



# Rosemary, (*Rosmarinus Officinalis*) Linn. An Updated Review

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## Abstract

*Rosmarinus officinalis* L. also called as Rosemary is an evergreen perennial shrub native to Southern Europe and has been cultivated in all Brazilian states. *Rosmarinus officinalis* L belongs to Lamiaceae/Labiatae family, which posses various medicinal healing properties for human life. Traditionally parts like leaves, flowers and stems are being used in the treatment of disorders such as inflammation, circulatory disorders, rheumatism, muscular affections, ulcers, diabetes etc. Into this *Rosmarinus officinalis* L. was reported to have anti-nociceptive, antioxidant, antidiabetic, anticolitic, antifungal, antimicrobial, antiulcer, antidepressant, antibacterial, hepatoprotective, neuroprotective, anticancer properties. The main constituents present in *R. officinalis* L. are 1, 8-cineole, alpha-pinene, camphor, borneol, camphene, limonene, linalool, terpineol, verbenol, apigenin, diosmetin, diosmin, rosmarinic acid, oleanilic acid and ursolic acid. The aim of this work is to highlight the updated review consists of scientifically proved medicinal activities against various disorders.

**Key Words:** *Rosmarinus officinalis*, Lamiaceae/Labiatae, uses, updated review.

## Introduction

*Rosmarinus officinalis* L (Labiatae/Lamiaceae) is an evergreen perennial shrub grown in many parts of the world and widely used as a spice in different culinary schools (Al-Sereiti et al., 1999; Baiett al., 2010; Harach et al., 2010). It is native to the Southern Europe and has been cultivated in all Brazilian states. It is a small aromatic shrub measuring about 0.8-2 m tall. It has narrow dark green leaves, violet coloured flowers with violet blue tips. Flower stalk, leaf stalk and calyx are star shaped with simple long glandular hairs. The plant is usually cultivated for its aromatic oil (Polunin and Smythies., 1973; Davis, 1982 ) and supposed to be useful for controlling soil erosion (Aydin et al., 2001). Out of natural antioxidants, Rosemary has been widely taken as one of the species with greatest antioxidant activity (Peng et al., 2005). Activity of different extracts of rosemary in food industry and medicine is due to the presence of some major phenolic compounds and antioxidant oil, to prevent oxidative breakdown of oil and lipid containing foods (Stefanovits-Banyai et al., 2003). About 90% of the antioxidant activity is due to the presence of carnosol and carnosic acid (LO, A. et al., 2002). Essential oil of rosemary reported to be useful in aroma therapy (Buttner MP et al 1996), fragrance industries (Van de Braak SAAJ et al.,1999), and food preservation (Faid M et al., 1995).The oil of Indian rosemary is characterised by relatively high amounts of 1,8- cineole, camphor and  $\alpha$ - pinene (L. Rahman et al 2007).

## Classification

<b>Species-</b>	<i>Rosmarinus officinalis</i>
<b>Synonym-</b>	Rosemary, Garden Rosemary, Incensier
<b>Class-</b>	Magnoliopsida
<b>Division-</b>	Magnoliophyta
<b>Order-</b>	lamiales
<b>Parts Used-</b>	Leaves and Twigs
<b>Family-</b>	labiates/Lamiaceae.
<b>Genus-</b>	Rosemerinus
<b>English-</b>	Rosemary

<b>Sanskrit-</b>	Rusmary
<b>Folk-</b>	Rusmari

**Uses –**

Rosemary extracts exerts a number of pharmacological activities like hepatoprotective (Sotelo-Felix et al., 2002), antiulcerogenic (Dias et al., 2000), diuretic (Haloui et al., 2000), antidiabetic (Bakirel et al 2008), antioxidant (Bakirel et al., 2008), antibacterial (Del Campo et al., 2000), antithrombotic (Yamamoto et al., 2005), antinociceptive (Gonzalez-Trujano et al., 2007), anti-inflammatory (Altinier et al., 2007), antidepressant (Heinrich et al., 2006), antimicrobial (Moreno et al., 2006), anticancer (Leal et al., 2003). Rosemary is being used traditionally in renal colic as an antispasmodic, to relieve symptoms of dysmenorrhea (Takaki et al., 2008), stimulate hair growth and to relieve respiratory disorders (Al-Sereiti et al., 1999; Fabio et al., 2007). Also used in epilepsy and headaches (Heinrich et al., 2006), neuroprotective and anti-aging (Adams et al., 2007)

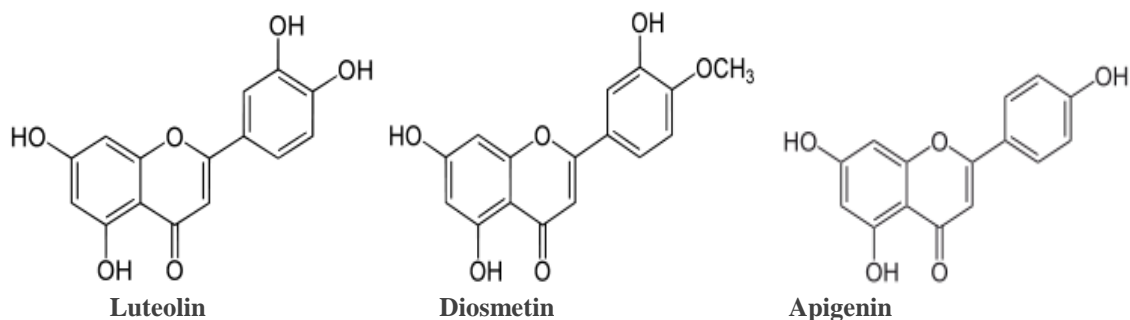


**Figure: 1- *Rosmarinus officinalis* Plant**

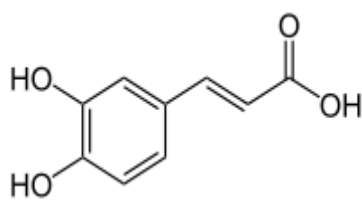
**Chemical constituents –**

Rosemary has various chemical constituents present in it, including flavanoids, phenols, volatile oils, terpenoids.

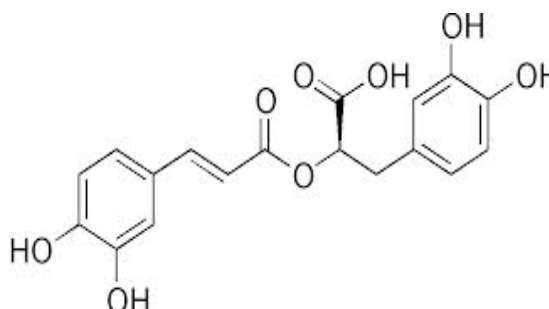
**Flavanoids:** Includes diosmin, diosmetin, luteolin, apigenin (Barnes et al., 2001).



**Phenols:** Includes caffeic and rosmarinic acid (Parnham and Kesselring, 1985).



Caffeic acid

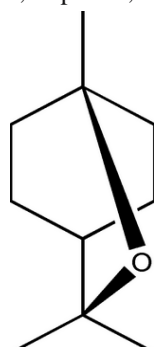


Rosmarinic acid

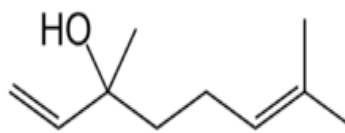
Volatile oil: Includes 1,8-cineole, alpha-pinene, camphor, borneol, isobutyl acetate, camphene, limonene, linalool, 3-octanone, terpineol, verbenol. (Barnes et al., 2007).



Limonene



1,8 - cineole

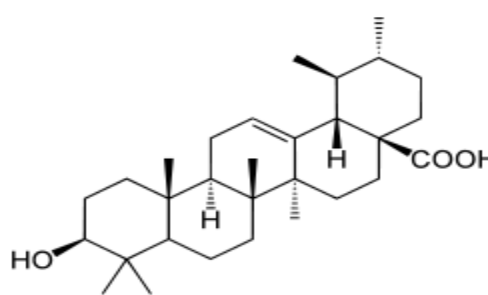


Linalool

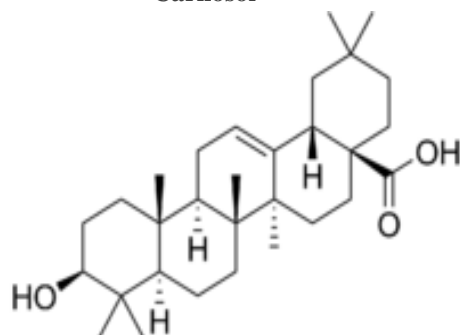
**Terpenoids:** Includes carnosol, rosmanol, oleanolic acid, ursolic acid (Barnes et al.,2001, Kosaka and Yokoi. 2003).



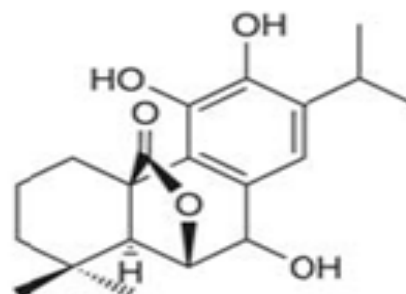
Carnosol



Ursolic acid



Oleanolic acid



Rosmanol

#### Reported Activities:

### Anti diabetic Activity and Antioxidant Activity-

The ethanolic extract of the leaves of *Rosmarinus officinalis* shows the effects on glucose homeostasis and antioxidant defence in rabbits. First set of experiment showed the hypoglycaemic effect of oral administration of different doses (50, 100 and 200 mg/kg) of the extract were studied in normoglycaemic and glucose-hyperglycaemic rabbits. Best effects was observed in both of the animal groups at a dose of 200mg/kg of the extract and this activity was independent from the effects of insulin. Another part of experiment showed the acute effect of different doses of the extract of *Rosmarinus officinalis* extract on serum insulin and blood glucose levels was examined in alloxon induced diabetic rabbits. Of the three different doses of the extract, the highest dose (200mg/kg) particularly lowered blood glucose level and increased serum insulin concentration in alloxon induced diabetes in rabbits. The last set of experiments aimed to investigate the subacute effect of *Rosmarinus officinalis* extract on repeated dose administration alloxon diabetic rabbits. Antihyperglycaemic effect of the extract at the doses of 100 and 200mg/kg was showed by a significant increase in serum insulin levels in diabetic rabbits. During 1 week treatment of diabetic rabbits at the dose of 200 mg/kg of the extract showed that the extract have a capability to inhibit the lipid peroxidation and activate the enzymes that shows the antioxidant properties. It was concluded that may be, due to the antioxidant properties, *Rosmarinus officinalis* extract exerts antidiabetogenic effect. (Bakirel et al 2008).

### Anti nociceptive Activity and Anti-inflammatory Activity-

The ethanolic extract of the aerial parts of *Rosmarinus officinalis* (RO) shows the antinociceptive activity using three different experimental models: formalin test in mice, acetic acid induced writhing test, and arthritic pain model: pain induced functional impairment model in rat (PIFIR model). Antinociceptive effects were evaluated using time courses and several time response curves. The antinociceptive effects from the extract of *Rosmarinus officinalis* were compared to that of antinociceptive effects of either tramadol (TR: 1.0-31.62 mg/kg i.p. in rats and 3.16-50 mg/kg, i.p. in mice) or acetylsalicylic acid (AA: 31.62-562.32 mg/kg, p.o.). Number of writhing movements induced by the i.p. administration of acetic acid solution reduced significantly ( $P < 0.001$ ) by RO extract (10-300 mg/kg, p.o.) in a dose-dependent way ( $ED_{50} = 108.84$  mg/kg, whereas, TR showed an  $ED_{50} = 12.38$  mg/kg). In addition, RO extract (30-300 mg/kg) inhibit significantly shanking and licking behaviours in both early (neurogenic pain) and in the late (inflammatory pain) phases of the formalin test. These effects were similar to that of TR. Concerning the results using the PIFIR model, RO extract (30-3000 mg/kg, p.o.) like either TR or AA, produced a significant ( $P < 0.001$ ) and dose dependent antinociceptive response in rats (RO:  $ED_{50} = 222.78$  mg/kg versus TR:  $ED_{50} = 11.36$  mg/kg and AA:  $ED_{50} = 206.13$  mg/kg). These results strongly showed that aerial parts of RO possess anti-inflammatory and antinociceptive activity, and reinforce the use of this plant in folk medicine. (Gonzalez-Trujano et al., 2007).

### Antidepressant Activity-

The hydroalcoholic extract of stems and leaves of *Rosmarinus officinalis* was investigated in two behavioural models, tail suspension test (TST) and forced swimming test (FST) in mice. Acute treatment of mice with the *R. officinalis* extract by p.o. route significantly reduced the immobility time in the TST (10-100 mg/kg) and FST (100 mg/kg), thus shows the antidepressant like effect as compared to a control group, without accompanying changes in ambulation in the open field test. Moreover, the repeated administration of *R. officinalis* extract by p.o route, also shows an antidepressant like effect in the TST (100-300 mg/kg). The pretreatment of mice with p-chlorophenylalanine (PCPA, 100mg/kg, i.p., an inhibitor of serotonin synthesis, for 4 consecutive days), ketanserin (5mg/kg, i.p., a 5-HT<sub>3</sub> agonist), SCH 23390 (0.05 mg/kg, s.c., a dopamine receptor antagonist), NAN-190 (0.5 mg/kg, i.p., a 5-HT<sub>1A</sub> receptor antagonist), prazosin (1mg/kg, i.p., an  $\alpha_1$ -adrenoreceptor antagonist), 1-(m-chlorophenyl) biguanide (m CPBG, 10 mg/kg, i.p., a 5-HT<sub>3</sub> receptor agonist) or sulpiride (50 mg/kg, i.p., a dopamine D<sub>2</sub> receptor antagonist), but not yohimbine (1 mg/kg, i.p., an  $\alpha_2$  adrenoreceptor antagonist) was able to alter the anti-immobility effect of the extract (10 mg/kg, p.o.) in the TST. The combination of sub-effective dose of the *R. officinalis* extract (1mg/kg, p.o.) with MDL72222, (0.1 mg/kg, i.p., a 5-HT<sub>3</sub> receptor antagonist) produced an immobility effect in the TST. The result shows that the action of the *R. officinalis* extract is mediated by the interaction with the monoaminergic system and that this plant should be used as an alternative therapeutic approach for the treatment of depression. (Mahado et al 2009).



### Antifungal Activity-

The essential oil examined from the aerial parts of *Rosmarinus officinalis* were obtained using gas chromatography/mass spectrometry and gas chromatography. The antifungal effects of the oil sample tested against strain of *Aspergillus flavus* (PTCC = 5004) fungi by using disc diffusion method via average inhibition zone. The results showed that the yield was found to be 3.2% of Rosemary oil from Kerman province. Forty one compounds were diagnosed in the essential oil concluded as 99.74% of the total oil. The major components were  $\alpha$ - pinene (15.52%), camphor (11.66%), verbenone (11.10%) and 1,8 cineole (10.63%). The results shows that essential oil from Rosemary plant at 1, 1/ 2 and 1/4 oil dilutions shows strong antifungal activity then gentamycin antibiotic on *A. flavus* and exhibit moderate of borneol was at 10% dilution. Benomil fungicide has no inhibitory effect on *A. flavus* at 10% dilution. Large percentage antifungal activities of Rosemary oil are related with  $\alpha$ -pinene of monoterpenes as the main compound. (Moghtader et al., 2011).

### Antiulcer Activity-

Crude hydroalcoholic (70%) extract of *Rosmarinus officinalis* L. was evaluated for antiulcerogenic activity by using different experimental models. Ulcerative lesion index produced by ethanol, indomethacin and reserpine in rats is decreased by crude hydroalcoholic extract (CHE) of *R. officinalis*.. Their was no antisecretory activity observed on pylorus ligation model. The previous administration of a NO-synthase inhibitor, L-NAME, did not show reduction in the antiulcerogenic activity of CHE in ethanol induced ulcer model, suggesting that nitric oxide (NO) has no relationship with pharmacological mechanism. Using the same experimental models, when animal groups were treated with indomethacin, the antiulcerogenic activity did not reduced by CHE, suggesting that prostaglandins has no relationship with pharmacological mechanism. The previous treatment with a thiol blocker, N-ethymaleimide, including nonprotein sulfhydryl groups, lowers the antiulcerogenic activit of CHE on ethanol induced ulcer model. This result suggest that the CHE of *R.officinalis* L. has active substances that increase the mucosal nonprotein sulfhydryl groups content. In another hypothesis, the pharmacological mechanisms could be attributed to the activity of antioxidant compounds present in the CHE which can react with N-ethymaleimide. (Dias et al., 2000).



### Anti colitic Activity-

This study was carried out to investigate the hydroalcoholic extract (RHE) and essential oil (ROE) of rosemary leaves in a well defined model of experimental colitis induced by trinitrobenzene sulfonic acid (TNBS) in rats. Different doses of REO (100, 200 and 400  $\mu$ l/kg) and RHE (100, 200 and 400 mg/kg) were administered intraperitoneally (100, 400  $\mu$ l/kg) and orally (100, 400 mg/kg) to male Wistar rats (n=6), 6 h after colitis induction and continued for 5 days by intracolonic instillation of 0.25 ml TNBS (80 mg/kg)/ethanol 50% v/v. Weight/length ratio of wet colon was measured and tissue damage scores as well as indices of colitis were evaluated both histopathologically and macroscopically. REO and RHE at all test doses were effective to reduce colon tissue lesions and colitis indices while greater doses were significantly effective to diminish histopathologic parameters irrespective to the route of administration. Administration of parenteral hydrocortisone acetate and oral prednisolone, Ascol (mesalazine microgranules) were effective to reduce colon tissue injury as well. These data suggest that REO and RHE are both effective to possess anti-colitic activity, and reinforce the use of this plant in traditional medicine as a remedy for inflammatory bowel disease. (Minaiyan et al., 2011).

### Neuroprotective Activity

Leaves extract of Rosemary (*Rosmarinus officinalis* L) shows a very high antioxidant activity and used as food additives. Neuroprotective effect of the leaves extract of Rosemary was investigated against neurotoxicity induced by acrylamide (ACR) in male albino rats. Pure acrylamide daily dose (30mg/kg b.w.) i.p. injection for four weeks shows a significant decrease in catecholamines: norepinephrine (NE), epinephrine (E) and dopamine (DA) content all tested areas (Brainstem, striatum, cerebellum, cerebral cortex, hippocampus and hypothalamus) studied at most of the time intervals. This is may be due to axon and nerve terminal degradation, which caused changes in transmitter synthesis, release, storage uptake andand reduction in synaptic vesicle as a result decrease in the content of neurotransmitters. Whereas, daily dose (100 mg/kg b.w) i.p injection of extract of rosemary for 30 days and subsequent withdrawal cause a significant decrease in the content of catecholamine all tested areas at most of time intervals studied. This is may be due to the presence of rosmarinic acid and caffeic acid which affects the uptake of monoamines and monoamines oxidase activity. This is may be due to the presence of carnosol and ursolic acid (UA) which increase in the levels of nitric oxide (NO) so decrease in the content of catecholamines. The present study revealed that moderate improvement in alteration of the catecholamine content caused by acrylamide, this is may be due to its attributed to its antioxidant and free radical scavenging activities. In conclusion, the results suggests that neuroprotective effects of Rosemary (*Rosmarinus officinalis* L) leaves extract against ACR-induced neurotoxicity injury. (Abeer et al., 2008).

### Anticancer and Antibacterial Activity

Essential oil of *Rosmarinus officinalis* L. and three of its main constituents  $\alpha$ -pinene (19.43%),  $\beta$ -pinene (6.71%) and 1,8-cineole were evaluated for their antibacterial activities and toxicology properties. *R. officinalis* L. essential oil possessed antibacterial activity little bit better than  $\beta$ -pinene and similar to  $\alpha$ -pinene, while 1,8-cineole possessed lowest antibacterial activities. *R. officinalis* L. essential oil used to treat cancer as it has found that its essential oil exhibit strongest cytotoxic activity towards three human cancerous cells. Its inhibitory concentration 50% (IC<sub>50</sub>) values on HO-8910, Bel-7402 and Sk-OV-3 were 0.076%, 0.13% and 0.025% (v/v), respectively. All test samples exhibit stronger cytotoxicity on Sk-OV-3 than on HO-8910 and Bel-7402. *R. officinalis* L. essential oil showed greater activity than its components in both antibacterial and anticancer test systems, and the activities were depends upon their concentration. (Wang et al., 2012).

### Hepatoprotective Activity

In traditional medicine *Rosmarinus officinalis* L. characterized by antioxidant and hepatoprotective activities that can be attributed to its hydroxyphenolic constituents, including carnosol, rosmarinic acid and flavanoids. It has also been reported to have neuroprotective effects. The aim of the study was to determine the effect of the *R. officinalis* L. treatment on neuronal damage in the frontal cortex and expression of the glutamate transporter (GLT-1) of rats and hepatic damage which was induced by carbon tetrachloride (CCl<sub>4</sub>). It was evaluated that the protective effect of *R.officinalis* L. against hepatic damage induced by CCl<sub>4</sub> in Wistar rats treated with *R.officinalis* L. extract one week prior to, and then chronic treatment with CCl<sub>4</sub>. Expression of GLT-1 was determined using a reverse transcriptase-polymerase chain reaction (RT-PCR), and the morphological features of the cells which were irreversibly damaged in the cerebral cortex were studied using light microscopy. The morphological evaluation showed that *R.officinalis* L.exerts a protective effect in the frontal cortex that was correlated with increased GLT-1 expression. The protective effect of *R. officinalis* L. against CCl<sub>4</sub> leads to hepatic damage. This hepatic damage may occur due to improved hepatocellular function. Moreover the presence of flavanoids which contains antioxidant in the extract may contribute to a probable mechanism for this effect.

### Conclusion

The extensive literature survey revealed that *Rosmainus officinalis* L. is important medicinal plant. The plant shows the presence of many chemical constituents which are responsible for various pharmacological and medicinal property. The

evaluation needs to be carried out on *Rosmarinus officinalis* L. in order to its uses and formulation of the plant in their practical clinical applications, which can be used for the welfare of mankind.

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