زانکۆی سەلاحەدین — هەولێر

Salahaddin University –Erbil

The Role of Rosemary in the treatment of Memory Disease

Research Project

Submitted to department of (Chemistry) in partial fulfilment of the requirements for the degree of   BSc. In (Chemistry).

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Supervisor certification:

I certify that this thesis was prepared under my supervision in the Department of chemistry, college of Education, University of Salahaddin-Erbil and hereby recommend it to be accepted in partial fulfillment of the requirements for the Role of Rosemary in the treatment of Memory Disease/Biochemistry.

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Table (1):List of abbreviation.

No	Abrivation	Full name
1	AD	Alzheimer Disease
2	PD	Parkinson Disease
3	CD8-T	Cytotoxic Tlymphocytes
4	TNF	Tunor Necrosis Factor
5	1L-1	Interleukin-1
6	SAR	Structure-activity relationship
7	QSAR	Quantitative structure-activity reationship
8	CA	Carnosic Acid
9	CS	Carnosol
10	RE	Rosemary- Extract
11	BHA	Butylated hydroxyl anisole
12	TBHO	Tert-butylated hydroxyl droquinone
13	SARS-cov2	Severe acute respiratory syndrome coronavirus2
14	COVID_19	Coronaviruse
15	NLRP3	NLR Family pyrin domain containing3
16	NRF2	Nuclear Factor erythroid2-related factor2
17	CCl_3O_2	Trichloro methyldioxy
18	AchE	Acetyl Cholines terase
19	Pd-cl	Prairie du chien correctional institution
20	PD-Mcl	Parkinson disease –mild cognitive impairment
21	PDD	Pervasive developmental disorders

Table(2) :

Abstract: Rosemary (Rosemarinus officinalis L.) is a widely consumed aromatic plant that belongs to the Lamiaceae family. Fresh and dried leaves are frequently used in traditional Mediterranean cuisine and in folk medicine.

An herb of economic and gustatory repute is employed in traditional medicines in many countries. Rosemary contains carnosic acid (CA) and carnosol (CS), abietane-type phenolic diterpenes, which account for most of its biological and pharmacological actions, although claims have also been made for contributions of another constituent, rosemarinic acid. The treatment of the oil with rosemary extract effectively delayed its oxidation, having lower levels in all the oxidation markers that were analysed. It was also found that rosemary extract is able to reduce oil consumption by fried foods. Therefore, ROE ensures soybean oil a high stability against oxidation and a longer shelf life, making it a good natural alternative to synthetic antioxidants.

INTRODUCTION

1.1. Memory Disease

The human body, and in particular mucosal surfaces, are constantly exposed to a wide-range of pathogens and developing malignancies that the immune system needs to keep in check(Rodríguez-Rojo et al., 2012). The adaptive immune system serves here a critical role to mediate a memory response that rapidly could re-encounter pathogens and malignancies to limit disease propagation. In this regard, memory T cells are utterly pivotal and are mainly categorized into two different subsets with distinct functions. Memory CD4 + T cells surveil peripheral tissues for extracellular and intracellular pathogens and provide essential helper functions that augment other arms of the immune system. Memory CD8 + T cells are primarily known for their abilities to eradicate neoplastic cells and intracellular pathogens through direct lysis via cytotoxic mechanisms. As such, both memory CD4 + and CD8 + T cells coordinate immunity at mucosal surfaces to rapidly promote disease protection(Lange et al., 2022, Van der Auwera et al., 2023). Memory impairment and cognitive deficits are common phenomena with increasing age and early symptoms of neurodegenerative disorders, such as Alzheimer's disease (AD) .AD is a progressive disorder characterized by deterioration of cognitive function but also mobility and language problems. On the biological side, AD is associated with the accumulation of amyloid β plaques in different brain regions, the degeneration of nerve cells, and finally brain atrophy. This may be caused by a combination of multiple biological and environmental factors. (Van der Auwera et al., 2023, Jia et al., 2023)

Fig(1):Show the memory disease.

1-2 Memory losses:-

Although a fundamental function of daily life, memory continuously declines as people age, impairing both life quality and work productivity and increasing the risk of dementia. However, age related memory decline is not always a prodrome of dementia; memory loss can merely be senescent forgetfulness, which is more prevalent among older individuals, and can be reversed or become stable rather than progress to a pathological state. Thus, the prevention and slowing of age related memory decline in older individuals is paramount. Fortunately, memory decline can be mutable because various contributing factors are reportedly associated with memory loss.(Jia et al., 2023, Nishal et al., 2023)
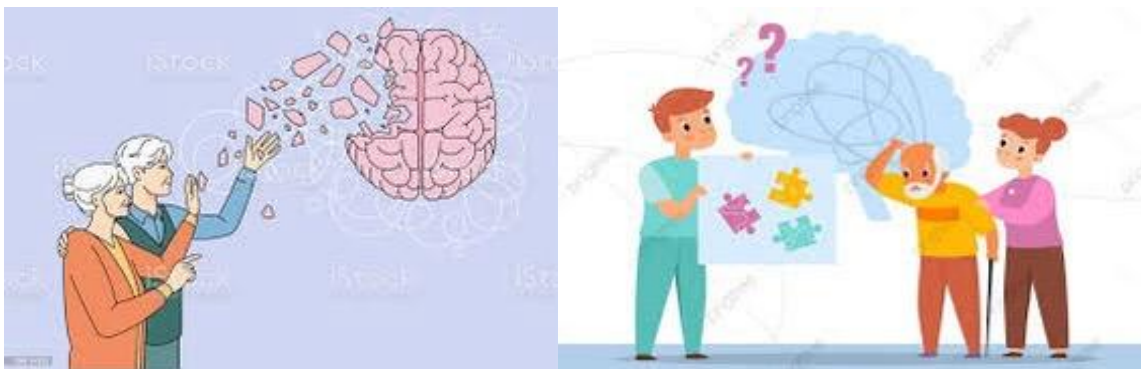
Fig(2); Show the memory losses.

1-3 Common disease of memory losses:

Alzheimer's disease (AD) and Parkinson's disease (PD) are the two most common neurological illnesses that affect people in their later years. Memory loss is the hallmark of Alzheimer's disease, while dyskinesia, or loss of mobility, is associated with muscle rigidity and tremors in PD. Both diseases are unrelated, however, they do have a few similarities associated with extrapyramidal abnormalities, particularly stiffness, which has been linked to concomitant PD in many AD patients. Increased levels of IL-1, IL-6, and TNF in the AD and PD patients can be regarded as evidence of systemic inflammation associated with

each of these neurodegenerative disorders. One of the primary variables in the progression of neurodegenerative disorders is oxidative stress. Many medicinal plants and their secondary metabolites have been claimed to be able to help people with neurodegenerative disorders like AD and PD. Anti-inflammatory, antioxidant, antiapoptotic, monoamine oxidase inhibition, acetylcholinesterase, and neurotrophic pursuits are among the major mechanisms identified by which phytochemicals exert their neuroprotective effects and potential maintenance of neurological health in old age. In regard to neurodegenerative disorders, numerable plant-based drugs like alkaloids, iridoids, terpenes, and flavones are employed for the treatment. Structure-activity relationships (SAR) and quantitative structure-activity relationships (QSAR) are used to investigate the link between bioactivity and the chemical configuration of substances. (Nishal et al., 2023, Castellani et al., 2010)

1-4 Alzheimer disease :

In 1907, Alois Alzheimer described the case of a 51 year old woman who presented with a relatively rapidly deteriorating memory along with psychiatric disturbances. She died four years later. While a variety of progressive and fatal neurological conditions were known at that time, including senile dementia, the early age at onset, and a new pathological finding, the neurofibrillary tangle (NFT), made this condition unique. The justification for Alzheimer disease (AD) as a new nosologic entity, and the motivations of the prominent psychiatrist, Emil Kraepelin, for promoting an evidently new condition, continue to be debated. Nevertheless(Castellani et al., 2010, Beata et al., 2023), AD is today, as it was then, a relentless neurologic deterioration accompanied by hallmark pathology. In 1907, Alois Alzheimer described the case of a 51 year old woman who presented with a relatively rapidly deteriorating memory along with psychiatric disturbances. She died four years later1. While a variety of progressive and fatal neurological conditions were known at that time, including senile dementia, the early age at onset, and a new pathological finding, the neurofibrillary tangle (NFT), made this condition unique. The justification for Alzheimer disease (AD)

as a new nosologic entity, and the motivations of the prominent psychiatrist, Emil Kraepelin, for promoting an evidently new condition, continue to be debated. Nevertheless, AD is today, as it was then, a relentless neurologic deterioration accompanied by hallmark pathology.(Beata et al., 2023, Funayama et al., 2023)
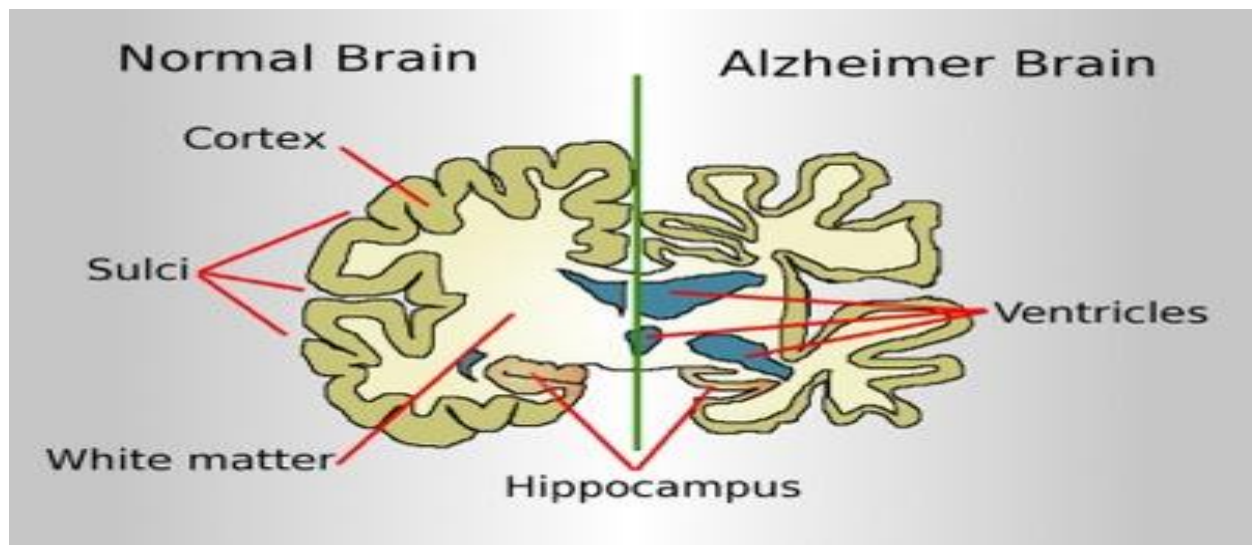
Fig(3):Show the Brain before and after Alzheimer disease.

1-5 Parkinson disease:

Parkinson's disease (PD) is a progressive neurodegenerative disease whose main symptoms are motor dysfunctions, such as tremor, rigidity, bradykinesia, and postural instability. Selective degeneration of dopaminergic neurons in the substantia nigra of the midbrain underlies these symptoms. PD patients often have comorbid non-motor symptoms that include autonomic dysfunctions, such as constipation and orthostatic hypotension, as well as psychiatric symptoms, such as anxiety and depression. Thus, PD is not a disease of the central nervous system alone, but rather a systemic disease. Because the prevalence of PD increases with age, it is clear that aging is a risk factor for its development. Environmental factors are also thought to be important, as exposure to pesticides and other chemicals can cause PD symptoms. Advances in genetic research methods have

provided insights into how genetic backgrounds contribute to the development of PD. Accordingly, PD is a complex genetic disease that is caused by a combination of aging, environmental factors, and genetic factors. There are two major ways to identify genetic factors in PD . One is to investigate rare Mendelian forms of PD and identify the causative genes.(Funayama et al., 2023)

parkinson's disease is the second most common neurodegenerative disease and is characterized by bradykinesia, resting tremor, rigidity and postural instability. The loss of dopaminergic neurons in the substantia nigra pars compacta and the accumulation of α-synuclein forming Lewy bodies are the neuropathological hallmark of Parkinson's disease.3,4 While classic motor symptoms are key to the clinical diagnosis of Parkinson's disease, many patients also experience progressive cognitive impairment (PD-CI), including those with mild cognitive impairment (PD-MCI) and dementia (PDD).5 The heterogeneity of clinical presentations in Parkinson's disease makes it important to develop biomarkers to improve the accuracy of disease diagnosis and prognosis and potentially stratify for future therapeutic strategies based on personalized medicine.(Blommer et al., 2023)

Fig(4):Show the Parkinson disease.

1-6 Rosemary:

The use of herbal drugs to treat a broad spectrum of diseases and/or to modify non-pathological states has increased worldwide. It is known that the secondary metabolites of plants have therapeutic effects; many have been used in the treatment of different diseases, such as obesity and brain and skin diseases as well as in the treatment of non-pathological states, such as aging .

Rosmarinus officinalis L., commonly known as rosemary, belongs to the Lamiaceae family. The genus Rosmarinus has been merged into the genus Salvia in a recent phylogenetic analysis. This means that the Rosmarinus officinalis is no longer the correct name of the species studied. Since the name Salvia officinalis was already occupied when the merger was done, this species needed a new specific epithet in Salvia, so it is now known under the name Salvia Rosmarinus . It is an aromatic plant with needle-like leaves that is cultivated worldwide. Rosemary has therapeutic properties and has been used in folk medicine as an oral preparation to relieve renal colic, dysmenorrhea, and muscle spasms .

 Rosemary has antifungal, antiviral, antibacterial, anti-inflammatory, antitumor, antithrombotic, antinociceptive, antidepressant, antiulcerogenic, and antioxidant activities . Several medicinal applications for R. officinalis have been identified, such as treatment of disorders associated with the nervous, cardiovascular, gastrointestinal, genitourinary, menstrual, hepatic, and reproductive systems and with respiratory and skin conditions . Owing to its diverse properties, rosemary has also been used widely in the food and cosmetics industries .)de Macedo et al., 2020(

The biological activities of this plant are mainly related to the phenolic and the volatile constituents such as carnosol, carnosic acid and rosmarinic acid present in the extract of rosemary and α-pinene, (−)-bornyl acetate, camphor and eucalyptol present in the essential oil of this plant. Minor components

may have a potential influence on the biological activity due to the possibility of synergistic effect among their components .

R. officinalis L. can be used fresh, dried or as tea infusion. The essential oil and the extract of rosemary can be obtained for application in food packaging, aromatherapy and medicine treatment Rosemary is used for cooking as flavouring, in the preservation of foods, cosmetics or in folk medicine for anti-inflammatory, diuretic and antimicrobial applicationsand for the prevention and treatment of diabetes, cancer and cardiovascular diseases Rosemary provides protein, fibre, vitamins and minerals which are known to have disease preventing properties (United States Department of Agriculture .(Ribeiro-Santos et al., 2015)

Fig(5):Rosemary plant.

1-7 Why is rosemary used?

As the need for healthy and nutritional food rises, the use of medicinal and aromatic plants (fresh herbs) also increases due to the health benefits that they possess. However, these products are highly perishable and their shelf life might be limited, depending on the product.Rosemary (Rosmarinus officinalis L.) belongs to the Lamiaceae family and is a perennial aromatic herb that originates from the Mediterranean area. It is now widely used in cosmetics, pharmaceuticals, and food additives, as well as cancer prevention due to the presence of carnosol, carnosic, and rosmarinic acid . Rosemary has antibacterial , antioxidant , anticancer and anti-inflammatory properties;. these benefits expand its application to domestic animals, and many studies have shown that dietary supplementation with rosemary extract (RE) may improve growth performance and antioxidant status , regulate gut microbiota , modulate humoral immunity , alleviate heat stress , and enhance the quality of the product in monogastric animals. Gladine et al., (2007) demonstrated the antioxidant function of rosemary in ruminants by administering a single acute dose of rosemary to sheep using a duodenum T-shaped cannula. However, the presence of a rumen may influence the impact of RE. Further, feeding experiments found that adding rosemary and its by-products to the diet improved milk yield and quality in dairy sheep and dairy goats , as well as meat quality . The underlying mechanism may contribute to positive effects on ruminal fermentation and ruminants may benefit from the antioxidant effects of rosemary . Despite the dominant role of dairy cows compared with other ruminants in the dairy industry, very little is known about the application of RE in dairy cows.

High-production dairy cows typically experience high oxidative stress , which can be exacerbated under certain environmental, physiological, and dietary conditions . Research on dairy cows has shown that the high-concentrate diets used to support the energy demands of high-production dairy cows cause remodeling of the microbial composition and function in the gastrointestinal tract of dairy cows . For ruminants, the microbiota in the

rumen serves as a bioreactor that enables dairy cows to obtain nutrients from human-indigestible plant matter , and multi-omics studies have revealed that the rumen microbiota is crucial for dairy cow performance . Hence, caution should be exercised when using RE in dairy cow diets to enhance milk performance and oxidant status due to the potential antibacterial function of rosemary. However, the effect of RE on rumen fermentation is still not fully understood.

1-8 Rosmary Extract and Rosmary structure:

Rosemary is an economically important plant species that is widely distributed due to its culinary, medicinal, and cosmetic uses . Both fresh and dried leaves of rosemary have been used for their characteristic aroma and flavor in many food dishes. Additionally, rosemary extracts have been employed as lipophilic antioxidants to preserve foods against oxidation from environmental stress . Because of these characteristics, the European Union, United States, and Japan have all approved rosemary extracts as food additives for food preservation . Rosemary contains two groups of potentially active compounds. One group is comprised of small molecular weight aromatic compounds, called "essential oils", which rapidly evaporate to produce the characteristic smell and taste of rosemary. The other group is represented by the polyphenolic compounds including carnosic acid (CA) and carnosol (CS), which have been shown to manifest direct and indirect antioxidant actions . While our group has focused on the effects of CA, we also report here the work of others on CS.(Satoh et al., 2022)
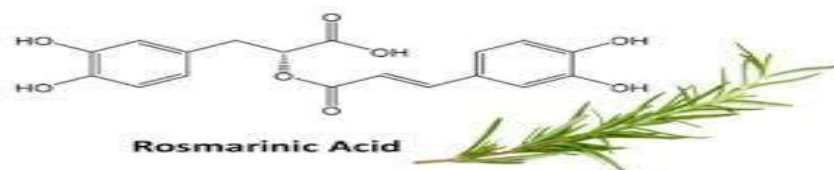
Fig(6):Rosemary structure.

1-9 Rosmary anti oxidant:

In the world, soybean is considered to be one of the most important sources of vegetable oils. It is the most widely consumed and extensively used in frying foods and other applications(Chang et al., 1977). Since soybean oil contains polyunsaturated fatty acids, it has an excellent nutritional profile . In spite of this, under heating conditions, it becomes unstable causing rapid quality deterioration through the oxidation process . As reported previously, throughout the frying process, vegetable oils such as soybean oil produce undesirable flavor compounds, and their oxidative stability changes due to hydrolysis, peroxidation, and polymerization. These reactions are even more likely to happen due to repetitive use and heating of frying oils, especially in restaurants and food manufacturing facilities. Moreover, these oxidative reactions are also affected by other factors such as oxygen in the air, the humidity of food, temperature, and unsaturation of oils . Oxidative reactions deteriorate the quality of the oil and affect the nutritional qualities of fried foods as well as their sensory characteristics . This deterioration is due to the absorption of oils by fried foods that increases with the duration of the frying process. Indeed, the more the oil oxidizes, the more viscous it becomes, and the more it is absorbed by the food(Nieto et al., 2018). Therefore, several synthetic antioxidants including butylated hydroxyanisole (BHA), tert-butylhydroquinone (TBHQ), and butylated hydroxytoluene (BHT) were explored to extend the shelf life of frying oils, to delay the formation of undesirable components, and to improve the sensory properties of fried products . However, it was shown in some studies that these substances were toxic and carcinogenic for humans . Thus, their use was restricted, and some of them were even banned or used with specific legal limits recommended in Europe and the USA . In the meantime, extensive efforts were made to minimize or prevent vegetable oil oxidation through the development of safe and effective antioxidants . In fact, in recent years, many studies have focused on rosemary extracts for their antioxidant activity and their ability to delay lipid oxidation, preserve food, and protect human health . The main active compounds in rosemary responsible for this high antioxidant activity

are carnosic acid, carnosol, and rosmarinic acid(Li et al., 2021). Among the uses of rosemary extract, frying oils feature prominently becauseof the degraded fats generated during the frying process that requires its antioxidant action.(Ribeiro-Santos et al., 2015)

1-10 Anti-oxidant Extraction:

Minimally processed vegetables provide consumers with a high content of bioactive phenolic compounds and nutritional properties. The consumption of vegetables is widespread because it can reduce the incidence of many diseases, such as cancer and cardio- and cerebrovascular diseases, thanks to their high content of antioxidant compounds(Bragagnolo et al., 2007).

In this context, radish (Raphanus sativus L.) is a vegetable recognized worldwide for its many bioactive compounds such as anthocyanins, flavonoids, phenols, vitamins and pigments, which affect its appearance and nutritional quality. Indeed, radish leaves and roots have been therefore used in various parts of the world for medical applications due to their antimicrobial, antiviral and antioxidant activity . The dietary consumption of fresh radish is also an excellent source of bioactive and useful compounds for human health. In this regard, it is well known that minimal processing operations, such as cutting or peeling, could damage the integrity of vegetable tissues, triggering deterioration processes including oxidative browning, tissue softening, water loss and the production of undesirable flavors and odors . The greatest losses in the quality and quantity of fresh fruits and vegetables occur from harvest to consumption, due to the change in the gas balance between oxygen consumption and carbon dioxide production by the plants . The gas transfer rate depends on internal and external factors, such as cultivar or atmospheric composition, in terms of the O2, CO2 and ethylene ratio . In this context, the main objectives of any post-harvest technology are quality optimization and loss reduction in fresh

produce(Genena et al., 2008). Controlled and modified atmosphere packaging or dipping with natural additives, such as salts or organic acids (e.g., calcium chloride or citric acid and ascorbic acid), have been used for preserving different minimally processed vegetables and for reducing variations in the quality and quantity of their components .(Zappia et al., 2023)

1-11 Effect rosemary to Alzheimer and Parkinson Disease :

Anti-Inflammatory Actions of Rosemary and Carnosic Acid

In this study, we present both an overview and new primary data describing the therapeutic effects of the herb rosemary, concentrating on its primary medicinal constituent, carnosic acid (CA). We focused on the effects of CA on neurological disorders including Alzheimer's disease (AD), Parkinson's disease (PD), and infection with SARS-CoV-2 causing coronavirus disease 2019 (COVID-19), as well as the long-term consequences of the infection, termed long-COVID. The anti-inflammatory action of CA through inhibition of the nucleotide-binding oligomerization domain-like receptor containing pyrin domain 3 (NLRP3) inflammasome is highlighted as a central pathway in promoting health by rosemary/CA. The keywords used as search terms for our literature review were 'Rosmarinus officinalis', 'rosemary', 'carnosic acid', 'carnosol', 'NLRP3′, 'Alzheimer's disease', 'Parkinson's disease', 'COVID', and 'NRF2′. All types of articles, abstracts, and books were included in the search. No time limitation on publication date was considered.(Satoh et al., 2022)

Rosemarinus officinalis L. an evergreen perennial aromatic shrub belongs to the family Labiatae. It is a popular household plant, commonly called rosemary, which is native to the north and south coasts of the Mediterranean Sea. Rosemary has many effective compounds with antioxidant properties. Andrade et al. studied the antioxidant and pro-oxidant properties of rosemary. Its main constituents with antioxidant properties are carnosic acid

and carnosol that are responsible for 90% of the properties. Both are inhibitors of lipid peroxidation in liposomal and microsomal systems; they are good scavengers of CCl_3O_2 (peroxyl radicals), reduce cytochrome c, and scavenge hydroxyl radicals. Particularly, carnosic acid scavenges H_2O_2, but could also act as a substrate for the peroxidase system. The antioxidant properties depend on the fruiting stages.

The increase in the concentration of polyphenols, which include carnosol, rosmarinic acid, and hesperidin, during the fruiting stage, is directly related to the enhancement of the extract antioxidant property. Rosmarinic acid and hesperidin have been cited in the literature as important free radical scavengers. This plant assumes significance in traditional medicine owing to its medicinal properties and treating cognitive function deficiencies. Rosemary contains essential oils of 0.6 to 2, including 1,8-cineoles, alpha pineol, camphor, porroneol, carvacrol with phenolic detergents. Flavones and caffeic acid are derivatives of rosemarynum acid. Rosmarinic acid acts as antioxidant compounds .

These compounds can treat memory deficit by removing free radicals. Neuronal deletion, particularly in the cortex region, is now known to lead to cognitive impairment in acquired learning skills and memory. Different in vitro and in vivo models evaluated rosemary and its efficacy in the management of patients with Alzheimer disease. The studies have demonstrated that extracts from plants of the Lamiaceae family are active in the inhibition of Acetylcholinesterase (AChE) and β-amyloid deposits. Besides, antioxidant, cytoprotective, and anti-inflammatory activities have been observed in Lamiaceae plant extracts. There are reports that compounds like 1,8-cineole and alpha-terpineol inhibit AChE, and notably, 1,8-cineole is the most potent inhibitor . The purpose of this study was to investigate the protective effect of rosemary extract against side effects of maternal sleep deprivation in neonate rats such as memory deficit. Neurotransmitter interactions may be responsible for the cognitive

enhancements observed in the present study. (Satoh et al., 2022)
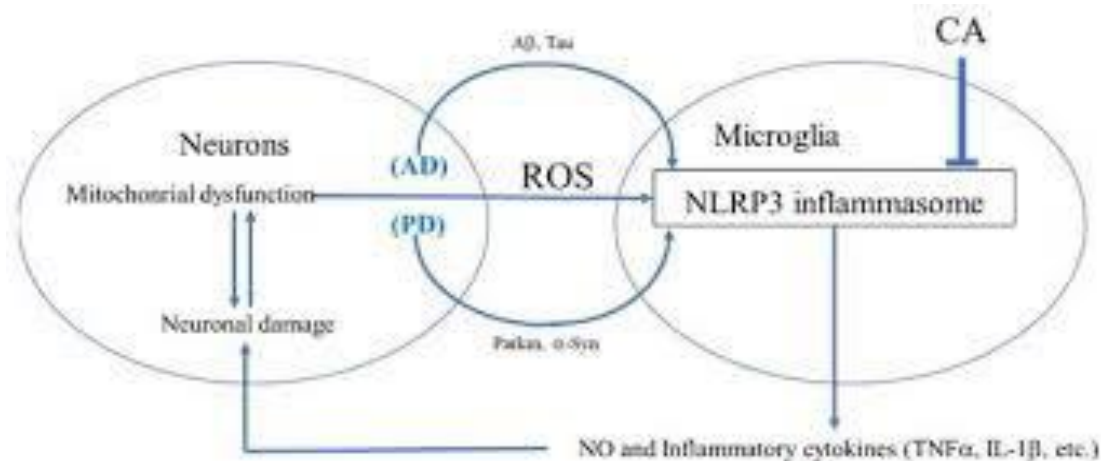
Fig(7):Show Effect Rosemary to PD and AD disease

2. Review Article

 Gema Nieto1,2 et all in year 2018 report that over the past few years,
 Nowadays, there is an interest in the consumption of food without synthetic additives and rather with the use of natural preservatives. In this regard, natural extracts of the *Lamiaceae* family, such as rosemary, have been studied because of its bioactive properties. Several studies have reported that rosemary extracts show biological bioactivities such as hepatoprotective, antifungal, insecticide, antioxidant and antibacterial. It is well known that the biological properties in rosemary are mainly due to phenolic compounds. However, it is essential to take into account that these biological properties depend on different aspects. Their use in foods is limited because of their odour, colour and taste. For that reason, commercial methods have been developed for the preparation of odourless and colourless antioxidant compounds from rosemary. Owing to the new applications of natural extracts in preservatives, this review gives a view on the use of natural extract from rosemary in foods and its effect on preservative activities. Specifically,   the   relationship   between   the   structure   and   activity

(antimicrobial and antioxidant) of the active components in rosemary are being reviewed.(Nieto et al., 2018)

Michael Yousef 1,2 et all in year 2016 report that over the past few years, Cancer cells display enhanced growth rates and a resistance to apoptosis. The ability of cancer cells to evade homeostasis and proliferate uncontrollably while avoiding programmed cell death/apoptosis is acquired through mutations to key signaling molecules, which regulate pathways involved in cell proliferation and survival. Compounds of plant origin, including food components, have attracted scientific attention for use as agents for cancer prevention and treatment. The exploration into natural products offers great opportunity to evaluate new anticancer agents as well as understand novel and potentially relevant mechanisms of action. Rosemary extract has been reported to have antioxidant, anti-inflammatory, antidiabetic and anticancer properties. Rosemary extract contains many polyphenols with carnosic acid and rosmarinic acid found in highest concentrations. The present review summarizes the existing in vitro and in vivo studies focusing on the anticancer effects of rosemary extract and the rosemary extract polyphenols carnosic acid and rosmarinic acid, and their effects on key signaling molecules.(Moore et al., 2016)

Luis Bravo-Díaz 1,2 et all in year 2020 report that over the past few year,This work is a bibliographical review of rosemary (*Rosmarinus officinalis*) that focuses on the application of derivatives of this plant for cosmetic products, an application which has been recognized and valued since Ancient Egyptian times. Rosemary is a plant of Mediterranean origin that has been distributed throughout different areas of the world. It has many medicinal properties, and its extracts have been used (mainly orally) in folk medicine. It belongs to the Labiatae family, which contains several genera— such as *Salvia*, *Lavandula*, and *Thymus*—that are commonly used in cosmetics, due to their high prevalence of antioxidant molecules. Rosemary is a perennial shrub that grows in the wild or is cultivated. It has glandular

hairs that emit fragrant volatile essential oils (mainly monoterpenes) in response to drought conditions in the Mediterranean climate. It also contains diterpenes such as carnosic acid and other polyphenolic molecules. Herein, the botanical and ecological characteristics of the plant are discussed, as well as the main bioactive compounds found in its volatile essential oil and in leaf extracts. Afterward, we review the applications of rosemary in cosmetics, considering its preservative power, the kinds of products in which it is used, and its toxicological safety, as well as its current uses or future applications in topical preparations, according to recent and ongoing studies.(González-Minero et al., 2020)

Mohammed R. Ragab 1,2,3, et all in year 2019 report that over the past few years,Liver cirrhosis, the terminal stage of various chronic liver diseases, affects hundreds of millions of patients worldwide. This study was conducted to evaluate the hepatoprotective effect of rosemary ethanolic extract on thioacetamide (TAA) induced liver cirrhosis. Sixty rats used in this study were divided into three groups: control group, TAA group received intraperitoneal (i.p) injection of TAA twice weekly at dose (200mg/kg) for 12 weeks, rosemary protective group received (i.p) injection of TAA twice weekly at dose (200mg/kg) and oral daily dose of rosemary ethanolic extract (200 mg/kg) for 12 weeks. The results revealed that injection of TAA increased liver enzymes. Additionally, concentration of interleukin-1β (IL-1β) and Nuclear Factor Kappa (NF-κβ) increased indicating a significant inflammatory response. Obvious state of oxidative stress in liver as evidenced by elevated
 malondialdehyde (MDA) and reduced total antioxidant capacity (TAC). On the other hand, protection with rosemary ethanolic extract exhibited a significant improvement in liver function, antioxidant capacities and inflammatory status of liver. It can be concluded that rosemary ethanolic extract has an ameliorating effect against cirrhosis induced by TAA.(Ragab et al., 2019)

Louay Labban 1,2,3, et all in year 2014 ,Various herbs have been used as treatment and prevention for several chronic diseases such as diabetes, hypercholesterolemia and triglyceridemia; one of those herbs is Rosemary, which has biological antioxidant mechanisms. Rosemary is a thorny Rhamnaceous plant which is widely distributed in Europe and South-Eastern Asia. It's used in traditional medicine for its therapeutic properties. The objective of this study was to investigate the effects of Rosemary (Rosmarinus officinalis) leaves powder on glucose level and lipid profile in human. Material and Methods: Forty eight adults' men and women participated in this study which has been carried out in the UOK University. The participants were randomly selected and divided into 3 groups. The first group was given 2 g/day of Rosemary leaves powder, the second group was given 5 g/day of Rosemary leaves powder while the third group was given 10 g/day of Rosemary leaves powder for a period of 4 weeks. Blood samples were analyzed for glucose, lipid profile and antioxidant at the beginning and the end of the study and the results were statistically analyzed. Results: The results indicated that a significant decrease in blood glucose level in the groups given 5 g and 10 g of the herb powder was observed but the difference was more significant in the group given 10 g/day. Values for total cholesterol and triglycerides were very significantly lower in the three treated groups. LDL-C level was significantly lower in the group given 10 g of the herb powder, while the increased levels of HDL-C was statistically significant in the group that was given 10 g/day. With regard to lipid peroxidation, giving 10 g/day of Rosemary leaves powder decreased significantly MDA and GR values whereas significantly increases the values of vitamin C and β carotene..(Labban et al., 2014)

Discussion:

Rosemary is an ancient symbol of fidelity and remembrance. The aromatic herb grows wild on the Gallipoli peninsula in Türkiye, where the original Anzacs served in World War I. Australians traditionally wear sprigs of rosemary as a symbol of remembrance on Anzac Day or Remembrance Day.

It found that rosemary **significantly enhanced the quality of memory and increased mental alertness**. Another study, published in Psychogeriatrics, tested the effects of rosemary oil aromatherapy on 28 elderly dementia and Alzheimer's patients and found that its properties can prevent and slow Alzheimer's disease.

Rosemary is described as **a woody, perennial herb that can become a bushy shrub**. The leaves are evergreen and needlelike in shape, and they produce the essential oil that gives rosemary its characteristic scent. They are dark green on the upper side, and the underside has a dense covering of short, white, woolly hairs.

The health benefits of rosemary include increase blood circulation to the brain, boost memory, reduce inflammation, treat Alzheimer's, reducing the severity of asthma attacks, heal cancer, relieve pain, and protect the immune system. Its fragrant oil is an ingredient in numerous toiletry products and in vermouth.

Rosemary has significant **antimicrobial, anti-inflammatory, anti-oxidant, anti-apoptotic, anti-tumorigenic, antinociceptive, and neuroprotective properties**. Furthermore, it shows important clinical effects on mood, learning, memory, pain, anxiety, and sleep.

Rosemary is a rich source of antioxidants and anti-inflammatory compounds, which are thought to help **boost the immune system and improve blood circulation**. Laboratory studies have shown rosemary to be rich in antioxidants, which play an important role in neutralizing harmful particles called free radicals.

Conclusion:

By reviewing the previous literature, it is concluded that the most important components of rosemary which are medicinally and pharmacologically active are rosmarinic acid, carnosic acid, and the essential oil. Rosemary is a rich source of antioxidants and anti-inflammatory compounds, which are thought to help boost the immune system and improve blood circulation. Laboratory studies have shown rosemary to be rich in antioxidants, which play an important role in neutralizing harmful particles called free radicals.

Rosemary has been one of the best-known plants since ancient times. The Ancient Egyptians used creams and oils for protection against high temperatures and desert heat.

Reference:

BEATA, B.-K., WOJCIECH, J., JOHANNES, K., PIOTR, L. & BARBARA, M. 2023. Alzheimer's Disease—Biochemical and Psychological Background for Diagnosis and Treatment. *International Journal of Molecular Sciences,* 24**,** 1059.

BLOMMER, J., PITCHER, T., MUSTAPIC, M., EREN, E., YAO, P. J., VREONES, M. P., PUCHA, K. A., DALRYMPLE-ALFORD, J., SHOORANGIZ, R. & MEISSNER, W. G. 2023. Extracellular vesicle biomarkers for cognitive impairment in Parkinson's disease. *Brain,* 146**,** 195-208.

BRAGAGNOLO, N., DANIELSEN, B. & SKIBSTED, L. H. 2007. Rosemary as antioxidant in pressure processed chicken during subsequent cooking as evaluated by electron spin resonance spectroscopy. *Innovative Food Science & Emerging Technologies,* 8**,** 24-29.

CASTELLANI, R. J., ROLSTON, R. K. & SMITH, M. A. 2010. Alzheimer disease. *Disease-a-month: DM,* 56**,** 484.

CHANG, S. S., OSTRIC-MATIJASEVIC, B., HSIEH, O. A. & HUANG, C. L. 1977. Natural antioxidants from rosemary and sage. *Journal of Food Science,* 42**,** 1102-1106.

DE MACEDO, L. M., SANTOS, É. M. D., MILITãO, L., TUNDISI, L. L., ATAIDE, J. A., SOUTO, E. B. & MAZZOLA, P. G. 2020. Rosemary (Rosmarinus officinalis L., syn Salvia rosmarinus Spenn.) and its topical applications: A review. *Plants,* 9**,** 651.

FUNAYAMA, M., NISHIOKA, K., LI, Y. & HATTORI, N. 2023. Molecular genetics of Parkinson's disease: Contributions and global trends. *Journal of Human Genetics,* 68**,** 125-130.

GENENA, A. K., HENSE, H., SMANIA JUNIOR, A. & SOUZA, S. M. D. 2008. Rosemary (Rosmarinus officinalis): a study of the composition, antioxidant and antimicrobial activities of extracts obtained with supercritical carbon dioxide. *Food Science and Technology,* 28**,** 463-469.

GONZáLEZ-MINERO, F. J., BRAVO-DíAZ, L. & AYALA-GóMEZ, A. 2020. Rosmarinus officinalis L.(Rosemary): An ancient plant with uses in personal healthcare and cosmetics. *Cosmetics,* 7**,** 77.

JIA, J., ZHAO, T., LIU, Z., LIANG, Y., LI, F., LI, Y., LIU, W., LI, F., SHI, S. & ZHOU, C. 2023. Association between healthy lifestyle and memory decline in older adults: 10 year, population based, prospective cohort study. *bmj,* 380.

LABBAN, L., MUSTAFA, U. E.-S. & IBRAHIM, Y. M. 2014. The effects of rosemary (Rosmarinus officinalis) leaves powder on glucose level, lipid profile and lipid perodoxation. *International Journal of Clinical Medicine,* 5**,** 297-304.

LANGE, J., RIVERA-BALLESTEROS, O. & BUGGERT, M. 2022. Human mucosal tissue-resident memory T cells in health and disease. *Mucosal Immunology,* 15**,** 389-397.

LI, P., YANG, X., LEE, W. J., HUANG, F., WANG, Y. & LI, Y. 2021. Comparison between synthetic and rosemary-based antioxidants for the deep frying of French

fries in refined soybean oils evaluated by chemical and non-destructive rapid methods. *Food Chemistry,* 335**,** 127638.

MOORE, J., YOUSEF, M. & TSIANI, E. 2016. Anticancer effects of rosemary (Rosmarinus officinalis L.) extract and rosemary extract polyphenols. *Nutrients,* 8**,** 731.

NIETO, G., ROS, G. & CASTILLO, J. 2018. Antioxidant and antimicrobial properties of rosemary (Rosmarinus officinalis, L.): A review. *Medicines,* 5**,** 98.

NISHAL, S., PHAUGAT, P., BAZAAD, J., DHAKA, R., KHATKAR, S., KHATKAR, A., KHAYATKASHANI, M., HAGHIGHI, S. M., MEHRI, M. & KASHANI, H. R. K. 2023. A Concise Review of Common Plant-derived Compounds as a Potential Therapy for Alzheimer's Disease and Parkinson's Disease: Insight into Structure-Activity-Relationship. *CNS & Neurological Disorders-Drug Targets (Formerly Current Drug Targets-CNS & Neurological Disorders).*

RAGAB, M. R., ABDELHAMID, O. M., SAID, A. M. & FARRAG, R. 2019. Protective effect of Rosmary on liver cirrhosis induced experimentally in rats. *World Journal Of Pharmacy And Pharmaceutical Sciences,* 9**,** 413-423.

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. 2015. A novel insight on an ancient aromatic plant: The rosemary (Rosmarinus officinalis L.). *Trends in Food Science & Technology,* 45**,** 355-368.

RODRíGUEZ-ROJO, S., VISENTIN, A., MAESTRI, D. & COCERO, M. J. 2012. Assisted extraction of rosemary antioxidants with green solvents. *Journal of Food Engineering,* 109**,** 98-103.

SATOH, T., TRUDLER, D., OH, C.-K. & LIPTON, S. A. 2022. Potential therapeutic use of the rosemary diterpene carnosic acid for Alzheimer's disease, Parkinson's disease, and long-COVID through NRF2 activation to counteract the NLRP3 inflammasome. *Antioxidants,* 11**,** 124.

VAN DER AUWERA, S., GARVERT, L., AMELING, S., VöLZKE, H., NAUCK, M., VöLKER, U. & GRABE, H. J. 2023. The interplay between micro RNAs and genetic liability to Alzheimer's Disease on memory trajectories in the general population. *Psychiatry Research,* 323**,** 115141.

ZAPPIA, A., SPANTI, A., PRINCI, R., IMENEO, V. & PISCOPO, A. 2023. Evaluation of the Efficacy of Antioxidant Extract from Lemon By-Products on Preservation of Quality Attributes of Minimally Processed Radish (Raphanus sativus L.). *Antioxidants,* 12**,** 235.