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The biological activity of essential oils extracted from some medicinal plants

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ABSTRACT

Since ancient times, humans have used aromatic plants and their extracts for religious rituals, perfumery, cosmetics, food manufacture and preservation, as well as for aromatherapy, disease control and for making medicinal drugs, which are needed nowadays in pharmaceutical industry. Essential oils, are essence extracted from the plant or from some of its parts, it could be defined as natural metabolic secretions that has not yet fully understood. It can also be considered as real plant hormones gives it an aromatic smell characterized by its strong concentration and easy volatilization as it evaporates completely without leaving a greasy trace behind it, these oils are extracted in different extraction methods.

Essential oils have been used as an alternative medicine since Twelfth century, and became more widespread in the second half of the Sixteenth century. This has allowed modern chemistry to adopt a scientific approach in using it, which gave many publications and research during the Nineteenth and Twentieth century. As they have been proven to be good sources of biologically active compounds with medicinal properties, such as reducing fever, treating digestive and respiratory disorders and strengthening the immune system, in addition to its impact on anxiety and depression.

This review paper is highlighting on some essential oils extracted from its medicinal plants and the methods of its extraction including the chemical structure of its most important components that give the therapeutic properties reflecting on general health and safety.

KEY WORDS: Medicinal plants, Essential oils, Chemical components, Medicinal properties, Oil extraction.

1. INTRODUCTION

Medicinal plants have been widely used since ancient times to prevent or treat various diseases. The past three decades have witnessed a massive surge in public interest and acceptance of natural remedies in both developing and developed countries. It is estimated that up to four billion people (representing 85% of the world's population) rely on herbal medicinal products as an alternative treatment to traditional medicines. Moreover, about 25% of all modern medicines are derived directly or indirectly from medicinal plants (WHO, 2019).

Essential oils are considered one of the most important natural products derived from plants for their various biological properties and medicinal uses. They have been used by many cultures for different purposes as perfumes, food flavorings and beverages or to heal the body and mind (Wei and Shibamoto, 2010). Essential oils also called (volatile or etheric oils) because they evaporate when exposed to heat unlike fixed oils, are volatile compounds that are only present in 10% of the plant kingdom, stored in plants by special glands that may be found in flowers, leaves, stems, or roots also it could be found in the bark of some trees (Ciccarelli, 2008; Liolios, 2010). The total content of essential oil in most plants is very low and rarely exceeds 1% (Bowles, 2003), however it is significant due to its active components that are formed in the plant as a result of a series of reactions. It is mainly a group of mono hydrocarbons and terpenes and their oxygenated derivatives, in addition to aliphatic aldehydes, alcohols and esters (Abdelouaheb and Amadou, 2012). The chemical composition of any oil is closely related to the extraction procedure that is being done, so choosing the appropriate extraction method is very important, relying on the characteristics of each plant material. For extraction oils there are specific techniques such as steam distillation, extraction Solvents, Soxhlet extraction and water distillation (Monica, 2018). The extraction of essential oils is expensive knowing that large amount of raw materials needed to produce a few milliliters of oil, so the optimal method must be tested so that it does not affect the characteristics of the oil.

For physical properties of aromatic oils, it is found that most of them are colorless and they do not dissolve in water while they dissolve in alcohol and in ether and most of them have a fragrant smell that evaporates or volatilize completely under normal conditions.

Essential oils have healing properties that could treat and protect some diseases, as in the eighteenth and nineteenth centuries; chemists documented the active ingredients of medicinal plants and such as caffeine, quinine, morphine and atropine, which have important biological effect. Recent studies confirm the possibility of using essential oils in coming future as suitable alternatives for many industrially produced drugs.

This paper provides an overview of the chemical composition of some essential oils that are derived from their medicinal plants that concentrated in them. The detailed information will be about mechanism of their impact on the general health of the human being.

Methods of Extraction oils: There are several methods of manufacturing essential oils that depends on the type of plant from which the essential oil is extracted. These methods can be simple in practice, but it should be noticed that not using the correct manner could leads to the destruction of the effective content of the aromatic oils having negative impact on oil characteristics and its chemical properties losing whole medicinal value.

Hydro Distillation; In order to isolate essential oils by hydro distillation, the aromatic plant material is packed in a still and a sufficient quantity of water and brought to a boil; alternatively, live steam is injected into the plant charge. Due to the influence of hot water and steam, the essential oil is freed from the oil glands in the plant tissue. The vapor mixture of water and oil is condensed by indirect cooling with water. From the condenser, distillate flows into a separator, where oil separate automatically from the distillate water.

Steam distillation: Steam distillation is essentially a process of distilling plant material with steam generated by a boiler. In this method, the material is placed on a perforated plate above the steam inlet (Oztekin and Soysal, 1995).

Enfleurage: Enfleurage it is one of the oldest methods of essential oil extraction that implements the use of fat. By the end of this process, either vegetable fat or animal fat becomes infused with the flower's fragrance compounds. The fats that are used are odorless and solid at room temperature. The enfleurage process can be done either "hot" or "cold." In both instances, the fat that is saturated with fragrance is called "enfleurage pomade."

Expression Extraction: Expression or cold pressing, is only used in the production of citrus oils. The term expression refers to any physical process in which the essential oil glands in the peel are crushed or broken to release the oil. One method that was practiced many years ago, particularly in Sicily (spugna method), commenced with halving the citrus fruit followed by pulp removal with the aid of sharpened spoon-knife (known as a rastrello). The oil was removed from the peel either by pressing the peel against a hard object of baked clay (concolina) which was placed under a large natural sponge or by bending the peel into the sponge. The oil emulsion absorbed by the sponge was removed by squeezing it into the concolina or some other container. It is reported that oil produced this way contains more of the fruit odor character than oil produced by any other method (Arnould, 1981).

Solvent extraction: This method employs food grade solvents like hexane and ethanol to isolate essential oils from plant material. It is best suited for plant materials that yield low amounts of essential oil, that are largely resinous, or that are delicate aromatics unable to withstand the pressure and distress of steam distillation. This method also produces a finer fragrance than any type of distillation method.

Once the plant material has been treated with the solvent, it produces a waxy aromatic compound called a "concrete." When this concrete substance is mixed with alcohol, the oil particles are released. The aforementioned chemicals used in the process then remain in the oil and the oil is used in perfumes by the perfume industry or for aromatherapy purposes (Chrissie, 1996).

The following highlighted on biological effect of some essential oils extracted from its medicinal plants commonly used in treating disease.

***Rosmarinus officinalis* L.:** R. officinalis L., popularly known as rosemary, is a plant belonging to the family Lamiaceae, where the origin of the name ″ Rose-Marie ″ is Latin: ″ Rose," which means ″ Sumac ", and ″ Marinos ″ which means ″ sea ", and some call her ″ Anthos ″ derived from the word agher ″ Venus ″ means ″ flower " (Rotblatt, 2000). It grows in warm regions, so the Mediterranean and Asia were its original habitat, but it may be found sparingly in areas with cold weather and has a high potential for drought and prolonged water shortage (AL-sereiti, 1999). Rosemary is a perennial aromatic woody shrub, with narrow, tall, evergreen leaves that smell aromatic. Leaves are 2-4 cm in length and 2-5 mm in width. It is green on the top and white on the bottom, covered with dense hairs. Its flowers are multicolored as it could be pink, purple, and white or blue. It is used as a spice and as a food preservative, in addition to its medicinal importance for curing many diseases (Raskovic, 2014; Gonzalez, 2010).

Rosemary essential oil is extracted from its leaves by steam distillation, as leaves contain a volatile oil, ranging between 0.44-0.73%, and this oil has many chemical components (Jamshidi, 2009), which makes it one of the most important sources for medicines manufacturing with biological effectiveness, Figure.1, shows the most important chemical components present in the essential oil of rosemary that are attributed to its medicinal importance. Numerous studies have proven that carnosic acid is the most bioactive compound, followed by carnosole, rosmarinic acid and ursolic acid.

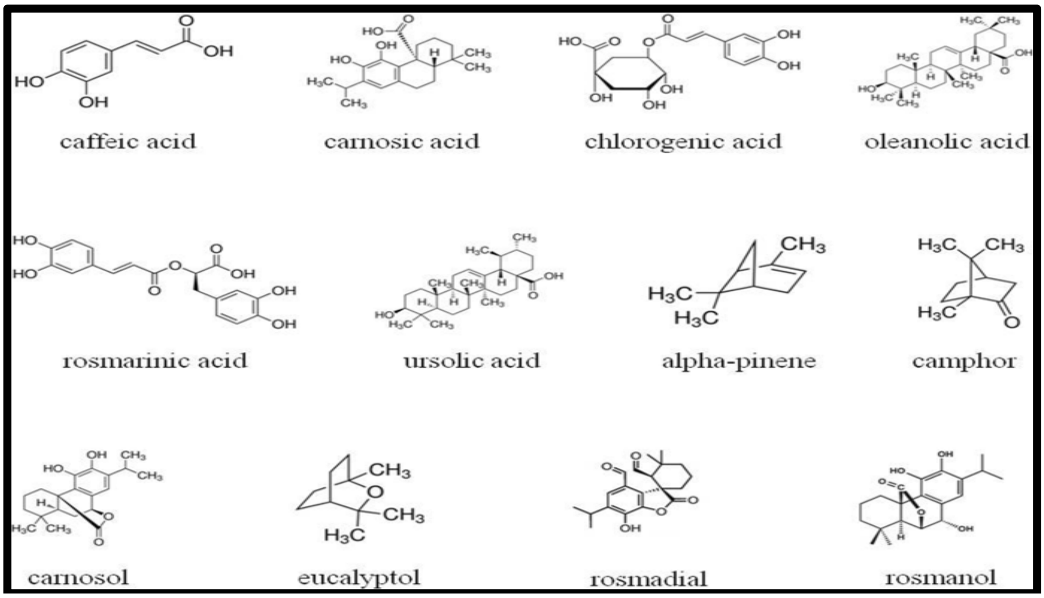

Figure.1. Major components in rosemary essential oil (Mehmet and Jean-Claude, 2008)

The medicinal importance of rosemary oil: Rosemary oil has many benefits, it was considered as sacred oil by ancient civilizations such as Greek, Roman and Egyptian, and here are some studies that shed light on the its medicinal importance and the chemical components:

Boosting the immune system: Antioxidants are considered as biggest weapons that help in protecting the body from disease. Rosemary oil contains carnosol and myrcine, those two chemicals act as powerful antioxidants and anti-free radicals so it could protect cells from damage and treats number of infections and diseases. Thus, inhaling rosemary oil on a regular basis can help in boosting and strengthen the immune system (Borhan, 2015).

Anti-inflammatory: Rosemary oil is considered as a strong anti-inflammatory agent because it contains caffeic acid, rosmarinic acid, and α-pinene that could reduce swelling and muscles pain (Stefan, 2009).

Improve digestion: Rosemary oil contains flavonoids and phenolic acids, improves the quality of gastric acid secretions that is necessary for good digestion, and thus can help in relieving constipation, stomach cramps, bloating, indigestion symptoms and hepatotoxicity (Galisteo, 2000).

Reduce stress: Chronic stress is closely related to an increase in the secretion of the hormone, especially cortisol that could destroy the sensitive hormonal balance and normal metabolism, giving way to a number of other diseases. So that many studies concluded that the smell of rosemary oil reduces significantly the level of cortisol in saliva (Atsumi and Tonosaki, 2007).

Improving respiratory function: Eucalyptol and camphor found in rosemary oil expanding the airways in the lungs leading to better airflow, reducing a number of respiratory problems such as chest congestion and nasal congestion, coughing, cold and sore throat, and also it control the symptoms of respiratory allergies and sinusitis (Majid, 2018).

Antidepressant: Rosemary oil works as an anti-depressant, due to its chemical compounds such as carnosol and betulinic acid that has anti-depressant effect, the smell of oil helps in relaxing and stress relieve (Daniele, 2013).

***Cedrus sp.*:** There are four varieties of Cedrus belonging to Conifer family (Pinaceae), they are classified according to their morphological diversity. Three of them are naturally found in the Mediterranean region, *Cedrus libani A. Rich*, in Lebanon, Syria, and Turkey, *C. atlantica* in Algeria and Morocco, and *Cedrus brevifolia* on the island of Cyprus, while *C. deodara* in the Himalayas according to (Pantesos, 1992). The most famous type of cedar is the Lebanese cedar, which is currently endangered and spread in Lebanon (at elevations 1050-1925 m), and in Lattakia Mountains of Syria (at an altitude of 1200-1850 m) and in the Turkish Taurus Mountains (at an altitude of 530-2000 m) (Boydak, 2003). It was introduced into Europe and the United States of America around 1840 during the forestation and tree planting process in this region (Renau-Morata, 2005; Chaudhary, 2015).

The cedar is a perennial tree with a short and broad trunk, with thick branches extend horizontally and form a pyramidal wide corona. It is distinguished by its resistance to disease (Singh, 1988) this made it perennial tree (it can live up to 3000 years). The cedar tree has a unique self-defense mechanism, as it produces buds that replace infected leaves and branches when attacked by pests (Chaudhary, 2011). Interest in the Cedrus genus for possible therapeutic purposes goes back to ancient times. It was used in medicinal approach known as “Ayurveda”, it is an ancient Indian system of health care and longevity (before 2500 BC) (Dev, 1999). Ayurvedic treatment of ailments includes the healthy use of medicines, diet and some other practices (Kar, 1975; Chowdhry, 1997; Chaudhary, 2015). Also, the oil extracted from the cedars was used to embalm the ancient pharaohs in Egypt.

The essential oils of Cedrus (in leaves, seeds, roots and wood) are extracted by steam distillation (Clevenger, 1928) and the chromatographic analysis will be by GC / FID and GC / MS to obtain the chemical compounds of it (AFNOR, 2000). The yield is 2-5%. It is characterized by various chemical components (terpenes, resin acids, aldehydes, phenols, etc.) (Baser and Demircakmak, 1995) and the biochemical composition varies according to the extraction conditions and the used part. 37 components were distinguished, representing 90-93% of the oils from the roots and leaves of Lebanese cedar. While, the hemachline compound constituted 58% of the extracted oils, considered as an essential characteristic of the Lebanese cedar wood oil (Saab, 2005).

Hemachline is important for manufacturing anti-inflammatory and anti-cancer pharmaceutical products (Elias, 2019). Terpenoids also, according to (Loizzo, 2008) are excellent markers for distinguishing between the different Cedrus varieties. Figure.2, shows the most important chemical compounds found in Cedrus essential oil.

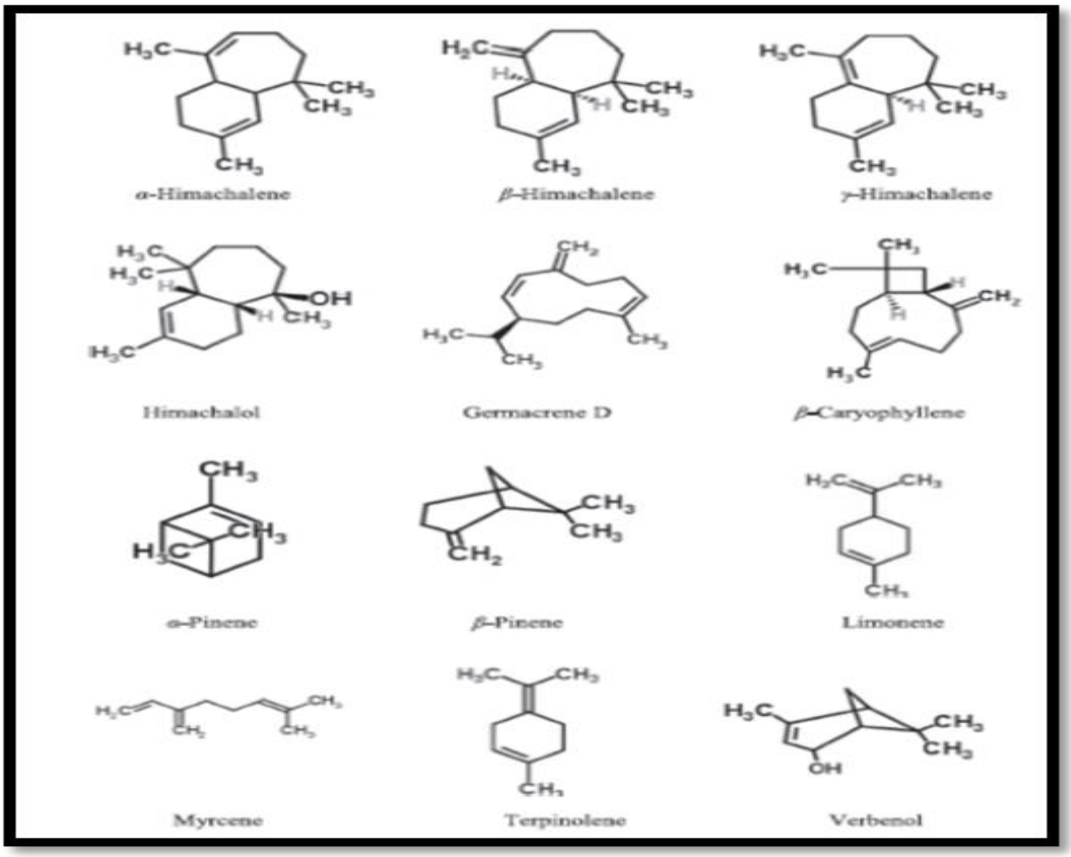

Figure.2. Major components in Cedrus essential oil (Saab, 2017)

The medicinal importance of cedar oil: The essential oils extracted from the *Cedrus sp* are considered as important natural raw materials for many pharmaceutical industries, where research has shown it has many medicinal uses, due to its chemical components that possess a wide range of biological activities, in the following some of the therapeutic benefits attributed to its aromatic oil:

Anti-inflammatory: Inflammation is the host's defense mechanism to eradicate infectious pathogens and initiate the healing process, but an overproduction of inflammatory mediators may cause host cells to become infected. Experiments have proven the importance of the hemachline compound that present in the essential oil of Lebanese Cedrus in the treatment of inflammatory conditions due to its anti-inflammatory properties (Loizzo, 2008; Saab, 2017).

Controling of respiratory diseases: Cedar wood oil helps to treat and combat all types of spasms that may affect the body, including spasms that may affect the respiratory system, so it is used to treat asthma or spasms in the respiratory system. Hemashlin has been identified as the main anti-seizure component in Cedar oil (Saab, 2017).

Anti-cancer: The essential oils of *C. libani* seeds have strong anti-leukemia activity (Saab, 2011). It has been shown that the compound (7-HC) has promising anti-cancer and anti-inflammatory properties, and may act as a key molecule in the treatment of Cancer (Elias, 2019).

Anti-microbial and anti-virus: Cedrus is considered as the most interesting plants, because it contains active compounds that are resistant to many diseases, microbes and viruses (Loizzo, 2008; Saab, 2012) this is due to the Methanol compound derived from cones and wood which has these properties.

Arthritis: Joints Inflammation can lead to discomfort or pain. Cedar wood oil can be used either by inhaling, or even by using it as a local anesthetic for joint and muscle pain, it has shown that it could reduce rheumatic joint stiffness (Kumar, 2015).

Origanum Majorana**:** Marjoram is herbaceous perennial with height of 30 - 60 cm. Its stalk is solid, ribbed, and covered with fine bristles, the color on top is brown mixed with red, and the leaf is in the shape of a tongue, its flowers are in spindle clusters that are bright red in color with a fragrant smell (Danin and Kunne, 1996). Marjoram is used as a food flavoring and preservative, where its oil is added to preserving meat products (Busatta, 2008). It is used as traditional home remedy for many respiratory diseases and digestive disorders (Bremness, 1994), also it can be used in the manufacture of soaps, perfumes and cosmetics.

The essential oil is extracted from the leaves and flower tops by steam distillation, with ranges between 1-2% and it contains many chemical components (Hussain, 2011) most of them are terpenes, tannins, carotenoids and vitamin C. Figure.3, shows the chemical structure of the most important compounds in the essential oil of marjoram.

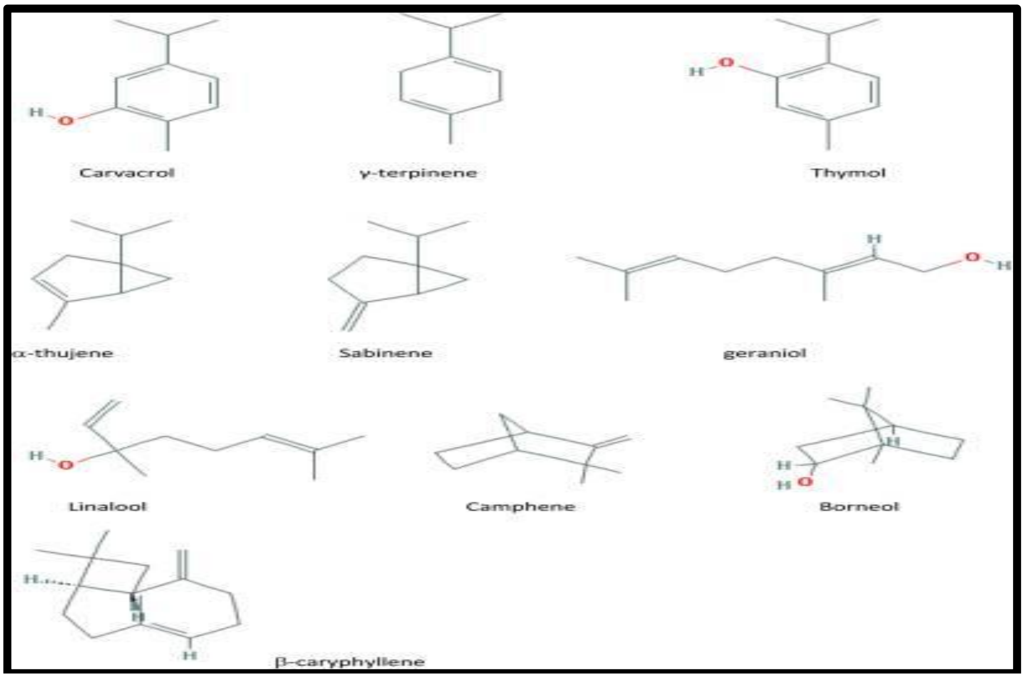

Figure.3. Major components in Marjoram essential oil (Vera and Chane, 1999)

Medicinal importance of marjoram oil: The marjoram plant and its essential oil have been used for thousands of years in Greek civilization, and here are some studies about health benefits of essential oil based on its most important chemical components:

Antioxidant: One of the most well-known benefits of marjoram essential oil is as antioxidant due to its phenolic compounds such as carnosic and ursolic acid (Vagi, 2005). It helps in elimination of free radicals and aiding in repairing damage caused by cellular metabolism and oxidation processes.

Antibacterial: Marjoram oil is considered as bacteria inhibitor protects against bacterial and viral including colitis and urinary tract infection, cholera, typhoid, ulcers, skin infections, and temporary body problems such as food poisoning (Charai, 1996).

Immune system booster: Marjoram oil is considered as immune system booster due to the presence of the rosmarinic acid compound (Ramadan, 2013). Thus, it can be a natural treatment for people suffering from high blood pressure and heart problems.

Calming nervous system: Marjoram oil gives a feeling of psychological stability to the brain and the body, as well as relieves the constant feeling of anxiety, and increases happiness and calm mood rates due to its linalool compound (Sugawara, 2013).

Anti-inflammatory: Marjoram oil is one of the most important anti-inflammatory essential oils whether it is internal or external, relieving the pain, helping to recover the body quickly (Fatemeh, 2017).

Respiratory diseases treatment: Marjoram oil has active ingredients such as thymol and carvacol, it combat colds, treat tracheal diseases, calming coughs and sinus infections (Charles, 2013).

Improve digestive system: The flavonoids present in oregano oil enhance the secretion of digestive enzymes inside the stomach, which leads to improved digestion and also works to improve appetite. Marjoram oil contains ethanol that soothes stomach cramps, controlling diarrhea, cramps, and stomach ulcers.

***Lavandula spp*:** Lavender plant belongs to Lamiaceae family, includes 39 species and many hybrids, and about 400 cultivated species. It grows naturally in the countries of the Mediterranean basin, also it spreads in North Africa, Europe and western India. Lavender is an annual plant with height of 30-60 cm. Its branches are woody; the leaves are smooth, while the flowers are purple at the base (Lis-Balchin 2002; Salehi, 2018).

Lavender plant is cultivated for commercial purposes in many countries, mainly France, UK, Bulgaria, Italy, Hungary, Australia, China, Russia and India (Shawl and Kumar, 2000; Salehi, 2018). The chemical compounds of lavender oil have drawn a lot of attention due to their variety and high commercial importance. It use in pharmaceutical and cosmetic industry, In addition to the aromatherapy therapeutic effects (Chang and Shen 2011; Woronuk, 2011; Sasannejad, 2012; Lopez, 2017; Young, 2017; Malcolm and Tallian, 2018).

Lavender oil is extracted mostly from the flowers through steam distillation. It contains more than 60 compounds. The chemical composition of the essential oil varies among species depending on many factors: climate, genetics, growing conditions, location, extraction conditions and growth stage (Tarakemeh, 2012; Smigielski, 2009; Lakusic, 2014; Chrysargyris, 2016), The main and most active compounds are linalool, linalyl acetate, camphor, and terpenes (Woronuk, 2011; Messaoud, 2012; Danh, 2012; Bajalan, 2017; Salehi, 2018) Figure.4, shows the most important chemical compounds in lavender oil.

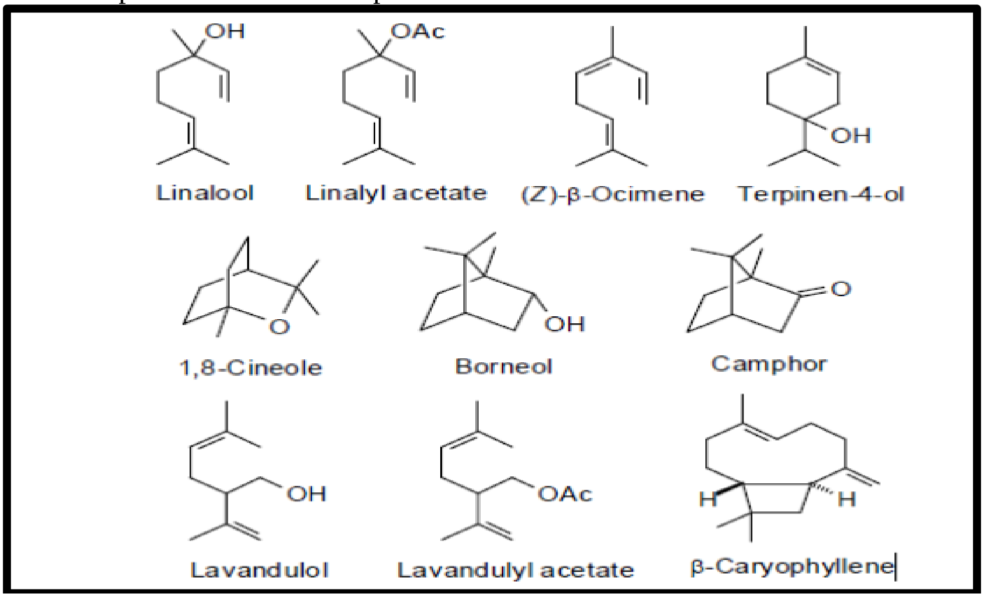

Figure.4. Major components in Marjoram essential oil

The medicinal importance of lavender oil: The essential oils of lavender have been used in traditional medicine for hundreds of years. Currently, bioactive compounds of lavender are used in the development of the pharmaceutical and therapeutic industries. Post-indication strategies are considered one of the most well-known biological activities of the lavender species. Below are some reviews of these characteristics:

Antioxidant: Oxidative stress is caused by reactive oxygen species (ROS) and their excess accumulation in cells lead to occurrence of many chronic and degenerative diseases, such as cancer, autoimmune disorders, rheumatoid arthritis, cardiovascular disease and neurodegenerative diseases (Gayoso, 2018).

Antioxidants play an important role in protecting cells against ROS. Lavender oil contains flavonoids and phenolic acids such as limonene, camphor, linalool, which are distinguished by their high antioxidant activity.

Anti-inflammatory: Nowadays, there is a growing interest in complementary medicine, including herbal remedies for treating inflammatory diseases. Lavender oil due to its phenolic compounds that is distinguished by its anti-inflammatory properties (Carrasco, 2015), treating many inflammatory diseases that affecting the body and skin (Hajhashemi, 2003; Carrasco, 2015; Giovannini, 2016).

Nervous system calming: The essential oil of lavender plant possesses therapeutic properties that are assisted by linalool and linalyl acetate, it has been shown to be effective in treating mild cases of depression (Gaware, 2013; Bikmoradi, 2017). Improves mood, fighting anxiety, and enhance the sleep quality (Fismer and Pilkington, 2012).

Reduce physical pain: Lavender essential oil used in aromatherapy to relieve pain. Where the essential oil is absorbed or inhaled, and many differences can be observed in the body such as stimulating physiological responses of nervous system that reflect on heart rate, blood pressure, respiration, brain wave activity and hormones (Cooke and Ernst, 2000; Chang and Shen, 2011; Gaware, 2013; Malcolm and Tallian, 2018).

Antibiotic: Studies have found the possibility of using lavender oil to combat the fungal infections of the skin and nails, also it can be considered as an anti-bacterial due to its antibacterial nature (Zuzarte, 2013; Minooeianhaghighi, 2017).

Laurus nobilis: The noble laurel belongs to the Lauraceae family, which includes about 2,500 species, it is considered native to the southern parts of Europe and the Mediterranean countries (Lucia, 2017). The evergreen laurel tree ranges from two to ten meters in height, has a bare stem and a smooth bark. Black and pale yellow wood with upright branches, its leaves are dark green and shiny at the top with wavy edges. This tree is considered separate in sex as the male trees do not bear fruits (Green, 2006) it used in ancient time as a symbol of victory.

The essential oil is extracted by steam distillation it range between (0.8% - 3%) in leaves and (0.6% -10) in fruits according to the method of picking and storing. And the chemical components differ according to environmental factors, geographical distribution, genotypes, and extraction methods (Woolf, 1999).

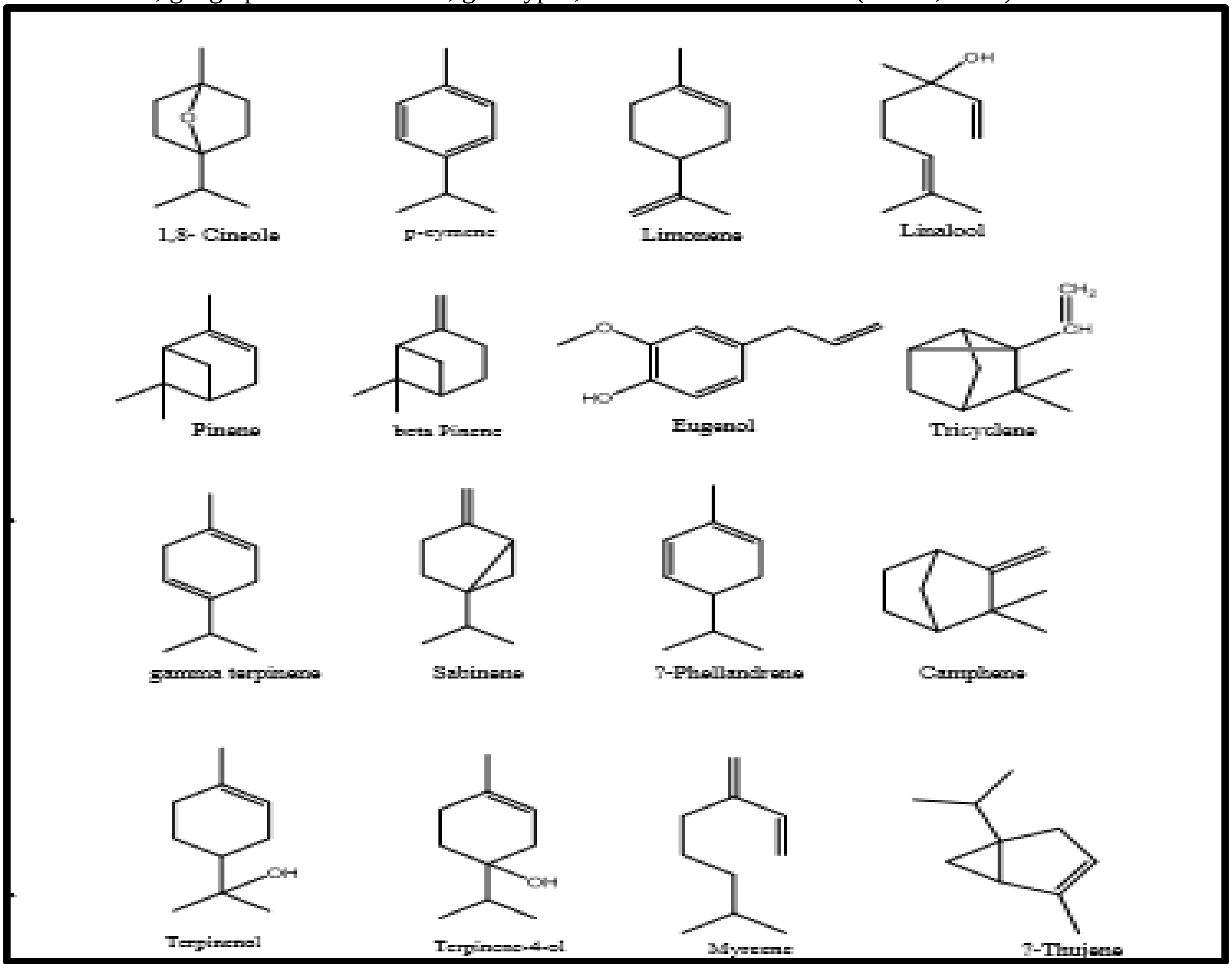

Figure.5. Major components in *Laurus nobilis* essential oil (Bouzouita, 2001)

The medicinal importance of laurel oil:

Wound healing: Studies have proven that laurel oil has antimicrobial activity due to the presence of the active compound 1-8 cineole (Hafize, 2019), also it contains many healing properties that reduce wound inflammation and enhance healing processes speed.

Antioxidant: Laurel oil contains volatile active ingredients such as α-pinene, β-pinene, myrcene, limonene and eugenol (Tiziana, 1998). These compounds possess antiseptic, antioxidant, and anti-free radical properties.

Anti-fungal: The active compound 1-8 cineole is considered an anti-fungal and analgesic reduce mouth yeast known as aphrodisiacs (Al-Hussaini and Mahasneh, 2011).

Pain Relief: According to studies, laurel essential oil provides an analgesic and anti-inflammatory effect similar to morphine and piroxicam impact. Thus it can relieve the emotional and physical pain associated with muscle and joint problems (Aparna, 2018).

Anti-anxiety and depression: The active compound 1-8 cineole of laurel essential oil passes easily through the blood-brain barrier (Moss, 2003) and shows effects at the nervous level by acting on receptor sites and enzyme activity that could limit negative emotions.

Eucalyptus: Eucalyptus belongs to the Myrtaceae family includes about 900 species (Brooker and Keing, 2004). It is considered native to Australia and representing more than 700 species worldwide (Safaei-Ghomi, 2013; Goldbeck, 2014). Eucalyptus is a large tree that can reach up to 50 meters with diameter of nearly 2 meters. The crown is spherical and large with slightly flabby branches. The fruits are roughly semi-spherical, topped by a fully protruding cylinder with a diameter of 5-6 mm. The tree shows high flexibility in terms of environmental factors and soil, but it cannot bare extreme cold and therefore it is not advised to grow it in areas where the temperature is below (-5 m).

It is cultivated in many parts of the world due to the healing properties of its essential oil (Safaei-Ghomi, 2013, Goldbeck, 2014). In addition to its use in the production of paper and charcoal (Maria, 2016) also its participation in the production of cosmetics (Pino, 2011).

The oil is extracted from leaves by steam distillation, as more than 300 species of this genus contain volatile oils in their leaves. The oil quantity depends on the species (Ishnava, 2013; Goldbeck, 2014; Luis, 2016). Less than 20 species known for their high content of 1-8 cineole that makes up more than 70% of the essential oil. Figure.6, shows the most important chemical compounds present in the essential oil of eucalyptus.

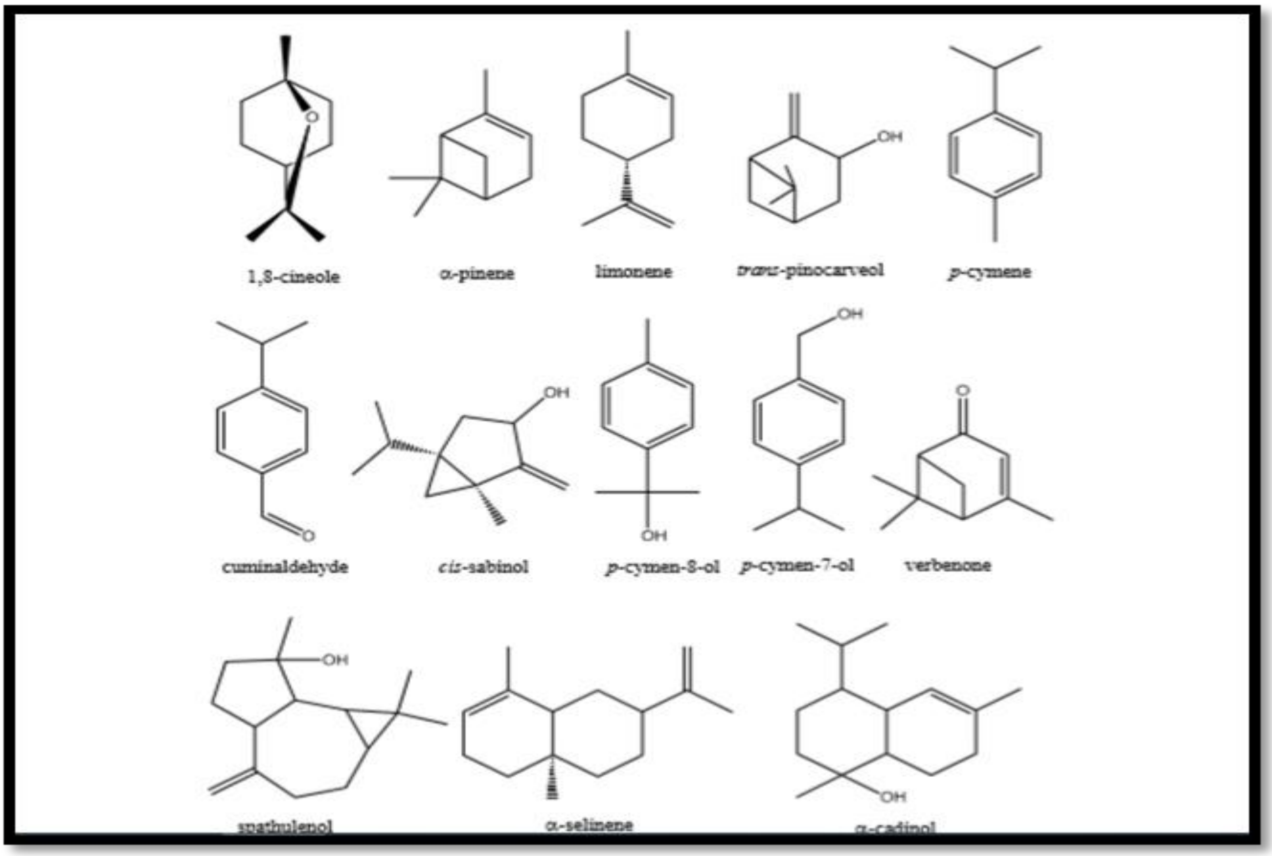

Figure.6. Major components in Eucalyptus essential oil Singh (1994)

The medicinal importance of eucalyptus oil:

Control respiratory disorders: Eucalyptus is well-known for its bioactive compounds, it is used for traditional medicine as antiseptics, treating upper respiratory tract disorders, such as colds and sinus congestion (Safaei-Ghomi, 2013; Boukef, 1986; Elaissi, 2012), and control influenza (Cermelli, 2008).

Antioxidant: Polyphones which presents in Eucalyptus oil reduce oxidative stress preventing disease development (Wang, 2008, Safaei-Ghomi, 2013; Hafsa, 2016). Eucalyptus essential oils are considered potential antioxidant alternatives to the synthetic once (Luis, 2016).

Anti-bacterial: Studies have demonstrated that eucalyptus contains organic substances with antibacterial and antimicrobial activity (Goldbeck, 2014; Sartorelli, 2007; Cermelli, 2008; Elaissi, 2012; Hafsa, 2016). According to Duarte (2006) and Kotzekidou (2008), the antimicrobial affect can be attributed to the presence of a high concentration of 1-8 cineole (15% -78%) and the plant polyphones.

Relieves joint and muscle pain: Eucalyptus oil has analgesic and anti-inflammatory properties affecting the central nervous system, it also has stimulant properties so it is usually prescribed for inhalation or topical use for patients suffering from rheumatism and lower back pain, sprained joints and muscle stiffness (Tapanee, 2018).

2. CONCLUSION

The recent studies have shown that essential oils can be potential alternatives to chemical drugs as antioxidants, antimicrobials and antiviral without side effects.

However, more research is needed to better understand of the basic mechanisms that responsible for the vital activities as well as the main compounds of these oils. This review paper highlights on the therapeutic efficacy of essential oils in the prevention and treatment of various diseases directly or indirectly. The main goal remains to attract attention to medicinal plants by following the correct methods of its cultivating, harvesting, and determination the most effective methods of distillation that affect the quality and effectiveness of essential oil, which is reflected on its medicinal proprieties.

REFERENCES

Abdelouaheb D and Amadou D, Therapeutic Benefits of Essential Oils. Nutrition, Well-Being and Health, Book chapter, Intech Open, Croitia, 2012, 155-178.

AFNOR, Association Francaise de Normalisation, Recueil de normes: les huiles essentielles, Tome 2, Monographies relatives aux huiles essentielles, AFNOR, Paris, 2000, 661-663.

AL-Hussaini R and Mahasneh A.M, Antibacterial and antifungal activity of ethanol extract of different parts of medicinal plants in Jordan, Jordan Journal of Pharmaceutical Sciences, 4 (1), 2011, 57-69.

AL-Sereiti M.R, Pharmacology of Rosemary (*Rosmarinus Officinalis* Linn.) and its Therapeutic Potentials, Indian J Exp. Biol., 37 (2), 1999, 124-130.

Aparna A, Health Benefits of Bay Leaf, Health Action, 31 (7), 2018, 24 – 261.

Arnould – Taylor W.E, Aromatherapy for the Whole Person, Stanley Thornes, UK, 1981, 22-26.

Atsumi T and Tonosaki K, Smelling lavender and rosemary increases free radical scavenging activity and decreases cortisol level in saliva, Psychiatry Res., 150, 2007, 89-96.

Bajalan I.R, Rouzbahani A.G, Pirbalouti and Maggi F, Chemical Composition and Antibacterial Activity of Iranian *Lavandula x hybrid*, Chem. Biodivers., 14 (7), 2017, 13-17.

Baser K.H.C and Demircakmak B, The essential oil of taurus cedar (*Cedrus libani* A. rich): Recent results, Chemistry of Natural Compounds, 31 (1), 1995, 16-20.

Bikmoradi A, Khaleghverdi M, Seddighi I, Moradkhani S, Soltanian A and Cheraghi F, Effect of inhalation aromatherapy with lavender essence on pain associated with intravenous catheter insertion in preschool children: A quasi-experimental study, Complementary Therapies in Clinical Practice, 28 (1), 2017, 85-91.

Borhan S, Effect of rosemary (*Rosmarinus officinalis*) extract on weight, hematology and cell-mediated immune response of newborn goat kids, J. Agr. Rural Dev. Trop., 116 (1), 2015, 91-97.

Boukef M.K, Les plantes dans la medecine traditionnelle tunisienne, Agence de cooperation culturelle et technique, Paris, 1986, 350.

Bouzouita N, Nafti A, Chaabouni M.M, Lognay G.C, Marlier M and Zghoulli S, Chemical Composition of *Laurus nobilis* Oil from Tunisia, Journal of Essential Oil Research, 13 (2), 2001, 116-117.

Bowles E.J, The Chemistry of Aroma therapeutic Oils, 3rd ed., Griffin Press, Australia, 2003, 265.

Boydak M, Regeneration of Lebanon cedar (*Cedrus libani* A. Rich.) on Karstic lands in Turkey, Forest Ecology and Management, 178 (3), 2003, 231-243.

Bremness L, The Complete Book of Herbs, A Practical Guide to Growing and Using Herbs, 1st ed., Studio, Seattle Goodwill, WA, USA, 1994, 288.

Brooker M.I. and Keing D.A, Field guide to Eucalyptus, 2nd ed., In Bloomings Book, Northern Australia: Melbourne, 2004, 428.

Busatta C, Application of *Origanum majorana* L. essential oil as an antimicrobial agent in sausage, Food Microbiology, 25 (1), 2008, 207-211.

Carrasco A, Thomas V, Tudela J and Miguel MG, Comparative study of GC-MS characterization, antioxidant activity and hyaluronidase inhibition of different species of Lavandula and Thymus essential oils, Flavour and Fragrance Journal, 31, 2015, 57-69.

Cermelli C, Fabio A, Fabio G and Quaglio P, Effect of Eucalyptus Essential Oil on Respiratory Bacteria and Viruses, Current Microbiology, 56 (1), 2008, 89-92.

Chang K.M, and SHEN C.W, Aromatherapy benefits autonomic nervous system regulation for elementary school faculty in Taiwan, Evidence-based complementary and alternative medicine, eCAM, 2 (1), 2011, 946537-946537.

Charai M, Mosaddak M and Faid M, Chemical composition and antimicrobial activities of two aromatic plants: *Origanum majorana L.* and *O. compactum Benth*, J Essential Oil Res., 8 (1), 1996, 657–664.

Charles D.J, Marjoram sweet, In: Antioxidant Properties of Spices, Herbs and other Sources, Springer, New York, 2013, 399.

Chaudhary A, Ahmad S and Mazumder A, *Cedrus deodara (Roxb.)* Loud: A Review on its Ethnobotany, Phytochemical and Pharmacological Profile, Pharmacognosy Journal, 3, 2011, 12–17.

Chaudhary A.K, Ahmad S and Mazumder A, Isolation, structural elucidation and in vitro antioxidant activity of compounds from chloroform extract of *Cedrus deodara* (Roxb.) Loud, Nat. Prod. Res., 29 (1), 2015, 268–273.

Chowdhry L, Khan Z.K. and Kulshrestha D.K, Comparative in vitro and in vivo evaluation of himachaol in murine invasive aspergillosis, Indian J Exp Biol., 35, 1997, 727–734.

Chrissie W, The Encyclopedia of Aromatherapy, Healing Arts Press, Vermont, 1996, 21.

Chrysargyris A, Laoutari S, Litskas V.D, Stavrinides M.C and Tzortzakis N, Effects of water stress on lavender and sage biomass production, essential oil composition and biocidal properties against *Tetranychus urticae* (Koch), Scientia Horticulturae, 213, 2016, 96-103.

Ciccarelli D, Garbari F and Pagni A.M, The flower of *Myrtus communis* (Myrtaceae): Secretory structures, unicellular papillae, and their ecological role, Flora, 203, 2008, 85-93.

Clevenger J.F, Apparatus for the determination of volatile oil, J. Am. Pharm. assoc., 17, 1928, 341-346.

Cooke B and Ernst E, Aromatherapy: a systematic review, The British Journal of general practice: The Journal of the Royal College of General Practitioners, 50 (455), 2000: 493-496.

Danh L.T, Triet N.D.A, Han L.T.N and Zhao J.R, Mammucari and Foster N, Antioxidant activity, yield and chemical composition of lavender essential oil extracted by supercritical CO_2, The Journal of Supercritical Fluids, 70, 2012, 27-34.

Daniele G, Antidepressant-like effects of fractions, essential oil, carnosol and betulinic acid isolated from *Rosmarinus officinalis* L, Food Chemistry, 136 (2), 2013, 999-1005.

Danin A and Kunne I, *Origanum jordanicum (Labiatae),* a new species from Jordan, and notes on other species of sect, Campanulaticalyx, Willdenowia, 25, 1996, 601-611.

Dev S, Ancient-modern concordance in Ayurvedic plants: some examples, In: Saxena P, Development of plant-based medicines: conservation, efficacy and safety, Springer-Science, Berlin, 1999, 67.

Duarte N, Bucek E, Karam D, Sa N and Scotti M.R, Mixed field plantation of native and exotic species in semi-arid Brazil, Australian Journal of Botany, 54, 2006, 211-118.

Elaissi A, Rouis Z, Salem A.B, Mabrouk Y, Ben Salem K.B.H, Salah M, Aouni F, Farhat R, Chemli F, Harzallah-Skhiri and Khouja M, Chemical composition of 8 eucalyptus species essential oils and the evaluation of their antibacterial, antifungal and antiviral activities, BMC Complementary and Alternative Medicine, 12 (1), 2012, 81.

Elias A, Shebaby W, Nehme B, Faour W, Bassil B, El Hakim J, Iskandar R, Dib-Jalbout N, Mroueh M, Daher C and Taleb R, *In Vitro* and *In Vivo* Evaluation of the Anticancer and Anti-inflammatory Activities of 2-Himachelen-7-ol isolated from *Cedrus Libani,* Scientific Reports, 9, 2019, 128-155.

Fatemeh B, Sweet Marjoram, A Review of Ethnopharmacology, Phytochemistry, and Biological Activities, J Evid Based Complementary Altern Med., 22 (1), 2017, 175–185.

Fismer K.L and Pilkington K, Lavender and sleep: A systematic review of the evidence, European Journal of Integrative Medicine, 4, 2012, 436.

Galisteo M, Suarez A, Del Pilar Montilla M, Del Pilar Utrilla M, Jimenez J, Gil A, Faus MJ and Navarro M, Antihepatotoxic activity of Rosmarinus tomentosus in a model of acute hepatic damage induced by thioacetamide, Phytother. Res., 14, 2000, 522-526.

Gaware V, Nagare R, Dhamak K.B, Khadse A.N, Kotade K.B, Kashid V.A and Laware R.B, Aromatherapy: Art or Science. International Journal of Biomedical Research, 4, 2013, 74-83.

Gayoso L, Roxo R.Y, Cavero M, Calvo D, Ansorena I, Astiasaran and Wink M, Bioaccessibility and biological activity of *Melissa officinalis*, *Lavandula latifolia* and *Origanum vulgare* extracts: Influence of an *in vitro* gastrointestinal digestion, Journal of Functional Foods, 44, 2018, 146-154.

Giovannini D, Gismondi A, Bassao A, Canuti L, Braglia R, Canini A, Mariani F and Cappelli G, *Lavandula angustifolia* Mill. Essential oil exerts antibacterial and anti-inflammatory effect in macrophage mediated immune response to *Staphylococcus aureus*, Immunological Investigations, 45, 2016, 11-28.

Goldbeck J.C, Do Nascimento J.E, Jacob R.G, Fiorentini A.M and Da Silva W.P, Bioactivity of essential oils from *Eucalyptus globulus* and *Eucalyptus urograndis* against planktonic cells and biofilms of *Streptococcus mutans*, Industrial Crops and Products, 60, 2014, 304-309.

Gonzalez N, Gil L, Martinez F, Malo C, Cano R, Mur P and Espinosa E, Effect of natural antioxidant Rosemary in canine soya freezing extender, Reprod Domest Anim., 45, 2010, 88.

Green A, Field guide to herbs and spices, Quirk book, Philadelphia, 2006, 384.

Hafize F, Chemical Composition and Antimicrobial Activity of *Laurus nobilis* L. Essential Oils from Bulgaria, Molecules, 24 (4), 2019, 804.

Hafsa J, Smach M.A, Ben Khedher M.R, Charfeddine B, Limem H, Majdoub and Rouatbi S, Physical, antioxidant and antimicrobial properties of chitosan films containing *Eucalyptus globulus* essential oil, LWT - Food Science and Technology, 68, 2016, 356-364.

Hajhashemi V, Ghannadi A and Sharif B, Anti-inflammatory and analgesic properties of the leaf extracts and essential oil of *Lavandula Angustifolia* Mill, Journal of Ethnopharmacology, 89, 2003, 67-71.

Hussain A.I, Anwar F, Rasheed S, Nigam P.S, Janneh O and Sarker S.D, Composition, antioxidant and chemotherapeutic properties of the essential oils from two Origanum species growing in Pakistan, Brazil, Jour. Pharmacog., 21 (6), 2011, 943–952.

Ishnava K.B, Chauhan J.B and Barad M.B, Anticariogenic and phytochemical evaluation of *Eucalyptus globules* Labill, Saudi Journal of Biological Sciences, 20 (1), 2013, 69-74.

Jamshidi R, Afzali Z and Afzali D, Chemical composition of hydro distillation essential oil of rosemary in different origins in Iran and comparison with other countries, American-Eurasian J. Agric. & Environ. Sci., 5 (1), 2009, 78-81.

Kar K, Puri V.N, Patnaik G.K, Sur RN, Dhawan B.N and Kulshrestha D.K, Spasmolytic constituents of *Cedrus deodara* (Roxb) Loud: Pharmacological evaluation of Himachalol. Pharm Sci., 64, 1975, 258-262.

Kotzekidou P, Giannakidis P and Boulamatsis A, Antimicrobial activity of some plant extracts and essential oils against food borne pathogens in vitro and on the fate of inoculated pathogens in chocolate, LWT - Food Science and Technology, 41 (1), 2008, 119-127.

Kumar K, Sharma Y.P, Manhas R.K and Bhatia H, Ethnomedicinal plants of Shankaracharya hill, J Ethnopharmacol., 170, 2015, 255-274.

Lakusic B, Lakusic D, Ristic M, Marcetic M and Slavkovska V, Seasonal variations in the composition of the essential oil of *Lavandula angustifolia* (Lamiacae), Natural Product Communications, 9, 2014, 859-862.

Liolios C.C, Graikou K, Skaltsa E and Chinou I, Dittany of Crete: A botanical and ethno-pharmacological, Journal of Ethnopharmacology, 131, 2010, 229-241.

Lis-Balchin M, Lavender. The Genus Lavandula, 1st ed., Taylor & Francis, New York, 2002, 296.

Loizzo M.R, Saab A.M, Tundis R, Statti G.A, Menichini I, Lampronti R, Gambari J, Cinatl I and Doerr H.W, Phytochemical analysis and *in vitro* antiviral activities of the essential oils of seven Lebanon species, Chemistry & biodiversity, 5 (3), 2008, 461-470.

Lopez V, Nielsen B, Solas M, Ramirez M.J and Jager A.K, Exploring Pharmacological Mechanisms of Lavender (*Lavandula angustifolia*) Essential Oil on Central Nervous System Targets, Front Pharmacol., 8, 2017, 280.

Lucia C, Filomena N and Luceia F, Laurusnobilis: Composition of essential oil and its biological activities, Molecules, 22 (930), 2017, 1-11.

Luis A, Duarte A, Gominho J, Domingues F and Duarte A.P, Chemical composition, antioxidant, antibacterial and anti-quorum sensing activities of *Eucalyptus globulus* and *Eucalyptus radiata* essential oils, Industrial Crops and Products, 79, 2016, 274-282.

Majid M, Afsaneh T, Vahideh G and Shadi G, Effects of *Rosmarinus officinalis* and *Platanuso rientalis* extracts on asthmatic subjects resistant to routine treatments, Avicenna J Phytomed., 8 (5), 2018, 399–407.

Malcolm B.J and Tallian K, Essential oil of lavender in anxiety disorders: Ready for prime time?, The mental Heath clinician, 7 (4), 2018, 147-155.

Messaoud C, Chograni H and Boussaid M, Chemical composition and antioxidant activities of essential oils and methanol extracts of three wild *Lavandula L.* species, Natural Product Research, 26, 2012, 1976-1984.

Minooeianhaghighi M.H, Sepehrian L and Shokri H, Antifungal effects of *Lavandula binaludensis* and *Cuminum cyminum* essential oils against *Candida albicans* strains isolated from patients with recurrent vulvo-vaginal candidatais, Journal de Mycologie Medicale, 27, 2017, 65-71.

Monica B and Ioan S, Essential Oils from Plants, JBBS, 1 (4), 2018, 35-43.

Moss M, Cook J and Wesnes K, Aromas of rosemary and lavender essential oils differentially affect cognition and mood in healthy adults, Int. J. Neurosci., 113 (1), 2003, 15–38.

Oztekin S and Soysal Y, Extraction methods in medicinal and aromatic plants, Nisan, 45 (1), 1995, 22-31.

Pino J, Marbot R, Quert R and Garcia H, Study of essential oils of *Eucalyptus resinifera Smith*, *E. tereticornis Smith* and *Corymbia maculata* (Hook.) K. D. Hill & L. A. S. Johnson, grown in Cuba, Flavour and Fragrance Journal, 17, 2011, 1-4.

Ramadan G, El-Beih N.M, Arafa N.M and Zahra M.M, Preventive effects of Egyptian sweet marjoram (*Origanum majorana* L.) leaves on hematological changes and cardio toxicity in isoproterenol-treated albino rats, Cardiovasc Toxicol., 13, 2013, 100–109.

Raskovic A, Milanovic I, Pavlovic N, Cebovic T, Vukmirovic S and Mikov M, Antioxidant activity of rosemary (*Rosmarinus officinalis* L.) essential oil and its hepato protective potential, BMC Complement Altern. Med., 14, 2014, 225.

Renau-Morata B, Nebauer S.G, Sales E, Allainguillaume J, Caligari P and Segura J, Genetic diversity and structure of Natural and managed populations of *Cedrus atlantica* (Pinaceae) assessed using random amplified polymorphic DNA, Am J Bot., 92, 2005, 875–884.

Rotblatt M, Herbal medicine: expanded commission E monographs, Ann. Intern. Med., 133 (6), 2000, 487.

Saab A, Harb F and Koenig W, Essential oils components in heart wood of *Cedrus Libani* and *Cedrus Atlantica* from Lebanon, Minerva biot., 17, 2005, 159-161.

Saab A, Lampronti I, Borgatti A, Finotti F, Harb S, Safi and Gambari R, *In vitro* evaluation of the anti-proliferative activities of the wood essential oils of three Cedrus species against K562 human chronic myelogenous leukaemia cells, Natural product research, 26, 2012, 2227-2231.

Saab A, Lampronti I, Grandini A, Borgatti M, Finotti A, Sacchetti G, Gambari R and Guerrini A, Antiproliferative and Erythroid Differentiation Activities of *Cedrus libani* Seed Extracts against K562 Human Chronic Myelogenous Leukemia Cells, International Journal of Pharmaceutical & Biological Archives, 2, 2011, 1744-1748.

Saab A, Gambari R, Sacchetti G, Guerrini A, Lampronti I, Tacchini M.A, Samrani S, Medawar H, Makhlouf M, Tannoury J, Abboud M, Diab A, Kijjoa R, Tundis J, Aoun and Efferth T, Phytochemical and pharmacological properties of essential oils from Cedrus species, Natural Product Research, 32, 2017, 1-13.

Safaei-Ghomi J, Abbasiahd A, Behpour M, and Batooli H, Antioxidant Activity of the Essential Oil and Metanolic Extract of *Eucalyptus largiflorens* and *Eucalyptus intertexta* from Central Iran, Journal of Essential Oil Bearing Plants, 13, 2013, 377-384.

Salehi B, Mnayer D, Ozcelik B, Altin G, Kasapoglu K.N, Daskaya-Dikmen C, Sharifi-Rad M, Selamoglu Z, Acharya K, Sen S, Matthews K.R, Fokou P.V.T, Sharopov F, Setzer W.N, Martorell M and Sharifi-Rad J, Plants of the Genus Lavandula: From Farm to Pharmacy, Natural Product Communications, 13 (10), 2018, 40-50.

Sartorelli P, Marquioreto A, Barolli A, Lima M and Moreno P, Chemical composition and antimicrobial activity of the essential oils from two species of Eucalyptus, Phytotherapy Research, 21, 2007, 231-233.

Sasannejad P, Saeedi M, Shoeibi A, Gorji A, Abbasi M and Foroughipour M, Lavender essential oil in the treatment of migraine headache: a placebo-controlled clinical trial, Eur. Neurol., 67 (5), 2012, 288-291.

Shawl A and Kumar S, Potential of Lavender oil industry in Kashmir, Journal of Medicinal and Aromatic Plant Sciences, 22, 2000, 319-321.

Singh A.K, Chemical Composition of the Leaf Oil of *Eucalyptus radiate*, A Rich Source of Eucalyptus Oil of Pharmacopoeia Grade, Journal of Essential Oil Research, 6 (6), 1994, 657-659.

Singh D and Agarwal C.H, Himachalol and β-Himachalene: Insecticidal principles of Himalayan Cedar wood oil, J. Chem. Ecol., 14 (11), 1988, 45-51.

Smigielski K, Raj A, Krosowiak K and Gruska R, Chemical composition of the essential oil of *Lavandula angustifolia* cultivated in Poland, Journal of Essential Oil Bearing Plants, 12, 2009, 338-347.

Stefan J, Anti-Inflammatory Effects of *Rosmarinus officinalis* Essential Oil, Acta. Veterinaria. Brno., 78 (1), 2009, 121-127.

Sugawara Y, Shigetho A, Yoneda M, Tuchiya T, Matumura T and Hirano M, Relationship Between mood change, odour and its physiological effects in humans while inhaling the fragrances of essential oils as well as linalool and its enantiomers, Molecules, 18, 2013, 3312–3338.

Tapanee H, Development of Aroma Massage Oil for Relieving Muscle Pain and Satisfaction Evaluation in Humans, Journal of Applied Pharmaceutical Science, 8 (4), 2018, 126-130.

Tarakemeh A, Rowshan V and Najafian S, Essential Oil Content and Composition of *Lavandula Angustifolia* Mill. as Affected by Drying Method and Extraction Time, Analytical Chemistry Letters, 2 (4), 2012, 244-249.

Tiziana B, Damien M, Deans D.H.J, Biondi S.G and Ruberto G, Chemical composition, antimicrobial and antioxidative activity of laurel, sage, rosemary, oregano and coriander essential oils, J Essential Oil Res., 10, 1998, 618-627.

Vagi E, Rapavi E and Hadolin M, Phenolic and tri terpenoid antioxidants from *Origanum majorana* L. herb and extracts obtained with different solvents, J Agric. Food Chem., 53, 2005, 17–21.

Vera R.R and Chane J.M, Chemical composition of the essential oil of marjoram (Origanum majorana L.)from Reunion Island, Food Chemistry, 66 (2), 1999, 143-145.

Wang H, Zhao M, Yang B, Jiang Y and Rao G, Identification of polyphenols in tobacco leaf and their antioxidant and antimicrobial activities, Food Chemistry, 107 (4), 2008, 1399-1406.

Wei A and Shibamoto T, Antioxidant/Lipoxygenase Inhibitory Activities and Chemical Compositions of Selected Essential Oils, Journal of Agricultural and Food Chemistry, 58 (12), 2010, 7218-7225.

Woolf A, Essential oil poisoning, Journal of toxicology: Clinical Toxicology, 3, 1999, 721-727.

World Health Organization, Global report on traditional and complementary medicine, GINIVA, 2019.

Woronuk G, Demissie Z, Rheault M and Mahmoud S, Biosynthesis and therapeutic properties of Lavandula essential oil constituents, Planta Med., 77 (1), 2011, 7-15.

Young K, The Healing Art of Essential Oils: A Guide to 50 Oils for Remedy, Ritual, and Everyday Use, Llewellyn Worldwide, USA, Limited, 2017, 386.

Zuzarte M, Goncalves M.J, Cavaleiro C, Cruz M.T, Benzarti A, Marongiu B, Maxia A, Piras A and Salgueiro L, Antifungal and anti-inflammatory potential of Lavandula stoechas and Thymus herba-barona essential oils, Industrial Crops and Products, 44, 2013, 97-103.