



PHARMACOGNOSY, PHYTOCHEMICAL AND PHARMACOLOGICAL PROFILE OF ROSEMARY (*ROSMARINUS OFFICINALIS* L.)

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ABSTRACT

Rosemary is a condiment famous for its volatile oil. Rosemary has many uses and properties than just for its volatile oil usage. In the present article a comprehensive review on pharmacognostic, phytochemical and pharmacological profile in detail.

Key words:

Rosmarinus Officinalis, Rosemary, Essential oil, Aromatic plant, Medicinal plant.

INTRODUCTION

Rosemary is a fragrant, evergreen herb that lives for many years. It was once known by its scientific name *Rosmarinus Officinalis* and is part of the mint family, Lamiaceae. However, recent research on plant relationships has led scientists to group it under the *Salvia* genus. As a result, rosemary is now called *Salvia rosmarinus*.^[1] This is a fragrant shrub that can grow up to 2 meters tall. Its leaves are the most useful part and can be used either fresh or dried. People have used these leaves for cooking, medicine, and beauty products for a long time because of their health benefits.

When the dried leaves are crushed, they give off a strong, camphor-like smell that adds flavor to many dishes. The oil from the leaves is also commonly used in cosmetics.^[2]

Rosemary is a herb known for its many health benefits, including antibacterial, anti-inflammatory, antioxidant, and anti-cancer properties. It has been grown for centuries and widely used in traditional medicine, cosmetics, and natural skincare. In folk remedies, rosemary extract has been used to treat problems like nerve disorders, poor blood circulation, fatigue, urinary infections, and hair loss.^[2]

It's also been used as a natural remedy to support digestion, reduce muscle spasms, improve liver function, and ease respiratory issues. Thanks to its powerful antioxidants and overall health-boosting effects, rosemary is becoming increasingly popular today. Recently,

scientists have been studying rosemary extracts because they can help fight harmful germs. Research shows that the main ingredients in rosemary oil—like α -pinene, myrcene, 1,8-cineole, camphor, camphene, α -terpineol, and borneol—have the power to kill or stop the growth of bacteria. Rosemary oil has been found to work well against several bacteria, including *Staphylococcus Epidermidis*, *Staphylococcus aureus*, *Bacillus subtilis*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, and *E. coli*.^[3] Rosemary, a pleasant-smelling herb from the Lamiaceae family, is a powerful natural source of antioxidants. It is a perennial shrub that grows in many parts of the world.^[4] Rosemary is a well-known and helpful medicinal herb. It is often used in both modern medicine and traditional remedies. People use it to help with digestion, boost energy, tighten tissues, increase urine flow, reduce sweating, and treat urinary problems.^[5]

Health means being completely well in body, mind, and social life, not just being free from sickness. To stay healthy in body and mind, it's important to prevent diseases and slow down aging. That's why looking after your appearance and using cosmetic products matters. This isn't something new people have cared about how they look since ancient times.^[6] Since the year 2000, about 120 research papers have been published each year about different aspects of rosemary. Recent studies show that it has useful plant chemicals, health benefits, and nutritional value.^[7-8] It helps reduce inflammation, can be used for

treatment and prevention of illness, and is also useful when applied to the skin. [9-11] rosemary was often used at weddings as a symbol of love and loyalty. It was also added to scented flowers to freshen the air and keep away bad spirits. For a long time, rosemary has been a key part of

traditional herbal medicine. It was used to treat many health problems, like breathing issues, headaches, and stomach pain. Rosemary is also popular in cooking because its leaves add a strong, pleasant flavor. [12]



Figure 1: Image of Rosemary plant. [55]

HISTORY:

Rosemary has been used since ancient times. In Egypt, King Ramesses III gave 125 portions of rosemary to the god Amon at Thebes. In ancient Greece, people thought rosemary helped improve memory, so students used it while studying. In Medieval France, it was used to preserve dead bodies. For centuries, rosemary has been part of folk medicine. People believed it could help with menstrual pain, memory problems, epilepsy, pain, and infertility. Rosemary also stands for remembrance, love, and loyalty. It's often used in funerals and war memorials in Europe and Australia, and planted near graves.

Rosemary (*Salvia Rosmarinus*, once called *Rosmarinus Officinalis*) is a strong-smelling herb that comes from the Mediterranean region. People have used it for many years in cooking, medicine, and special traditions. In ancient times, the Greeks and Romans believed rosemary could help improve memory and clear thinking. Greek students even wore rosemary in their hair while studying. [13] The Romans used it in religious events and saw it as a sign of love and remembrance. In the Middle Ages, people burned rosemary to clean the air and protect themselves from sickness during plagues. Later, rosemary became common in European kitchens, especially in England and France. Today, it is grown in many parts of the world and is still loved for its taste, health benefits, and meaning. [14]

CLASSIFICATION:

Taxonomical classification of *rosemary Officinalis* is given in table 1. [15]

Taxonomic Rank	Classification
Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Lamiales
Family	Lamiaceae (mint family)
Genus	Salvia
Species	Salvia rosmarinus
Common Name	Rosemary

Table 1: taxonomic classification of Rosemary plant

PHARMACOGNOSY:

Macroscopic characters [16-17]

Character	Description
Colour	Dark green or whitish grey
Odour	Strong, aromatic, characteristic of volatile oils
Taste	Slightly bitter, pungent, aromatic
Shape	Linear and cylindrical shape
Texture	Pine-needle like texture

Table 2: Macroscopic characters of Rosemary

Microscopical characters ^[18-19]

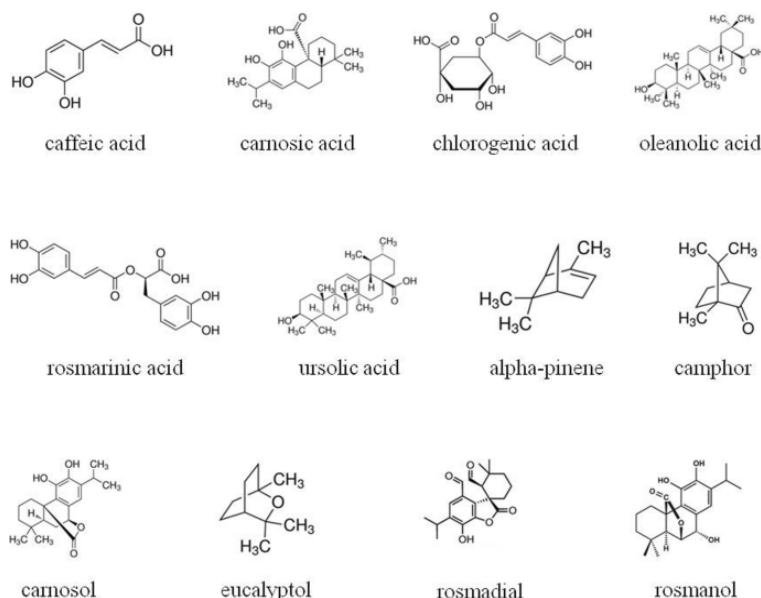
Tissue	Microscopical Features
Leaf	- Dorsiventral (bifacial) structure
Epidermis	- Upper epidermis with thick cuticle and abundant trichomes - Lower epidermis with stomata and abundant trichomes
Mesophyll	- Loose with air space
Stem	- Epidermis with thick cuticle and multicellular trichomes - Cortex: collenchyma (outer), parenchyma (inner)
Vascular Bundles	- Collateral vascular bundles with sclerenchyma sheath - Phloem outside and xylem inside

Table 3: Microscopic characters of Rosemary**PHYTOCHEMISTRY:**

Standardization of Plant material: Standardizing the rosemary (*Rosmarinus Officinalis*) plant means making sure its quality is consistent, safe, and effective, especially when used in medicine, cosmetics, and food. This process starts with identifying the plant correctly and checking its physical and microscopic features. Important chemical compounds like rosmarinic acid, carnosic acid, and essential oils such as 1,8-cineole, camphor, and α -pinene are measured using special lab techniques like HPLC and GC-MS. Other tests include checking moisture, ash, and extract levels. It's also important to make sure the plant doesn't contain harmful microbes, pesticides, or heavy metals. According to the World Health Organization

(1998), these steps help ensure that herbal products made from rosemary are safe and work reliably.^[20]

Qualitative phytochemical analysis: *Rosmarinus Officinalis*, also called rosemary, is a fragrant and medicinal herb that has been used in traditional medicine for a long time. It contains many natural chemical compounds (called phytochemicals) that are known to help with health problems like infections, inflammation, and damage from free radicals.^[21] To find out what types of phytochemicals are in rosemary, its leaves are first soaked in a liquid like alcohol (ethanol or methanol) or water to extract the useful compounds. Then, simple lab tests are done on the extract to check for different natural substances like alkaloids, flavonoids, tannins, and others.^[22]

**Figure 2: Phytochemistry of Rosemary plant.** ^[56]**PHARMACOLOGY:**

Anti-inflammatory and Antioxidant Effects: Rosemary can help reduce inflammation by blocking certain enzymes (like COX-2 and iNOS) and lowering the levels of

chemicals in the body that cause inflammation, such as IL- 1β and TNF- α . This makes it useful for conditions like arthritis and asthma. Rosemary is also a strong antioxidant, meaning it helps protect the body's cells from damage

caused by harmful molecules called free radicals. This protection can lower the risk of diseases like cancer and heart problems.^[23]

Antimicrobial and Anticancer Properties: Rosemary essential oil can kill or stop the growth of germs like bacteria, fungi, and viruses. Ingredients like 1,8-cineole and camphor break down the germs' protective layers, causing them to die. Some parts of rosemary, like carnosol and rosmarinic acid, have also been found to slow the growth of cancer cells, help them die naturally, and stop tumors from forming new blood vessels. This shows promise for rosemary in cancer treatment.^[24]

Neuroprotective and Brain Benefits: Rosemary is believed to help improve memory and thinking. It works by slowing down the breakdown of a brain chemical called acetylcholine, which helps nerve cells communicate. A compound called carnosic acid in rosemary also helps protect brain cells from damage, especially damage caused by harmful proteins like amyloid- β , which are linked to diseases like Alzheimer's.^[25]

Liver and Metabolism Support: Rosemary is also good for the liver and metabolism. It can help lower bad cholesterol and triglyceride levels, while increasing the activity of enzymes that protect the liver. This can help prevent liver damage and reduce the risk of conditions like fatty liver and metabolic syndrome.^[26]

MEDICINAL VALUE:

Antioxidant Properties

Rosemary has strong natural compounds like carnosic acid, carnosol, and rosmarinic acid that help protect the body by fighting harmful molecules called free radicals. This helps reduce damage to cells and keeps the body healthy.^[27]

Anti-inflammatory Effects

Rosemary has natural chemicals that help reduce swelling and pain in the body. It has been found to be helpful in conditions like arthritis and digestive problems caused by inflammation.^[28]

Cognitive and Memory Enhancer

Rosemary has long been used to boost memory. Smelling its scent can help you focus better and remember things more quickly and accurately.^[29]

Digestive Health

Rosemary helps your body make bile, which is needed to digest food. It has been traditionally used to ease indigestion and reduce bloating.^[30]

MISCELLANEOUS:

Toxicity: High doses or strong extracts can be harmful, causing stomach problems, brain-related issues, and even miscarriages.

Allergic Reactions: Some people might be allergic to rosemary. It can cause itchy skin, rashes, or breathing problems like sneezing or coughing, especially if you touch it or breathe in its smell.^[31]

Drug Interactions: Rosemary might not be safe to use with certain medicines like anticoagulants, blood pressure drugs, lithium, or water pills. It can change how these medicines work or make their side effects worse.^[32]

MARKETING VALUE:

The global demand for both fresh and dried rosemary leaves is increasing in terms of both price and quantity.^[33] Similarly, the demand for rosemary essential oil is also rising. This growth is mainly due to factors like population increase, greater awareness of the health benefits of rosemary, the rising popularity of organic foods and natural products, growing health issues, and more interest in natural remedies^[34]. Because of its high demand as a food additive and ingredient in food and drinks, the rosemary extract market was valued at USD 215 million in 2019 and is expected to grow by 3.7% each year from 2020 to 2025.^[35]

SUMMARY TABLE:

Summary table of rosemary plant as described below in table 2. [36-54]

S.No	Plant Part	Activity	Extract	Model	Standard Drug	Dose	Parameters	Mechanism	Status P Value	Author Year
1	Leaves	Antioxidant	Ethanolic	DPPH radical-scavenging assay (in vitro)	Ascorbic acid	25–200 µg/mL	IC ₅₀ for DPPH (%)	Radical scavenging by high phenolic content	< 0.001	Inatani et al., 1983 [36]
2	Aerial parts	Antinociceptive	Ethanol	formalin test	Tramadol (31.6 mg/kg, i.p.)	100, 300 mg/kg p.o	Number of writhes (AUC)	Involvement of endogenous opioids	< 0.001	López et al., 2007 [37]
3	Leaves	Neuroprotective	Hydroalcoholic	Olfactory bulbectomy-induced behavioral changes in mice	Not specified	10–300 mg/kg (daily for 14 days)	Behavioral assessments, serum glucose, hippocampal AChE activity	Modulation of neurotransmitter systems	Not specified	M. Rakhshandeh 2012 [38]
4	Leaves	Anti-inflammatory	Rosmarinic acid	Carrageenan-induced paw edema in rats	Indomethacin	25 mg/kg p.o.	% Paw edema reduction	Modulation of NF-κB; MMP-9 inhibition	< 0.001	Rocha et al., 2015 [39]
5	Leaves	Anticancer	Methanolic	MCF-7 (human breast cancer) cell proliferation	Doxorubicin	50–200 µg/mL	Cell viability (MTT assay)	Induction of apoptosis via caspase-3 pathway	< 0.01	Moore et al., 2016 [40]
6	Leaves	Antiulcer	Aqueous	Rat (Ethanol-induced ulcer)	Omeprazole	400 mg/kg (oral)	Ulcer index, Mucus production	Cytoprotection, antioxidant effect	p < 0.05	El-Toumy et al., 2017 [41]
7	Leaves	Anti-inflammatory	Essential oil (REO)	Carrageenan-induced paw edema in rats	Indomethacin (10 mg/kg p.o.)	10, 30, 90 mg/kg p.o.	Paw-volume (mL), leukocyte migration	NF-κB inhibition; suppression of arachidonic cascade	< 0.05	Sousa et al., 2018 [42]
8	Leaves	Hepatoprotective	Methanolic	Rat (CCl ₄ -induced hepatotoxicity)	Silymarin	300 mg/kg (oral)	ALT, AST, MDA, GSH, Histology	Antioxidant, membrane stabilizing effects	p < 0.01	Mahmoud et al., 2018 [43]

9	Leaves	Anticancer	Supercritical	Colon cancer cell lines (HT-29, HCT 116, SW480)	Not specified	None	Cell proliferation, apoptosis markers	Induction of apoptosis, inhibition of proliferation pathways	Not specified	Almudena Pérez-Sánchez, 2019 [44]
10	Flowers	Antifungal	Ethanol	In vitro (Microdilution method)	Fluconazole	MIC = 1-4 mg/mL	Inhibition zone, MIC	Inhibition of fungal growth and cell membrane disruption	p < 0.01	Gupta et al., 2019 [45]
11	Leaves	Antidiabetic	Ethanolic	Rat (STZ-induced diabetes)	Glibenclamide	250 mg/kg (oral)	Fasting glucose, HbA1c, Insulin level	Enhancement of insulin secretion, β -cell repair	p < 0.01	Yener et al., 2019 [46]
12	Leaves	Anticancer	Methanolic	In vitro (MCF-7 breast cancer cells)	Doxorubicin	100 μ g/mL (in vitro)	Cell viability, Apoptosis markers	Induction of apoptosis via ROS pathway	p < 0.01	Jalali et al., 2020 [47]
13	Leaves	Antioxidant, Anticoagulant	Hydroalcoholic	NIH3T3 and MDA-MB-231 cell lines	IC ₅₀ : 0.24 mg/mL (NIH3T3), 0.48 mg/mL (MDA-MB-231)	Not specified	Cell viability, H ₂ O ₂ scavenging, thrombin activity	Rich in bioactive compounds	Not specified	Francesca Faraone, 2020 [48]
14	Leaves	Neuroprotective	Aqueous	Rat (Aluminum chloride-induced neurotoxicity)	Donepezil	200 mg/kg (oral)	Cognitive tests, AChE activity, MDA levels	Inhibition of AChE, antioxidant effect	p < 0.05	Al-Sereiti et al., 2020 [49]
15	Leaves	Antioxidant (FRAP assay)	Aqueous	In vitro	Vitamin C	50-100 μ g/mL (in vitro)	Reducing power, Total phenolic content	Reducing power via phenolic compounds	p < 0.01	Singh et al., 2020 [50]
16	Leaves	Antioxidant (DPPH assay)	Methanolic	In vitro	Ascorbic acid	100 μ g/mL (in vitro)	IC ₅₀ , Free radical scavenging	Free radical scavenging activity	p < 0.01	Patel et al., 2021 [51]
17	Leaves	Analgesic	Ethanolic	Rat (Hot plate test)	Morphine	10 mg/kg (oral)	Pain threshold, Latency time	Inhibition of pain signals in CNS	p < 0.05	Patel et al., 2021 [52]
18	Leaves	Anti-inflammatory	Ethanolic	Rat (Carrageenan-induced inflammation)	Dexamethasone	200 mg/kg (oral)	Edema, Inflammatory markers (TNF- α , IL-6)	Inhibition of pro-inflammatory cytokines	p < 0.05	Khan et al., 2022 [53]
19	Leaves	Antibacterial	Methanolic	In vitro (agar diffusion)	Gentamicin	MIC = 1-10 mg/mL	Inhibition zone, MIC	Disruption of cell wall synthesis	p < 0.05	Sharma et al., 2023 [54]

Table 2. Summary table of rosemary plant.

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