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Phytochemical Composition and Biological Activities of Rosemary Extracts

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ABSTRACT :

Background: The use of natural antioxidant products to treat a variety of pathological liver disorders is growing in popularity since oxidative stress plays a part in their aetiology. The food sector has long utilised rosemary essential oil as a preservative because of its antibacterial and antioxidant properties, but studies have also revealed that it has other health advantages. Our study sought to determine if rosemary essential oil's mode of action is linked to hepatic oxidative state adjustment and to assess the oil's preventive impact against carbon tetrachloride-induced liver damage in rats.

Method :

Using mass spectrometry and gas chromatography, the chemical makeup of the extracted rosemary essential oil was ascertained. Using the DPPH test, antioxidant activity was assessed in vitro. Utilising kinetic spectrophotometric techniques, the activities of antioxidant enzymes in liver homogenates and enzyme indicators of hepatocellular damage in serum were assessed.

Result :

Out of the 29 chemical compounds found in the examined rosemary essential oil, the primary ingredients were camphor (12.53%), α-pinene (11.51%), and 1,8-cineole (43.77%). Rats with acute liver injury caused by carbon tetrachloride showed a 2-fold reduction in AST and ALT activity in their blood when the investigated essential oil was administered at dosages of 5 mg/kg and 10 mg/kg. When added to liver homogenates, carbon tetrachloride increased lipid peroxidation, whereas rosemary essential oil stopped it. Furthermore, antioxidant enzymes catalase, peroxidase, glutathione peroxidase, and glutathione reductase activity in liver homogenates were dramatically reversed after a 7-day pretreatment with the investigated essential oil, particularly at a level of 10 mg/kg

Conclusion:

Our findings show that in addition to having DPPH assay-measured free radical scavenging activity, rosemary essential oil also mediates its hepatoprotective effects by triggering physiological defence mechanisms.

Keywords: oxidative stress, hepatoprotection, essential oil, antioxidant enzymes, rosemary, and Rosmarinus officinalis

Introduction:

There are now over 400 different kinds of essential oils that can be used in medicine and therapy. A subject may be administered them to promote relaxation or lessen particular symptoms. The scientific name for rosemary is Rosmarinus officinalis L., and it is a tiny perennial plant that belongs to the mint family. In essence, rosemary oil is an essential oil that is extracted from the leaves and a tiny, light blue flower to produce its smell. It is occasionally used as a flavouring for food and as a component in fragrances.

With a sticky viscosity and the appearance of clear water, rosemary oil has a strong, revitalising herbal scent [1].Some medical conditions, including rheumatic pain, circulatory blockages, baldness, and acne, have been demonstrated to respond well to rosemary oil therapy. Furthermore, rosemary oil is a potent tool for promoting mental clarity and raising consciousness because of its strong effects on the brain and central nervous system (CNS). Additionally, it has demonstrated exceptional brain-stimulating qualities and functions as a memory-improving aid [2]. α-pinene, camphor, and 1,8-cineole are the predominant chemical constituents of rosemary oil. These compounds' common characteristics include stimulatory, astringent, antispasmodic, antidepressant, carminative, aromatic, and antibacterial effects [3].The effects of rosemary oil have been extensively studied in a number of research. It has been observed that 1,8-cineole stimulatingly affects the rat brain cortex in in vitro experiments [4]. Mice were shown to exhibit greater locomotor activity after being exposed to 0.5 ml of rosemary oil for an hour [5]. Additionally, when Graham et al. investigated the effect of rosemary on canine behaviour, they discovered that, in contrast to exposure to other kinds of odoriferous chemicals, the diffusion of rosemary into the dogs'

surroundings greatly increased their activity levels [6]. Human subjects are likewise capable of exhibiting the stimulatory effects. 35 volunteers in the group, following their massage withIn human beings, the stimulatory effects are also discernible. Measurements of the blood pressure and respiration rates of a group of 35 participants increased following a massage with rosemary oil. They were also noted to be happier, more alert, and more attentive at the same time [7].

Furthermore, the alpha (8–12 Hz) wave strength over the bilateral mid-frontal areas of the electroencephalography (EEG) recordings significantly decreased [8]. Given these results, it is possible that the higher level of alertness is connected to the lower alpha power. However, by selecting just four electrodes throughout the frontal and parietal brain areas, brain wave variations were only observed in a limited area in this experiment.

The inhalation of essential oils has also been shown to affect other parts of the brain. It is linked to emotions and is the temporal area [9].

There is currently a lack of adequate research on how inhaling rosemary oil affects people's emotional states and the autonomic nervous system (ANS). However, after transdermal delivery of rosemary oil to humans, a prior research showed changes in ANS markers [7-8].Nevertheless, research on how inhaling rosemary oil affects nervous system activities is currently lacking. The way drugs are administered may have a major impact on the degree of response, according to numerous studies. For instance, topical treatment of methyl salicylate lowers blood pressure since the local effects are contained, whereas inhaling it results in hypertension and convulsions [10]. After inhaling it, α-Santalol, the primary ingredient in East Indian sandalwood, causes alertness. However, after being applied transdermally through body massage, it lowers physiological arousal [11]. Our current research focuses on how breathing in rosemary oil affects the human nervous system. [12]

Botanical Profile of Rosemary:

Taxonomy of Rosemary:

Taxonomy Rank	**Nomenclature**
Kingdom	Plantae
Division	Tracheobionta
Class	Spermatophyta
Order	Magnoliopsida
Familly	Asteridae
Subfamilly	Lamiales
Genus	Lamiaceae
Species	Rosmarinus L.

Fig; Rosemary Plant 1. Flower 2. Roots And Leaves

Fig: Dried powder form of Rosemary

Occurrence and Distribution:

California in the United States and Europe both grow rosemary, which is native to the Mediterranean region. In addition, it is grown in Algeria, China, Morocco, the Middle East, Russia, Romania, Serbia, Tunisia, Turkey, and, to a lesser degree, India. It is suitable to grow rosemary in a temperate climate. Rosemary oil output and composition are influenced by the characteristics of the land.[14],[15],[16].

Description of plant part

Ethanomedicinal use of Rosemary:

In the industry, rosemary is employed as a food additive flavouring, and preservation

According to Ali et al. the addition of rosemary aqueous extract improved the yoghurt's taste, body and texture, appearance, and overall quality. However, a 25% rosemary extract treatment with food has a favourable impact on African catfish development without having any discernible consequences on health. Fresh rosemary leaves, also known as Asmerino or YetibseKetel in Ethiopia, are used in many hotels and restaurants to flavour cuisine and season meat. Additionally, traditional preparations of spicy food ingredients use dried rosemary leaves.Numerous sectors, including pesticide, pharmaceutical, cosmetic, and traditional medicine, use rosemary essential oil as a raw material Extracts from rosemary offer both pesticidal and preservation qualities.[17],[18],[19]. A rosemary essential oil extract was found to be efficient in reducing fungal disease in maize It was noted how crucial rosemary essential oil is as a fumigant against bruchid in storage settings.In addition to its cultural and industrial applications, rosemary has positive social and environmental effects. Rosemary production and nursery was being regarded as business due to the workforce possibilities. Additionally, the environmental benefits of growing rosemary have been scientifically demonstrated [20],[21].

Traditional Uses of Rosemary:

The Mediterranean region is the native home of Rosmarinus officinalis L. (Rosemary), a culinary herb of the Lamiaceae family that is grown all over the world. Dense thickets up to one meter high are where the plant grows The leaves are opposite, leathery, sessile, evergreen, and linear. There is a noticeable midrib on the lower surface, which is coated in tomentous, while the upper surface is dark green. The scent of crushed leaves is distinctive. Rosemary comes in about 20 different types (14). Flowers with petals merged into the upper and lower lips are either pink, white, or light blue (the most common color) [22],[23].

Phytochemistry profile of Rosemary:

Composition of R. officinalis essential oil

The extraction process used, which can be either hydrodistillation extraction or supercritical CO2 extraction, determines how much essential oil can be extracted from rosemary. The harvest season and the age of the plants may also be factors in the difference. Typically, the essential oil volume is stated as 10 milliliters per kilogram of the dry plant. [24] 1:8-cineole, (25) α-pinene, and (26) camphor are the main monoterpenoids, with trace amounts of limonene, p-cymene, camphene, borneol, and terpineol. Rosemary essential oil has recently been the subject of numerous gas mass spectroscopic analyses in Morocco, Italy, Tunisia, Spain, Brazil, and the Balkans. Thus far, around 75 phytochemicals have been identified. [27] ,[28].

Changes in morphological variety:

Investigating changes in plants requires consideration of geography, climate, and the ecological features of habitats. The chemical makeup of essential oils and the distribution of R. officinalis chemotypes are significantly impacted by the geographic location and dispersion of this species. According to Kausic et al. The oil composition of rosemary is similarly influenced by the stages of ontogenesis. [29] The primary chemotypes identified in the oil composition analysis of the rosemary genotype in Belgrade were camphor (18.2–28.1%), 1,8-cineole (6.4–18.0%), α-pinene (9.7–13.5%), borneol (4.4–9.5%), camphene (5.1–8.7%), β-pinene (2.1–8.1%), β-phellandrene (4.6–6.5%), myrcene (3.4-5.9%), and bornyl acetate (0.2-7.9%). [30].According to the analysis, the same genotypes during a growing season produce oil that can be further divided into various chemotypes. This suggests that the oils' chemical makeup also varies depending on when they are collected. The oil composition study identified six monodominant and six intermediate

chemotypes in the Mediterranean region's native and cultivated plants. Cineol and camphor are the most common chemotypes, while verbenone is also present. [31] and α-pinene while only one sample included p-cymene and linalool These three intermediate chemotypes were identified: 1,8-cineole/camphor, 1,8-cineole/linalool and 1,8-cineole/camphor/borneol. According to Kausic et al. the camphor type is often rather common, however the 1,8-cineole/camphor chemotype is uncommon and has only been detected in the oils of rosemary from the Greek island of Zakynthos.[32],[33].

Pharmacological Activity/ Profile of Rosemary:

Antioxident Activity :The antioxidants found in plants are becoming more and more important. also in the field of preventive medicine, in addition to the nutritional field. Research on antioxidant chemicals has focused on the Lamiaceae family because of its high polyphenol concentration. Apart from the essential oil components, the primary contributors to rosemary's potent antioxidant properties were its essential diterpenes, carnosol, and carnosol acid. [33] The pharmacological properties of essential oils and their active components made them an amazing pastime at the time. Rosemary leaves are typically used as a condiment to add flavor to food and as a source of antioxidant chemicals that are used to preserve food.[32]. The most important thing to keep in mind while testing a new rosemary extract is the extraction method and the kind ofThe method of extraction and the kind of solvent employed are the most important factors to keep in mind when testing a new rosemary extract because they may affect the antioxidant properties.[34],[35].

Anti-infection Activity;

Antimicrobial secondary metabolites are produced by the majority of plants either naturally as a result of their normal growth and development or in response to stress or pathogen invasion. A novel strategy to reduce the growth of microbes is the application of essential oils. Nowadays, Rosmarinus officinalis L. is widely used as a food preservation and is well-known for its potent antibacterial properties [26].The compounds rosmarinic acid, rosmaridiphenol, carnosol, epirosmanol, carnosic acid, rosmanol, and isorosmanol are responsible for the inhibitory effect of rosemary. [28] Through their contact with the mobile membrane, they modify the genetic fabric and nutrients, change the way electrons are transported, cause mobile additives to leak, and change the way fatty acids are produced. Likewise, it resulted in an interaction with the protein membrane that caused the membrane's functionality to be lost and its shape [28]

Anti inflammatory Activity:

In the evaluation of analgesic activity, doses exhibiting a broad range of anti-inflammatory properties had been employed.[37], [38]. Prostaglandin E2 (PGE2) levels in collected cell culture supernatants have been identified using a quantitative enzyme-related immunosorbent assay (ELISA) package that is commercially available (Abcam PGE2 ELISA package deal, uk) in accordance with the manufacturer's instructions.[42]

Anti-inflammatory chemicals can be found in plants, and the ongoing quest for novel molecules, particularly from plants with known pharmacological properties, has great promise for the pharmaceutical industry. [39], [40]Anti-inflammatory medications' primary goal is to regulate the release of mediators during the inflammatory process. Wheel healing and the generation of free radicals, which may prolong the inflammatory process, are linked to pain and inflammation. Therefore, two major components that cause cardiovascular and neurological disorders are the inflammatory response and oxidative damage; however, polyphenols from some plants can lessen these issues. In traditional medicine, rosemary is noted for its ability to alleviate stomach discomfort and treat inflammatory respiratory conditions including bronchial asthma.[28]

Analgesic Activity:

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Anti Tumour Activity:

Activity against tumors: Diabetes mellitus is one of the most common metabolic disorders in the world. To manage diabetes, insulin and oral hypoglycemic medications are utilized; however, these capsules have excellent side effects and do not cure the condition. Numerous investigations conducted in vivo have demonstrated that rosemary lowers blood glucose. According to a few in vitro and in vivo investigations, treating Zucker rats with high carnosic acid levels inhibited the activity of gastric lipase inside their bellies, which improved their lipid profiles.Carnosic acid and carnosol together were consequently found to be the most effective chemicals for glycemic control [47],[48]. additionally, a growing trend of research on novel neuroprotective tablets derived from herbal sources was observed.[40]

Future perspective :

The demand for both fresh and dried rosemary leaves is rising globally, as is their price In addition, the demand for rosemary essential oil is rising globally. [49],[50]

According to Kaur et al. and Tzima et al. , the main causes of the increase in rosemary products are population growth, growing awareness of the benefits of rosemary products, the popularity of organic foods and substances, an increase in health issues, a rise in consumer interest in organic natural products, and the expansion of industries. Owing to its high demand as a food additive and component in food and beverages, the market for rosemary extracts was valued at USD 215 million in 2019 and is projected to expand at a 3.7 percent annual pace from 2020 to 2025. [38],[39].

Conclusion

The amount of polyphenols and bioactive chemicals found in RE can be influenced by a variety of factors, including the soil, climate, and stressor exposure of the plants.

Furthermore, RE's potency may be impacted by the way it is extracted and stored. Several investigations have employed the extraction techniques of water, methanol, ethanol, and supercritical carbon dioxide; evidence indicates that the extraction of methanol, an alcoholic solvent, may result in RE with greater potency (lower IC50) [31]. The potency and biological activity of RE may be impacted by its source and extraction technique, therefore this should be taken into account when planning future research. [43]

In recent years, attention has turned to developing novel targeted cancer therapies that can alter particular pathways that are frequently altered in cancer.It is possible to use RE and its polyphenols CA and RA as chemicals to target particular pathways that result in apoptotic induction and reduced cell survival. Neutraceuticals like RE, CA, and RA can also be utilised to boost the anticancer effects of existing chemotherapeutics. [44]. This may enable the use of lower dosages and less toxicity to the surrounding healthy tissue. While research on signalling molecules and pathways aimed at There aren't many studies looking at the signalling molecules and pathways that RE, CA, and RA target, but the ones that are available support the use of these substances both alone and in conjunction with other cancer treatments. [45] It has been demonstrated that RE, CA, and RA exhibit a variety of strong and efficient anticancer qualities. However, prior to starting human investigations, more thorough research in animals is needed. The in vivo animal studies should determine the appropriate dosages, the most effective delivery method, the levels of CA, RA, and other bioactive ingredients in

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