# A REVIEW ON BIOLOGICAL ACTIVITIES OF ESSENTIAL OILS

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**Abstract:** The over use of synthetic antibiotics resulted in the emergence of drug-resistant microorganisms. To overcome, many plants have been subject of medical research for their medicinal properties. The worldwide research aim is to find new, effective natural therapeutic agents with new modes of actions.
Essential oils (EOs) or volatile oils are found in the most parts of the plant, in some plants being found throughout the various organs, in others found restricted to one special part of the plant. For example in the conifers, which the pine is a typical kind, much volatile oil is found in most parts of the tree like cone needle bark wood; whereas in the rose, the oil is mostly confined in the flower ; in the peppermint, to the stem and the leaves, in the Citrus family, mainly to the flowers and the fruit. The volatile compounds of these mixtures are mainly mono- and sesquiterpenoids, benzenoids, phenylpropanoids, etc that exert biological activities on humans, animals, and other plants. The antimicrobial activity of essential oils is assigned to a number of small terpenoids and phenolic compounds (thymol, carvacrol, eugenol), which also in pure form demonstrate high antibacterial activity.
This study is concerned with the Biological activities of essential oils. The goal of this study is to revise the biological aspects of Essential oils and their constituent ranging from; aroma chemicals of all aromatherapy kinds, chemistry, pharmacology, perfumery and cosmetics, skin softeners to shower gels and body lotions, food and flavor industries for the flavoring, fast foods, ice creams, beverages, both alcoholic as well as nonalcoholic soft drinks, biological activities and regulatory aspects.
After an overview and definition of essential oil, researches and development activities on Essential oils with a historical perspective is documented. Sources and essential oil producing plant examples are followed by properties and components of essential oils. Usage and methods of essential oil extraction is summarized.
A great many research papers investigating the bioactivity of essential oils conclude that the results are very encouraging that clinical trials and more benefits are coming.
In recent years there has been extensive research to explore and determine the biological activities of essential oils
This study intends to make an overview on considerable range applications of essential oils.
**Keywords:** Essential oil, Antimicrobial activity, Oil extraction

## 1. INTRODUCTION

Since the beginning of human kind, people have been fascinated by the medical properties of plants. For centuries different herbs and plants have been experimented. The modern pharmacy, with its modern methods, gives us possibilities to obtain various extracts from different plants and examine their effects on certain pathogenic microorganisms, whose extracts can later be used to do further research and come to some medicines, creams and oils useful for the people's health.
Plant oils and extracts have been used for a wide variety of purposes. In particular, the antimicrobial activity of plant oils and extracts has formed the basis of many applications, including raw and processed food preservation, pharmaceuticals, alternative medicine and natural therapies [1].
It is well established that these extracts have antimicrobial properties against bacteria, molds and yeast .Many plant genera such as Betula, Fagus, Fraxinus, Juniperus, Picea, Pinus etc., are among the medicinal plants recorded in Pharmacopeias .Today close to 300 plant family grows in nature about 1 / 3 of them produces volatile [2].
The main advantage of natural agents is that they do not enhance the "antibiotic resistance" commonly encountered with the long-term use of synthetic antibiotics [3].
Essential oils are complex mixtures of volatile compounds produced by living organisms and isolated by physical means only (pressing and distillation) from a whole plant or plant part of known taxonomic origin.Although the concept in aromatherapy has existed for centuries, today products used in recent years have been a large increase. Effects on humans caused by aromatherapy such as stress reduction, relaxation, increase in work performance, improvement of mood is noticed by a growing number of consumers, this will grow the trade market even more. Essential oils, derived from aromatic medicinal plants (e.g. fennel (Foeniculum vulgare), peppermint (Mentha piperita), thyme (Thymus vulgaris), have been reported to be active against Gram-positive and Gram-negative bacteria as well as against yeasts, fungi, and viruses.
They are mixtures of different lipophilic and volatile substances, such as monoterpenes, sesquiterpenes, and/or phenylpropanoids, and have a pleasant odor. Furthermore, they are considered to be part of the preformed defense system of higher plants [4].An definition of essential oils, established by Professor Dr. Gerhard

Buchbauer of the Institute of Pharmaceutical Chemistry, University of Vienna, includes the following suggestion: "Essential oils are more or less volatile substances with more or less odorous impact, produced either by steam distillation or dry distillation or by means of a mechanical treatment from one single species" [5]. Given the current and future demand for phytomedicines, very little fundamental research has been conducted on the physiology and biochemistry of medicinal plants. From the perspective of plant physiology, extensive opportunities exist for basic research on medicinal plants and the study of their phytomedicinal chemical potential. This study presents a discussion of some fundamental aspects and biological properties of essential oils and their biological activities. The purpose of this was to create directly comparable, qualitative, quantitative, biological and activities of essential oils.

## 2. ESSENTIAL OIL PRODUCING PLANTS

All plants possess principally the ability to produce volatile compounds, quite often, however, only in traces. "Essential oil plants" in particular are those plant species delivering an essential oil of commercial interest. Two principal circumstances determine a plant to be used as an essential oil plant:

**a)** A unique blend of volatiles like the flower scents in rose (Rosa spp.), jasmine (Jasminum sambac), or tuberose (Polyanthes tuberosa). Such flowers produce and immediately emit the volatiles by the epidermal layers of their petals [6]. Therefore the yield is even in intensive smelling flowers very low, and besides distillation special techniques, as an example, enfleurage has to be applied to recover the volatile fragrance compounds.

**b)** Secretion and accumulation of volatiles in specialized anatomical structures. This leads to higher concentrations of the essential oil in the plant. Such anatomical storage structures for essential oils can be secretory idioblasts (secretory cells), cavities/ducts, or glandular trichomes [7]. Labiatae, Compositae, Rosaceae, Rutaceae, Iridaceae, Umbelliferae,Lauraceae,Pinaceae and Zingiberaceae are the families which contains a large number of essential oil bearing Essential oils from Lamiaceae family (Origanum, Thymus, Ocimum, Mentha, Rosmarinus, Sideritis, Salvia), prevents the development of bacteria and some yeasts in food as a natural protector [8].

The plant families comprising species that yield a majority of the most economically important essential oils are not restricted to one specialized taxonomic group but are distributed among all plant classes: gymnosperms, for example, the families Cupressaceae (cedarwood, cedar leaf, juniper oil, etc.) and Pinaceae (pine and fi r oils, etc.), as well as angiosperms, and among them within Magnoliopsida, Rosopsida, and Liliopsida.

The most important families of dicots are Apiaceae (e.g., fennel, coriander, and other aromatic seed/root oils), Asteraceae or Compositae (chamomile, wormwood, tarragon oil, etc.), Geraniaceae (geranium oil), Illiciaceae (star anise oil), Lamiaceae (mint, patchouli, lavender, oregano, and many other herb oils), Lauraceae (litsea, camphor, cinnamon,sassafras oil, etc.), Myristicaceae (nutmeg and mace), Myrtaceae (myrtle, cloves, and allspice),Oleaceae (jasmine oil), Rosaceae (rose oil), and Santalaceae (sandalwood oil). In monocots (Liliopsida), it is substantially restricted to Acoraceae (calamus), Poaceae (vetiver and aromatic grass oils), and Zingiberaceae (e.g., ginger and cardamom) [9].

## 3. ESSENTIAL OIL PRODUCING PLANTS IN MACEDONIA

According to the data obtained from Macedonian Forests in 2001, the legal timber harvest in the Republic of Macedonia was 520,915 m3 (of which 463,840 m3 were cut by local Macedonian Forests branches and 57,075 m3 by private individuals in public forests). The total quantities of timber harvested included 417,355 m3 of fuel wood and 97,837 m3 commercial timbers.

The tree species primarily harvested are: Beech (fuel wood and commercial timber), Oak (fuel wood and commercial timber) and Pine (commercial timber). Other species (Chestnut, Fir, Poplar and Walnut) are of lesser importance. Essential oils are extracted from cones, needles or seeds of Pine and other plant species. For the production of gin, the alcohol industry uses the berries (mainly the blue ones) of the juniper bush. The exported amount in 2001 was 991,067 kg, valued at $758,463. The annual purchase of juniper berries by various organizations is 3-4,000 tones. Reeds, Cattails and Willows are used in construction; either dried, woven, as thatch or in handicraft products. They are mainly collected on the lakes (Ohrid, Prespa, Doyran), however this activity is on the decline[10].

## 4. PROPERTIES AND COMPONENTS OF ESSENTIAL OILS

Essential oils are complex natural mixtures of volatile secondary metabolites, isolated from plants by hydro- or steam-distillation. The main constituents of essential oils, for example, monoterpenes and sesquiterpenes and phenylpropanoids including carbohydrates, alcohols, ethers, aldehydes and ketones, are responsible for the fragrant and biological properties of aromatic and medicinal plants [11] .

Terpene groups in the essential oils of *Pinaceae* cones were investigated by Tumen et all. The main groups and terpenes were grouped into monoterpene hydrocarbons, monoterpene alcohols, sesquiterpene hydrocarbons,sesquiterpene alcohols and diterpenes.Terpene groups and their amounts in different cones are recorded in Table 5.1 Monoterpene hydrocarbons were recorded to be at the highest level in *A.cilicica* (93.14%), the highest level of monoterpene alcohols were found in *A. equi-trojani* (10.70%),sesquiterpene hydrocarbons were highest in *P. halepensis* (20.82%), diterpenes were the highest in *P.sylvestris* at 28.94%.

Acoording to findings of Tumen et all. the essential oil compounds of pine cones As can be seen from Table 1.1; the main compounds were as follows: α-pinene, β-pinene, β-myrcene, Δ3-carene, limonene and β-caryophyllene. α-Pinene was the major compound in the cones of *Pinaceae* family.

This compound was also found to account for more than 50% of the contents in the fir species too. α-Pinene were also identified as a major compound in *P. nigra* (45.36%) and *P. halepensis* (47.09%). Except for *P. brutia* and *P. orientalis*,β-pinene was found to be the second most important component in all cones. In the *P. brutia* (39.56%) and *P. orientalis* (32.67%) samples this compound was the most abundant compound. Limonene was the dominant component in *P. pinea* (69.54%, combined with β-phellandrene) and in *C. libani*. This terpene is used as an antimicrobial inhibitor in the food industry. Although β-caryophyllene, an important sesquiterpene, was found to be less than 1% in the Abies species, the amount of this compound was more than 10% in *P. halepensis* (11.22%)[12].

Table 1.1 Terpene groups in Pinaceae family cones %

| Species | MTHK | MT-OL | STHK | ST-OL | terpene | Others |
|---|---|---|---|---|---|---|
| *A.cilicica* | 93,14 | 1,2 | 1,31 | - | 0,66 | 3,69 |
| *A.nordmanniana* | 85,72 | 4,1 | 2,8 | - | 0,39 | 6,99 |
| *A.equi-trojani* | 77,22 | 10,7 | 2,85 | 0,1 | 0,65 | 8,48 |
| *A.bornmülleriana* | 84 | 1,8 | 4,17 | 0,41 | 0,18 | 9,44 |
| *P. orientalis* | 78,4 | 7,55 | 6,16 | - | 1,83 | 6,06 |
| *C. libani* | 57,3 | 0,9 | 6,78 | - | 27,01 | 8,01 |
| *P.sylvestris* | 19,31 | 2,28 | 13,14 | - | 28,94 | 36,33 |
| *P.nigra* | 51,08 | 1,44 | 15,7 | - | 16,08 | 15,7 |
| *P.halepensis* | 54,5 | 1,7 | 20,82 | - | 4,1 | 18,88 |
| *P.pinea* | 82,62 | 0,64 | 1,34 | - | 0,67 | 14,73 |
| *P.brutia* | 83,94 | 3,53 | 8,11 | - | 0,62 | 3,8 |

MTHK: Monoterpene Hydrocarbons; MT-OL: Monoterpene alcohol; STHK: Sesquiterpene Hydrocarbons; ST-OL: Sesquiterpene alcohols

## 5. USAGE OF ESSENTIAL OILS

Essential oils are one of these well-known plant extracts used in a very large variety of fields. They are an integral constituent of fragrances used in perfumes and cosmetics of all kinds, aromatherapy, and skin softeners to shower gels and body lotions. Very large quantities of natural essential oils are used by the food and flavor industries for the flavoring, fast foods, ice creams, beverages, both alcoholic as well as nonalcoholic soft drinks, and so on. During the last decade, a variety of essential oils have been screened to assess their antimicrobial activity. The antimicrobial activity of plant-derived essential oils formed the basis of many applications, especially in food preservation, complementary medicine and aromatherapy [13].

Biological activity of the essential oil of *Kadsura longipedunculata* (Schisandraceae) and its major components were analaysed by Mulyaningsih et all.The oil also showed a significant in-vitro antimicrobial activity against Gram positive pathogens (Streptococcus pyogenes and Streptococcus agalactiae) with minimum inhibitory concentration (MIC) values ranging from 0.125 up to 4.00 mg/ml. The in-vitro cytotoxicity of the essential oil on six human cancer cell lines (HepG2, Caco-2, CCRF-CEM, HeLa, MiaPaCa-2 and MCF-7) examined using the MTT assay revealed the highest activity to be in the CCRF-CEM cell line with an IC50 (concentration which resulted in a 50% reduction in cell viability) of 46.01 microg/ml after 24 h treatment [14].

## 6. METHODS OF ESSENTIAL OIL EXTRACTION

The methods of essential oil extraction are categorized mainly in three groups: Distillation Methods, Mechanical Method or Expression, Enfleurage Method (Essential Oil Extraction through Acquisition). Steam distillation, the most common method of essential oil production, involves the flow of steam into a chamber holding the raw plant material. The steam causes small sacs containing essential oil to burst. The oil is then carried by the steam out of the chamber and into a chilled condenser, where the steam once again becomes water. The volatility of the oil constituents is not influenced by the rate of vaporization but does depend on the degree of their solubility in water. As a result, the more water-soluble essential components will distil over before the more volatile but less water-soluble ones [15].

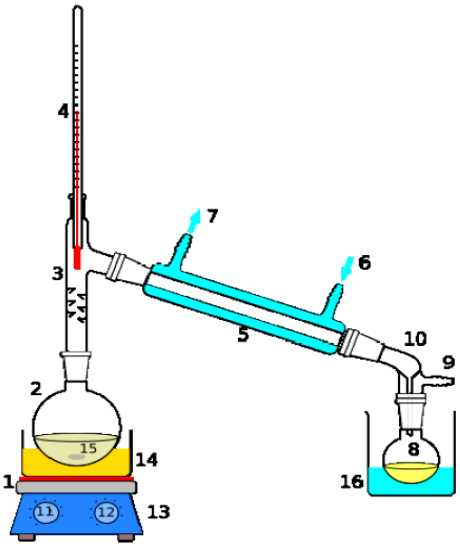


Figure.1.1 Laboratory distillation set-up : **1:** Heat source **2:** Still pot **3:** Still head **4:** Thermometer/Boiling point temperature **5:** Condenser **6:** Cooling water in **7:** Cooling water out **8:** Distillate/receiving flask **9:** Vacuum/gas inlet **10:** Still receiver **11:** Heat control **12:** Stirrer speed control **13:** Stirrer/heat plate **14:** Heating (Oil/sand) bath **15:** Stirrer bar/anti-bumping granules **16:** Cooling bath.

Hydro distillation of citrus fruit yields poor quality oils owing to chemical reactions that can be attributed to heat and acid-initiated degradation of some of the unstable fruit volatiles. Furthermore, some of the terpenic hydrocarbons and esters contained in the peel oils are also sensitive to heat and oxygen. Enfleurage method is mainly used for delicate flowers such as Rose, Jasmine, Neroli, and Violet. Enfleurage involves using a fixed oil, usually a vegetable oil or animal fat. The raw materials, flower petals are spread with the fixed oil. These are then placed in the sun until the fixed oil is saturated with the essential oil. The mixture of plant material and oils dissolved in alcohol and evaporated from the essential oil. These will be labeled 'absolute' rather than 'essential oil'. Enfleurage is quite rare because of it expensive procedure.

There are several other procedures well established for the extraction of the flavor, fragrance or medicinal aroma. The most delicate fragrance and flavor components from flowers are extracted by concentration using solvent wash. Repeated wash of the delicate flowers with a solvent such as hexane, gives a broth concentrated with aroma pure components.

Recently, microwave-assisted hydrodistillation methods have been developed, so far mainly in the laboratory or only for small-scale projects. Glass vessels filled with biomass, mainly herbs and fruits or seeds, are heated by microwave power. By controlling the temperature at the center of the vessel, dry heat conditions are established at about 100°C. As the plant material contains enough water, the volatiles are evaporated together with the steam solely generated by the microwave heat and can be collected in a suitably designed condenser/cooling system. In this case, changes in the composition of the oil will be less pronounced than in oil obtained by conventional hydrodistillation. This method has attracted interest owing to the mild heat to which the plant matter is exposed [15] .

## 7. CONCLUSION

With rising health care and medicine costs is increase in the consumption of essential oils. Parallel to this, the increase in various needs is giving rise to further demands for natural essential oils. In the field of agriculture, attempts are being made at the identification of ecologically natural biocides, including essential oils, to replace synthetic biocides. A great many research papers investigating the bioactivity of essential oils conclude that the results are very encouraging that clinical trials and more benefits are coming.

With the continuing search for new medicaments from natural sources, especially in the antimicrobial therapy, it is hoped that future research into the efficacy of essential oils will be both stimulated and funded.

It can be concluded that the industrial use of essential oils is a very promising area and that regular growth shall be observed in future. Much research work will be undertaken both on the safety of existing products and on development of new oil-bearing plants that are used locally in different regions of the world both as healing agents and as food flavorings.

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