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The Multifaceted World of Essential Oils: Historical Overview, Extraction Techniques and Composition. Note I

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Abstract

Essential oils, derived from aromatic plants, possess a wide array of bioactivities that have drawn significant interest in both traditional medicine and modern scientific research. This review explores the diverse bioactivities and underlying modes of action of essential oils. Essential oils exhibit a broad spectrum of biological activities, including antimicrobial, anti-inflammatory, antioxidant, antispasmodic, and analgesic effects. These bioactivities are attributed to the complex chemical composition of essential oils, primarily consisting of terpenes, phenolics, and aldehydes, which interact synergistically. The mode of action of essential oils is multifaceted, involving various biochemical and molecular mechanisms.

Keywords: essential oils, bioactivity, effects, mode of action.

1. Introduction

Throughout our evolution, plants have been with us since ancient times, both for nutritional, ornamental, aesthetic, environmental, cultural, spiritual and medicinal purposes. Without the existence of plants, life on Earth as we know it, would not have been possible. Even today, the plant kingdom continues to fascinate us with its complexity, containing many mysteries that we are still trying to decipher and understand. Plants are part of our lives, enriching us in extraordinary and varied ways, and a harmonious and respectful relationship with them is essential to our future as humankind.

A special category is represented by aromatic plants, recognized for their aroma and taste, which have been used since ancient times for their healing powers and their culinary qualities. In fact, the history of the use of medicinal plants is as old as that of human existence, and it has significantly contributed to shape our culture. Evidence of the use of aromatic plants dates back to the Middle Paleolithic era, as shown by the archaeological findings of the grave of a Neanderthal man who lived more than 60,000 years ago [27]. Even today, people are turning to the healing properties of plants, both in less developed countries, where traditional medicine is the main form of treatment, and in the developed countries, through the new and growing trend of using more and more natural substances and organic products [41].

In recent years, although the medicine and the pharmaceutical industry have evolved enormously, people are still sick, and humanity faces many life-threatening challenges such as the increasing incidence of cardiovascular diseases, respiratory diseases, cancers, diabetes and neurological diseases (Alzheimer's, other forms of dementia) [45].

Furthermore, one of the most significant threats is the rise of antimicrobial resistance, classified by the WHO as one of the "top global public health and development threats", which renders many of the currently used antimicrobials ineffective [44].

This has led to an increase in nosocomial infections, which is another risk factor that threatens our health and even our life expectancy [46]. Therefore, to respond to the current problems we are facing, new natural solutions that are free from the adverse effects of conventional drugs, are being investigated [10].

Medicinal and aromatic plants contain a very large variety of bioactive compounds used in various sectors such as the cosmetic industry, food additives, flavors and preservatives. In addition, through their pharmacological properties, medicinal plants represent an important resource for the development of new pharmaceutical products, being easy to obtain and affordable as an investment. It is estimated that approximately 40% of the development of modern drugs such as: aspirin (extracted from the bark of various species of willow *Salix alba* sp.), artemisinin (*Artemisia annua*, antimalarial), morphine (extracted from *Papaver somniferum*, powerful analgesic) or paclitaxel (obtained from *Taxus brevifolia*, anticancer), was based on the traditional knowledge of natural remedies [2, 10, 47].

Essential oils (EOs) are complex mixtures of secondary metabolites, soluble in organic solvents, which are extracted from various parts of aromatic plants where they are produced and stored, such as: roots, rhizomes, leaves, buds, flowers, fruits or seeds [30]. To date, there are more than 300 EOs available on the market and more than 3000 substances in their composition have been studied [39]. Their numerous biological qualities and applications make EOs among the most important natural products obtained from plants [18].

In recent years, the EOs market has followed an upward trend, reaching the value of USD 23.74 billion in 2023, with the estimate to be quoted at USD 40.12 billion by 2030 [23].

Due to the complexity of the composition of EOs and their properties, their utilizations are very diverse. Essential oils are currently used in cosmetics, pharmaceuticals, foods and beverages, detergents and cleaning products, perfumery, SPA and relaxation, aromatherapy, religious purposes, agriculture and, increasingly, they are being researched and appreciated for their therapeutic qualities [34].

In addition, a great benefit of the EOs is that many of them have received the GRAS ("Generally Recognized as Safe" - "Generally Recognized as Safe") classification by the FDA, which means that due to their natural origin, they are considered to have a high safety profile, which makes them much more accepted by consumers, compared to the synthetic substances [32].

Essential oils are synthesized, secreted and stored according to the information specific to each plant, contained in the DNA molecule, in specialized exoderm or endoderm cells. The exoderm secretory cells, called trichomes, located on the surface of certain organs such as leaves, stems, petals or sepals. This category includes EOs of basil, lavender, mint, sage, patchouli or geranium. Also, EOs can also be produced inside plants, within the endoderm secretory cells, which are found in the peel of citrus fruits, in the root of ginger or vetiver, in the seeds of carrot, cumin, cardamom, coriander or anise, in the bark of cinnamon, in the oleo-resins of frankincense or myrrh, in flower petals such as those from ylang ylang, rose, in the buds of clove, conifer needles - fir, pine, cedar -, or inside the wood tissue as in the case of palo santo, sandalwood, or juniper [39, 49]. Moreover, the environmental and stress factors (temperature, climate, soil type, drought, predators, etc.) to which the plant is exposed, influence the synthesis of the EOs component molecules [49].

2. The role of essential oils within the plant

Essential oils are made up of small molecules, which can cross the walls of the plant, bringing nutrition and information at the cellular level, also having the role of eliminating waste resulted from various intra and intercellular reactions. Due to the fact that they are composed of volatile molecules, EOs secreted by plants also determine their perfume [42].

Plants communicate with the surrounding world through their EOs that have a role of attraction or repulsion. Thus, they attract insects, birds or animals that have an essential role in pollination or in expanding the geographical range by redistributing seeds, while repelling potential menaces. Moreover, they communicate through EOs vapors with the surrounding plants, warning them of the existence of dangers and supporting them to secrete their own protective substances [49].

Thus, at the level of the plant, EOs fulfill various roles such as: alerting and defending the plant (from pathogens, herbivores, harmful insects), internal signaling (certain molecules from the EOs can move from an affected part of the plant to an unaffected one, with the aim of protecting it), modulation of the plant's microbiome, reproductive role by attracting pollinators, defense of the plant area by inhibiting the germination of other seeds (allelopathic role), adaptation to abiotic stress (generated by variations in temperature, light, CO_2, water, ozone), seed dispersal or preserving the space above and around the plants to be able to ensure their resource needs and develop properly [39, 49].

In addition, some EOs, such as those extracted from oleo-resins (frankincense) have the role of covering the damaged parts of the tree, to protect and heal them. Another particularly important role is manifested by their antimicrobial action that protects the plant from bacterial, fungal or viral degradation [1]. Moreover, under the influence of intense solar radiation in the desert, frankincense and myrrh plants use the secreted EOs vapors to protect themselves from the sun's rays [14].

Sometimes, when sunlight is insufficient and affects the photosynthesis process, these aromatic compounds serve as a valuable energy reserve. Thus, EOs becomes a kind of "solar concentrate" at the plant level, which can be reused as needed for other important processes. For this reason, in cloudy or rainy periods, the secretion of EOs is lower [21].

3. Essential Oils along the Years – Brief History

The use of EOs dates back to ancient times. Documents as old as 4500 BC speak of the use of aromatic plants in ancient religious rituals in temples, given as offerings to deities to thank and to appease them, in embalming rituals and for therapeutic purposes [5,18]. Oils such as frankincense, cedar, myrrh, cinnamon, basil, juniper and rosemary were used in their embalming rituals due to their antibacterial, antiviral and antifungal properties [14, 42]. The first distilling apparatus in a rudimentary form was discovered in North-East Mesopotamia, which corresponds to today's North Iraq and dates back to 3500 BC [20].

Other documents attest the fact that the Egyptians were masters of using EOs for therapeutic purposes and in healing rituals. They knew the healing properties of EOs as well as their ability to support physical, mental and spiritual health. At the same time, they used EOs as perfume, for personal care, food preparation and preservation, in massage or for the preparation of various cosmetic products. They were also used to increase personal attractiveness [5,19].

In ancient Egyptian culture, EOs were considered particularly precious as symbols of luxury, beauty, wealth and spirituality. Therefore, they were often buried inside tombs. The use of perfume vessels in Egyptian culture reflects the importance they placed on aromatic substances and EOs [17]. Hieroglyphs discovered on the walls of certain temples, such as that of Edfu, on the west bank of the Nile, attest to the fact that the Egyptians had the science of extracting EOs which they used in various mixtures for religious, perfumery and therapeutic purposes. These were kept in alabaster or gold vessels that managed to keep the smells of different perfumes over time [19]. Essential oils were extracted through distillation, maceration or enfleurage [17, 21].

The use of aromatic oils was also practiced in the oriental traditions of China, Persia and India. The first records appear reported in China and India between 3000 and 2000 BC. The Vedas mention over 700 remedies such as ginger, myrrh, cinnamon, and sandalwood [18,42]. In China, the oldest surviving text, the *Pen Ts'ao Ching*, is a treatise on herbal medicine, dating from around 2700 BC that belongs to Shen Nung. Both cultures used massage infused with indigenous plant oils [14, 31].

Tibetans also used fumigations of cedar wood inside temples, both for its repellent and protective properties against microbial decay and for its ability to induce meditative states, while cardamom was used to treat anxiety [139]. Today, a large majority of these plants continue to be successfully used in Ayurvedic and Traditional Chinese Medicine [8].

More than 200 EOs such as cedar, fir, cinnamon, cassia, hyssop, myrrh, frankincense, spikenard and myrtle, appear mentioned in the Bible as being used in the form of fumigations, myrrh, perfumes and as medicines [42]. They were considered to be important healing agents, acting on a physical, mental and spiritual level [24].

Subsequently, as they were inspired by the oriental cultures, the Greeks and Romans used aromatic plants such as pepper, cassia, cinnamon and ginger with great interest, for their culinary and healing properties. It was the Greeks who discovered that plants have an effect on the psyche, some inducing states of invigoration and awakening, and others having sedative or hypnotic effects [16, 31].

Hippocrates (460-377 BC), considered to be the "father of medicine" wrote about aromatic plants such as thyme, mint, cinnamon or marjoram [31]. He used aromatic remedies to treat women's ailments. His way of saving Athens from the plague epidemic by fumigating with rosemary, lavender, thyme, hyssop and other aromatic plants also remains notable [14,21]. Later on, this practice also saved the Europeans who faced the same menace. Moreover, 19th century perfumers who worked with natural substances noticed that they were unaffected by cholera [19].

In the first century, the physician Dioscorides, a Greek surgeon in Nero's army, added a chapter to his medical encyclopedia, *De Materia Medica*, about the use of EOs. This work has remained a standard for both Eastern and Western medicine for more than 1500 years [14, 31]. Influenced by the Greeks, the Romans developed the practice of perfumery which was highly valued and respected. Aromatic plants were used intensively in Nero's time, in gastronomy, cosmetics and for healing. The first to describe the process of extracting turpentine from pine by the distillation process was Herodotus [16, 36]. Their aphrodisiac properties were highly appreciated, and the consumption of wine with myrrh protected the Roman soldiers during the battles from colds and the prolonged discomfort of traveling in difficult conditions [42].

By expanding to new territories, the Romans favored the spread of the culture of the use of aromatic plants to other peoples, including the Arab countries. Initially, they were used as a source of trade, but later the knowledge of their properties and therapeutic actions developed considerably [16,31]. In the 8th century, Jabir ibn Hayyan, a Persian pharmacist was the one who obtained the floral waters through the distillation process, which were used as remedies and perfumes [36]. Arabian people play an important role in spreading their knowledge of medicinal plants and perfumes to Asia Minor, the Middle East and then North Africa [14]. Later, in the 10th century, it was the Persian physician Avicenna who developed and refined the steam distillation method especially for obtaining rose flower water [19,36].

In the 11th century, it was the Christian crusaders who took the alchemical practices of the use of aromatic plants and the art of the famous perfumes from Arabia and reintroduced them to Europe [14]. And in the 12th century, the Benedictine nun Hildegard of Bingen, being passionate about biology, medicine, art and mysticism, wrote the book *Physica*, an extensive compendium on the therapeutic use of natural remedies. This treatise is divided into 9 books and includes 230 chapters dedicated to plants [26].

The art of creating perfumes and using medicinal plants expanded in Europe during the Middle Ages, especially in countries like Italy, Spain, Portugal and France, which had also begun to have access to newly discovered plants in the Americas [36]. The use of EOs spread, especially following the development of distillation methods due to the contribution of doctors, alchemists and later pharmacists from Switzerland, France, Germany, Italy and England [14]. In the 17th century, more than 100 EOs were already used to treat various ailments [21].

In the modern era, the knowledge of EOs was brought back to life thanks to René-Maurice Gattefossé, a French businessman and chemist involved in the development of cosmetics and perfumery. He is considered the father of Aromatherapy by publishing the book of the same name in 1937. He discovered the effectiveness of lavender oil in the treatment of burns, following a laboratory fire in which he burned his hand, managing to heal completely and without scars thanks to the use of this oil [21].

An important role was also played by Dr. Jean Valnet, a military surgeon who, inspired by Gatefossé's writings, used this knowledge to treat soldiers' wounds, thus discovering the anti-infective effect of EOs [11].

A key moment for the development of contemporary aromatherapy was the year 1990, when the first reference book on EOs, "*L'Aromathérapie exactement - Encyclopédie de l'utilisation thérapeutique des extraits aromatiques*" (*The Exact Aromatherapy– Encyclopedia of the Therapeutic Use of Aromatic Extracts*), written by biochemist Pierre Franchomme, together with MD. Daniel Pénoël and sociologist Roger Jollois, was published. It presents the monograph of more than 250 EOs, which are described both clinically and biochemically, providing the foundation of a coherent aromatic medicine through their effective use in medical practice [21].

The longevity and effectiveness of EOs is demonstrated by their long history. These fragrant substances have been valued for their therapeutic qualities and ability to enhance well-being since the dawn of human civilization and through today's contemporary holistic therapies.

4. The Extraction of the Essential Oils

Essential oils are concentrated oily liquids extracted from plants that contain a rich combination of aromatic and volatile products [6]. This stage is particularly important and delicate, as there is a great concern to capture the volatile molecules in a state as pure as possible, avoiding contamination and alteration of the final product [21]. Therefore, the method chosen for extraction is very important and decisive for the quality of the oil obtained [50].

In general, EOs are obtained by various methods of distillation, solvent extraction or cold pressing [63]. In addition, many other extraction methods are being studied to optimize the process and to find new environmentally sustainable solutions.

The most used method of extracting EOs is distillation, which can be of several types: water distillation, water and steam distillation or steam distillation [3]. Steam distillation manages to extract about 30-70% of the molecules from the plant [49]. Oil molecules are released as the protective membranes are activated by the presence of steam. Oil can be damaged if the membrane breaks while it is being expelled [19]. Only the volatile molecules are obtained through the distillation process, while many heavier molecules such as diterpenes, triterpenes and tetraterpenes are not extracted, requiring temperatures higher than 100°C to mobilize them into the final oil. This fact can influence the final EO content, some important molecules remaining in the vegetal substrate [4, 49].

Thus, the modalities used can influence the chemical composition of EOs and, hence, their quality [3]. In general, oils obtained by primary distillation are stronger than those obtained by secondary or tertiary distillation. However, in the case of certain oils, some valuable compounds are only obtained in the later stages of distillation, namely through secondary or even tertiary distillation [19]. Therefore, the extraction process can be laborious, lengthy and even expensive, which is also reflected in the price of certain EOs [14, 23].

Additionally, the type of vegetal material used (fresh or dried), its weight, its degree of comminution, the rate and duration of the distillation process, the pressure or vacuum conditions, the amount of steam injected as well as the methods related to the separation of compounds, all have a significant impact on the qualitative and quantitative characteristics of the EOs. Steam distillation and water distillation may have very different results [3].

In general, EOs tend to have a simpler and less valuable composition if they are obtained at high temperatures and pressures, as these conditions favor the breaking of bonds that can lead to the loss of important compounds with therapeutic activity [19].

The production of a single drop of EO requires very large amounts of plant material. For example, to produce 1 liter of rose oil, more than 2,250 kg rose flowers are needed, about 3,500-4,000 rose petals, the equivalent of one hectare of Damask roses, for 1 liter of lemon balm (*Melissa officinalis*) between 4,000 and 12,000 kg of plant are employed [19, 21]. The extraction yield generally varies between 1 and 10%, depending on the plant from which the oil is extracted [14].

Another method, frequently used, especially for the production of citrus EOs, is cold pressing, since hydrodistillation causes unfavorable sensory and chemical changes, except for lime EO (*Citrus aurantifolia*) [37].

Over time, research has shown that solvent extraction of EOs can lead to partial loss of volatile compounds and adulteration with non-volatile substances from the solvent or even from the plant material, making it a less desirable method [4]. Currently, new extraction methods are being researched to increase the yield, shorten the time or improve the composition and quality of the EO. Other ways to obtain EOs include: supercritical fluid extraction, solid-phase microextraction, stir bar sorptive extraction, pretreatment in a Pulse Electric Field (PEF) followed by distillation, ultrasonic or microwave extraction, and hydrodistillation assisted by electromagnetic or magnetic induction heating [4, 5, 13 ,25, 40].

5. Composition

The chemical composition of EOs is extremely complex, often comprising tens or even hundreds (100-300) of different compounds that synergistically contribute to their therapeutic effect [48, 49].

Essential oils differ from fatty oils as they contain substances with very small molecules, with a molecular weight below 500 atomic mass units (aum), which allows them to cross cell membranes and exert a series of therapeutic effects in the human body, while fatty oils contain larger molecules, exceeding 1000 aum and don't have a therapeutic effect. Another difference is that EOs are created in various parts of the plant and are mobile, performing various functions inside and outside the plant, whereas fatty oils are formed inside seeds or fruits (olives) and remain at that level, to later provide energy during the germination period [42]. Additionally, fatty oils are subject to oxidation and have no antibacterial properties [19].

The main substances found in the composition of EOs are terpenes and phenylpropanoids, which are synthesized through the two main pathways: the terpenoid pathway (the most representative and the most common) and the phenylpropanoid pathway [21].

Terpenes are hydrocarbons, formed by several isoprene molecules that are synthesized through the mevalonic acid pathway, in the cytoplasm of the cell [21, 39]. Depending on the number of carbon atoms, they are classified into several classes: monoterpenes, sesquiterpenes, diterpenes, triterpenes or tetraterpenes [42].

Monoterpenes are the smallest molecules of this type and, at the same time, the most widespread at the level of secondary metabolites, being found in abundance in most of the EO [53]. They consist of 10 C atoms and 16 H atoms, being formed by joining two isoprene molecules. Currently, more than 1000 different molecules have been identified, each with its own structure, flavor form and biochemical activity. EOs such as lavender, geranium, lemon, sage, basil and frankincense are mainly composed of monoterpenes. Monoterpenes are the lightest molecules and therefore the most volatile giving the top note of the EOs [49].

Monoterpenes can be acyclic like geraniol, linalool and (+)-citronellol, cyclic like thymol, limonene and eugenol, (-)-menthol or bicyclic like alpha and beta-pinene, mithrenal and (+)-camphor [53]. Examples of EOs rich in monoterpenes (over 50%) include: lemon, frankincense, orange, bergamot, lemon, geranium, sage, lavender, white fir, pine, thuja, juniper, myrrh, thyme, cumin, angelica, hyssop, and eucalyptus [37, 43, 49]. Monoterpenes have antiviral, antibacterial, antifungal, antioxidant, anti-inflammatory and antitumor properties [53].

Sesquiterpenes are hydrocarbon molecules made up of 15 C atoms and 24 H atoms. They have farnesyl pyrophosphate as their precursor and can be acyclic, mono, bi or tricyclic [21].

It is estimated that there are more than 5000 sesquiterpene molecules that differ in structure and shape [12]. They are considered to be very precious because they have a molecule small enough to penetrate the blood-brain barrier, just like monoterpenes, having various effects on the nervous system, including the role of oxygenation. In addition, beneficial effects on the respiratory, immune, digestive and cardiovascular systems have been observed, as well as having an antiseptic, anti-inflammatory and immunomodulatory activity, among others. They also have a grounding effect on the body, mind and emotions [29, 49].

An oil rich in sesquiterpenes is patchouli EO which contains high amounts of patchoulol, α-guaiene and α-bulnesene. Also, a high concentration of sesquiterpenes can be found in the EO of lemon balm, Roman chamomile, ylang ylang, ginger, frankincense, vetiver, sandalwood, myrrh and cedar [19, 41, 49].

Diterpenes are molecules consisting of 20 C atoms and numerous hydrogen atoms. While in the EO of frankincense extracted from the species *Boswellia karterii* from Somalia, a diterpene molecule, cembrene, was identified in a percentage of 0.1%, the EO of frankincense extracted from the species *Boswellia sacra* from Oman, contains numerous diterpenes. Other oxygenated diterpenes like incensol and incensyl acetate are specific to frankincense EOs. Along with them, cembrenol and manool are also found [49]. Oils rich in oxygenated diterpenes are the EO of pine, fir, cypress, juniper, jasmine, frankincense [41,49]. Diterpenes have antifungal, antimicrobial and expectorant properties [29].

As these are larger molecules, only a small percentage of diterpenes tend to be found in the EO extracted by distillation, while triterpenes and tetraterpenes, having larger molecules as they contain 30 or 40 C atoms, do not evaporate, requiring temperatures higher than 100 °C to mobilize them in the final oil [49]. However, high performance liquid chromatography (HPLC) revealed the presence of boswellic acid, a triterpene acid, in the composition of frankincense oil [19].

The second category of active substances in EOs is that of phenylpropanoids, which are aromatic molecules with a propanoid tail, synthesized through the shikimic acid pathway starting from phenylalanine or tyrosine [21, 51]. The simplest molecule of this type has 9 atoms of C, 12 atoms of H and 1 atom of O.

Phenylpropanoids are found in the EOs of basil, cinnamon, clove, anise, Korean mint, fennel, parsley, nutmeg, tarragon [28, 41]. They are considered to be responsible for the aroma and smell of the plants from which they originate [49]. Among the best-known compounds in this class are: eugenol, methyl eugenol, chavicol, cinnamaldehyde, estragole, anethole, myristicin and isoeugenol. In general, phenylpropanoids are known for their anti-inflammatory, anti-aging skin, antimicrobial and antitumor properties [51].

Phenols, such as thymol from thyme and eugenol from clove, cinnamon and basil, represent a special category of molecules recognized especially for their antioxidant role, which are found both in the class of terpenes and in the class of phenylpropanoids [38].

Moreover, both classes can have oxygenated compounds that can belong to one of these functional categories: alcohols (menthol, patchoulol, linalool), esters (cinnamyl acetate, geranyl formate), aldehydes (cinnamaldehyde, citronellal), ketones (carvone, menthone), ethers (eucalyptol), oxides (rose oxide), phenols (thymol, eugenol, carvacrol) and carboxylic acids (cinnamic acid, geranic acid, valerianic acid) [19, 41, 34, 49].

The composition of the EOs is determined by the DNA of the plant, but also by the environmental factors to which the plant is exposed [41, 49]. Research has revealed that the same plant can generate an EO with a different composition, this being influenced by: geographical region, amount of precipitation, temperature, soil conditions, PH and climate, altitude, fertilizer applied (chemical or organic), harvesting period, genotype, the part of the plant used, its age and vegetative cycle and the extraction method. The composition will also influence its therapeutic action [22, 38, 39].

Additionally, a particularly important characteristic is the chemotype of the plant. It refers to the fact that plants of the same species, which present the same morphological characteristics, produce different chemical compounds, which determines a different composition of the EO and, implicitly, a distinct biological activity of it [41]. Thus, the action of the basil EO, officially called *Occinum basilicum*, can vary greatly depending on its main constituents. The Essential Oils Desk Reference – Seventh Edition lists three chemotypes of basil (*Ocimum basilicum*). It can be rich in linalool and fenchol, having antiseptic properties, or it can be rich in methyl-chavicol, which gives its anti-inflammatory properties. The variant rich in eugenol has both anti-inflammatory, anti-algesic and antiseptic properties [19]. At the same time, a study by Giachino et al, from 2014, determined seven chemotypes for basil (*Ocimum basilicum*): (linalool, citral/methyl chavicol, methyl chavicol, methyl eugenol, methyl cinnamate/linalool, methyl chavicol/linalool and linalool/methyl eugenol) [22]. Other plants that produce EOs with different chemotypes are generally plants from the *Lamiaceae* family such as lavender, thyme, mint, lemon balm, rosemary or sage [21, 43, 49]. It has also been reported that tea tree, Roman chamomile, eucalyptus or frankincense may present several chemotypes [7, 15, 52].

Currently, a great concern of some EOs producers is their quality and purity, which is given by the integrity of their composition. With the increase in the requirement of EOs, in order to reduce costs, certain manufacturers prefer to alter their composition and augment the quantity of EOs by adding synthetic constituents to potentiate their aroma, by diluting them with fatty oils or by mixing them with cheaper EOs [9]. In addition, certain solvents that were used to increase the extraction yield could be found in the final composition of the oil. All these methods of adulteration of EOs affect their therapeutic actions, prejudicing the integrity of aromatherapy and may even present toxic effects that endanger the safety of users, through their irritating or allergenic effects, causing redness and even burns of the skin [19].

In general, EOs are known to be fat soluble. However, some molecules, especially the oxygenated ones, can show a certain solubility in water, depending on the mixing temperature and their structure [34].

6. Conclusion

The journey of essential oils, from their historical origins to their modern extraction processes and complex compositions, reflects a rich tapestry of cultural heritage, scientific advancement, and therapeutic application. The historical evolution of essential oils and their complex composition demonstrates their enduring value and versatility, adapting through the ages from traditional

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