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ROSMARINUS OFFICINALIS: HAIR, SKIN AND OTHER POSSIBLE THERAPEUTIC ACTIVITIES

SATYALAKSHMI S, SRINIVASA RAO Y, BHOOMIKA M* AND KAMALA KUMARI PV

Department of Pharmaceutics, Vignan Institute of Pharmaceutical Technology, Duvvada, Beside VSEZ, Visakhapatnam, Andhra Pradesh, India

***Corresponding Author: M Bhoomika: E Mail: lakshmisiragam48@gmail.com**

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ABSTRACT

Rosmarinus Officinalis L. commonly referred as rosemary, and it has needle like leaves. It is currently one of the most promising herbal remedies. It also provided substantial scientific evidence of the plant's anti-inflammatory, antimicrobial, wound-healing, and anticancer activity in dermatological practice. Mainly steam distillation, solvent extractions are used to extract the oil. According to the study of EFSA, the effective amount is 400 mg/kg of rosemary extract can be taken. Rosemary is prepared with various pharmaceutical combinations. It gives an effective result for alopecia. Due to the presence of carnosol/carnosic and ursolic acids, which give rosemary its antioxidant and anti-inflammatory qualities. Rosemary has been employed in traditional medical, pharmaceutical, and cosmetic sectors. In addition to its medicinal purpose, rosemary may be used in cosmetic formulation for the treatment of pathological and non-pathological disorders like aging, baldness, cellulite, sun damage and various medicinal properties including ailments of hair and scalp, cardiovascular, nervous disorders, etc. The main objective of this review is to provide pertinent information for creation of topical formulation of rosemary's bioactive constituents, as well as to critically examine the topical and other dosage form applications of rosemary.

Keywords: Rosemary, Antioxidant, Wound healing, Alopecia, Anti-inflammatory

INTRODUCTION

Rosemary (*Rosmarinus officinalis* L.), a member of the Lamiaceae family, is an evergreen perennial shrub, characterized by a unique aromatic odor. Among the three species of genus Rosmarinus used for essential oil production, *Rosmarinus officinalis* is one of the most productive species. Native to Mediterranean environments, this plant is now widely grown globally due to its medicinal, aromatic and ornamental properties. Currently, the three largest producers and exporters of rosemary essential oils worldwide are Spain, Tunisia and Morocco **[1]**.

It is also cultivated in the Mediterranean basin and India. Chemical properties of the plant include essential oil with main constituents including camphene, camphor, cineol, and borneol. It is reported to contain a lot of flavonoids, bitter principles, tannins, and terpenoids. Rosemary is used for several health conditions as a digestant, diuretic, emmenagogue, laxative, etc. It is also used as a flavoring agent in various cosmetic preparations. Hair loss is a dermatological disorder that is considered to be a problem from time immemorial and is reported to affect approximately 0.2-2% of the world population **[2]**.

Rosemary plant has various medicinal properties, of which extracts appear in the composition of hundreds of cosmetics. A Google search of the words "*Rosmarinus*" and "cosmetics" returns approximately 2,390,000 results (as of August 2020). In this search, it was observed that derivatives of rosemary are formulated in essential oils for massages and aromatherapy, rosemary alcohol, gels, shampoos, soaps, rosemary water, cleansing milk, deodorant, anti-wrinkle cream, aftershave lotion, hydrating facial cream, cream for the eye contour area, etc. **[3]**.

Taxonomical studies:

Clade: Angiosperms

Order: Lamiales

Family: Lamiaceae or Labiatae

Genus: Rosmarinus

Number of species: Five

Accepted name: *Rosmarinus officinalis* L. (*Salvia rosmarinus* Scheid.)

Synonyms: 21 (*R. angustifolius*, *R. latifolius*, *R. tenuifolius*, etc.)

The bioactive compounds of rosemary-such as monoterpenes, diterpenes, and polyphenols-are obtained from plant materials by steam distillation or similar processes. The most used classic extraction methods of essential oil are maceration, decoction, hydrodistillation, and solvent extraction.

Others, related to so-called green chemistry, are supercritical fluid extraction (SCF) and the use of microwave and ultrasound methods **[3]**. Rosemary can be harvested three to four times per year, and stands of rosemary remain productive for 5 to 7 years **[4]**. The below flow chart outlines the bioactive molecules present in rosemary (**Figure 1**).

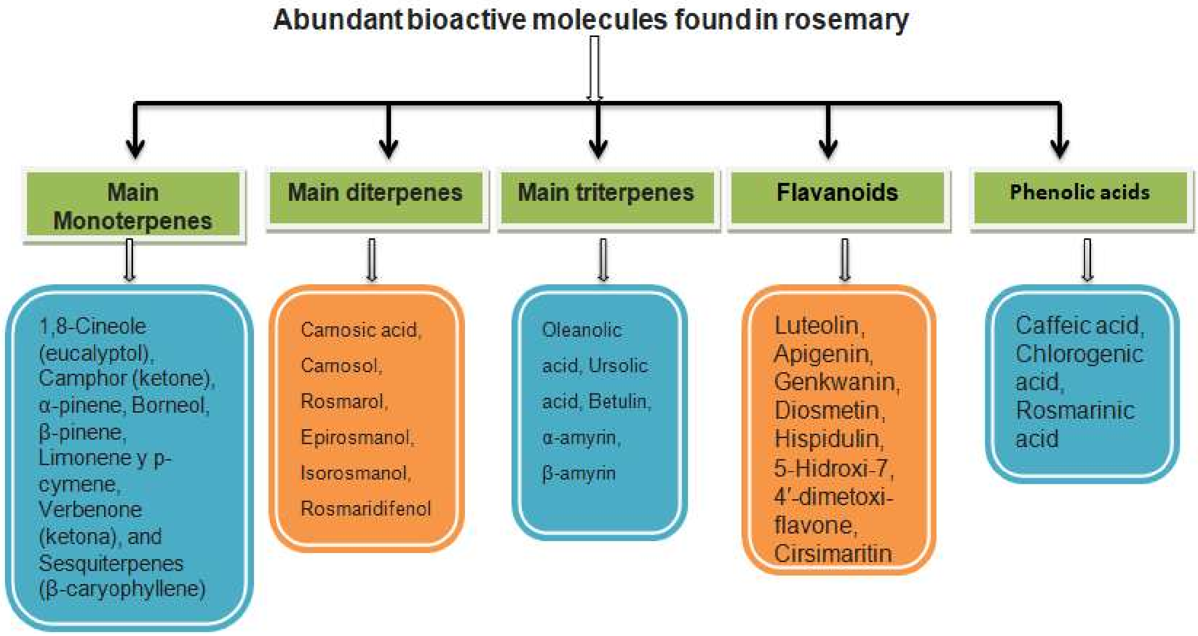

Figure 1: Bio-active compounds present in rosemary

Rosemary oil (*Rosmarinus officinalis L.*) is a medicinal plant with diverse actions, including enhancing microcapillary perfusion, which might explain its usefulness in reducing hair loss and increasing hair growth. It has also been shown to increase the production of prostaglandin E2 and reduce the production of leukotriene B4 in human polymorphonuclear leukocytes. Further, it inhibits the complement system. A single-blind, randomized clinical trial investigated the clinical efficacy of rosemary oil in the treatment of Androgenetic alopecia (AGA) and compared its effects to minoxidil 2% ointment. The study showed that application of rosemary oil was as effective as minoxidil 2% ointment. In addition, there was better treatment adherence in the rosemary group as compared with in the minoxidil group. The study provided evidence with respect to the efficacy of rosemary oil as an alternative treatment option for AGA **[5-7]**.

Due to its pharmacological and antibacterial properties, rosemary-which was once only used as a scent in the cosmetics industry-has progressively found extensive uses in the food and pharmaceutical industries. The volatile components found in rosemary leaves, such as rosmarinic acid, carnosol, and carnosic acid, might impede the growth of microbes. Additionally, the extract of rosemary leaves contains polyphenols that can augment the antioxidant capacity of food preservation. Carnosol and carnosic acid found in rosemary extracts, which are added to foods and drinks in the EU at up to 400 mg/kg, have an estimated high intake range set by the European Food Safety Authority (EFSA) **[8]**. Food preservation is one among the most recent uses of rosemary extract because of its capacity to avert oxidation and microbiological contamination. This justification has generated interest from the industry and consumers to reduce or eliminate the use of artificial antioxidants in food. The safety of using rosemary extracts as food additives has been examined by the European Food Safety Authority (EFSA). The panel concluded that in 90-day rat experiments, the No Observable Adverse Effects Level (NOAEL) of rosemary extracts was 180-400 mg RE/kg/day, which is equivalent to 20-60 mg/kg/day of CL[carnosol] + CA[carnosic acid] **[9]**.

Various extraction methods of rosemary oil

Steam Distillation

Steam distillation is the method used to extract essential oils from *Rosmarinus officinalis* L. It was made up of four components: the separator, condenser, extraction chamber, and boiler. The extraction chamber consisted of a vessel where leaves and steam interact to evaporate the oils. Before the procedure began, leaves were fed into the extraction chamber. The chamber was packed as tightly as possible to prevent the channeling effect. On the other side, if the effect continues, low yield might be a possibility. However, if the effect continues, there may be a chance of low yield. The oil vapors and steam were turned into liquid using a coil flow condenser. The water layer was drained out by turning on the tap until the meniscus was slightly over the calibration mark in order to separate the water from the oil **[10]**.

Fractionating tests

A 250 ml flask in the base, which served as the reboiler (bottom of the column), and two stages made up the fractional distillation column that was used to separate the oil. The packaging consisted of eight mm-diameter glass Raschig rings. The column had a diameter of 3 cm and a total height of 100 cm. A vacuum pump with a maximum vacuum of 10 kPa was connected to the system. At its top was an analog vacuum meter for monitoring vacuum. PWM (pulse width modulation) was used to control the 150 W electrical heating mantles at the base of the column. Glass flasks attached to the column held the condensed sample from each step. Electronically connected valves carried out the sample collecting in each step. The top and bottom of the column's temperature were tracked using PT100 sensors in between stages.

Samples from the top, the flask, and the first stage were used for the distillation experiments. 120 mL of raw oil were used in each batch. The vacuum pump's limit of 10 kPa was the absolute pressure at which the column worked under vacuum. Because the vapor temperature varied during the operation, the top tests were conducted as a function of temperature (from room temperature to oil boiling point) at the bottom of the column. 20% of the heating system's total output was initially used to heat the flask. The steam that passed through the column during the distillation process was collected in the condenser after achieving stability at these intervals, collecting some of the distillate and discarding the rest. The samples were then kept in the same manner as the raw oil and sent right away for both qualitative and quantitative examination. Three duplicates of each experiment were used to conduct the experiments. Stage examinations were conducted 30 minutes apart. The vapor was condensed and collected in cooled vials for these tests by opening a solenoid valve that was connected to the appropriate stage. The samples that were taken were sent right away for examination **[11]**.

Solvent extraction

The dried ground herb is extracted using food-grade solvents such as hexane, acetone, methanol, ethanol, water, or combinations of these to create many commercially available rosemary products. In a subsequent stage, vacuum and heat are used to eliminate the solvents. The solvent used is tetrafluoroethane (TFE), where TFE boils at 27 °C so the extraction of the sample takes place in a pressure vessel. Where TFE is blended with methanol and acetone in the ratio of 85:15:5 (TFE/methanol/acetone). The patent describes solvent and volatile oil removal using a vacuum drum dryer **[4]**.

Mechanical extraction

The process involves combining ground dried rosemary with oil, heating it while stirring, and then pressing the mixture to separate the oil from the plant residue. Low-viscosity oils, like mediumchain triacylglycerols (MCT), are the easiest to filter, while more viscous vegetable oils are more difficult. Another method used by the researchers is, 10% by weight of distilled water was applied to the dried rosemary, which was found to help transfer carnosic acid to the MCT. This was followed by 50% by weight MCT. After an hour of shaking, the mixture was put into a cylindrical press and squeezed to a pressure of 80 to 120 bar. After centrifuging and filtering the resultant oil extract, half of the carnosic acid that had initially been present in the ground spice was present in the oleoresin. Carnosic acid levels in oleoresins ranging from 3 to 7% were achieved. This method's inability to extract polar antioxidants like rosmarinic acid is one of its shortcomings **[4]**.

Supercritical carbon dioxide extraction

Basically this process takes place in two steps, where first the volatile oils are taken from ground dried rosemary by operating at 300-350 bar at 35-40°C. And in second step pressure will be increased to around 500 bar, where the antioxidant fraction can be extracted from the biomass.

An alternative method of extraction is done at 500 bars to produce oleoresins with complement of volatile oil. It can be removed in second extraction process or by countercurrent partitioning of oleoresins with supercritical CO_2 with column which describes the use of supercritical CO_2 to refine an ethanol extract of sage to prepare extract with very high levels of antioxidant activity. Every preparation and extraction has their advantages and disadvantages. The advantage of extraction by supercritical CO_2 is the solvent can be removed at low temperatures because it has low latent heat of evaporation and high volatility. The disadvantage involved is to extract the full range of nonpolar and polar antioxidants found in rosemary **[4]**. Rosemary formulations and its pharmaceutical activities are explained in **Table 1**.

Table 1: Rosemary formulation and its pharmaceutical significance

Rosemary formulations	Pharmaceutical activity	Ref
Rosemary + Titanium Oxide nanoparticles +Ginger	**Acts as a potential antibacterial agents against *Staphylococcus aureus***	**[12]**
Rosemary +Peppermint into nanoemulsion	**Novel nanoemulsion formulation can elevate the therapeutic effect of rosemary and peppermint essential oil as a topical treatment for osteoarthritis**	**[13]**
Rosemary oil+timur oil developed into nanoemulgel	**Tim-Ros-NEG exhibits anti-fungal activity against *Candida albians* count, when compared to ketoconazole**	**[14]**

Cosmetic properties [15]

Rosemary oil finds application in cosmetics owing to its pharmacological attributes, which offer advantages for skincare and hair care formulations. The below **Figure 2** provides the information about rosemary cosmetic properties and their uses

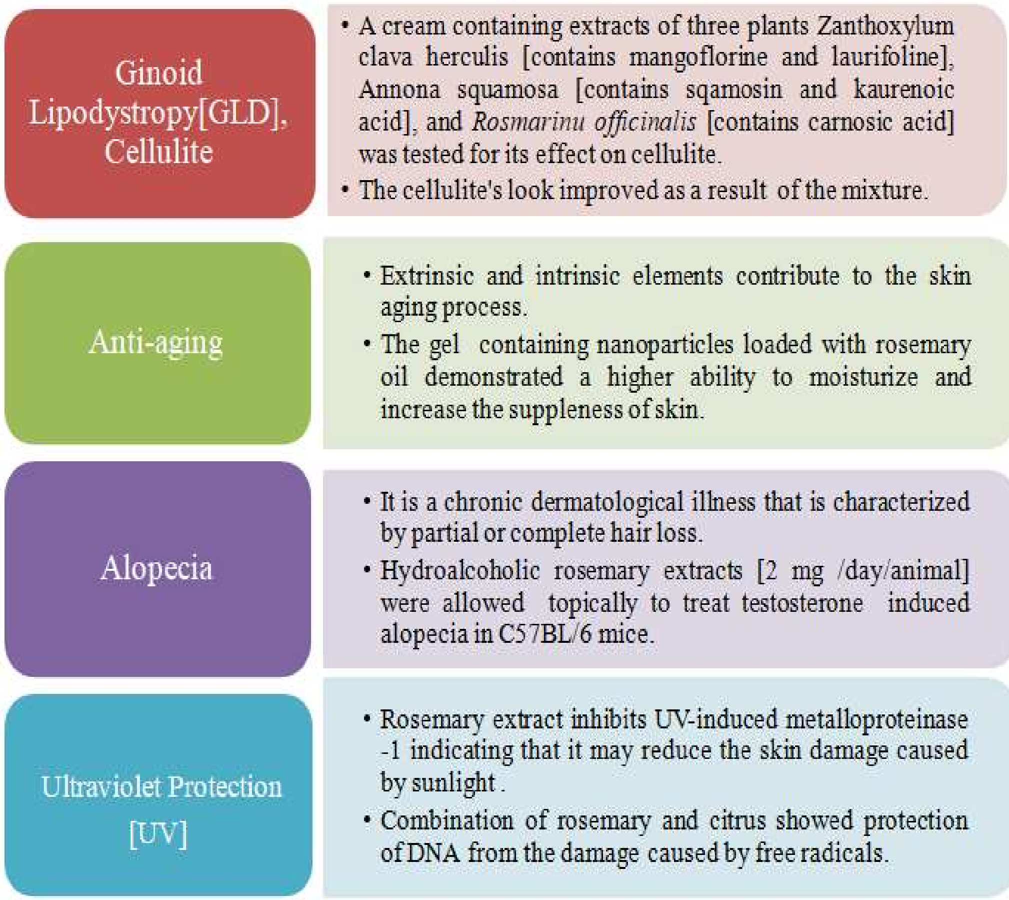

Figure 2: Various cosmetic properties of rosemary

Therapeutic benefits of rosemary [12, 15]

Rosemary oil possesses considerable therapeutic potential and is employed in treating a variety of ailments. Rosemary's therapeutic role and their therapeutic benefits are explained in **Table 2**.

Table 2: Rosemary therapeutic benefits

Therapeutic role	Mode of action
Skin cancer	**Rosmarinic acid was shown to exhibit chemo preventive activity against 7,12-dimethylbenz[a] anthracene-induced skin cancer, carnosic acid was shown to have an important protective role against melanoma**
Anti-epileptic	**Decreases glutamate neurotoxicity, ROS generation, oxidative stress, Ca2 influx, TTCC [T–type calcium channels], neural death, seizure severity and onset.**
Anti –anxiolytic	**Modulation of hypothalamus –pituitary-adrenal axis, GABAA receptors, decreases serum corticosterone level, and increases brain dopamine level and cholinergic activity.**
Anti-depressive	**Modulation of α1-receptors, D1, D2 receptors, 5HT1A, 5HT2A, 5HT3 receptors and decreases an hedonic behavior.**
Antinoceptive	**Modulation of GABAA, serotonin, nor-adrenaline and dopamine receptors.**
Alzheimers Disease	**Decreases oxidative stress, free radicals, cortisol level, AChE activity, BuCHE expression. Increases POP inhibition, CAT, SOD, Keap /Nrf2 transcriptional pathway.**
Anti –inflammatory	**Bioactive compound carnosic acid was reported to be a potent nitric oxide (NO) inhibitor.**

CONCLUSION

Rosemary is currently one of the most promising herbal remedies. With a focus on the recently discovered molecular mechanisms involved, this study evaluated the antioxidant role of *Rosmarinus officinalis* and its bioactive compounds on the skin. It has a wide range of bioactive compounds with promising medicinal applications. Topical doses of these secondary metabolites have been developed. By avoiding first-pass metabolism, topical administration techniques release the medication at the site of action and reduce the possibility of adverse effects. *Rosmarinus officinalis's* anti-inflammatory characteristics and ability to scavenge free radicals make it a useful tactic for enhancing the qualities of cosmetic products. Gram-positive bacterial, fungal, and drug-resistant illnesses may be treated with rosemary oil if the active components from it are identified and isolated. The biopharmaceutical study's results indicate that the following forms of phenolic compound release can be arranged in ascending order in modeled semisolid systems containing rosemary extract: water-in-oil-type cream < absorption-hydrophobic ointment < Pionier PLW oleogel < oil-in-water-type eucerin cream < hydrogel < oil-in-water-type gel-cream. According to the study's findings, the best vehicle for liquid rosemary extract employed as an active component is an oil-in-water gel-cream.

It is also important to highlight that more research has to be done on herbal medicines because it is still uncertain how safe and effective many of them are. Until more thorough safety studies are available, prolonged and high dose use of traditional formulations of rosemary and its active ingredients should be avoided. The new research may increase the therapeutic value of rosemary now and pave the way for its future application in contemporary medicine.

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REFERENCES

[1] Mwithiga G, Maina S, Gitari J, Muturi P. Rosemary (*Rosmarinus officinalis* L.) growth rate, oil yield and oil quality under differing soil amendments. Heliyon. 2022; 13: 8(4):e09277.

[2] Begum A, S S, N AK, Ali SS. evaluation of herbal hair lotion loaded with rosemary for possible hair growth in c57bl/6 mice. Adv Biomed Res. 2023; 21:12:60.

[3] González-Minero FJ, Bravo-Díaz L, Ayala-Gómez a. *rosmarinus officinalis* l. (rosemary): an ancient plant with uses in personal healthcare and cosmetics. *Cosmetics*. 2020; 7(4):77. https://doi.org/10.3390/cosmetics7040077

[4] Rosemary and sage extracts as antioxidants for food preservation https://doi.org/10.1016/B978-1-78242-089-7.00008-7

[5] Ezekwe N, King M, Hollinger JC. The use of natural ingredients in the treatment of alopecias with an emphasis on central centrifugal cicatricial alopecia systematic review. J Clin Aesthet Dermatol. 2020; 13(8):23-27.

[6] Al-Sereiti MR, Abu-Amer KM, Sen P. pharmacology of rosemary (*Rosmarinus officinalis* linn) and its therapeutic potentials. *Indian J Exp Biol.* 1999; 37(2):124-130.

[7] Panahi Y, Taghizadeh M, Marzony ET, Sahebkar A. Rosemary oil vs minoxidil 2% for the treatment of androgenetic alopecia: a randomized comparative trial. *Skinmed.* 2015; 13(1):15-21.

[8] Rosemary essential oil: Chemical and biological properties, with emphasis on its delivery systems for food preservation https://doi.org/10.1016/j.foodcont.2023.110003

[9] Veenstra JP, Johnson JJ. Rosemary (*Salvia rosmarinus*): health-promoting benefits and food preservative properties. Int J Nutr. 2021; 6(4):1-10.

[10] Frew T, Narendiran K, Surafel MB, Srinivasan NR. Extraction of essential oil from rosemary leaves: optimization by response surface methodology and mathematical modeling. Appl Food Reas. 2022; 2(2): 1-10. https://doi.org/10.1016/j.afres.2022.100133

[11] Silvestre WP, Medeiros FR, Agostini F, Toss D, Pauletti GF. Fractionation of rosemary (*rosmarinus officinalis* l.) essential oil using vacuum fractional distillation. J Food Sci Technol. 2019; 56(12):5422-5434.

[12] V T TS, Chokkattu JJ, S N, Ramakrishnan M, Shanmugam R. Green synthesis of titanium oxide nanoparticles with rosemary and ginger and their bactericidal action against *Staphylococcus aureus*. Cureus. 2023;15(9):e45892. doi: 10.7759/cureus.45892.

[13] Mohammadifar M, Aarabi MH, Aghighi F, Kazemi M, Vakili Z, Memarzadeh MR, Talaei SA. Anti-osteoarthritis potential of peppermint and rosemary essential oils in a nanoemulsion form: behavioral, biochemical, and histopathological evidence. BMC Complement Med Ther. 2021;9:21(1):57.

[14] Noor A, Jamil S, Sadeq TW, Mohammed Ameen MS, Kohli K. development and evaluation of nanoformulations containing timur oil and rosemary oil for treatment of topical fungal infections. Gels. 2023;9(7):516.

[15] de Macedo LM, Santos ÉMD, Militão L, Tundisi LL, Ataide JA, Souto EB, Mazzola PG. rosemary (*rosmarinus officinalis* l., syn *salvia rosmarinus* spenn.) and its topical applications: a review. Plants (Basel). 2020; 9(5):651.