many stamens, an upper ovary and a central yellow pistil (Evans, 1983; Min, 2014). Flowering period lasts from late May to June (Ljubojevíc et al., 2025).

After pollination, the tree produces hips that are round to oval, 5–7 mm in diameter; they ripen red to purple, and usually remain on the branches into winter without dropping or cracking the shell, facilitating seed dispersal and ecological drought tolerance (Osada et al., 2022).

4. PHYTOCHEMICAL COMPOSITION OF PARTS OF *R. MULTIFLORA*

Table 1 displays the chemical composition and extraction characteristics from different parts of *R. multiflora* showing a remarkable diversity in both the content and type of compounds obtained.

Hot water extract of the flowers (Tokyo, Japan), resulted in the highest polyphenol content (236.58 mg/g) and 16.91 mg/g of flavonoid (Park et al., 2022), showing the significant efficiency of hydrothermal extraction method in recovering water-soluble compounds. However, the extraction process using 70% acetone although did not yield the highest polyphenol content (216.97 mg/g) but yielded the highest flavonoid content (20.24 mg/g)—suggesting that solvent selection may influence the quantity of the target group of compounds to be extracted.

Notably, the 50% ethanol extract of the flowers (Seoul, Korea) in a study by Kim et al. (2018) yielded flavonoids up to 86.77 mg/g, which was significantly higher than that found in other studies, while maintaining polyphenols at a high level (202 mg/g), indicating that this solvent is a balance between efficiency and selectivity. Flavonoids ranged from 7.80 mg/g (70% ethanol; Tokyo, Japan) to 86.77 mg/g (50% ethanol-Seoul, Korea), polyphenols from 11.8 mg/g (fruit) to 236.58 mg/g (flower) (Cho, 2013; Kim et al., 2018; Park et al., 2022). This highlights the importance of optimizing the extraction process to achieve high yields and recover the correct target group of active compounds. In the fruit, the polyphenol content was found to be significantly lower (11.8 mg/g), although the presence of highly bioactive single compounds such as rosmarinic acid, caffeic acid, quercetin, and chlorogenic acid was notable (Cho, 2013). Although the total content is not high, the potential pharmacological value is due to valuable bioactive compounds.

Methanol extraction of the root resulted in 101.93 mg/g of polyphenol and 14.37 mg/g of flavonoid (Hwang et al., 2017) shows that the underground parts are also a rich source of active compounds—something that has been less exploited before.

The branches, although not specifically quantified, showed the potential for discovery of new polyphenolic compounds such as procyanidins, phlobatannins, flavan-3,4-diol glycosides and neolignan glycosides (Lee et al., 2022)—these structurally complex compounds, often associated with anti-inflammatory and anti-cancer activities, provide a foundation for further medicinal chemistry research.

Compared with other *Rosa* species (Table 2), it can be seen that *R. multiflora* has the highest polyphenol and flavonoid content. For example, hot water extract of *R. multiflora* flowers has a polyphenol content of up to 236.58 mg/g, which is higher compared to those in *R. sempervirens* (203.8 mg/g) and *R. nitidula* (142.83 mg/g) (Park et al., 2022; Bitis et al., 2017; Lacramioar and Rosu, 2021). Similarly, the flavonoid content

Table 1
Chemical composition and characteristics of extracts from parts of *Rosa multiflora.*

Parts/Sample source	Extraction solvent	Polyphenol content (mg/g)	Flavonoid content (mg/g)	Outstanding compounds discovered	References
Flower	Hot water	236.58	16.91	Total polyphenols, flavonoids	Park et al. (2022)
	Ethanol 70%	198.15	7.80	Total polyphenols	Park et al. (2022)
	Acetone 70%	216.97	20.24	Total polyphenols	Park et al. (2022)
	Water	140.74	45.31	Total polyphenols, flavonoids	Yeo et al. (2014)
	Ethanol 80%	37.83	42.68	Total polyphenols, flavonoids	Yeo et al. (2014)
	Ethanol 50%	202	86.77	Total polyphenols, flavonoids	Kim et al. (2018)
Fruit	Ethanol 70%	11.8	–	Rosmarinic, caffeic, quercetin, chlorogenic acid	Cho (2013)
Branch	Fractionated methanol	–	–	Procyanidins, phlobatannins, new neolignan glycosides	Lee et al. (2022)
Root	Methanol	101.925	14.365	Total polyphenols, flavonoids	Hwang et al. (2017)

Table 2

Polyphenol and flavonoid contents of extracts from other *Rosa* species.

Parts/Sample source	Extraction solvent	Polyphenol content (mg/g)	Flavonoid content (mg/g)	References
Rosa canina-Serbia	Methanol	74.6	1.22	Nađpal et al. (2016)
Rosa arvensis	Methanol	18.7	1.48	Nađpal et al. (2016)
Rosa damascena-Turkey	Water	0.481	–	Sengul et al. (2017)
Rosa damascena-Morocco	EtOH/water	20.07	0.987	Chroho et al. (2022)
Rosa indica	70% ethanol	3.355	3.736	Zahid et al. (2018)
Rosa centifolia	Water	3.529	2.805	Kayahan et al. (2024)
Rosa rugosa	Ethanol	50.73–96.69	15.93–31.88	Um et al. (2018)
Rosa sempervirens-Turkey	Methanol	203.8	95.81	Bitis et al. (2017)
Rosa nitidula	Methanol	83.02–142.83	7.32–19.45	Lacramioar and Rosu (2021)

in the 50% ethanol extract from *R. multiflora* flowers were found to be 86.77 mg/g, only lower than those in some samples from *R. sempervirens* (95.81 mg/g) but significantly higher than those in common species such as *R. canina*, *R. damascena* and *R. indica* (Kim et al., 2018; Bitis et al., 2017).

This confirms that *R. multiflora* is not only a rich source of polyphenols and flavonoids, but also has the potential to compete with other rose species that are widely exploited in the pharmaceutical and cosmetic industries. Furthermore, the diversity of geographical conditions and extraction solvents affecting the quality of extracts in all species also emphasize the importance of standardization of raw materials and extraction processes in the development of natural products from the *Rosa* family.

Besides the diversity in composition, the extraction yield from different parts of *R. multiflora* also has obvious fluctuations, reflecting the uneven distribution of phytochemical content in the plant (Table 3). According to Kim et al. (2022), the extraction yields from *R. multiflora* fruits (Suncheon, Korea) using different polar solvents such as hexane, ether, ethyl acetate and water ranged from 0.63 to 6.43%, whereas those from flowers ranged from 0.94 to 10.18%. For *R. wichuraiana*, the extraction yields from fruits and flowers using similar solvents were also in the range of 0.4–4.78% and 0.78–9.08%, respectively, which were generally lower than those from *R. multiflora*. In particular, Park et al. (2011) recorded exceptionally high extraction yields from *R. multiflora* roots using ethanol and acetone solvents, ranging from 14.13 to 17.82%, suggesting that the roots may be a source of higher quantities of soluble compounds than the aboveground parts, and that the yield also strongly depends on the solvent used. This difference not only depends on the plant part but may also be related to the species, ecological conditions, and extraction method. Therefore, when evaluating the potential for extracting active compounds from *R. multiflora*, attention should be paid to the selection of the appropriate plant part to optimize the extraction efficiency.

Table 3

Extraction yield (%) from parts of *Rosa multiflora* and other species

Species	Plant parts	Yields (%)	References
Rosa multiflora	Fruit	0.63–6.43	Kim et al. (2022)
Rosa multiflora	Flower	0.94–10.18	Kim et al. (2022)
Rosa multiflora	Root	14.13–17.82	Park et al. (2011)
Rosa wichuraiana	Fruit	0.4–4.78	Kim et al. (2022)
Rosa wichuraiana	Flower	0.78–9.08	Kim et al. (2022)
Hibiscus Rosa-sinensis	Flower	18.36–23.21	Khan et al. (2014)
Rosa damascena	Flower	40.5	Chroho et al. (2022)

In summary, this research results have partly clarified the rich chemical treasure hidden in *R. multiflora*. The structural diversity and biological activities of phytochemicals not only demonstrate great potential in the prevention and treatment of diseases related to oxidative stress, inflammation, and infection, but also open up the direction for the development of functional foods, cosmetics and pharmaceuticals of natural origin. It is necessary to continue to synthesize, systematically evaluate and standardize existing information, contributing to promoting the effective and sustainable application of this valuable medicinal resource in the future.

5. ANTIOXIDANT ACTIVITY OF *R. MULTIFLORA*

R. multiflora is one of the plants with strong antioxidant activity, with the ability to scavenge free radicals and inhibit oxidative stress markers through various mechanisms. This antioxidant activity plays a key role in protecting cells from damage caused by oxidative stress—a central mechanism involved in many chronic diseases such as inflammation, aging, cardiovascular disease, metabolic disorders and cancer (Nuzhyna and Tkachuk, 2019). Many studies have demonstrated that different parts of the plant, especially flowers, roots and fruits, contain many bioactive compounds such as polyphenols, flavonoids and tannins, which have the ability to scavenge free radicals, inhibit lipid peroxidation, reduce oxidative inflammation indicators, and enhance the endogenous antioxidant enzyme system.

In a study by Park et al. (2022) conducted in Cheongdo (Korea), extracts from *R. multiflora* were evaluated and compared for their antioxidant capacity through several indices. Specifically, ethanol extract from roots showed the highest DPPH radical scavenging ability (59.88%) and at the same time demonstrated a clear anti-inflammatory effect through the inhibition of iNOS (53.94%)—an enzyme related to the oxidation reaction in inflammatory tissue. Meanwhile, acetone extract from roots achieved the highest 2,2′-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid (ABTS) radical scavenging level (99.1%), and inhibited the pro-inflammatory enzyme COX-2 by 61.48%, indicating dual roles in anti-oxidation and anti-inflammation. Water extract from root recorded the highest superoxide dismutase–like) enzyme activity of 62.04%, reflecting the ability to enhance endogenous defense barriers against reactive oxygen species (Park et al., 2022).

In addition to their ability to neutralize free radicals, the extracts also demonstrate high biological safety, as demonstrated by cell experiments. Ethanol extract from roots not only ensured a cell survival rate of more than 90%, but also strongly inhibited cell death caused by oxidative stress, with the level up to 70.86% (Park et al., 2022). These data confirm that *R. multiflora* not only functions effectively *in vitro*, but also has great potential for practical applications in the protection of biological cells and tissues.

Many other independent studies have contributed to consolidate and expand the above findings Kim et al. (2022) in Suncheon (Korea) determined that the IC_{50} of *R. multiflora* fruit extract ranged from 0.14 to 0.34 mg/mL, whereas that of the flower was 0.06–0.36 mg/mL, indicating a very good free radical scavenging effect. In addition, the study by Cho (2013) showed that the fruit extract could scavenge ABTS radicals up to 97%, and at the same time reduced the thiobarbituric acid reactive substances (TBARS) index—a marker of lipid peroxidation—from 1.3 μM to only 0.15 μM at a dose of 200 μg/mL, demonstrating its effectiveness in protecting cell membranes from degradation caused by lipid peroxidation.

In Japan, Osada et al. (2022) conducted a comparitive study between *R. multiflora* and *R. rugosa* (another wild rose species) in Hokkaido, showing that the DPPH of *R. multiflora* fruits ranged from 303 to 1185.5 mmol Trolox equivalent (TE)/g DW, compared to that of *R. rugosa* (335.2–943.1 mmol TE/g DW). This demonstrates that *R. multiflora* can compete with or surpass other prominent plant species in antioxidant quality.

An important factor affecting the antioxidant activity of *R. multiflora* is the type of extraction solvent. For example, ethanol extracts from flowers (Seoul, Korea) showed a relatively high IC_{50} (131 mg/mL), whereas aqueous extracts (Jeju, Korea) showed much better results, suggesting that antioxidants can be better extracted in polar solvents such as water (Kim et al., 2018). The ability to extract compounds such as flavonoids, tannins and phenolic acids vary significantly depending on the solvent used—this is very important in the formulation of applied products.

In summary, several studies agree that the antioxidant activity of *R. multiflora* is mainly through the following mechanisms: Scavenging free radicals DPPH and ABTS—helping neutralize harmful reactive oxygen molecules. Inhibiting lipid peroxidation (TBARS)—reducing cell membrane damage and slowing down the aging process. Increasing the activity of endogenous antioxidant enzymes such as superoxide dismutase—supporting the cell defense system. Inhibiting inflammatory enzymes involved in oxidative stress such as iNOS and COX-2—protecting tissues from chronic inflammation (Park et al., 2022).

Thus, *R. multiflora* is a natural raw material with great potential for application, not only in the field of natural pharmaceuticals but also opens up opportunities for the development of anti-aging cosmetic products and functional foods to prevent diseases caused by oxidative stress. The combination of antioxidant and anti-inflammatory properties, along with high biological safety, makes this plant an ideal research and application subject in modern medical and health care trends.

6. ANTIBACTERIAL OF *R. MULTIFLORA*

Several studies have demonstrated that *R. multiflora* possesses significant antibacterial activity, especially against common pathogenic bacterial strains (Table 4). Ethanol extracts of the fruit showed significant inhibitory effects on both Gram-positive and Gram-negative bacteria (*S. aureus*, *S. epidermidis*) and Gram negative (*E. coli*, *H. pylori*), with inhibition zone diameters ranging from 13 to 25 mm (Cho, 2013). Essential oils from the whole plant also showed high antibacterial efficacy against *S. aureus* and *Enterococcus faecalis*—both Gram-positive bacteria—with inhibition zones up to 17.67 mm, whereas the inhibitory ability against Gram-negative bacteria such as *E. coli* and *Pseudomonas aeruginosa* was less (Elhawary et al., 2021). In addition, the root extract of *R. multiflora* was also reported to have anti-*E. coli* and *Salmonella typhimurium* activity; however, the efficacy was quite low with an inhibition zone of only about 7.6–9 mm (Frey and Meyers, 2010).

Comparisons between species within the genus *Rosa* showed significant differences in the degree of bacterial inhibition. According to Frey and Meyers (2010), root extracts of *R. multiflora* produced inhibition zones of only 7.6–9 mm for *E. coli* and 8.1 mm for *S. typhimurium*—indicating only weak to moderate antibacterial activity.

Meanwhile, *Rosa indica* is reported to have superior antibacterial effects. Khan and Tewari (2011) evidenced that the extract of this species produced inhibition zones of 25, 26 and 27 mm against *S. aureus*, *P. aeruginosa*, and *E. coli*, respectively, reflecting very strong inhibition levels.

In addition, another study by Khan et al. (2014) also showed that *Hibiscus Rosa-sinensis* Linn flower extract inhibited the growth of human pathogenic bacterial strains such as *Staphylococcus* sp., *Bacillus* sp. and *E. coli* with inhibition zone diameters ranging from 12.75 mm to 16.75 mm, significantly higher than that of *R. multiflora*.

Although *R. multiflora* has some antibacterial activity, especially against Gram-negative bacteria such as *S. typhimurium* and *E. coli,* the level of inhibition is limited compared to that of *Rosa indica*, which showed much stronger effects, both in terms of inhibition zone diameter and stability of the results. This suggests differences in the content and type of natural antibacterial compounds (such as flavonoids, tannins and phenolic acids) between *Rosa* species, is an important factor affecting the potential application in pharmaceuticals and cosmetics.

Overall, the results suggest that *R. multiflora* has the potential to be a natural source for the development of antibacterial agents, especially targeting Gram-positive bacteria. However, the effectiveness depends on the part used, the extraction solvent, and the characteristics of each bacterial strain.

Table 4
Antibacterial activity of *Rosa multiflora.*

Source	Bacteria	Diameter of the inhibition zone (mm)	References
Ethanol extract from fruit	*S. epidermidis*	25	Cho (2013)
	S. aureus	14	Cho (2013)
	E. coli	13	Cho (2013)
	H. pylori	14	Cho (2013)
Essential oils from whole plant	*S. aureus*	17.67	Elhawary et al. (2021)
Root extract	*E. faecalis*	14.00	Elhawary et al. (2021)
	E. coli	< 13	Elhawary et al. (2021)
	P. aeruginosa	< 13	Elhawary et al. (2021)
	E. coli	7.6–9	Frey and Meyers (2010)
	S. typhimurium	8.1	Frey and Meyers (2010)

7. ANTI-INFLAMMATORY OF *R. MULTIFLORA*

Recent studies have shown that parts of *R. multiflora* possess many biological effects with high potential in the field of modern medicine, especially anti-inflammatory and lipid metabolism regulating effects. These effects are clearly expressed through various biological mechanisms, are related to specific biomarkers and confirmed by *in vitro* and *in vivo* tests (Table 5).

The root of *R. multiflora* is the most studied part, notable for its anti-inflammatory, lipid metabolism-regulating and anti-lipogenic properties. In a model of non-alcoholic steatohepatitis, root extract reduced liver enzyme levels (ALT, AST) and inhibited lipogenesis—an important mechanism in the formation of fatty liver (Kim et al., 2024a). In addition,

Table 5
Anti-inflammatory and metabolic effects of *Rosa multiflora*

Parts	Main effects	Mechanism/Biomarkers involved	References
Root	Reduce non-alcoholic steatohepatitis (NASH)	Reduce ALT, AST; inhibit new fat formation	Kim et al. (2024a)
	Inhibition of 3T3-L1 cell adipogenesis	Reduced adipocyte differentiation	Kim et al. (2024b)
	Regulates fat metabolism	Inhibition of PPARγ, C/EBPα; increase of PGC-1α	Yu et al. (2024)
	Anti-allergic dermatitis	Decreased iNOS, COX-2; increased IL-10	Park et al. (2014)
Flowers	Anti-inflammatory RAW 264.7 cells	Decreased NO, PGE2, IL-6, TNF-α	Kwak et al. (2016)
	Anti-aging skin caused by UV	Reduces skin damage caused by UV rays	Kwak et al. (2020)
	Lipid and bile metabolism	Increased UDP-glucuronyl transferase activity	Choi et al. (2015)
Roots	Inhibition of osteoclast formation	Inhibition of BTK, PLC-γ2, p38 MAPK	Park et al. (2020)
Branch	Neuroprotection	Procyanidins, Phlobatannin	Lee et al. (2022)
Fruit	CORT-induced depression reduction	Reduced depressive behavior; compared with selegiline	Kim et al. (2025)

research on the 3T3-L1 cell line showed that the roots also inhibited adipocyte differentiation, thereby limiting the formation of white adipose tissue (Kim et al., 2024b). This mechanism was further elucidated by inhibiting the expression of PPARγ and C/EBPα genes, two key transcription factors in adipose differentiation, while increasing the expression of PGC-1α, a regulator of thermogenesis and fatty acid oxidation (Yu et al., 2024).

Notably, the root also displayed anti-inflammatory effects on the skin by reducing the production of pro-inflammatory enzymes such as iNOS, COX-2, while increasing IL-10—an endogenous anti-inflammatory cytokine (Park et al., 2014). In addition, another study demonstrated that the root also inhibits osteoclastogenesis by regulating signals such as BTK, PLC-γ2 and p38 MAPK, showing potential application in the treatment of bone diseases such as osteoporosis (Park et al., 2020).

Other parts such as flowers and fruits of *R. multiflora* also contribute to confirm the broad spectrum of anti-inflammatory activity of this plant. Flowers showed significant reduction of pro-inflammatory factors such as NO, PGE2, IL-6 and TNF-α in LPS-stimulated RAW 264.7 macrophage model (Kwak et al., 2016), confirming its potential to fight acute and chronic inflammation at the level of innate immune cells. In addition, the flower has also been shown to reduce skin damage caused by ultraviolet (UV) rays—a leading factor causing premature skin aging, thereby opening up the direction of application in anti-aging cosmetics (Kwak et al., 2020). Another study also showed that flower extract increased the activity of the enzyme UDP-glucuronyl transferase, supporting lipid and bile acid metabolism, contributing to the regulation of blood lipids and liver function (Choi et al., 2015).

In addition, *R. multiflora* fruits reduced corticosterone-induced depressive-like behavior in mice (Kim et al., 2025), indirectly reflects the role of regulating the stress–immune–inflammatory axis, which is closely related to chronic inflammatory diseases.

The branches contain compounds such as procyanidins and phlobatannins, which have been noted to have neuroprotective effects, opening up research directions in the treatment of neurological disorders and neurodegenerative diseases (Lee et al., 2022). The fruit of *R. multiflora*, although less studied, shows potential in the treatment of corticosteroid-induced depression, with an effect on reducing depressive behavior comparable to the drug selegiline, an MAO-B inhibitor (Kim et al., 2025).

Taken together, the evidence suggests that *R. multiflora*, especially the root extract, exerts a comprehensive anti-inflammatory effect on multiple organs and levels: from the skin, liver, adipose tissue, bone, to the central nervous system. These mechanisms extend beyond the inhibition of inflammatory mediators, to include the regulation of genes, enzymes, and immune cytokines, opening up the potential for the development of multi-mechanism medicinal plants, aiming to treat allergies, chronic inflammation, metabolic disorders, and aging in a safe and natural way.

8. POTENTIAL AND CHALLENGES IN EXPLOITING *R. MULTIFLORA*

Current studies show that *R. multiflora* is a plant with high biological potential, with diverse phytochemical compositions, including flavonoids, phenolic acids, tannins, triterpenoids, carotenoids, and volatile compounds. These compounds contribute to valuable biological activities such as strong antioxidant, broad-spectrum antibacterial, and significant anti-inflammatory effects. This is an important scientific basis for developing *R. multiflora* into a natural ingredient in pharmaceuticals, functional foods and cosmetics. However, exploiting this potential still faces many challenges. First, most studies have been conducted only at the *in vitro* level or on animal models, and there is not much clinical data to verify the effects of *R. multiflora* on humans. Second, the conditions of cultivation, harvesting, and storage of raw materials can strongly affect the content and biological effectiveness of active compounds, although there is currently no clear standardization for this species. In addition, current studies mainly focus on individual fruit, leaf, and petal parts, without a comprehensive view of the whole plant and the variation in chemical composition between parts as well as by season.

In native regions such as East Asia, especially Korea and Japan, the plant is often cultivated or harvested from the wild during the flowering (late spring–early summer) and fruiting seasons (late summer–early autumn) to obtain high biological value raw materials (Kim et al., 2022). In Vietnam, although this species is not popular in commercial agricultural production, it can be developed as a source of raw materials for medicine, cosmetics and functional foods. In traditional medicine, each part of the plant has its own uses. The leaves are often crushed to apply on the skin, helping reduce swelling and pain without having to quantify the dosage. Flowers, fruits and roots are used in the form of decoction, with a usual dose of 10–20 g/day, with diuretic and blood-activating effects, and supporting the treatment of mild infections (Lợi, 2004).

In terms of toxicity, some of the major flavonoids in *R. multiflora*, such as quercetin and kaempferol, are generally considered safe at usual doses. However, these compounds may affect drug-metabolizing enzymes and cause interactions if used concurrently with other pharmaceuticals (Ding et al., 2023). Another study showed that a component from

R. multiflora fruit (multinoside A acetate) had a strong purgative effect with an ED_{50} of about 150 mg/kg, suggesting that dosage caution should be exercised when using whole extract forms (Seto et al., 1992).

Although *R. multiflora* has been extensively studied in some parts such as roots, flowers and fruits with potential biological effects such as antioxidant, anti-inflammatory, antibacterial and cytoprotective, there are still some notable limitations in the current evidence system. First of all, the leaves of the plant have been almost unexplored in terms of biological activities, although this is a popular and easy-to-harvest part—this opens up a completely new research direction.

In addition, although *R. multiflora* flowers have been shown to have strong antioxidant and anti-inflammatory activities, no studies have clearly published information on the antibacterial activity of this part, which limits the potential application of the flowers. In addition, toxicological studies have only focused on fruit extracts, mainly evaluating cytotoxicity, not extending to other parts such as roots, flowers, leaves and whole plant extracts. The lack of *in vivo* and chronic toxicity data makes the development of products from this plant more cautious.

These shortcomings indicate the need for further systematic and in-depth studies, including the identification of active compounds, comprehensive bioactivity surveys of unstudied parts, as well as comprehensive toxicity assessments—from acute to chronic—to ensure the safety of developing practical applications from *R. multiflora*.

Therefore, to effectively exploit the potential of *R. multiflora*, it is necessary to conduct more systematic studies on growth conditions, standardization of extraction processes, toxicity assessment and especially clinical trials. At the same time, comparison with other *Rosa* species also contributes to clarifying the position and value of this species in the Rosaceae family, toward sustainable application in practice.

9. CONCLUSION

The literature review shows that *R. multiflora* is a promising natural resource with high potential for application in medicine and food industry. The diverse chemical composition, especially the high content of phenolic compounds and flavonoids, has contributed to its strong biological activities such as antioxidant, antibacterial and anti-inflammatory. However, the remaining limitations such as lack of *in vivo* data, clinical trials and standardization of extracts are still major barriers to the commercialization of products from this species. In future, comprehensive studies, combining *in vitro*, *in vivo* and clinical models, are needed to fully evaluate the therapeutic potential and toxicity of *R. multiflora*, thereby developing practical applications.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

AUTHOR CONTRIBUTIONS

Research concept and design: L.P.T.Q.; Collection and assembly of data: P.M.H., L.P.T.Q.; Data analysis and interpretation: P.T.Q., P.M.H.; Writing the article: L.B.B.P., L.P.T.Q., P.T.Q.; Critical revision of the article: L.B.B.P.; Final approval of the article: L.P.T.Q. All authors have read and agreed to the published version of the manuscript.

ORCID

Le Pham Tan Quoc	0000-0002-2309-5423
Pham My Hao	0000-0003-2797-3139
Pham Thi Quyen	0000-0003-3695-3703
Lam Bach Bao Phuong	0009-0004-4152-609X

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