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Essential Oils from Plants

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Abstract

Essential oils, called volatile oils or ethereal oils, are natural metabolic secretions of plants, the role of which is not yet fully understood by science. Some specialists consider them to be true plant hormones, fluid manifestations of the immune system of plants, in the sense that they contribute to the removal of pests, attracting, instead, pollinating agents, which are some insects and birds. Small, light–colored spherical structures, is, in fact, modified filaments, which behave like some secretory glands of essential volatile oils. They are the ones who give the fragrance of the aromatic plant and have, in the case of salvation, medicinal curative properties, such as fever reduction, blood cleansing, and relieving pain. Essential oils are products isolated from plants or organs through a physical process that have a certain volatility (higher or lower) and possesses an agreeable odour characteristic of the source from which they originate. They are also known as volatile or essential oils and their name are usually given by the popular name of the plant from which they are extracted. The most important characteristic of these mixtures, which also gives the special economic value, is the specific smell. This is the basis for their use in perfumery, cosmetics and the food industry. Many essential oils have special therapeutic qualities, some of which have been known and used since antiquity.

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Background

Oils are extracted from the leaves, petals, stems, seeds, and even the roots of the plants. Aromatic plants generally contain volatile oil in all their proportions in different concentrations. The rose, for example, predominantly secretes etheric oil at the level of flowers, while ginger produces more aromatic oil in the rhizome. Each the volatile oil is unique, being different even within the same plant, and has wonderful applications and as varied as Nature itself. The complex combination of organic substances that form a volatile oil gives its specific note, which depends on the species, the harvest period, the climate, as well as the part of the plant from which it is extracted. Numerous compounds that make up essential oils have been identified. Only the mint oil has no more than 200 different components. Many the compounds are structural isomers [1]. Among these active principles of plants, substances such as cineol, fenchone, limonene, menthol, mentone, pinene, sabinen are found, some of which are present in infinitesimal quantities, making it virtually impossible to reproduce synthetically the laboratory composition of herbal aromatic oils[2]. Nature is undoubtedly the greatest chemist, for the aromatic essences of plants in the entire known flora could not be synthesized in the thousands of years of joint efforts of all chemists in the world.

What are Essential Oils

Essential oils are aromatic substances present in the specialized cells or glands of certain plants used by them to protect themselves from predators and pests, but also to attract polinators. In other words, essential oils are part of the immune system of the plant. The famous alchemist, physician, physicist, astrologer, theologian and philosopher of Switzerland, Paracelsus, called distilled oils from herbs–quinta essentia–the quintessence of the plant, and hence the name of essential oils[2]. Essential oils are highly concentrated volatile substances extracted from various parts of certain plant species, each with specific therapeutical and energetic effects. These volatile liquids are very complex molecular substances, extremely potent and precise as action. Essential oil is not actually an oil because it contains no fatty substance. It is obtained from the essence rich in natural flavors and active ingredients that it secretes the cells of certain parts of the plant. Precious liquids are obtained by distilling or pressing the secretory organs. For example, citrus peel is cold pressed, and the other parts of the plant (stem, leaves, flowers, root, wood) are distilled[3, 4]. These processes result in an aromatic concentrate and a genuine source of active substances. Essential oil is also known as volatile oil or ethereal oil[5].

Extraction of essential oils is expensive because of the large amount of raw material required to produce a few milliliters of oil. This explains the high prices required for genuine essential oils. For example, to obtain a single drop of essential rose oil, approx. 60 roses [6]. However, there are also less expensive oils due to the abundance of inexpensive raw materials and high productivity. Such oils are citrus–lemon, orange, bergamot, lime, lemongrass oil, tea tree oil. So, the essential oil is very precious, but only one drop is sufficient for beneficial results, moreover, overtaking a 2 % dosage is toxic and produces adverse effects[7–8].

Spreading

Essential oils are relatively widespread in the plant kingdom, some families being very rich in such substances, both in number and quantity. Typically, essential oils are found in superior plants (about 50 families) belonging to orders of angiosperms (Asterales, Laurales, Magnoliales, Zimgiberales, etc.) or ginsenosides (Pinales), but also known as sesquiterpenic lactone sesquiterpene volatile, or algae that produce halogenated sesquiterpenes. Although terpenic compounds are characteristic of the plant kingdom, some biosynthesized monoterpenes have been reported from soil bacteria, insects (probably pheromones), and some sesquiterpene and diterpenes of animal origin[10–12].

The synthesis and accumulation of essential oils occur either outside the plant, in the glandular brushes (Asteraceae, Geraniaceae, Laminaceae, etc.) and in the papillae, either inside the plant, in the secretory cells, in the intercellular spaces (secretory channels) secretory bags (Anacardiaceae, Rutaceae, Myrtaceae). Essential oils can accumulate in all plant organs, but in varying amounts. Thus we can meet them in: roots, leaves, flowers, fruits, wood of the stems or in the bark. The content in essential oils of plants is often below 1 %, rarely reaching 15 % or even more, in the dry product of some plants. The name of aromatic plants is

attributed to those species which contain a higher amount of volatile oil (at least 0.1–0.2 %), which have a sufficiently perceptible odor or which lend themselves to economically viable exploitation [13–15]. In addition, there are other species that, although characteristically smell, still contain therapeutic substances that are comprised of essential oils.

Biosynthesis of Essential Oils

The biosynthesis of odorous substances takes place in the leaves, where most of them are found and remains until flowering. Flowering, essential oils migrate into flowers, and part is consumed in the fertilization process. After fertilization, it accumulates in fruits and seeds or there is a migration to leaves, bark and root[16,17]. During the maturation of plants, the composition of essential oils changes: in young plants they contain mainly terpenic hydrocarbons and simpler molecules, while the reproductive organs contain etheric oils richer in oxygenated compounds. Although their role in the plant organism is partly known, ethereal oils have multiple uses. There are more than 3,000 essential oils that are physically and chemically characterized, about 150 of which are manufactured on an industrial scale[18–20].

Chemical Composition of Essential Oils

Essential oils are complex mixtures (5000–7000 chemical constituents) in which mono– and sesquitrpene constituents predominate, but also contain aromatic compounds, often phenylpropane derivatives, and rarely meet diterpenes. The terpenic compounds may be hydrocarbons or oxygenated derivatives (oxides, alcohols, aldehydes, ketones, acids) or reaction products thereof (esters, ethers). Terpenic compounds are substances of vegetable origin that enter into the natural composition of molecular mixtures that lead to the formation of volatile (essential, etheric) oils. Obtaining aromatic waters and essential oils requires raw materials, plant products, quality. First of all, harvesting the plant material should be done with great care, so that it is not contaminated with other plant species. Essential oils are widespread in the most varied organs of the plant, but are more commonly found in flowers and leaves [21,22].

The chemical composition of essential oils is very varied and the main components can be part of the aliphatic, aromatic and terpenic series. Generally, essential oils contain ternary, rarely quaternary substances. Volatile products are made up of terpenes, aromatics, aldehydes, ketones, phenols, volatile acids, esters, *etc*. The plant material that is subject to hydrodynamics is not always processed after harvesting[23]. Generally, fresh plants lead to more pleasant odor solutions and greater therapeutic action; except cinnamon, lime flowers and lavender flowers that are used dry. In the case of dry plants, the lower volatile urine is sometimes obtained as a result of morphological and chemical changes due to the action of air, heating, because of the accumulation of grams, possibly by alteration[24, 25].

Also, the technological process of obtaining volatile oil intervenes decisively in its composition and its quality. In the case of hydrodistillation, physical and chemical processes are produced which significantly alter the content of the plant material and, consequently, the volatile oil released. Vegetable products are brought to a convenient degree by crushing, cutting, grinding, which is chosen according to its nature and chemical composition[26-28]. Thus, the flowers and leaves fall down to pass through the sieve I, and bark and roots, dried fruits and seeds, through sieve II or III. Fresh fruits are crushed to obtain a pulp that is subject to water vapor entrainment. The vehicles used for extractive and distillation dissolution are distilled water or demineralized water, freshly forged and cooled to 35–40 ºC[19]. The plant–solvent ratio ranges from 1: 1 to 1: 5. This proportion is dependent on the amount of volatile oil contained in the plant and its solubility[29]. The excess undiluted volatile oil is separated from the saturated aqueous solution.

Extraction of Essential Oils

- Essential oils are obtained, as appropriate, by one of the following processes by pressing (process used especially for extracting lemon peel oil).
- by distillation in the stream of water vapor.
- by extracting fresh vegetable products with solvents, such as ether, petroleum, benzene, acetone or toluene, or with supercritical fluids such as carbonic anhydride under pressure.

- by extraction from concentrated solutions obtained by extraction from perfumes or maceration.

The industrial extraction of essential oils from various aromatic plants is carried out according to different methods according to their characteristic properties. In practice, the most common methods are:

- extraction of essential oils by steam distillation.
- extraction of essential oils with different solvents[30–32].

Extraction of Essential Oils by Steam Distillation

It is the method commonly used to extract volatile oil from most aromatic plants. In this case it is useful to have hot water vapor to remove and transport, in particular, very essential oils. Water vapours penetrate into the vegetative mass, subjected to distillation, destroy the coating of the olefins, volatilize the oil and then mix with it. The mixture of water vapor and oil vapor passes into the refrigerant (condensing vessel), where it turns into a liquid that is nothing but water and volatile oil. This mixture reaches the florentine vessel (separation vessel) where the separation takes place, namely, the volatile oil being easier to deposit in the start above the water [33]. Depending on how the raw material is placed in the boiler, the following types of distillation are known:

1. Distillation in water: Used for all essential oils which do not decompose at 100 °C. The raw material is 1: 4.
2. Distillation in water and water vapor: it is applied to essential oils where certain components dissolve in water, whereby the raw material is placed above the water. Heating water from the boiler for vapor transformation is done either with direct fire or with blind steam pipes. The volatile oil will thus be extracted from the vapor being formed.
3. Water vapor distillation: it is used in the extraction of most oils. The process consists in the passage of water vapor, obtained in special boilers at high temperatures and pressures, through vegetative mass placed in special baskets.

Water vapor distillation is the most common method and applies in most countries producing essential oils[34].

Extraction of Essential oils with Different Solvents

It is one of the oldest known and used methods for producing essential oils. The use of solvents is a cumbersome and expensive method and is therefore rarely applied. This method is based on the ability of essential oils to dissolve in various substances such as animal fats, vegetable oils, gasoline, petroleum ether, *etc*. Extraction of essential oils is called extraction, and non–volatile solvents, such as fats, are called macerates. The extraction with solvents is particularly useful for the oil obtained from flowers and those species whose volatile oil degrades under the influence of high temperatures[35]. The method described above is applied to the processing of rose, lilac, acacia, shrubs, etc. In the case of maceration, the raw material subjected to extraction is placed in the fat. If the animal fat is used it will remain at 40–60 °C. The raw material, depending on its properties, will be maintained for 24–48 hours in the solvent. Dissolvent is used 6–15 times for the extraction of a volatile oil[36]. It changes after complete saturation.

How to Choose Essential Oils and How we Recognize a Genuine Essential Oil

In order to benefit from the therapeutic properties and ensure that the essential oil contains valuable active principles for health and beauty, it is important to choose purely pure oil, distilled with no additives and dangerous solvents, preferably an organic certificate[32]. Given that there are a lot of so–called essential oils on the market, it is difficult to make the right choice without prior the documentation[7]. Here are some key things to keep in mind when buying the essential oil

- the label must contain: the method by which the oil (cold pressing, distillation, critical CO_2 extraction) has been obtained, the country of origin of the plant, the Latin name of the plant;
- the label must also contain the part of the plant from which the oil was extracted (leaves, stems, flowers);
- containers must be of dark glass (brown or blue);
- containers must not be exposed to sunlight;
- the label specifies that the product is 100 % natural;

- the phrase "lacking chemical solvents" is what will convince us that the oil is natural;
- avoid essential oils that have only aromatherapy indications–pure, genuine oil can be used both internally for aromatherapy and for skin applications. If the essential oil presents all the above–mentioned quality data, but it is mentioned that it is not for internal use, the reason could be that it was packaged in a unit where cosmetic ingredients are processed, and that internal use should only be made with recommendation and agreement of a specialist. However, it would be good if the oil is certified organic.
- the best essential oils must contain the "100 % therapeutic grade" specification and mention the certification body;
- quality essential oil has a high shelf life (over 2 years), if the oil has a 6–8 month period, it is of lower quality. If stored properly (protected from sunlight and heat) the essential oil does not change its flavor in any way;
- after the olfactory sense–a genuine essential oil contains many notes, although not all the essential oils have a pleasant smell; When the oil is diluted the flavor develops even more and opens in interesting, distinct notes. The difference between the flavor of a synthetic essential oil and a pure essential oil is the difference between a good, authentic and inexpensive wine, or a genuine perfume and another counterfeit. Note that there are essential oils that smell bad even after they have been diluted, for example tea tree oil has a strong medicinal smell[33–35].

How to Properly use Essential Oils

Essential oils have real therapeutic properties–cure certain diseases and protect against diseases and also have scientifically proven cosmetic properties[36]. In fact, in the recent years, numerous studies have been conducted that have shown the effectiveness of these herbal essences for health and beauty. Famous cosmetic brands use various essential oils in cosmetics, and the most expensive perfumes contain pure essential oils, which gives them that special note and makes the difference between a cheap and an exclusive fragrance. There are essential oils that have antibiotic properties–thyme oil, oregano oil and tea tree oil[37–39]. Essential oil efficiency is also confirmed by the scientific world; however, essential oils are free from contraindications and adverse effects that can often complicate some health problems.

What is the Life Span of an Essential Oil

Some the oils, such as citrus, have a lower life expectancy than others, such as patchouli and sandalwood, the latter seeming to be getting better as time passes [40]. The average life span of essential oils varies, depending on both the manufacturing process and the conservation methods. Oils should be stored in hermetic and resistant glass containers at temperatures between 15 and 20 degrees C. If the optimal conditions are met, most oils can be stored for at least 3 years. The shorter life span of citrus oils (lemon, orange, *etc.*) is due to the fact that they are extracted from the fruit bark and the unstable components, such as waxes and fatty acids, also remain in the essential oil[41]. Most the essential oils are extracted using the steam distillation method, and the heat produced during this process changes and stabilizes the natural components of the plant[42,43]. After the distillation, the extracted oils undergo a maturation process and at this stage additional chemical changes occur before the odor can stabilize. This stabilization may take a few weeks, as in the case of peppermint oil [36]. Heavier, heavier oils such as patchouli and sandalwood need more time to manifest their full potential.

What's the Difference Between Ethereal Oils and Perfumes?

Essential oils are highly concentrated, volatile and fermented essences, 100 % natural, extracted from plants, either by vapor distillation or by cold pressing[44]. While essential oils are perfumed on their own, the term perfume is commercially used to designate some synthetic oils by combining basic chemical aromatic components derived from coal tar. It should be noted that they differ fundamentally from pure essential oils. Other studies have shown that Gram–positive bacteria are more resistant to the effect of essential oils than Gram–negative[45]. Even though some of these fragrances have an odour quite close to that of natural oils, they

are, in turn, completely devoid of their therapeutic effects. Artificial oils are contraindicated for aromatherapy and are used, usually, only in the recipe cosmetic products.

Conclusions and Remarks

The essential term indicates that the oil has a distinct (essence) fragrance, that of the plant. By the nature and number of the component atoms, many compounds are structural isomers, so it can be argued that the aroma of essential oils depends on the spatial arrangement of some simple groups: methyl (CH_3) carbonyl (C=O), *etc*. They are also called essential oils, volatile oils, essences or absolute oils. Given the large number of different groups of the chemical compounds present in the essential oils composition, it is very possible that their activity cannot be attributed to a specific mechanism but to the existence of a large number of target locations in the cell. Not all of these mechanisms are separate targets, some are consequences of other target mechanisms. An important feature of essential oils and their compounds is hydrophobicity, allowing them to affect the lipid structure of the bacterial cell membrane and increase its permeability, cells losing ions and other cellular components. Essential oils are a rich source of biologically active compounds, the antifungal properties of extracts obtained from medicinal plants, especially those of essential oils, are increasing interest. A wide range of the plant compounds within these oils has specific and general antimicrobial activity and a potential antibiotic effect. Essential oils and the vegetable extracts have been used for thousands of years in alternative medicine, pharmaceuticals, herbal therapies and food preservation, these oils being potential sources of novel antimicrobial compounds, especially against bacterial pathogens. (Table 1)

Table 1. Therapeutic qualities of essential oils from different plant families

Plant families	Therapeutic qualities
angiosperms plants	Medicinal and anti-microbial properties, i.e. constipation, dysentery, malaria, measles, onchocerciasis, stomach pain, yellow fever, etc, while slender roots and stem branches of the plant are used as chewing stick that are very effective in dental care, etc.
Ginsenosides plants (Pinales)	analgesic activity, antibacterial activity, anticataleptic activity, antidiabetic and antihyperlipidemic activity, antifungal activity, antihypercholesterolemic activity, antimicrobial activity, antioxidant activity, diuretic, having anti-inflammatory properties, hepatoprotective activity, and neuroprotective activity in Parkinson's disease, etc.

An the important feature of essential oils and their components is hydrophobia, a property that allows them to partition lipids from bacterial cell membranes and mitochondria, affecting the cellular structures and making them more permeable; loss of molecules and indispensable ions will lead to the death of bacterial cells.

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