International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 8 Issue 2, March-April 2024 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Rosemary Grass “A Fragrant Herb with Endless Possibilities"

Borade Manjiri Ramdas, Kate Mahesh Sudam, Jadhav Shubham Mahendra, Padol Kalyani Anil

Matoshri College of Pharmacy, Nashik, Maharashtra, India

ABSTRACT

Rosemary (Rosmarinus officinalis L.) is an enduringly cherished herb with a rich history dating back to ancient civilizations. Its botanical prominence extends from the Mediterranean to Europe, Asia, and Africa. Aptly named “Dew of the Sea” in Latin, rosemary symbolizes memory, love, and loyalty. This perennial shrub emits a distinct aroma from its plentiful leaves, which are harvested three to four times a year.

Highly valued for its culinary and medicinal properties, rosemary boasts significant antioxidant and hepatoprotective attributes. European and US regulatory bodies affirm its safety for consumption. The herb’s extracts, rich in carnosic acid and carnosol, exhibit remarkable health benefits, prompting their incorporation into various foods and beverages.

Historically, rosemary has been utilized for embalming, aromatherapy, and medicinal purposes. Its efficacy in combating ailments ranging from cardiovascular diseases to inflammation underscores its therapeutic versatility. Notably, rosemary oil extraction methods, including microwave-assisted and hydrodistillation techniques, ensure the preservation of its beneficial compounds.

Rosemary’s nutritional profile highlights its abundance in essential vitamins and minerals, contributing to overall health and well-being. Recent research emphasizes its effectiveness in cardiovascular health, inflammation reduction, allergy relief, antimicrobial activity, and cognitive enhancement.
Despite its numerous benefits, caution is warranted regarding potential adverse effects, particularly in high doses. Side effects may include vomiting, coma, and pulmonary edema, with pregnant women advised against excessive consumption due to the risk of miscarriage.

In conclusion, rosemary stands as a multifaceted botanical treasure, intertwining culinary delight with therapeutic efficacy. Its enduring legacy persists as a testament to its remarkable contributions to human health and culture throughout millennia.

How to cite this paper: Borade Manjiri Ramdas | Kate Mahesh Sudam | Jadhav Shubham Mahendra | Padol Kalyani Anil | Rosemary Grass “A Fragrant Herb with Endless Possibilities" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-8 | Issue-2, April 2024, pp.779-786, URL: www.ijtsrd.com/papers/ijtsrd64788.pdf

IJTSRD64788

Introduction:

Fig 1.1

Fig 1.2

The Rosmarinus officinalis L. is a hardy and aromatic evergreen plant that comes from the Mediterranean region but has since expanded over Europe, Asia, and Africa. Rosmarinus means "Dew of the Sea" in Latin, which is where the term first originated. Positive qualities like memory, love, and loyalty have long been connected to this herb [1,2]. Evergreen and well-known for its unique scent is this perennial shrub. Its leaves are plentiful and emit a distinct aroma that

permeates the atmosphere[3].It's vital to remember that leaves can be plucked three or four times year, no matter what[4]. Rosemary is a highly prized spice in Europe and the United States that is frequently used as potent antioxidant[5].Significant hepatoprotective properties have been demonstrated by its extracts, which have also been utilized to treat a number of illnesses [6]. It's important to remember that the European Food Safety Authority (EFSA) conducted a thorough safety evaluation and determined that rosemary extracts were safe to eat. In the US and Europe, this amazing spice is easily accessible for commercial use. It is well known for having strong antioxidant qualities, which offer significant value to any recipe[7].Did you know that in the European Union, extracts of rosemary are frequently added to foods and drinks? And not simply because of how delicious it tastes! Since rosemary contains significant amounts of carnosic acid and carnosol, it is also well known for its many health advantages. It's noteworthy to note that carnosic acid and carnosol consumption estimations are shown in recent research to be rather high, with values ranging from 0.81 mg/kg per day in toddlers to 0.09 mg/kg per day in the elderly. This emphasizes the necessity of additional study to fully comprehend the ramifications of these discoveries and to investigate viable approaches for controlling the concentrations of these substances in our meals. When you sum up the levels of these amazing compounds, they can reach up to 400 mg/kg! With all of these incredible benefits, it's no wonder that rosemary is a beloved herb all around the world. It has been demonstrated to exhibit strong antifungal, antiviral, antibacterial, anti-inflammatory, antitumor, antithrombotic, antinociceptive, antidepressant, antiulcerogenic, and antioxidant activities [8-10].

Fig 1.3

Scientific classification [11]

Kingdom	Plantae
Family	Lamiaceae
Genus	Salvia
Species	S. rosmarinus
Synonyms	• Rosmarinus angustifolius Mill. • Rosmarinus communis Noronha • Rosmarinus flexuosus Jord. & Fourr. • Rosmarinus latifolius Mill. • Rosmarinus ligusticus Gand. • Rosmarinus officinalis L.

History and background:

Fig 1.4

Rosemary has been recorded on cuneiform stone tablets as early as 5000 BCE, making it one of the oldest herbs known to mankind[12]. Its use in embalming corpses by the ancient Egyptians can be traced back to 3500 BCE with certainty[13].Rosemary has been a widely recognized plant since ancient times. The Ancient Egyptians used creams and oils containing rosemary as a means of protecting themselves against high temperatures and desert heat[14]. Rosemary was a crucial ingredient among other plant extracts like myrrh, thyme, marjoram, chamomile, and cedar, used to formulate these products[15]. Moreover, bouquets of rosemary were placed in the tombs of the Egyptian pharaohs to ensure their journey to the underworld was perfumed. Evidence suggests that rosemary was introduced to China around 220 BC, marking its global recognition[16].Rosemary was named Libanotis coronaria by Dioscorides, who lived from 40 BC to 90 BC. This was due to its remarkable ability to invigorate the tired human body upon application[17]. De Materia Medica, an ancient book about medicine, confirms that rosemary was used extensively in aromatherapy for perfuming rooms and as an insecticide. The fathers of ancient medicine, namely Hippocrates, Avicenna, and Galen, used ointments made from rosemary flowers and leaves soaked in olive oil to treat joint pains and as a vulnerary to heal wounds[18]. Since rosemary has so many wonderful health advantages, it is little wonder that it has been used for so long. In the midst of the extremely contagious Yersinia pestis-caused Great London Plague in 1665, inhaling rosemary vapors was a tried-and-true way to stay safe when passing through infested areas. Furthermore, burning a concoction of

juniper berries and rosemary leaves in French hospitals proved to be a successful means of eliminating infections during World War II[19].

Nutritional Value of Rosemary:

The nutritional value of rosemary is as shown below:

Components	Percent/100gm
Folates	27%
Vitamin C	36%
Pantothenic acid	16%
Pyridoxine	26%
Calcium	32%
Thiamin	03%
Vitamin A	97%
Niacin	06%
Manganese	42%
Potassium	14%
Copper	33%
Riboflavin	12%
Iron	83%
Magnesium	23%
Sodium	02%
Zinc	8.5%

Table depicting the nutritional value of rosemary[20]

Method for extraction of rosemary oil :

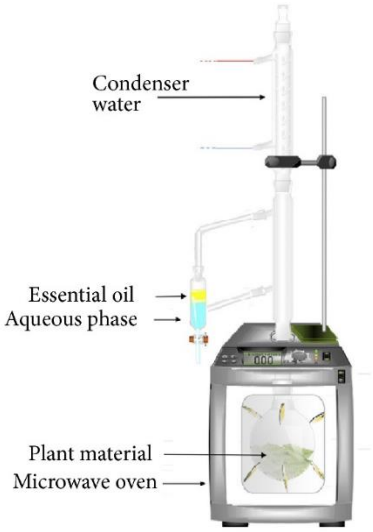
1. Plant material

Fig1.5

The rosemary samples were collected in May 2018 from the Fez region (406 m, 34°01′59″ Latitude North and 5°00′01″ Longitude West), during the flowering stage of the plant. Only the aerial parts of the plant were used for the study, while the leaves and apical parts were dried in the shade for eight days at a fixed room temperature of 25°C. This approach was carefully chosen to ensure that the plant material was of the highest quality and would yield accurate results[21].

2. Microwave assisted extraction

Microwave-assisted hydrodistillation is an efficient process that involves using a domestic microwave oven directly connected to a Clevenger-type extractor and a cooling system to continuously condense the distillate. The excess of condensed water is refluxed to the extraction flask to restore the water to the plant material. The optimal conditions for extracting time, microwave power, and ratio of water to plant material have been determined with certainty [22].



To carry out this process, 100 g of rosemary samples are placed in a 2-liter flask containing 200 ml of distilled water. The mixture is heated inside the microwave oven cavity at a fixed power of 600 W until all essential oils are fully extracted. The essential oils extracted are dried under anhydrous sodium sulphate and stored in the dark until they are used for analysis. The extractions are done at least three times, and the mean values of the yield and standard deviation are determined with accuracy.

3.Hydrodistillation by clevenger

The Clevenger hydrodistillation method was utilized to extract essential oils from rosemary under optimal operating conditions. To achieve this, 100g of rosemary was added to 800ml of distilled water in a 2-liter flask. The flask was positioned in a balloon heater attached to a refrigerator to ensure condensation of essential oils for precisely 3 hours. Upon the completion of the distillation process, two phases were observed, an aqueous phase (aromatic water) and an organic phase (essential oil), with the essential oil being the less dense of the two. The essential oil was collected, dried under anhydrous sodium sulphate, and stored in sealed vials in the dark, at a temperature of 4°C, until used. The experiments were conducted twice for each condition to ensure consistency[23].

Rosemary for health benefits:

1) Rosemary's Cardiovascular Effects :

Rosemary is a highly useful herb for individuals with high blood pressure[24]. Researchers at the University of Massachusetts have conclusively established that rosemary acts as an ACE inhibitor and effectively blocks the formation of the hormone angiotensin II. This hormone is a notorious instigator

of inflammation within the arteries and accelerates the development of atherosclerosis, resulting in constriction of blood vessels which leads to high blood pressure. Studies also indicate that rosemary enhances the ability of blood vessels to dilate in healthy young individuals[25].

2) Quenches Inflammation :

Rosmarinic acid, which is abundant in rosemary, sage, and basil, has been shown to successfully lessen pulmonary inflammation brought on by diesel particulates in the air. These dangerous particles raise the chance of dying from lung ailments and drastically lower quality of life[26,27]. Additionally, it has been discovered that rosemary works well to prevent dust mite-induced allergic inflammation in the bronchial passages. Additionally, rosmarinic acid helps shield DNA from the deteriorating consequences of long-term inflammation. Furthermore, rosemary lessens the release of inflammatory chemicals and limits the migration of white blood cells to damaged tissues[28].

3) Allergy relief :

Rosmarinic acid is a highly potent compound that surpasses antihistamines in its ability to reduce allergy symptoms, including inflammation and swelling. It effectively eliminates allergy-triggered T-lymphocytes that are no longer required, while preserving the essential T-cells that fight off bacteria and viruses. The latest research conducted in Japan using rodents provides compelling evidence that daily administration of rosmarinic acid can prevent allergic asthma caused by house mites[29].

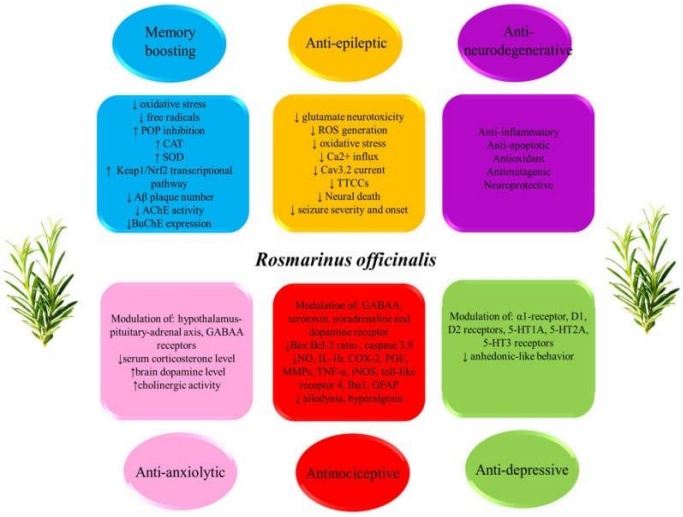
4) Germ Fighter :

Extensive studies conducted between the 1990s and 2015 have conclusively shown that rosemary essential oil outperforms all other essential oils in terms of its potent antimicrobial properties. The synergistic combination of compounds found in rosemary makes it an effective and reliable source of both antibacterial and antifungal agents, leaving no doubt as to its superiority over other essential oils[30].

5) Brain booster:

The scent of rosemary is known to increase the absorption of its compounds into the bloodstream, leading to a surge in the levels of acetylcholine - a vital neurotransmitter in the brain. Thanks to its dozen-plus compounds that inhibit the breakdown of acetylcholine, rosemary has emerged as a promising therapeutic herb for Alzheimer's disease[31].The aroma of rosemary essential oil is proven to significantly enhance working memory in children. It is a reliable and effective way to improve memory and cognitive function[32,33]

*** Properties of Rosmarinus officinalis.**



1) Antioxidant properties of rosemary:

Rosemary is a potent plant with high antioxidant activity due to its chemical constituents, such as carnosol, carnosic acid, ursolic acid, rosmarinic acid, and caffeic acid. The major diterpenes, carnosol, and carnosic acid, as well as the essential oil components, have potent antioxidant properties [34].

The pharmacological effects of essential oils have garnered a lot of attention lately, along with their active components. Not to be overlooked is the fact that Rosemary essential oil (REO) is a clear or light yellow liquid with a peculiar smell that is similar to the plant. Monoterpenes like camphor, 1,8-cineole, and α-pinene make up the majority of its composition [35]. REO is already employed as a biopreservative in the food sector [38], and because of its antioxidant and antibacterial activities, it can prolong the shelf-life of food products [36,37]

There are several advantages to using rosemary as a natural antioxidant. It successfully prevents and postpones food and pet food's lipid breakdown, extending its shelf life. Additionally, it lessens the effects of oxidation catalysts like temperature, light, and oxygen. Because of its great adaptability, rosemary can be used to a variety of meals, including meat, poultry, fish, and baked goods, as a natural antioxidant. It doesn't cause any rancidity or offensive odors to emerge, nor does it change or lower the food's quality or impart an odd flavor. Additionally, it stabilizes nuts and seeds high in polyunsaturated fatty acids (PUFAs) and makes up for the lack of stability brought on by unsaturated fats[39]

2) Antibacterial properties of rosemary

Plants from around 60 families, including Alliaceae, Apiaceae, Asteraceae, Lamiaceae, Myrtaceae, Poaceae, and Rutaceae, produce essential oils that are an excellent source of antimicrobial compounds. Since ancient times, aromatic plants and their

essential oils have been used for various purposes such as food, agriculture, medicine, cosmetics, as condiments and spices, as well as for therapeutic and insecticidal uses. Moreover, they are also used as flavoring agents and for storage as insecticidal agents[40-42].The use of plant essential oils has emerged as a superior alternative to synthetic food additives in the agricultural and food industries. This is because it effectively eliminates microorganisms such as pathogenic and spoilage bacteria which can cause food safety and public health-related issues during transportation, storage, shelf-life, and packaging. Antimicrobials are crucial in food for two primary reasons: to control natural spoilage processes and to prevent/control the growth of microorganisms, including pathogenic microorganisms. This is necessary to ensure food safety and prevent any harmful consequences[43,44].

3) Anti-inflammatory and analgesic properties

Plants are an abundant and potent source of compounds that possess powerful anti-inflammatory and analgesic properties. The search for new compounds from plants with traditional medicinal uses presents an enormous potential for pharmaceutical development[45]. The primary objective of anti-inflammatory drugs is to control the release of mediators in the inflammatory process[46].Pain and inflammation are closely linked to the production of free radicals and wound healing, which can extend the inflammation process[47].Oxidative damage and the inflammatory response are the two primary factors that lead to cardiovascular and neurodegenerative diseases, but polyphenols from specific plants can mitigate these problems[48].

Rosemary, a plant with a long history of use in folk medicine, is renowned for its therapeutic properties against abdominal pain and respiratory inflammatory diseases, such as bronchial asthma[49].Experimental studies have reported the remarkable anti-inflammatory and analgesic activities of rosemary's essential oil and biologically active terpenes, including carnosic acid, carnosol, ursolic acid, and betulinic acid, as well as rosmarinic acid, rosmanol, and oleanolic acid. These compounds have demonstrated remarkable antinociceptive activity, with each individual triterpene exhibiting a similar potency to that of ketorolac, a no nsteroidal anti-inflammatory drug[45,50]

Chemical constituents;

Several phytochemicals are found in rosemary, such as betulinic acid, carnosic acid, camphor, caffeic acid, ursolic acid, and carnosol[51].The GC/MASS chemical analysis of plant essential oils has conclusively identified 19 compounds making up 96.57% of the rosemary essential oil. These compounds include 1.8 Cineole (21.8%), α-pinen (18.7%), Camphor (14.6%), Linalool (13.4%), and Camphene (7.2%). The microdilution broth tests conducted on S. aureus and E. coli bacteria have unequivocally demonstrated that rosemary essential oil has potent antimicrobial properties. Furthermore, the study has established that essential oils are significantly more effective against Gram-positive bacteria than Gram-negative bacteria[52].

Side effects:

When used in small dosages, rosemary is generally safe. Extremely high dosages, however uncommon, can have major adverse effects.

Among the side effects are:

- vomiting
- Coma
- Spasms
- High dosages of rosemary may induce miscarriage; so, it is not advised for pregnant women to take any additional rosemary.
- Pulmonary edema (fluid in the lungs).

References

[1] Ulbricht C, Abrams TR, Brigham A, et al. An evidence-based systematic review of rosemary (Rosmarinus officinalis) by the Natural Standard Research Collaboration. J Diet Suppl. 2010; 7: 351–413.

[2] Al-Sereiti MR, Abu-Amer KM, Sen P. Pharmacology of rosemary (Rosmarinus officinalis Linn.) and its therapeutic potentials. Ind J Exp Biol. 1999; 37: 124–130.

[3] Nieto, Huvaere, & Skibsted, 2011

[4] De Oliveira et al., 2019

[5] Cuvelier, M.E.; Richard, H.; Berset, C. Antioxidative activity and phenolic composition of pilot-plant and commercial extracts of sage and rosemary. J. Am. Oil Chem. Soc. 1996, 73, 645–652. [Google Scholar] [CrossRef]

[6] Rašković, A.; Milanović, I.; Pavlović, N.; Ćebović, T.; Vukmirović, S.; Mikov, M. Antioxidant activity of rosemary (Rosmarinus officinalis L.) essential oil and its hepatoprotective potential. BMC Complement. Altern. Med. 2014, 14, 225. [Google Scholar] [CrossRef] [PubMed]

[7] Aguilar, F.; Autrup, H.; Barlow, S.; Castle, L.; Crebelli, R.; Dekant, W.; Engel, K.H.; Gontard, N.; Gott, D.; Grilli, S.; et al. Use of rosemary extracts as a food additive–scientific opinion of the panel on food additives, flavourings, processing aids and materials in contact with food. EFSA J. 2008, 721, 1–29. [Google Scholar]

[8] Begum, A.; Sandhya, S.; Vinod, K.R.; Reddy, S.; Banji, D. An in-depth review on the medicinal flora Rosmarinus officinalis (Lamiaceae). Acta Sci. Pol. Technol. Aliment. 2013, 12, 61–74. [Google Scholar]

[9] Ribeiro-Santos, R.; Carvalho-Costa, D.; Cavaleiro, C.; Costa, H.S.; Albuquerque, T.G.; Castilho, M.C.;Ramos, F.; Melo, N.R.; Sanches-Silva, A. A novel insight on an ancient aromatic plant: The rosemary(Rosmarinus officinalis L.). Trends Food Sci. Technol. 2015, 45, 355–368. [Google Scholar] [CrossRef]

[10] Ojeda-Sana, A.M.; van Baren, C.M.; Elechosa, M.A.; Juárez, M.A.; Moreno, S. New insights into antibacterial and antioxidant activities of rosemary essential oils and their main components. Food Control 2013, 31, 189–195. [Google Scholar] [CrossRef]

[11] "Salvia rosmarinus Spenn". Plants of the World Online. Royal Botanic Gardens, Kew. Retrieved 2019-10-07.

[12] Leafy Medicinal Herbs: Botany, Chemistry, Postharvest Technology and Uses by Dawn Ambrose, 216, 210-11

[13] Boi, Marzia. "The Ethnocultural significance for the use of plants in Ancient Funerary Rituals and its possible implications with pollens found on the Shroud of Turin" (PDF). www.shroud.com. Retrieved 2020-12-07.

[14] Muñoz-Centeno, L.M. Spanish Medicinal Plants. Rosmarinus officinalis L. (Lamiaceae) (Rosemary). Available online: http://revistas.usal.es/index.php/0211-9714/article/view/6111/6131 (accessed on 9 March 2020).

[15] Nicholson, P.T. Ancient Egyptian Materials and Technology; Cambridge University Press: Cambridge, UK, 2000; p. 175. [Google Scholar]

[16] Flora of China. Available online: http://www.efloras.org/flora_page.aspx?flora_id=2 (accessed on 7 March 2020).

[17] González-Bueno, A. Un Dioscórides para el Profano, Atribución, Significado y Utilidad de un Herbario Renacentista Castellano: El "Libro de las Yerbas" de Juan de Jarava; Colegio Oficial de Farmacéuticos: Burgos, Spain, 2006; p. 272. [Google Scholar]

[18] Font-Quer, P. Plantas Medicinales. El Dioscórides Renovado; Península: Barcelona, Spain, 2007; p. 562. [Google Scholar]

[19] Sousa-Borges, R.; Sánchez-Ortiz, B.L.; Matías-Pereira, A.C.; Keita, H.; Tavares-Carvalho, J.C. Rosmarinus officinalis essential oil: A rewiew of the phytochemistry, anti-inflammatory activty, and mechanims of action involves. J. Etnopharmacol. 2019, 229, 29–45. [Google Scholar] [CrossRef]

[20] Lixandru M. Properties and Benefits of Rosemary. Nat World. June 20, 2020.

[21] S. Moradi, A. Fazlali, and H. Hamedi, "Microwave-assisted hydro-distillation of essential oil from rosemary: Comparison with traditional distillation," Avicenna Journal of Medical Biotechnology, vol. 10, no. 1, pp. 22–28, 2018.View at: Google Scholar

[22] M. Akhbari, S. Masoum, F. Aghababaei, and S. Hamedi, "Optimization of microwave assisted extraction of essential oils from Iranian Rosmarinus officinalis L. using RSM," Journal of Food Science and Technology, vol. 55, no. 6, pp. 2197–2207, 2018.View at: Publisher Site | Google Scholar

[23] M. Fadil, A. Farah, Ihssane, T. Haloui, and S. Rachiq, "Optimization of parameters influencing the hydrodistillation of Rosmarinus officinalis L. by response surface methodology," Journal of Materials and Environmental Science, vol. 6, no. 8, pp. 2328–2336, 2015.View at: Google Scholar

[24] Kwib YI, et al., Evaluation of clonal herbs of Lamiaceae specis for management of diabetes, and hypertension, Asia Pac J Clin Nut, 2006; 15 (1): 107-18.

[25] Sinkovic, A, et al., Rosemary extracts improve flow-mediated dilatation of the brachial artery and plasma PAI-1 activity in healthy young volunteers. Phytother Res. 2010 Aug 23

[26] Sanbongi C, et al., Rosmarinic acid in perilla extract inhibits allergic inflammation induced by mite allergen, in a mouse model. Clin Exp Allergy. 2004 Jun; 34(6):971

[27] Lukaczer, D, et al., Effects of volatile constituents of a rosemary extract on allergic airway inflammation related to house dust mite allergen in mice. Int J Mol Med. 2005 Aug;16(2):315-9.

[28] Nogueira de Melo GA. Rosmarinus officinalis L. essential oil inhibits in vivo and in vitro leukocyte migration. J Med Food. 2011 Sep;14(9):944-6.

[29] Sanbongi C, et al., Rosmarinic acid in perilla extract inhibits allergic inflammation induced by mite allergen, in a mouse model. Clin Exp Allergy. 2004 Jun;34(6):97.

[30] Andrade J. Rosmarinus officinalis L.: an update review of its phytochemistry and biological activity. Future Sci OA. 2018 Apr; 4(4): FSO283.

[31] Duke Green Pharmay www.alzheimersweekly.com/2017/03/rosemary-emulates-aricept-donepezil.html.

[32] Moss, L. Plasma 1,8-cineole correlates with cognitive performance following exposure to rosemary essential oil aroma. Therapeutic Advances in Psychopharmacology, 2012. DOI: 10.1177/2045125312436573.

[33] British Psychological Society. "Rosemary aroma can aid children's working memory: Exposure to the aroma of rosemary essential oil can significantly enhance working memory in children." ScienceDaily. 2 May 2017.

[34] Ngo SN, Williams DB, Head RJ. Rosemary and cancer prevention: preclinical perspectives. Crit Rev Food Sci Nutr. 2011;51:946–954. doi: 10.1080/10408398.2010.490883. [PubMed] [CrossRef] [Google Scholar]

[35] Kadri A, Zarai Z, Ben Chobba I, Bekir A, Gharsallah N, Damak M, Gdoura R. Chemical constituents and antioxidant properties of Rosmarinus officinalis L. essential oil cultivated from South-Western Tunisia. J Med Plants Res. 2011;5:5999–6004. [Google Scholar]

[36] Al-Sereiti MR, Abu-Amer KM, Sen P. Pharmacology of rosemary (Rosmarinus officinalis Linn.) and its therapeutic potentials. Indian J Exp Biol. 1999;37:124–130. [PubMed] [Google Scholar]

[37] Bozin B, Mimica-Dukic N, Samojlik I, Jovin E. Antimicrobial and antioxidant properties of rosemary and sage (Rosmarinus officinalis L. and Salvia officinalis L., Lamiaceae) essential oils. J Agric Food Chem. 2007;55:7879–7885. doi: 10.1021/jf0715323. [PubMed] [CrossRef] [Google Scholar]

[38] Prabuseenivasan S, Jayakumar M, Ignacimuthu S. In vitro antibacterial activity of some plant essential oils. BMC Complement Altern Med. 2006;6:39. doi: 10.1186/1472-6882-6-39. [PMC free article] [PubMed] [CrossRef] [Google

[39] Ojeda-Sana AM, van Baren CM, Elechosa MA, Juarez MA, Moreno S. New insights into a bacterial and antioxidant activities of rosemary essential oils and their main components. Food Control. 2013;31:189–195. doi: 10.1016/j.foodcont.2012.09.022. [CrossRef] [Google Scholar]

[40] Raut JS, Karuppayil SM. A status review on the medicinal properties of essential oils. Industrial Crops and Products. 2014;62:250?264.

[41] Friedman M, Henika RP, Mandrell ER. Bactericidal Activities of Plant Essential Oils and Some of Their Isolated Constituents against Campylobacter jejuni, Escherichia coli, Listeria monocytogenes, and Salmonella enterica. J Food Prot. 2002;65(10):1545–1560.

[42] Bakkali F, Averbeck S, Averbeck D, et al. Biological effects of essential oils?a review. Food and Chemical Toxicology. 2008;46(2):446–475.

[43] Smith-Palmer A, Stewart J, Fyfe L. The potential application of plant essential oils as natural food preservatives in soft cheese. Food Microbiology. 2001;18(4):463–470.

[44] Tajkarimi MM, Ibrahim AS, Cliver OD. Antimicrobial herb and spice compounds in food. Food Control. 2010;21(9):1199–1218

[45] Beninca JP, Dalmarco JB, Pizzolatti MG, Fr ´ ode TS. Analysis of the anti-inflammatory properties of ¨ Rosmarinus officinalis L. in mice. Food Chem. 124(2), 468–475 (2011).

[46] da Rosa JS, Facchin BM, Bastos J et al. Systemic administration of Rosmarinus officinalis attenuates the inflammatory response induced by carrageenan in the mouse model of pleurisy. Planta Med. 79(17), 1605–1614 (2013).

[47] Backhouse N, Rosales L, Apablaza C et al. Analgesic, anti-inflammatory and antioxidant properties of Buddleja globosa, Buddlejaceae. J.Ethnopharmacol. 116(2), 263–269 (2008).

[48] Peng C-H, Su J-D, Chyau C-C et al. Supercritical fluid extracts of rosemary leaves exhibit potent anti-inflammation and anti-tumor effects. Biosci. Biotechnol. Biochem. 71(9), 2223–2232 (2007).

[49] Zanella CA, Treichel H, Cansian RL, Roman SS. The effects of acute administration of the hydroalcoholic extract of rosemary (Rosmarinus officinalis L.) (Lamiaceae) in animal models of memory. Brazilian J. Pharm. Sci. 48(3), 389–397 (2012).

[50] Mart´ınez AL, Gonzalez-Trujano ME, Ch ´ avez M, Pellicer F. Antinociceptive effectiveness of triterpenes from rosemary in visceral ´nociception. J. Ethnopharmacol. 142(1), 28–34 (2012).

[51] Vallverdú-Queralt, Anna; Regueiro, Jorge; Martínez-Huélamo, Miriam; Rinaldi Alvarenga, José Fernando; Leal, Leonel Neto; Lamuela-Raventos, Rosa M. (2014). "A comprehensive study on the phenolic profile of widely used culinary herbs and spices: Rosemary, thyme, oregano, cinnamon, cumin and bay". *Food Chemistry*. **154**: 299–307. doi:10.1016/j.foodchem.2013.12.106. PMID 24518346

[52] Sales, A.J. and M. Pashazadeh, Study of Chemical Composition and Antimicrobial Properties of Rosemary

[53] (Rosmarinus Officinalis) Essential Oil on Staphylococcus Aureus And Escherichia Coli in vitro.

[54] International Journal of Life Sciences and Biotechnology, 2020. 3(1): p. 62-69. DOI: 10.38001/ijlsb.693371