Herbal oils in healthcare: a review

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Abstract

The herbal medicine market has grown considerably as an alternative currently used for the application of plants in the treatment of various diseases. In this environment, studies on the bioactivity of essential oils and the search for those that have antimicrobial, analgesic, anti-inflammatory, anti-tumor, antioxidant properties and also oils that can inhibit key enzymes are highlighted. However, research on the use of plants in the pharmaceutical industry, chemical composition of native species and possible biological activities are still scarce. Therefore, studies for the knowledge of native species with therapeutic potential gain great relevance. This study carried out a review of the research already done on essential oils from species with potentially promising biological activities for the contribution of the sustainable use of biodiversity and the relevance of their medicinal potential.

Keywords: Medicinal and aromatic plants, Essential oil, Phytotherapy, Healthcare

Resumo

O mercado de fitoterápicos tem crescido consideravelmente como uma alternativa atualmente utilizada para a aplicação de plantas no tratamento de diversas doenças. Nesse ambiente, destacam-se os estudos sobre a bioatividade de óleos essenciais e a busca por aqueles que apresentem propriedades antimicrobianas, analgésicas, antiinflamatórias, antitumorais, antioxidantes e também de óleos que possam inibir enzimas-chave. Porém, pesquisas sobre o uso de plantas na indústria farmacêutica, composição química de espécies nativas e possíveis atividades biológicas ainda são escassas. Portanto, estudos para o conhecimento de espécies nativas com potencial terapêutico ganham grande relevância. Este estudo efetuou uma revisão das pesquisas já realizadas sobre os óleos essenciais de espécies com atividades biológicas potencialmente promissoras para a contribuição do uso sustentável da biodiversidade e a relevância dos seus potenciais medicinais.

Palavras-chave: Plantas medicinais e aromáticas, Óleo essencial, Fitoterapia, Cuidados da saúde

Resumen

El mercado de la fitoterapia ha crecido considerablemente como alternativa que se utiliza actualmente para la aplicación de las plantas en el tratamiento de diversas enfermedades. En este entorno, destacan los estudios sobre la bioactividad de los aceites esenciales y la búsqueda de aquellos que tienen propiedades antimicrobianas, analgésicas, antiinflamatorias, antitumorales, antioxidantes y también aceites que pueden inhibir enzimas clave. Sin embargo, la investigación sobre el uso de las plantas en la industria farmacéutica, la composición química de las especies nativas y las posibles actividades biológicas son todavía escasas. Por lo tanto, los estudios para el conocimiento de las especies nativas con potencial terapéutico adquieren gran relevancia. En este estudio se realizó una revisión de las investigaciones ya realizadas sobre los aceites esenciales de especies con actividades biológicas potencialmente prometedoras para la contribución del uso sostenible de la biodiversidad y la relevancia de su potencial medicinal.

Palabras clave: Plantas medicinales y aromáticas, Aceite esencial, Medicina herbaria, Cuidado de la salud

1. Introduction

The World Health Organization (WHO) has prioritized the pharmacological investigation of medicinal plants for the treatment of various diseases, due to the fact that natural products are considered effective sources of substances with biological activity. Natural sources influence the production of about 40% of available medicines, directly or indirectly, with the majority being plants (Calixto, 2001; WHO, 2011; Dias et al., 2022).

According to Newman and Cragg (2012), these natural products are provided with a great structural and chemical diversity, not being able to compare them to any synthetic library of small molecules, thus inspiring new discoveries in chemistry, biology and medicine.

In Brazil and in the world, the interest in phytotherapics and natural products has been growing a lot. In countries like Canada, France, Germany and Italy, the use of products of the so-called natural therapies is used by 70 to 90% of the population, having the same weight of the allopathic system (WHO, 2011).

In view of these facts, studies for knowledge of native species with therapeutic potential gain great relevance. In this treadmill are the researches with essential oils (EO) of native species. Knowing the chemical composition and possible biological activities related to the essential oils coming from native natural resources, amplifies the possibility of creating protocols of sustainable use of biodiversity.

Over the year's bioprospecting has been defined in different ways, as it is a comprehensive topic and can be conceptualized in different ways, depending on the area to which it refers. Even so, in a general way, it is taken by the search of organic compounds in microorganisms, plants and animals that are useful for humanity. Many times, researchers search for these resources in peculiar environments, where an extreme adaptation of their biota is expected or environments with singular characteristics.

That is why the natural elements found in forests become resources from the moment they are used and their use is indispensable for the survival of the human being. These resources are present in practically everything we need and depend on. However, when using natural resources, a number of different interests and interpretations come into play. Faced with this fact, strategies involving the conservation of biological diversity are essential.

On the other hand, natural resources have been used by humanity since the beginning as important tools in natural therapy procedures (Murray; Sánchez-Choy, 2001), aiming at the relief and cure of diseases through the use of herbs and possibly consisting of one of the first ways of using these resources.

In this context, it is known that the market for plant-derived pharmaceutical products is a promising segment, besides being an effective and culturally appropriate therapeutic option (Simões et al., 2003). It is known that the use and demand for natural products is growing worldwide, especially due to the problems that are attributed to numerous synthetic products for both human health and the environment (Bandoni; Czepak, 2008).

Despite the development of synthetic drugs, studies conducted to understand the chemical composition and biological activity of plants are becoming more important every day. Because the products obtained from natural sources, have a great chemical diversity in their composition, which favors the discovery of new drugs (Badke et al., 2012; Trevisan et al., 2003)

As reported by Simões *et al.* (2003), the increased demand for the use of medicinal plants in curing or preventing diseases, the cultivation and/or extraction of these plants becomes an increasingly important alternative in national agriculture. However, the intense extractivism puts countless native species at risk of extinction, causing ecological disturbances and it is in this context that our research is inserted.

Aromatic plants, as well as their essential oils, have been used since the beginning of human history to flavor foods and beverages; empirically used to disguise unpleasant odors; attract other individuals and control health problems, also contributing to communication between individuals and influencing the well-being of humans and animals, thus demonstrating an ancient socio-cultural and socioeconomic tradition of using these products (Christaki et al., 2012).

The pharmacological properties attributed to EOs are diverse and some are recommended because they present important advantages when compared to other drugs, such as their volatility, which makes them ideal for use in nebulizations, immersion baths or simply in inhalations. The volatility and low molecular weight of their components allow them to be rapidly eliminated from the body through metabolic pathways (Bandoni; Czepak, 2008). Thus, in this review aims to present some aspects about essential oil related with its importance in health care.

In this study we will address some discussions on the subject. The main one refers to the use of essential oil from native plants as herbal agents and in health care. And also, the use of natural products and how this affects the biome where they are found.

2. Bioactivity of essential oils

The ability to accumulate volatile oils is characteristic of some groups of plant families. The essential oil is a mixture of volatile chemical constituents, being a product obtained from vegetable matter. It is often found in leaves, flowers and fruits. The knowledge of the structure of the compounds present in the oil is of immense importance for industries, highlighting the pharmaceutical industry and is the object of intense study to identify their chemical composition and biological activity.

Another important aspect of oils is that they are biodegradable and generally present low toxicity to mammals and because they can act on several target molecules at the same time, when compared to synthetic drugs, they become key substances for the research of new drugs (Figueiredo et al., 2008).

The activity of the oils includes phytotherapic, antiviral, antiseptic, nutritional, antifungal, among others (Burt, 2004).

Moreover, as an example of antibacterial potential, we can mention the study conducted by Magalhães et al. (2022) with the essential oil from fresh leaves of *Cochlospermum regium*, which proved to be efficient against Gram-negative and Gram-positive bacteria strains, *Escherichia coli*, *Staphylococcus aureus and Enterococcus faecalis*. The same study also verified a high antioxidant activity of EO in the reduction of the DPPH free radical, as well as cytotoxic activity in *Artemia salina* (Magalhães et al., 2022).

It should be noted that, as pointed out by Menezes Filho et al. (2020), the EO of the flower of *C. regium* species presents important antifungal activity on the phytopathogen *Sclerotinia sclerotiorum*.

Antimicrobial, insecticidal, antioxidant, antifungal, analgesic, and immunostimulant potentials have also been observed in studies conducted with the species *Ocimum gratissimum L.* (alfavaca) and *Ocimum basilicum* (basil) (Vasconcelos et al., 2021).

In this sense, the study by Vasconcelos et al. (2021) showed that essential oils of *O. gratissimum* and *O. basilicum* showed good antioxidant activity in the sequestration of the DPPH free radical and bactericidal activity against strains of *E. coli* and *S. aureus*, with the essential oil of *O. gratissimum* showing greater inhibitory potential than the essential oil of *O. basilicum*, at the concentrations evaluated.

In summary, the addition of EOs to edible oils and other foods with potential natural antioxidant agent to inhibit oxidative deterioration, maintaining quality and extending the shelf life of the food product is another important application to EOs, associated with microbiological control in foods (Siddique et al., 2017).

However, the composition and activity of an essential oil can be modified by several aspects, from the way of extraction, to factors proper to the plant and the environment in which it is inserted (Silva et al., 2011).

The oils are active against a wide variety of microorganisms: viruses, fungi, protozoa and bacteria. The compounds and their percentages present in the oils vary according to the species considered, the conditions of collection and extraction, and the parts of the plant used. The main isolated compounds of the essential oils are terpenes and their oxygenated derivatives, terpenoids, including phenolic compounds (Solórzano-Santos; Miranda-Novales, 2011).

The constituents of essential oils can be classified as terpene derivatives or phenylpropanoids, depending on the biosynthetic pathway from which they originate (Simões; Spitzer, 2010).

Terpene oils can be classified according to the number of isoprenic units present in the structure: monoterpenes (C10) and diterpenes (C20), which are biosynthesized by the methylerythrite pathway and sesquiterpenes (C15), which are biosynthesized by the mevalonate pathway. Phenylpropanoids, on the other hand, are biosynthesized from the shikimic acid pathway, originating the nucleus C6-C3, which is a phenolic ring attached to a propyl group (Simões; Spitzer, 2010).

Meanwhile, plant extract has been studied as a source of chemicals to be purified for use in perfumes, cosmetics, medicines, household products, and others. Therefore, developing drugs or natural products from plants is viable, simple to use, and lower cost than modern medicines (Chaveerach et al., 2016). Researches point out to the sustainable use of the biodiversity of the Brazilian ecosystems as a real alternative to supply some of the market demands. In addition, scientific studies need to be deepened in order to guarantee the sustainable use of natural resources in a perspective of national sovereignty and generation of new products and technology for society.

3. Uses

Over time for the treatment of diseases and in food conservation, man has used a diversity of natural products, predominantly derived from plants (Najar et al., 2019). In this context, substances of plant origin, such as EOs that have always been used in traditional medicine, currently had a stimulus in the scientific world for the development of research in order to discover and identify these substances due to the ability to combat pathogenic microorganisms, either as a mixture or individual components (Nazzaro et al., 2019).

Still according to Nazzaro *et al.* (2019) species of the same genus have different chemical compositions, so they can offer different bioactive substances, such as the hydroalcoholic fraction or essential oils, for the qualitative and quantitative aspect and this divergence is also due to the environmental and climatic conditions in which it grows, the stage of maturity and the method of extraction.

In addition, many efforts have been made to explore the use of EOs in the treatment of many infectious diseases that surpass pharmaceutical drugs (Irshad et al., 2019). Also called ethereal or volatile oils, they are used in applications in the pharmaceutical, medical and perfume industries (Silori et al., 2019).

Their individual components have important uses in various fields such as agriculture, environment and human health (Hanif et al., 2019). The blends of essential oils are used in bath items and in aromatherapy. According to Hanif et al. (2019), aromatherapy is defined as a therapeutic technique consisting of inhalations, massages or baths with essential oils.

Thus, as for example, the EOs that have the menthol, act as natural repellent of insects, as well as in the treatment of respiratory allergies, joint pains, muscular pains, headaches, provides hair growth and relief of fever, and alsoin the treatment of cancer in a way that protects against cellular death and DNA damage (Reddy, 2019).

This use increases day by day in industries, covering beverages, food, personal care, aromatherapy and cosmetics (Irshad et al., 2019).

The EOs can also be useful to plants and can help in several ways when present, such as acting against pathogens, keeping out predators, reducing losses by perspiration, communication between different plants and microbes and also attracting pollinating agents (Guha; Nandi, 2019).

Another important aspect is the fact that EOs have antiseptic properties, giving them an extensive range of bactericidal, fungicidal, and medicinal applications. Due to this, agriculture and the medical sector are, among others, greatly favored by the uses of the EO (Silori et al., 2019).

Another important activity present in the EO is the antimicrobial, accepted for a long time and used in the form of spices, herbs, extracts and EO of several families of plants of which are the origin of some of the main natural antimicrobial agents. In face of this fact, the EOs were considered as a great alternative to the chemical-based synthetic food preservatives, thus gaining space as antimicrobials in the conservation of food and increasing the tendency to green consumption, since most of their elements have GRAS status because they come from edible plants, unlike synthetic chemicals (Basakand Guha, 2018).

This high interest of consumers for aromatic and medicinal plants is continuously increasing as there is a growing demand such as attraction to these plants for medicinal, culinary and other anthropogenic applications (Hanif et al., 2019).In view of this scenario, in the year 2018 the world market for essential oils reached a demand of 226.8 tons and it is estimated that from 2019 to 2025 there will be an increase with a CAGR (compound annual growth rate) of 8.6% (Irshad et al., 2019). However, only about 300 out of more than 3.000 known essential oil types are present in commercially important global markets (Reddy, 2019).

For what has been exposed, there is a promising scenario of the use of plants in the pharmaceutical industry, therefore studies for knowledge of native species with therapeutic potential gain great importance and relevance, aiming to contribute to the sustainable use of biodiversity and the verification of its medicinal potential.

4. Biological activity of essential oils in a health context

From the identification of the chemical composition, it is possible to perform tests on potential biological activities. Therefore, isolating, identifying and characterizing the main compounds of the EO is of paramount importance for a primary notion (Reddy, 2019).

In general, this composition is based on special metabolites, of which sesquiterpenes are the most frequent, followed by monoterpenes (Bogo et al., 2016). For example, the individual components in the EO mixture such as thymol, camphor, limonene, α-pinene, terpinolene, menthol, menthon among others, demonstrate broad biological properties (Reddy, 2019).

Moreover, several essential oil compounds have high potential antibacterial activity and these compounds are monoterpenic, sesquiterpenic and phenylpropanoids (Magalhães et al., 2022) with proven action such as β-bisabolene (Mazaheritehrani et al, 2021), thymol (Majolo et al., 2020), limonene (Goulart et al., 2018), germacrene D (Freitas et al., 2020), caryophyllene and α-pinene (Nelson, 2019), and myrcene (Cabral et al., 2020).

Under this approach, according to Chaudhari et al. (2019), multiple phytochemicals have several pharmacological activities, such as terpenoids that have antibacterial, anti-inflammatory, anticancer, antimalarial and antiviral activities. The majority of alkaloids present anesthetic properties. The special metabolites, in turn, play an important role in the neutralization of free radicals. The flavonoids group, belonging to the phenolic compounds, has innumerable clinical properties, such as antiatherosclerotic, anti-inflammatory, antitumoral and antiviral (Chaudhari et al., 2019).

Although synthetic chemicals are still widely used commercially as biological activities, plant essential oils are more competent and safe natural sources for human health and the environment (Reddy, 2019).

Thus, Hanif et al. (2019) describes that the EOs have notorious antimicrobial properties and also present excellent antioxidant properties due to their active compounds that demonstrate this activity, such as carvacrol and thymol, through their phenolic structure, but this activity can also be attributed to other compounds present in essential oils, such as alcohols, ketones, aldehydes, ethers and monoterpenes.

Another important aspect to be mentioned is that the EOs have a wealth of mechanisms that show repellent and insecticide activities due to the fact that they have numerous chemical compounds. Furthermore, they exhibit cytotoxicity, i.e., they have the capacity to break layers of phospholipids, fatty acids and polysaccharides due to their lipophilic mixtures (Hanif et al., 2019).

Still evidencing the biological activities of the EOs, it is important to point out that some present antidepressant, antibacterial, fungicide, antiparasitic, acaricide, stimulant and relaxing effect. They can be considered effective in the treatment of hypertension, because they demonstrate hypotensive activity and, also used in the treatment of cancer, such as breast, tumors, leukemia and glioma, presenting anti-cancer properties (Hanif et al., 2019).

In this perspective, knowing the chemical composition and possible biological activities related to the essential oils from native natural resources increases the possibility of creating protocols for sustainable use of biodiversity. In this sense, although there are several studies on the structure of communities and flora of the Atlantic Forest biome, the potential genetic resources of aromatic plants are still little explored (Souza et al., 2017). In view of this, the plant families Myrtaceae, Lauraceae and Piperaceae, are of special importance for medicinal applications.

The Myrtaceae family, also known as the Myrtle family, in wich has highly acclaimed essential oil sources, has approximately 145 genera in which more than 6000 species are distributed (The Plant List, 2017). Notably, its main genera are Eucalyptus, Eugenia, Leptospermum, Malaleuca, Myrtus, Pepper, Psidium, and Syzygium (Ebadollahi, 2013).

They can be trees or shrubs, regularly producing fruits and are mainly present in tropical and subtropical regions of the world (Stefanello et al., 2011).

However, Brazil is home to 23 genera, where out of 985 species, 744 are endemic (Sobral et al., 2012). Therefore, most of these species are found in the Atlantic Forest and also stand out in this biome for being considered one of the predominant woody families (Barroso, Perón, 1994; Reitz et al., 1978).

The species of the Myrtaceae family, besides representing ecological importance, are considered aromatic plants with broad agroindustrial potential (Sardi et al., 2017; Stefanello et al., 2011).

As an example of this, in the study conducted by Papachristos et al. (2004) one can verify the insecticidal action of the EO of the species *Eucalyptus globulus* Labill on the insect *Acanthoscelides obtectus* (Say), being attributed to this potential a correlation between the oxygenated monoterpenes of the EO and the insecticidal activity.

Thus, Ebadollahi (2013) shows that in studies already conducted with the Myrtaceae family it can be observed that the toxicity of essential oils of this family against insect pests is related to the main components of the oil. In a way that, the components of EOs such as 1,8-cineole, caryophyllene, chavicol, citral, p-cymene, limonene, linalool, myrcene, α-pinene, γ-terpinene, terpinen-4-ol, and α-terpineol can be considered responsible to the insecticidal activities of EOs of Myrtaceae family for their insecticidal bioefficiency on insect pests (Ebadollahi, 2013).

There are also studies related to the antifungal activity of Myrtaceae family species, such as the one reported by Lago et al. (2011) in which EO from *Myrciaria trunciflora* leaves showed good inhibition results on *Candida* *dubliniensi* (99%), *Candida albicans* (82%), *Candida glabrata* (100%), *Candida parapsilosis* (98%), *Cryptococcus grubii* (serotype A) (97%), *Candida gatii* (serotype C) (98%) and for *Saccharomyces cerevisiae* yeast (100%). In addition, it also showed antibacterial activity for *Streptococcus equi* (94%) and *Staphylococcus epidermidis* (95%), being this activity related to the presence of sesquiterpenes (Lago et al., 2011).

As for the studies conducted with the fruits of species of the Myrtaceae family, we can mention the extract of the jambolan fruit (*Syzygium cumini* (L.) Skeels) in which demonstrated bacterial activity against *Klebsiella pneumoniae, Salmonella typhimurium, Shigella flexneri, Staphylococcus aureus* and entero toxigenic *E. coli* by experimental model *in vitro* (Gopu; Kothandapani; Shetty, 2015; Haque et al., 2017).

In this sense, Sharma et al. (2013) claim that the *S. cumini* is considered the plant with the greatest nutritional richness, containing flavonoids, tannins, triterpenoids, carotenoids and sitosteroids, alkaloids, phenols, saponins, limonene, and α-pinene. Its extract has presented several activities such as cytotoxicity, anti-inflammatory, anticancer, and antidiabetic (Sharma et al., 2012).

It is also observed, immunomodulatory potential of EO from the leaf of *S. cumini* against *Leishmania amazonenses* activity (Rodrigues et al, 2015). Thus, new compounds, such as EOs, are constantly being tested for their potential leishmanicidal activity (Kaur et al., 2010).

It is also reported in the study of Bona et al. (2011) the effect of *S. cumini* leaf extract on the activities of erythrocyte enzymes and antioxidant potential in people with type 2 diabetes. Thus, the authors concluded that this extract promoted the reduction of inflammation and oxidative stress, in addition to presenting actions against the biochemical changes that occur due to diabetes mellitus (Bona et al., 2011).

There are also studies of the EO of the uvaia fruit (*Eugenia pyriformis* Cambess) as an antimicrobial agent, with bactericidal activity being observed against *Listeria inocua* and *Escherichia coli* (Farias et al., 2020). In addition, antibacterial potential has also been observed against *Staphylococcus aureus, Bacillus cereus*, and *Pseudomonas aeruginosa* (Agredo, 2017).

Another species with potential is red jambo (*Syzygium malaccense* L. Merr & Perry) with studies reporting its antiglycemic and antiobesogenic activities, through the leaf extract they could observe that myricetin derivatives in which exerts antiglycemic activity by inhibiting the enzymes α-glucosidase and α-amylase (Arumugam et al., 2016).

With regard to the species known as guabiroba (*Campomanesia xanthocarpa* Berg), the compounds isolated (2,6-dihydroxy-3′-methyl-4′-methoxychalcone and 2′,4′-di- hydroxy-3′,5′-dimethyl-6′-methoxychalcone) from the hydroethanolic extract of leaves of this species exhibited anti-inflammatory activity, in a way that they significantly inhibited edema in paw of adult male Wistar rats and reduced leukocyte migration and protein leakage in the pleural cavity (Silva et al. , 2016).

Still with regard to the species *C. xanthocarpa in vivo* and *in vitro* tests of its extract suggest cardioprotective effect, thus reducing the onset of diseases related to the cardiac system (Farias et al., 2020).

According to Stefanello et al. (2011), species of the Myrtaceae family are popularly used, and for this reason, many studies on their essential oils are being conducted to verify their biological potentials. Among the researches already conducted, it can be highlighted that its essential oils demonstrate important activities such as antimicrobial, antilarvae, antioxidant, anti-inflammatory, cytotoxic and analgesic.

Moreover, it is important to highlight that EOs can serve as raw material for the discovery of new synthetic products, which can be of great importance for the treatment of diseases (Bajalan; Pirbalouti, 2014; Menezes Filho et al., 2020b).

Thus, Aelenei et al. (2016) state that studies found in the literature show that EOs can have natural antibacterial activity against bacteria, and thus can replace synthetic antibacterial compounds such as chlorhexidine dihydrochloride. Or even be used in annex to synthetic antibiotics, since some EOs have the ability to reverse/paralyze efflux pumps, which are common mechanisms of resistance to antiseptics (Aelenei et al., 2016).

Complementing what was said, it is verified that, according to Blank et al. (2019) the species *Myrcia lundiana* and *Myrcia ovate* both have EOs with great antimicrobial activity and also, an evident potential of control for phytopathogenic fungi, which are responsible for the degradation of tropical fruits after harvest.

It is also observed, several studies that highlight the genus *Eugenia*, which due to the presence of compounds that stand out for having natural antioxidants end up arousing interest in industry and in the food, cosmetic and pharmaceutical sectors, thus demonstrating great economic potential (Sardi et al., 2017).

It should be noted that, as pointed out by Souza et al. (2018), the genus *Eugenia* is one of the largest in the family Myrtaceae, comprising approximately 1000 species widely used in folk medicine, with antidiabetic, antirheumatic, antipyretic, anti-inflammatory, antidiarrheal, antifungal, and antibacterial properties.

In this way, species of *Eugenia* have been studied in recent decades, demonstrating a great diversity in chemical composition, such as hydrocarbons and oxygenated derivatives composing the EOs of *Eugenia*, while in extracts of the aerial parts, triterpene compounds, flavonoids, tannins and cyanidins have been identified (Souza et al., 2018).

Also, the said author states that the chemical diversity described, presupposes that *Eugenia* species are probably a promising source of bioactive compounds (Souza et al., 2018). As for example, studies showing cytotoxic activity against tumor cells from EOs from species of the genus *Eugenia* (Han; Parker, 2017; Scalvenzi et al., 2017).

As the species *Eugenia brasiliensis* that is frequently found in the Atlantic Forest, in the south and southeast regions of Brazil and its varieties present great resources of bioactive compounds, especially when it comes to phenolic and carotenoid compounds (Simões et al., 2018; Araújo et al., 2019). Another important aspect to be highlighted is the fact that some studies suggest that the extract of *E. brasiliensis* can be considered an alternative for the treatment of chronic obstructive pulmonary diseases and also performs an antidepressant function in serotonergic, noradrenergic and dopaminergic systems, thus producing an implication similar to conventional treatment (Colla et al., 2012).

In light of these considerations, Souza et al. (2018) state that the species of the genus *Eugenia* possess promising biological activities, supporting the need for future research on drug development from the species' extracts and chemical constituents.

Still regarding the Myrtaceae family, it is worth mentioning the studies about the *Eucalyptus* genus. In short, Gallon *et al.* (2020) aims in their study to evaluate the efficacy of EOs of species of this genus in the control of larvae of *Aedes aegypti*, in which it can be concluded that the species demonstrated larvicidal activity in most of the evaluated concentrations, highlighting the species *Eucalyptus benthamii* and the hybrid species *urograndis* presented higher potential larvicide. Gallon *et al*. (2020) also pointed out that the compound α-pinene was the protagonist responsible for the larval mortality, therefore the compounds present in the eucalyptus EOs have competence to be used as a natural insecticide resource, thus being able to supplement or replace synthetic chemicals in mosquito control programs and exhibiting a formidable potential in the pharmaceutical, medical and mosquito vector control industry.

Another important genus of this family is Melaleuca, highlighting the study done by Lelesius *et al*. (2019) with the EOs of the species *Melaleuca alternifolia* which proved to be efficient against several viruses related to influenza, HSV-1 and SARS-CoV, so that it inhibited the proliferation of the virus involved inside the cells.

Still regarding the medicinal importance of some plant families present in the Atlantic Forest biome, the Lauraceae family is considered one of the most expressive of this biome in which it appears represented by 12 genera and 55 species (Lima et al., 2012). As an example, the study by Najar et al. (2019) demonstrates that the EOs of the species *Cinnamomum zeylanicum* and *Litsea cubeba*, belonging to this family, can be promising anti-cancer agents. In another perspective, other studies show the common use of *L. cubeba* for the treatment of atopic dermatitis and *C. zeylanicum* with anti-oxidant potential (Gogoi et al., 2018; Saeed et al., 2018).

Moreover, it is important to highlight other species of the genus *Cinnamomum*, such as *Cinnamomum cassia* and *C. zeylanicum* that had their EO described as cytotoxic against leukemia, liver cancer, prostate, colon, among others, but have not yet had studies properly clarified on their mechanisms of action (Dutta; Chakraborty, 2018).

Besides these definitions, it is important to highlight the study by Tu *et al.* (2018) on the EO of the species *C. zeylanicum* and *Syzygium aromaticum* (popularly known as clove and belonging to the Myrtaceae family), which demonstrated important antimicrobial activity against four food-borne bacteria tested, according to the authors the antibacterial activity increased with the increase in EO concentration and time of exposure. Another test in this same study was the one of fumigation, in order to investigate the toxicity of the EO against the insect *Sitophilus oryzae* and it can be concluded that both oils were extremely efficient in the established concentrations.

After these considerations, the Piperaceae family, which has five genera and approximately 3.700 species, stands out (Jaramillo et al., 2004). In Brazil, only three of the five genera are present, covering 466 species that are distributed exclusively in the Atlantic Forest and Amazon Forest (Flora do Brasil, 2020).

Thus, the genus *Piper* deserves to be highlighted, since it presents economic and ecological importance (Islam et al., 2020). Species belonging to this genus are used in the treatment of several diseases worldwide, such as natural antioxidants and antimicrobial agents in the food industry for food conservation (Salehi et al., 2019).

Regarding the study by Wang *et al.* (2014), about ten species belonging to this genus were used in traditional medicine in the treatment of cancer or similar symptoms, also showing that 35 extracts and 32 compounds isolated from 24 species showed cytotoxic effects against cancer cells.

Complementing this assertion, when isolating the compounds of the *Piper chaba* species, it can be observed according to Ren et al. (2015) that a dimeric alkaloid called chabamide, showed antimalarial, antituberculosis and cytotoxic activities. It is also observed another compound known as piperina, being a spicy alkaloid and standing out as the main component present in black pepper (*Piper nigrum*) and in other species belonging to the genus *Piper*, that it has several important pharmacological activities, such as antimicrobial, antitumoral, antioxidant, antimetastatic, immunomodulator, hepatoprotector, etc (Stojanovi'c-Radi'c et al., 2019). The piplartine, on the other hand, shows cytotoxic, genotoxic, antitumoral, antiangiogenic, antimetastatic, platelet antiaggregation, antinociceptive, anxiolytic, antidepressant, antiatherosclerotic, antidiabetic, antibacterial, antifungal, leishmanicide, trypanocidal and schistosomal (Bezerra et al., 2013; Menezes Filho, 2020; Menezes Filho; Castro, 2020).

In the same way, Bernuci et al (2016) pointed out in their study the potential of species of the genus *Piper* in the treatment of leishmaniasis and tuberculosis diseases. Through analyses to verify the cytotoxic activity of EO, they concluded that the species *Piper diospirifolium* and *Piper aduncum* demonstrated the greatest active potential against the parasite *Leishmania amazonensis*, responsible for the leishmaniasis disease. They could also observe that the greater presence of sesquiterpenes in the chemical composition of the EO, the greater isleishmanicidal activity. Already against the bacterium causing tuberculosis *Mycobacterium tuberculosis*, the authors observed that the EOs of the species *Piper rivinoides*, *Piper cernuum* and *Piper diospyrifolium* were the most active in the combat.

Also, worth mentioning what Da Silva et al. (2017) said about the chemical compounds present in the essential oils of the *Piper* genus and their related biological activities. The authors showed that the EOs that demonstrated greater insecticide and acaricide activity are abundant in phenylpropanoids and sesquiterpene hydrocarbons, while the inhibition of the acetylcholinesterase enzyme is associated with greater quantities of phenylpropanoids and sesquiterpenoids (hydrocarbons and oxygenates). In addition, they observed that the anti-inflammatory potential was evident mainly in oils that demonstrated sesquiterpene hydrocarbons as main compounds, however monoterpene hydrocarbons were related to antinociceptive effects.

On the other hand, Battistini et al., (2019) sought to evaluate in their study the efficacy of four essential oils in combating hepatitis A virus (HAV) contamination of berries. Three of the respective oils in this study are from plants belonging to the genus *Citrus* of Rutaceae family, they are: lemon (*Citrus limon*), sweet orange (*Citrus sinensis*) and grapefruit (*Citrus paradisi*). The other oil in question is rosemary cineole (*Rosmarinus officinalis*chemotype 1.8 cineole) which belongs to the Lamiaceae family. The authors showed that the EO of lemon, grapefruit and rosemary cineole significantly decreased the titles of HAV on the surface of the berries, being the EO of rosemary cineole the most relevant in the reduction, followed by grapefruit and lemon. Orange EO did not show significant results.

Another important genus to be highlighted is *Baccharis* genus belongs to the Asteraceae family and has approximately 500 species, of which are found exclusively in the Americas and most of them are located in southern Brazil (in the states of Rio Grande do Sul, Santa Catarina and Paraná) (Schripsema et al., 2019).

Among the reports already available, it is possible to observe the essential oils of several species with anti-inflammatory potential (Florão et al., 2012; Guimaraes et al., 2021), fungicidal, anti-bactericidal (Petenattiet al., 2000; Cobos et al., 2001; Demo et al., 2005) antiulcerogenic (Klopell et al., 2007) and as an insect repellent (Abad; Bermejo, 2007; Garcia et al., 2005; Alves et al., 2018).

Furthermore, one of the plants that has its known medicinal use in Brazil is Carqueja (*Baccharis spp*.) (Di Stasi et al., 2002). Usually used in the form of tea from dry aerial parts for the treatment of gastrointestinal disorders, being one of the 70 species of medicinal plants value ANVISA (National Health Surveillance Agency, Brazil) (Schripsema et al., 2019).

Moreover, *Baccharis dracunculifolia* because has many secondary metabolites, it is capable of producing and storing phenolic compounds and essential oil with antimicrobial activity (Cobos et al., 2001; Búfalo et al., 2009). Fundamental in the production of green propolis as a botanical source used by bees, presentation of gastroprotective action (Costa et al., 2019). The hydroethanolic extract of this species has a healing action for gastric ulcers (Costa et al., 2019).

In another study, the essential oil of *B. dracunculifolia* has anti-inflammatory effects, being effective for skin diseases (Brandenburg et al., 2020). Among other activities of this species, also antibacterial (Park et al. 1998) and antifungal activities (Pereira et al., 2011).

Other species also stand out for demonstrating a great anti-inflammatory potential, such as *Baccharis articulata (Lam.) Pers., Baccharis genistelloides* and *Baccharis gaudichaudiana* (Florão et al., 2012).

Antonelli et al. (2020) present in their study the health benefits of the so-called "forest bath" through the volatile organic compounds (VOC) that are left in the atmosphere through the plants. These VOCs can also be found in plant derivatives, such as in essential oils (Gmbh, 2015). And to what the authors refer, these oils differ from the biogenic VOCs (BVOCs) present in the atmosphere because they have a greater number of heavy compounds, such as sesquiterpenes, in which this is due to the distillation processes they undergo. The authors show that the importance of this interaction is perceived not only on an action in the respiratory system, but also after the absorption by inhalation through the systemic effects, such as in the nervous system causing relaxation, anxiolytic and antidepressant action. They also observe that results of laboratory researches prove these effects and warn about the limonene and pinene compounds that have the capacity to articulate the release of cytokines, inflammatory mediators and neurotransmitters, in such a way to benefit the quality of sleep, mood, anxiety and also reduce inflammation and pain. Thus, the authors conclude that the benefits of "forest baths" for general health, mainly anti-stress and immunological support, can not only be attributed to the inhalation of VOCs, but also to a series of factors that develop the stimulation of the five senses due to the natural environment involved.

Anwar et al. (2019) conducted a survey on the biological uses and potentials of species of the *Mentha* genus, in which they are aromatic herbs belonging to the Lamiaceae family. In the authors' conception, the plant species of the *Mentha* genus, together with extracts and EO from them, have been used in popular medicine and in food for aromatization.

They found that by having a diversity of special metabolites, such as tannins, phenols and flavonoids, these plants demonstrate a variety of biological activities such as antibacterial, antifungal, antiviral, urease inhibitor, antihypertensive, antidiarrheal activities, antiulcerous, anti-inflammatory and biopesticides (Menezes et al., 2020a; Menezes Filho et al., 2021a; Vasconcelos et al., 2021). Among the species evidenced in the study is Mentha arvensis, which has a great reserve of menthol and a wide variety of biological properties such as antispasmodic, antiulcerous, carminative and antimicrobial, because of this its extract and EO has utilities in the cosmeceuticals and pharmaceutical industry.

Mentha Piperita, as the authors highlight is popularly known as peppermint and has a variety of therapeutic applications, its EO has antiseptic properties which makes it promising in the development of new drugs. The EO of the species *Mentha suaveolens* has demonstrated a relevant antioxidant-reducing ferric potential and free radical combat activity.

So, in face of all the review made by Anwar et al. (2019) about the genus *Mentha*, it was possible to observe that the presence of menthol in its compositions propitiates a potent antimicrobial activity being possible to suggest that the species of this genus, in its majority, can be used as a viable source of natural antimicrobial agents in the combat of infectious diseases, but also, as food preservatives and in the control of pathogens.

Still, the presence of antiallergic compounds in the species of plants belonging to the genus *Mentha*, such as α-humulene and menthol, also allows a safe and natural way of use as antiallergic agents (Anwar et al., 2019).

This study by Anwar et al. (2019) reveals that the plant species of the genus *Mentha* have numerous biological potentials that can be explored in various fields as a sustainable source for the treatment of various diseases, in addition to other potential uses, such as food conservation.

The theme is quite broad and there are several works described in literature. However, in view of the studies presented in this review, the biological potentials of several essential oils and the importance of characterizing and studying their chemical components in order to expand the possibilities of their uses and explore biodiversity in a sustainable way in different biomes are evident.

5. Conclusions

Faced with the process of fragmentation and destruction of forests there was a decrease in biodiversity patterns, resulting in changes in the ecosystem and its elements. Among the immense biodiversity of the biome and countless plant species, the families described in this chapter can be highlighted.

Thus, it can be considered that studies of the chemical composition, yield and biological activities of the species coming from the Myrtaceae, Lauraceae, Piperaceae, Rutaceae, Asteraceae and Lamiaceae families, can provide important subsidies for the knowledge of their medicinal potential. The knowledge of sustainable use practices provides better use of species without degrading the natural environment, promoting development strategies that contribute to the preservation of local biodiversity.

6. References

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