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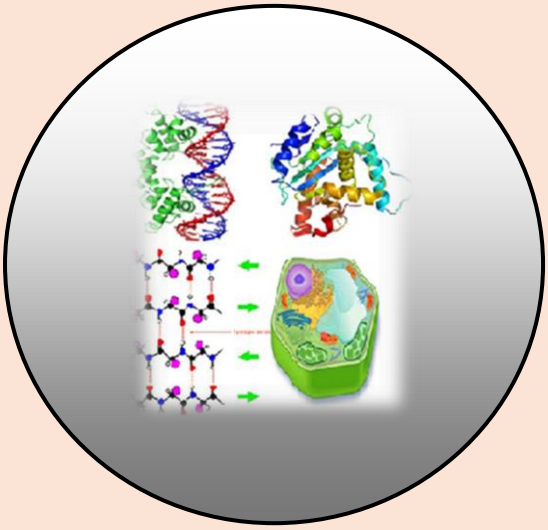

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REVIEW ARTICLE
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Innovations on Phytocompounds of *Rosmarinus officinalis L.* and Therapeutic Applications

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ABSTRACT

Rosemary is a fragrant evergreen herb native to the Mediterranean. It is used as a culinary condiment, to make bodily perfumes, and for its potential health benefits. Rosemary is a member of the mint family Lamiaceae, along with many other herbs, such as oregano, thyme, basil, and lavender. Salvia rosmarinus, commonly known as rosemary, is a shrub with fragrant, evergreen, needle-like leaves and white, pink, purple, or blue flowers, native to the Mediterranean region. Until 2017, it was known by the scientific name Rosmarinus officinalis. Rosmarinus officinalis L. (Rosemary) is a medicinal plant native to the Mediterranean region and cultivated around the world. Thus, in vivo and in vitro studies were presented in this Review, approaching the therapeutic and prophylactic effects of R. officinalis L. on some physiological disorders caused by biochemical, chemical or biological agents. The main objective of this study was showing that plant could be products phytocompounds and oils are equivalent to the available medicines. From this research, it can be concluded that R. officinalis has a promising future especially in the treatment and prevention of various diseases. Too we concluded that Rosemary has been widely used not only in cooking, especially to modify and enhance flavors, but also in traditional medicine, being a highly appreciated medicinal plant to prevent and cure colds, rheumatism, pain of muscles and joints.

Keywords: Rosmarinus officinalis, Medicinal Plant, Phytocompounds, Mediterranean region and Therapeutic Applications.

INTRODUCTION

Rosemary is a perennial evergreen shrub with blue flowers. It is an aromatic and distinctive herb with a sweet, resinous flavor. *Salvia rosmarinus* is now considered one of many hundreds of species in the genus Salvia. Here's how to grow your own rosemary plants.

Rosemary can be grown from seed, but germination rates are generally quite low and seedlings are slow to grow. Therefore, it's strongly recommended to start new rosemary plants from cuttings taken from established plants. Cuttings grow quickly in good conditions and should be ready for outdoor planting in about 8 weeks. For a head start, plant the seeds or cuttings indoors 8 to 10 weeks before the last. Water rosemary plants evenly throughout the growing season, but be careful not to overwater. Prune regularly so that plants won't get lanky. For fresh rosemary in the winter, grow the plant indoors in a pot (or take a cutting from an outdoor plant and keep a second indoors). Be sure to put it in bright light and protect it from cold drafts. Rosemary that's grown in the ground does not transplant to containers well, so consider growing it in a container that can be brought inside during the colder months. Be sure to get cuttings or divide the plant for next season if it won't survive winter in your area. Snip off stems to use fresh, or hang them in the kitchen for dried rosemary. During the winter, bring potted rosemary plants inside. Learn how to overwinter rosemary indoors. Harvest young stems and leaves for the freshest taste. Harvest up to a third of the rosemary at any one time, allowing the plant to replace its growth before taking more. Rosemary tea is said to enhance one's memory. Alternatively, wear a sprig of rosemary in your hair to improve your memory. In the language of flowers, rosemary symbolizes remembrance. A sprig of lavender or rosemary under your ironing board cover will release its fragrance with the heat (Drew et al., 2017).

The first mention of rosemary is found on cuneiform stone tablets as early as 5000 BC (Leafy Medicinal Herbs). After that not much is known, except that Egyptians used it in their burial rituals. There is no further mention of rosemary until the ancient Greeks and Romans. Pliny the Elder (23–79 AD) wrote about it in The Natural History. As did Pedanius Dioscorides (c. 40 to c. 90), a Greek botanist (amongst other things). He talked about rosemary in his most famous writing, De Materia Medica, one of the most influential herbal books in history.

Table 1. Some commonly known as rosemary.

Botanical Name	***Rosmarinus officinalis***
Plant Type	Herb
Sun Exposure	Full Sun
Soil pH	Slightly Acidic to Neutral
Bloom Time	Summer
Flower Color	Blue
Hardiness Zones	7, 8, 9, 10, 11
Soil Type	Loamy, Sandy

The herb then made its way east to China and was naturalized there as early as 220 AD, The Illustrated Encyclopedia of Fruits, 2017] during the late Han Dynasty (2021). Rosemary came to England at an unknown date; the Romans probably brought it when they invaded in the first century, but there are no viable records about rosemary arriving in Britain until the 8th century. This was credited to Charlemagne, who promoted herbs in general, and ordered rosemary to be grown in monastic gardens and farms (The Illustrated Encyclopedia of Fruits, 2017). Furthermore, there are also no records of rosemary being properly naturalized in Britain until 1338, when cuttings were sent by The Countess of Hainault, Jeanne of Valois (1294–1342) to Queen Phillippa (1311–1369), wife of Edward III.

It included a letter that described the virtues of rosemary and other herbs that accompanied the gift. The original manuscript can be found in the British Museum. The gift was then planted in the garden of the old palace of Westminster. After this, rosemary is found in most English herbal texts, and is widely used for medicinal and culinary purposes. Hungary water, which dates to the 14th century, was one of the first alcohol-based perfumes in Europe, and was primarily made from distilled rosemary.
Rosemary finally arrived in the Americas with early European settlers in the beginning of the 17th century. It soon was spread to South America and global distribution.

Cultivars

Rosmarinus officinalis L. (Labiatae) is a typical shrub of the Mediterranean maquis. In spite of its multiple ornamental and aromatic uses, and the great interest in its cultivation, only a few cultivars or clones have been well characterized. Natural phenolic antioxidants from genetically heterogeneous plants are becoming important for prevention of lipid oxidation in food. To produce uniform and enhanced levels of antioxidants we have developed elite clonal lines of rosemary using plant tissue culture techniques.

Numerous cultivars have been selected for garden use (AGM Plants, 2017).
'Albus' – white flowers
'Arp' – leaves light green, lemon-scented and especially cold-hardy
'Aureus' – leaves speckled yellow
'Benenden Blue' – leaves narrow, dark green
'Blue Boy' – dwarf, small leaves
'Blue Rain' – pink flowers
'Golden Rain' – leaves green, with yellow streaks
'Gold Dust' -dark green leaves, with golden streaks but stronger than 'Golden Rain'
'Haifa' – low and small, white flowers
'Irene' – low and lax, trailing, intense blue flowers
'Lockwood de Forest' – procumbent selection from 'Tuscan Blue'
'Ken Taylor' – shrubby
'Majorica Pink' – pink flowers
'Miss Jessopp's Upright' – distinctive tall fastigiate form, with wider leaves.
'Pinkie' – pink flowers
'Prostratus' – lower groundcover
'Pyramidalis' (or 'Erectus') – fastigate form, pale blue flowers
'Remembrance' (or 'Gallipoli') – taken from the Gallipoli Peninsula
'Roseus' – pink flowers
'Salem' – pale blue flowers, cold-hardy similar to 'Arp'
'Severn Sea' – spreading, low-growing, with arching branches, flowers deep violet
'Sudbury Blue' – blue flowers
'Tuscan Blue' – traditional robust upright form
'Wilma's Gold' – yellow leaves

The plant flowers in spring and summer in temperate climates, but the plants can be in constant bloom in warm climates; flowers are white, pink, purple or deep blue [The Illustrated Encyclopedia of Fruits, 2017].

Rosemary also has a tendency to flower outside its normal flowering season; it has been known to flower as late as early December, and as early as mid-February (in the northern hemisphere (McCoy, Michael, 2012). Rosemary (*Rosmarinus officinalis* L.) is an aromatic species with a relevant economic value due to its use as fresh condiment or dry spice. Spontaneous populations of rosemary spread in the Mediterranean basin and a high genetic variability is suitable to new cultivars selection for intensive growing management. Few standard cultivars of rosemary are actually available in nurseries and mainly for ornamental use. Furthermore, cultivars are not characterized for biomass quality and chemical composition of the essential oil (Figure 1 and Figure2).

Figure 1. Showing leaves color of rosemary.

Figure 2. Showing flower color of rosemary.

METHODS

The synergistic and antinociceptive activities of *R. officinalis* L. ethanol extract were reported in a study conducted in Wistar rats (Beltrán-Villalobos, 2017). The plant extract, phytocompounds was ursolic acid and oleanolic acid, ketorolac, and ketorolac associated with plant products.

RESULTS

Phytocompounds present in *R. officinalis* L. that we studied show in figure 3 and 4. The phytocompounds most reported include caffeic acid, carnosic acid, chlorogenic acid, monomeric acid, oleanolic acid, rosmarinic acid, ursolic acid, alpha-pinene, camphor, carnosol, eucalyptol, rosmadial, rosmanol, rosmaquinones A and B, secohinokio, and derivatives of eugenol and luteolin (Figure 3 and Figure 4).

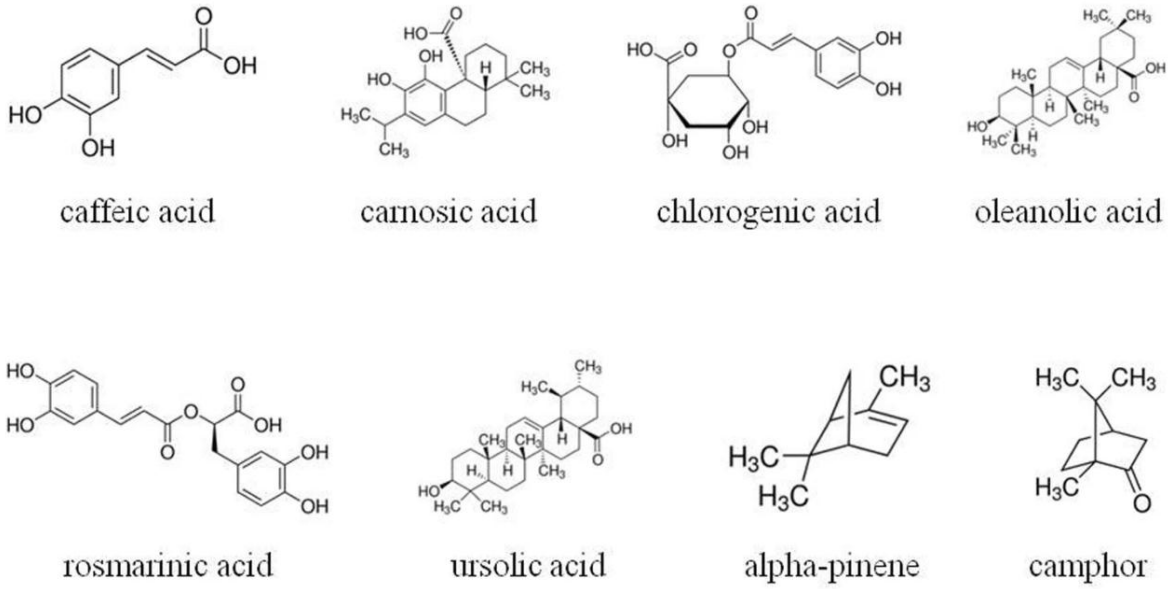

Figure 3. Phytocompounds present in *R. officinalis* L.

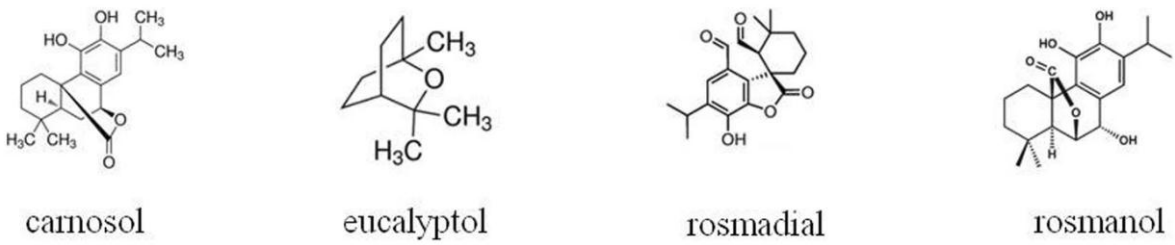

Figure 4. Phytocompounds present in *R. officinalis* L.

Antioxidant Activity

The natural antioxidants from plants are becoming increasingly important, not only in the nutritional area (food preservation and stability) but also in preventive medicine. The Lamiaceae family has been a focus of the research on antioxidant compounds due to its high polyphenol content. Likewise *R. officinalis* leaves are commonly used as a condiment for flavoring food, and as a source of antioxidant compounds employed in food conservation. Antioxidants play a major role in the prevention and treatment of diseases associated with oxidative damage, including cancer, cardiovascular and neurodegenerative diseases. Reactive oxygen species, including hydrogen peroxide and free radicals, such as superoxide anion (O2•-) and hydroxyl radical (HO•), are inevitably produced in living organisms resulting from metabolic processes or from external sources. Continued exposure to free radicals in biological systems may cause functional and structural damage, aging and cell death (Gutiérrez and García, 2003) (Figure 5).

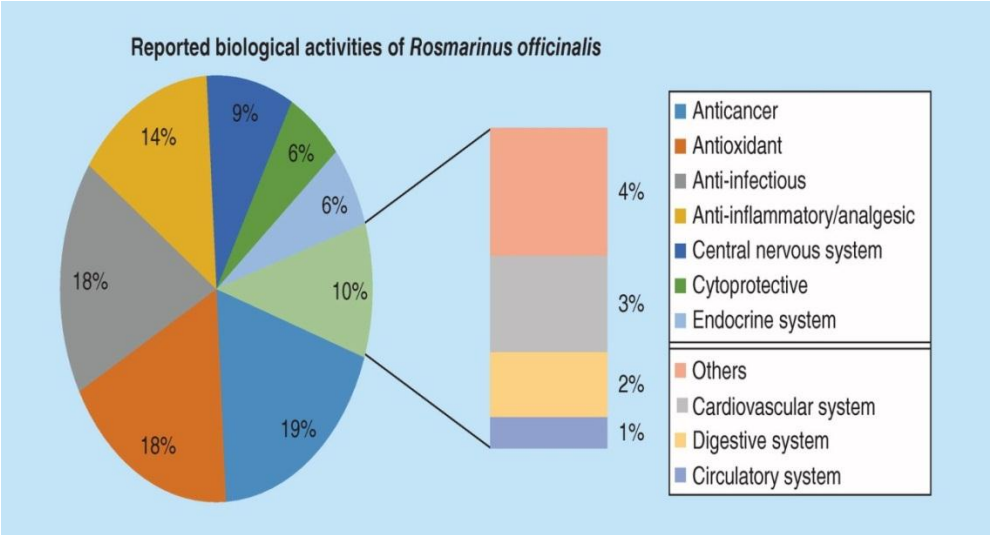

Figure 5. Showing biological activities of *Rosmarinus officinalis*.

CONCLUSION

In recent years, much effort has been devoted to the development of PBMs, proposing them as natural drugs in many pathological conditions including anti-inflammatory, analgesic, antioxidant, antitumor, anti-infectious, CNS and endocrine system activities. Phytotherapy is a major contributor to the discovery of new, safer and effective PBMs, as well as new drugs, knowing that what pharmaceutical chemistry has sought desperately, nature has in large quantities. Rosemary contains a number of phytochemicals, including rosmarinic acid, camphor, caffeic acid, ursolic acid, betulinic acid, carnosic acid, and carnosol. Rosemary essential oil contains 10–20 % campho. Rosemary oil can be used externally on the skin or hair (always dilute with a carrier oil first). Rosemary is also helpful in warding off smaller pests like mosquitos and is an ingredient in my homemade Bug-Off Bars. Used externally, rosemary oil can help soothe the stomach and relieve pain from indigestion, menstrual cramps or other difficulties. Rosemary antioxidant extract is a very effective natural preservative that can extend the shelf life of homemade lotions, cosmetics or other homemade body products. You can inhale rosemary oil or apply it to your skin. A diffuser can help distribute the essential oil in a room.

If using rosemary oil topically, dilute it with carrier oil, such as jojoba oil, to avoid skin irritation. The plant or its oil has been used in folk medicine in the belief it may have medicinal effects. Rosemary was considered sacred to ancient Egyptians, Romans, and Greeks. In Don Quixote (Part One, Chapter XVII), the fictional hero uses rosemary in his recipe for balm of fierabras. The plant has been used as a symbol for remembrance during war commemorations and funerals in Europe and Australia. Mourners would throw it into graves as a symbol of remembrance for the dead. In Australia, sprigs of rosemary are worn on ANZAC Day and sometimes Remembrance Day to signify remembrance; the herb grows wild on the Gallipoli Peninsula, where many Australians died during World War ("Rosemary", Australian War Memorial, 2013). This work performed an updated review on *R. officinalis* L., allowing us to emphasize the current state of the art, on studies and investigations, pointing out the awareness of the pharmacological activities related to the constituents of this plant. Since 1990s, there has been an increasing therapeutic interest in rosemary, from both in vitro and in vivo studies on several biological activities, such as antioxidant, anti-inflammatory, analgesic, etc., previously described in ethnobotanicals studies.

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