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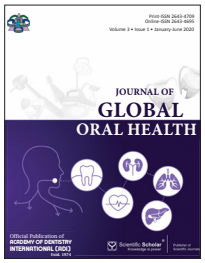

*Review Article*

# Nature's toothbrush: How rosemary transforms dental health

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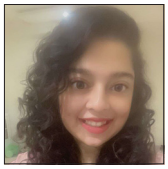

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## ABSTRACT

*Rosmarinus officinalis* has been used in Ayurveda and many other traditional systems of medicine. This plant has various dental uses and is more significant in periodontal therapy. The present review highlights the proven properties of *R. officinalis* and the scope of advancement for using it as an effective topical gel, projecting its use in the treatment of chronic gingivitis. Information compiled here will be useful to improve the present investigation regarding *R. officinalis* in periodontal therapy.

**Keywords:** Antibacterial, Antifungal, Antihemorrhoidal, Inflammation, *Rosmarinus officinalis*

## INTRODUCTION

Primary healthcare serves as the foundation of a nation's healthcare system. The excessive and improper use of antibiotics can lead to harmful effects on the body. Therefore, adopting an integrative approach that combines Allopathy with Ayurveda could help reduce the side effects associated with medications. Conventionally, medicinal plants have been utilized for centuries in Asian countries to treat various human ailments.[1] Rosemary essential extract, obtained from the *Lamiaceae* family, demonstrates potent antimicrobial and antifungal effects. It has shown efficacy in managing chronic and widespread cases of candidiasis. While ingesting concentrated rosemary essential oil is not advised, extracts of *Rosmarinus officinalis* have been explored for their potential therapeutic applications in treating a variety of diseases.[2]

## TAXONOMY

- Kingdom: Plantae
- Order: *Lamiales*
- Family: *Lamiaceae* Martinov – Mint family
- Genus: *Rosmarinus* L.
- Species: *R. officinalis* L.
- Binomial Name: *R. officinalis* L. (syn. *Salvia rosmarinus Spenn.*).

## GENERAL PROPERTIES

Rosemary is an aromatic evergreen shrub with needle-like leaves resembling those of the Tsuga tree. Native to the Mediterranean region, it is moderately hardy and adapts well to cooler climates. Certain cultivars, such as "Arp," can tolerate winter temperatures as low as −20°C (−4 °F). Rosemary is highly drought-resistant and capable of surviving extended periods without water. However, it is regarded as a

potentially invasive species. Its seeds are challenging to germinate due to their low success rate and slow growth, but the plant can have an impressive lifespan of up to 35 years.[2] Interestingly, rosemary may also bloom outside its typical flowering season, with instances of flowering as late as early December and as early as mid-February in the Northern Hemisphere.[3]

Rosemary essential oil, extracted from the *Lamiaceae* family, possesses potent antimicrobial and antifungal properties, making it effective in addressing chronic and widespread cases of candidiasis. Research highlights that *R. officinalis* demonstrates hepatoprotective, anti-hyperglycemic, antifungal, anticancer, and anti-ulcerogenic effects. In addition, it is noted for its strong antimicrobial and antioxidant capabilities.[4] *R. officinalis* essential extract is highly regarded for its wide range of medicinal benefits, offering strong antibacterial, cytotoxic, antimutagenic, antioxidant, anti-inflammatory, and chemopreventive properties. In traditional medicine, various species of *Rosmarinus* have been utilized to address numerous conditions, including diabetes, dysmenorrhea, cardiovascular diseases, respiratory ailments, renal colic, and rheumatism. Its active compounds exhibit analgesic effects, making it effective in reducing pain and discomfort. Topically, it has long been applied to relieve muscle pain, joint pain, and headaches.[5]

Historically, rosemary has been utilized as a medicinal remedy for conditions such as renal colic and dysmenorrhea. It has also been employed to alleviate symptoms of respiratory disorders and to promote hair growth. In addition, compounds such as carnosol and rosmarinic acid in rosemary are believed to contribute to inhibiting the proliferation of tumor cells.[4] Rosemary oil is widely recognized for its ability to enhance hair growth and improve scalp health. By stimulating blood flow to the scalp, it helps reduce dandruff and supports the growth of stronger, healthier hair. Due to its potent antioxidant and anti-inflammatory properties, rosemary is also a popular ingredient in skincare. It effectively reduces acne, redness, and puffiness while promoting circulation, which aids in skin healing and rejuvenation.[6]

## CHEMICAL COMPOSITION

The chemical composition of rosemary (*R. officinalis L.*) includes a wide variety of bioactive compounds that contribute to its medicinal, antioxidant, anti-inflammatory, and antimicrobial properties.

## PHENOLIC ACIDS IN ROSEMARY

Rosmarinic acid is a highly potent antioxidant and anti-inflammatory compound, rosmarinic acid is one of the most prevalent phenolic acids in rosemary, playing a major role in its therapeutic benefits. Renowned for its antioxidant and neuroprotective properties, carnosic acid safeguards cells from oxidative damage and is considered one of rosemary's key active components. Caffeic acid is an antioxidant that contributes to cellular protection against oxidative stress and also exhibits anti-inflammatory properties.[7]

## FLAVONOIDS IN ROSEMARY

Apigenin is a flavonoid recognized for its anti-inflammatory, antioxidant, and potential anticancer properties. Luteolin is known for its powerful antioxidant, anti-inflammatory, and immune-modulating effects while also enhancing rosemary's antimicrobial activity. Diosmin is an antioxidant with notable anti-inflammatory properties, diosmin is frequently utilized to support vascular health.[8]

## TERPENES AND TERPENOIDS IN ROSEMARY
**(Essential Oils)**

The primary monoterpene [1,8-Cineole (Eucalyptol)] in rosemary offers antimicrobial, anti-inflammatory, and analgesic properties while contributing to its characteristic aroma. Recognized for its anti-inflammatory and bronchodilator effects, α-pinene also shows potential for enhancing cognitive function. Known for its antimicrobial, analgesic, and anti-inflammatory properties, camphor is often used in topical treatments to relieve pain. Borneol possesses antimicrobial and analgesic effects and aids in the absorption of other substances in topical applications. Valued for its skin-soothing and regenerative properties, verbenone is a popular ingredient in skincare products for its beneficial effects on the skin.[9]

## VOLATILE OILS IN ROSEMARY

Commonly used in aromatherapy for its uplifting effects, limonene also boasts antioxidant and anti-inflammatory properties. Carnosol is a potent compound with antioxidant, anti-inflammatory, neuroprotective, and anticancer properties, Carnosol is also believed to exhibit antibacterial activity. Renowned for its anti-inflammatory, antioxidant, and anticancer benefits, ursolic acid is also valued for its skin-soothing qualities and its role in promoting wound healing.

Tannins in rosemary are responsible for its astringent properties, which help reduce inflammation and support tissue healing. They also possess antimicrobial and antioxidant activities. Saponins provide immune-enhancing, antimicrobial, and anti-inflammatory benefits while also promoting cardiovascular health. Rosemary also contains dietary fiber, which aids in digestion and fosters gut health by encouraging the growth of beneficial bacteria.[9]

## ANTIMICROBIAL PROPERTIES OF ROSEMARY

Rosemary exhibits potent antimicrobial activity, attributed to its unique blend of bioactive compounds. These properties make it

effective against a wide range of pathogens, including bacteria, fungi, and viruses. Key contributors to its antimicrobial effects include essential oils (such as 1,8-cineole, α-pinene, camphor, and borneol), phenolic acids (such as rosmarinic acid and carnosic acid), and flavonoids. Rosemary's antibacterial activity has been well-documented, particularly against oral and foodborne pathogens. Its essential oils and phenolic compounds are the primary agents responsible for these effects, as they disrupt bacterial cell membranes, inhibit protein synthesis, and block critical bacterial enzymes. Essential oils, especially 1,8-cineole and α-pinene, have the ability to penetrate bacterial cell walls and membranes, increasing permeability. This disruption causes leakage of cellular contents, ultimately leading to bacterial cell death. Meanwhile, compounds such as carnosic acid and rosmarinic acid target bacterial enzymes and hinder protein synthesis, effectively preventing bacterial growth and reproduction.[10] Rosemary has demonstrated effectiveness against antibiotic-resistant strains, such as methicillin-resistant *Staphylococcus aureus*, primarily due to its compounds' ability to disrupt bacterial cell walls. This makes rosemary a promising complementary treatment for combating resistant pathogens. In addition, rosemary exhibits antifungal activity against various fungal species, which is particularly useful in managing fungal infections in both food preservation and skincare. Rosemary essential oils, notably camphor and 1,8-cineole, damage fungal cell membranes, leading to the leakage of crucial ions and cellular components. The antioxidants in rosemary, such as rosmarinic acid and carnosic acid, induce oxidative stress in fungal cells, disrupting essential cellular functions and inhibiting growth.[11]

Rosemary is effective against *Candida albicans*, a yeast responsible for oral thrush and other fungal infections in humans. Its activity against *Candida* species makes rosemary valuable in antifungal mouthwashes and skincare products. In addition, rosemary's antifungal properties extend to molds such as *Aspergillus niger* and *Penicillium chrysogenum*, which are known to cause food spoilage. This has led to rosemary being utilized as a natural preservative in the food industry. Rosemary compounds disrupt viral attachment and entry into host cells, a critical step in the viral replication process. Rosemary extract has been shown to inhibit herpes simplex virus-1 (*HSV-1)* and *HSV-2*, the viruses responsible for oral and genital herpes, by blocking their entry into host cells. In addition, rosemary extract has demonstrated inhibitory effects against influenza virus strains, potentially reducing both the severity and duration of the infection. Rosemary has also shown synergistic effects when combined with conventional antibiotics and antifungal agents, enhancing their antimicrobial activity. For example, using rosemary essential oil alongside antibiotics such as tetracycline and erythromycin can increase bacterial susceptibility. This synergy is particularly beneficial for fighting antibiotic-resistant bacteria, as it allows for a reduction in the dosage of synthetic antibiotics needed.[12]

The antimicrobial properties of rosemary are effective in treating acne, regulating oil production, and reducing skin infections, making it a popular ingredient in skincare products. Rosemary's ability to combat bacterial and fungal infections has also made it a key component in topical formulations for wound healing and infection prevention.[13]

## CLINICAL APPLICATIONS OF ROSEMARY IN PERIODONTAL THERAPY

Rosemary (*R. officinalis* L.) is gaining recognition for its wide-ranging therapeutic benefits in periodontal care. Its antimicrobial, anti-inflammatory, and antioxidant properties address key issues in periodontal diseases, such as bacterial infections, gum inflammation, and oxidative damage. The essential oils and phenolic compounds in rosemary disrupt the bacterial biofilm matrix, which plays a crucial role in plaque formation and the progression of periodontal disease. Rosemary gels have been shown to significantly lower gingival index and bleeding on probing scores, indicating a reduction in gum inflammation and bleeding. Furthermore, its ability to decrease pro-inflammatory cytokines such as interleukin-1β and tumor necrosis factor-α makes it an effective option for managing gingivitis caused by bacterial plaque accumulation.[14]

When used in conjunction with mechanical therapies such as scaling and root planing, rosemary-based products aid in controlling bacterial recolonization, reducing inflammation, and promoting gum tissue healing. Its antioxidant properties help mitigate the oxidative stress linked to periodontitis, further supporting tissue repair. Rosemary gel can be applied postoperatively to enhance wound healing and reduce the risk of infection. Its anti-inflammatory and tissue-regenerative effects contribute to improved healing outcomes in procedures such as flap surgery, gingival grafts, and implant placements. Rosemary's essential oils, including 1,8-cineole and borneol, exhibit strong antibacterial activity against *Streptococcus mutans* and Porphyromonas gingivalis, the primary bacteria involved in plaque buildup and periodontal diseases. Rosemary-based gels and mouthwashes can help reduce periodontal pocket depth by controlling inflammation and bacterial growth, making them a valuable adjunct in the treatment of moderate-to-severe periodontal disease.[15] Rosemary's broad-spectrum antimicrobial properties against bacteria and fungi can help prevent reinfection in patients with a history of chronic periodontal issues. Regular use of rosemary-infused oral care products supports a balanced oral microbiome and reduces the likelihood of disease recurrence. Rosemary is frequently combined with other herbs, such as chamomile, sage, or thyme, in herbal mouthwashes and gels.[16] In patients with dental implants, rosemary gel or rinse can help prevent peri-implantitis by controlling bacterial biofilm formation and reducing inflammation at the implant site. In addition, rosemary's antioxidant and tissue-regenerative properties

aid in the repair of damaged gingival tissues, promoting regeneration and improving gum health in those with advanced periodontal disease.[17,18]

## CONCLUSION

Incorporating rosemary into periodontal therapy provides a natural and effective alternative or complement to traditional treatments. Its antimicrobial, anti-inflammatory, and antioxidant properties target the root causes of periodontal diseases, helping to promote healthier gums and overall oral health. Rosemary's versatility in periodontal care makes it a valuable addition to both preventive and therapeutic dental practices. It addresses key issues of periodontal disease, such as bacterial infections, inflammation, and oxidative stress, while also encouraging tissue healing and regeneration. Whether used as a supplement to conventional treatments or as a natural alternative, rosemary has the potential to improve periodontal outcomes, increase patient adherence, and deliver long-term oral health benefits. With its wide-ranging therapeutic properties, including anti-inflammatory, antimicrobial, and antioxidant effects, rosemary extract can significantly enhance oral health. Ongoing research should focus on optimizing formulations and dosing strategies to fully leverage the clinical advantages of this powerful natural remedy in periodontics.

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