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Chemical diversity of mint essential oils and their significance for aromatherapy

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Abstract

Plants of the mint genus (*Mentha* L.) are the sources of essential oils of various chemotypes, classified according to the content of the main component. Essential oils vary in chemical composition, which affects their fragrance and therapeutic properties. The present paper was focused on the properties and aromatherapeutic applications of mint oils, whose main constituents are menthol/menthone, carvone, linalool, pulegone or piperitenone oxide. The menthol essential oil, showing cooling, analgesic as well as antipruritic effects and facilitating concentration, is most commonly used in aromatherapy. Moreover, the carvone chemotype essential oils are popular; thanks to their astringent, lightening and anti-inflammatory action, they favourably affect the skin. The linalool chemotype (antiseptic, refreshing effects) and piperitenone essential oils are less commonly used. The use of pulegone essential oils can be risky due to possible toxic effects when applied in higher doses.

Key words: aromatherapy, *Mentha,* essential oils

Introduction

Mints (*Mentha* sp.) are perennial herbs from the *Lamiaceae* family that produce essential oils and thus are characterised by strong fragrance. Mint plants easily crossbreed in nature; therefore, a wide variety of hybrids and new varieties of modified taste and aroma values can be obtained. Mints are cut before flowering several centimeters above the ground. The herb or leaves (fresh or dried) or herb-derived products (predominantly essential oil or extract) are used. Raw materials are applied in pharmaceutical, food, and perfume industries and for production of cosmetics [1-3]. Peppermint is of the highest pharmacological significance; it shows cholagogic, cholepoietic, anti-inflammatory, relaxing, anti-flatulent, and expectorant properties [4-6]. The International Nomenclature of Cosmetic Ingredients system includes raw materials derived from various types of mint; beside the traditional essential oil of peppermint and green mint, food and gastronomic industries use new mint varieties, the scent of which resembles fruits, e.g. strawberry-flavoured, orange, pineapple, grapefruit, lemon, banana, apple, and food products, such as chocolate-flavoured, gingery, creamy [3].

The essential oils produced from 18 *Mentha* species and 11 hybrids, either cultivated or collected from their natural habitats, reveal a wide compositional diversity within the genus [7]. Essential oil compositions of aromatic plants depend on their genetic structure, climatic factors and agronomical practices [8-10]. The mint essential oils are valuable aromatherapeutic and aromatic raw materials used in food industry, for production of cosmetics, household chemicals and refreshing preparations. According to many authors [11-13], there are several chemotypes of

mint oils, depending on the prevailing ingredient, and each of them is characterized by different scent and aromatherapeutic properties.

The aim of the present paper was to describe the chemical composition of mint essential oils based on the available literature and the resultant possibilities of their use as well as significance for aromatherapy.

Plants from *Mentha* L. genus and their essential oils

Taxonomy of the *Mentha* genius has been continuously evolving. Since 1752, more than 3000 mint names have been published. The species within a particular genius are classified according to the inflorescence structure (three groups) or the type of monoterpene compounds occurring in the essential oil (menthol, carvone and linalool [7,14].

The following basic species and hybrids are distinguished in the Mentha genus : *Mentha aquatica, M. spicata, M. arvensis, M. longifolia, M. rotundifolia, M. × piperita, M. × villosa, M. × verticillata, M. × gentillis, M. × gracilis and M. pulegium.* In Northern Europe and other counties with similar climates, peppermint (*Mentha × piperita* L.) is most commonly cultivated. In general, peppermint is characterised by intensive menthol fragrance and a high essential oil yield. Its raw materials are described in numerous European and international pharmacopoeias. In the Mediterranean Sea basin and in England, spearmint (*Mentha spicata* L.) is most popular, whose essential oil contains mainly carvone [7,14].

Chemical composition

The most common components of mint essential oils that impart them with specific scent and properties include menthol/menthone, carvone, linalool, pulegone or piperitenone oxide (Tab. 1.)

Table 1. Plants from *Mentha* L. genus and their essential oil components

Name	Major chemical components of essential oils	Literature data
M. arvensis	Menthol	[7,14,15,19]
M. crispata	Carvone, Menthol	[13, 16]
M. piperita	Menthol/menthone, Linalool	[5, 7, 13, 14]
M. pulegium	Pulegone, piperitone oxide	[17, 18]
M. rotundifolia	Carvone	[13, 16]
M. spicata	Carvone	[7,10,11,13,14]
M. suaveolens	Piperitenone/ Piperitenone oxide	[13,16, 20]

Authors` compilation based on: [5,7,10,11,13-20]

Menthol is a waxy, crystalline substance used for various medicinal purposes, such as to relieve skin irritation, sunburn, sore throat, fever, muscle aches and in nasal congestion while menthone is used in perfumery and as a flavour agent. Normally, the essential oil of *M. × piperita* L. has 30–55% of menthol **and 14-32% of menthone [19].** *M. arvensis* essential oils are also rich in menthol and its content in individual varieties ranges from several to even 85% (Table 1.). Menthol is defined as a typical mint fragrance [7, 14, 15, 19, 21].

Menthol quickly provides cooling and refreshing sensations; moreover, it has anaesthetic effects and reduces mucosal irritation. Cooling sensations in the oral mucosa, skin and other body parts are not caused by the evaporation of menthol or dilatation of blood vessels but result from a specific action of menthol on the sensory nerve endings. Cold or heat sensation is determined by the activity of thermoreceptors in the skin and mucosal surfaces. Changes in temperature sensations are caused by changes in calcium levels around the thermoreceptors [22].

After its external use, menthol is removed by the liver and kidneys, simultaneously exerting a

favourable antiseptic effect. Although its action is mild, it effectively helps to eliminate the pain associated with slight biliary colic. Furthermore, menthol alleviates mucosal irritations, e.g. of the stomach, preventing vomiting. Due to its relaxant effects, it sooths contusion-related pain, migraine sensations and rheumatic pain. It is also used to treat the upper respiratory infections [6, 23, 24].

Menthol can be produced by freeze crystallization from the cornmint oil. The same enantiomerically pure compound can also be produced synthetically either from pulegone, piperitone, d-3-carene, thymol, or N,N-diethylgeranylamine [7].

Carvone is a monocyclic monoterpene ketone, existing both as R and S enantiomer in natural products. It has potent antiseptic properties and is used as a mosquito repellent and in the food industry as a flavouring agent. The L-Carvone-rich essential oils smell like sweet mint and have been recorded only for three species: *M. spicata* L., *M. longifolia* (L.) Huds. and *M. sauveolens* Ehrh. [19, 25] - Table 1.

Linalool refers to two enantiomers of a naturally occurring terpene alcohol. These have multiple commercial applications, the majority of which are based on its pleasant scent (floral, with a touch of spiciness). Linalool is used as a scent in 60% to 80% of perfumed hygiene products and cleaning agents, including soaps, detergents, shampoos, and lotions.

Linalool is produced by plants from various families, e.g. m.in.: *Lamiaceae* (basil, mint), *Lauraceae* (laurel, cinnamon) and Rutaceae (citrus fruits). In mint essential oils, linalool, as their main constituent, produces bergamot mint (*Mentha* × *piperita* L. var. citrata (Ehrh.) Briq) [12] – Table 1.

Linalool displays bactericidal action against Staphylococcus aureus (MIC in the range of 25-250 g/ml), Escherichia coli (MIC - 25-750 g/ml) and Candida albicans (MIC - 25-250 g/ml) [26].

Pulegone is a monoterpene naturally occurring organic compound and is commonly found in the essential oil of *M. pulegium* L. and *M. microphylla* Koch (*Mentha* species). The essential oil of *M. pulegium* L. (pennyroyal oil) contains pulegone as its main constituent, the percentage of which ranges from 25 to 92% [19, 27]. Pulegone provides the oil with a characteristic scent and taste resembling peppermint and camphor. It has been demonstrated to have antioxidative, antibacterial, antiviral and antifungal properties. It is used as a flavouring agent and in perfumery. Moreover, pulegone is the most potent insecticide among mint constituents. It is used as a pest repellent. Its application in aromatherapy is risky due to its toxic properties [17, 18, 28].

Piperitenone (p-menth-1,4(8)-dien-3-one) is an ingredient of essential oils displaying high antimicrobial activity. Mint oils rich in piperitenone and its derivative, i.e. piperitenone oxide include: *M. suaveolens* and *M. rotundifolia* (Table 1). This oxygenated monoterpene exhibits interesting activities, including cardiovascular, antimicrobial and insecticidal [16, 20].

Aromatherapeutic and cosmetic use

Aromatherapy is a branch of traditional medicine, in which the plant-derived essential oils are used as a therapeutic factor. There are two routes that essential oils permeate the body - inhalational and transdermal. The basic aromatherapeutic procedures in which the essential oils are applied transdermally include massage, bath, poultices, sauna, and aromatherapeutic cosmetics. Via the inhalational route, the oils can be applied during smelling, inspiration, inhalation, air odourising or sauna sessions. The philosophy of aromatherapy consists in the use of essential oils, the selection of which is based on their therapeutic properties and on subjective sensations of patients, although to lesser degree. The only oils to be used are those, the small of which is assessed by patients as nice,

following the rule that we like things beneficial for our body [29-31].

The essential oils containing **menthol** trigger refreshing sensations due to their cooling effects. Therefore, they are highly popular in the perfume industry to obtain an intensive and long-lasting top and middle note. The peppermint essential oil enables to obtain a characteristic fresh scent with a cooling and refreshing menthol note. In aromatherapy, oils containing menthol are used in cleansing and refreshing baths, cooling poultices in inflammations and pruritus (including the scalp). Menthol essential oils are recommended for relieving tiredness, headaches, nervous tension, upper respiratory infections, acne and photodermatoses [32-34] - Table 2. Moreover, menthol essential oils are increasingly used for composing aromatherapeutic cosmetics. They show the shrinking effects on pores and whitening effects on complexions; they also have local anaesthetic and anti-inflammatory action. They are recommended for complexion problems e.g. acne, discolourations and swellings. They are widely used as an active substance in many groups of cosmetics: deodorants, creams, shaving foams, and ointments. Furthermore, menthol essential oils can be used in cosmetics as preservatives [35-38] or as promoters of transepidermal passage, i.e. auxiliary substances, which reversibly alter the stratum corneum structure. Some components of essential oils, e.g. menthol, limonene or terpineol, have been demonstrated to display the above properties [39-40].

The oils in which carvone prevails are characterised by refreshing, sweet-bitter taste and scent. Their scent shows a very intensive to and middle note. The carvone essential oils have anti-inflammatory, calming, astringent, aseptic, and mucous-dissolving properties. They are used in aromatherapy and production of cosmetics or oils for massages; they display antiseptic, tonic, anti-inflammatory, and pore astringent effects. Moreover, they whiten the skin and are particularly recommended for sensitive, allergic and itching skin. In aromatherapy, spearmint is used in mixtures for massages and baths as an agent relieving tiredness and headaches, alleviating migraines, nervous tension, neurasthenia, stress; it can be also useful in upper respiratory tract infections, runny nose and acne (Table 2.) [3, 7, 10-12, 24-25, 29-32].

Linalool essential oils obtained from mint have not been commonly used in classical

Table 2. The important components of mint essentials oils and their aromatherapeutic significance

Main ingredient	Smell and properties	Aromatherapeutic use
Menthol /Menthone	Refreshing menthol-herbal scent showing cooling, antipruritic effects, irritation-relieving, analgesic, antibacterial, antiviral, antifungal, and concentration-facilitating effects	Baths, massage, inhalation, air aromatisation, pharmaceuticals, cosmetics
Carvone	Sweet-mint flavour and scent showing astringent, anti-inflammatory, acne-relieving, skin whitening, pore astringent, and antibacterial effects	Cosmetics massage, inhalation, sauna, air aromatisation
Linalool	floral scent with a touch of spiciness antibacterial antiseptic, refreshing scent	Massage, cosmetics, inhalation
Pulegone	Pungent, mint-herbal scent, alleviating skin diseases, antibacterial action;	Not recommended in classical aromatherapy due to toxic properties. It can be used as a room disinfectant
Piperitenone	Antibacterial effects	Local massage, inhalation,

Authors` compilation based on: [29-40]

aromatherapy. According to some sources [29,41] however, massages or inhalations with oils rich in linalool or pure linalool have relaxing and calming effects. The bergamot mint oil is mainly applied in the perfume industry. Thanks to its specific scent ad washing properties, this oil is also used for producing herbal shampoos, oral hygiene preparations and other washing cosmetics. The bergamot mint essential oil is antiseptic, though toxic in large doses [3, 12, 26].

The pulegone-rich pennyroyal essential oil (from *M. pulegium* L.) is characterised by an interesting, pungent and intensive fragrance. It is often used in original, sophisticated perfumes. Noteworthy, its high doses are toxic for people; therefore, its distribution in undiluted form is not recommended. Since only naturally concentrated essential oils are the raw materials in aromatherapy, their aromatherapeutic application is risky and unacceptable, particularly to infants and children. The pennyroyal oil is a potent insect repellent; its smell is nice, mint and much easier tolerated, as compared commercial repellents of chemical odour [17, 18, 28, 42].

In general, the essential oils containing **piperitenone** and **piperitenone oxide** have the smell that is liked by people, thus their scarce aromatherapeutic applications. Due to their antimicrobial properties, they can be used for local massages of the troublesome skin areas, e.g. feet [16, 20, 29].

Conclusion

Plants from the mint genus (*Mentha* L.) are a source of essential oils of various chemotypes. Their most popular ingredients include menthol/menthone, carvone, linalool, pulegone, and piperitenone oxide. Depending on the most abundant ingredient, essential oils have different fragrances and therapeutic properties. In aromatherapy, the menthol chemotype oil is preferable due to its cooling, analgesic, antipruritic, and concentration-facilitating effects. Oils of a carvone chemotype are also popular as they are beneficial for the skin, exerting astringent, illuminating and anti-inflammatory effects. Linalool chemotype oils (aseptic, refreshing properties) and piperitone oils are less commonly used. The oils with pulegone as the main ingredient can be risky due to potential toxic effects when used in higher doses.

Considering the diversity of applications and action of Mint essential oils, detained nomenclature should be popularised; full plant species names or even names of varieties (e.g. bergamot mint) have to be included on labels.

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