PROPERTIES OF MENTHA PIPERITA: A BRIEF REVIEW

Silvia Cristina Cerini Trevisan\(^1\), Aline Pereira Paes Menezes\(^1\), Sandra Maria Barbalho\(^{1*,2}\), Élen Landgraf Guiguer\(^{1,2}\)

\(^1\)Department of Biochemistry and Nutrition, Faculty of Food Technology of Marília (FATEC), Av. Castro Alves, 62, Marília 17506-000, SP, Brazil.
\(^2\)Department of Biochemistry and Pharmacology, School of Medicine, University of Marília, Av. Higino Muzzi Filho 1001, Marília 15525-902, SP, Brazil.

ABSTRACT

Among several plants, Mentha piperita is one of the herbs most widely used worldwide, with a long history of safe use in medicinal preparations. Its leaf is used as a remedy for common cold, inflammation of the mouth, pharynx, liver, as well as disorders in the gastrointestinal tract such as nausea, vomiting, diarrhea, cramps, flatulence and dyspepsia. This plant possess polyphenols that are highly effective antioxidants and are less toxic than the synthetic ones. This property makes it of great interest to the Food Industry, since the phenolic compounds retard the oxidative degradation of lipids improving the quality and nutritional value of food. The aim of this review is to show that several studies have demonstrated the presence of many different chemical compounds in Mentha piperita and their pharmacological effects. This plant has demonstrated the presence of a wide variety of bioactive compounds that represent a rich resource in phytochemicals of great interest to treat several pathologies. Some of the benefic biological effects show that this plant may play an important role as anti-oxidant, antinociceptive, anti-inflammatory, antimicrobial, anti-carcinogenic, antiviral, anti-allergic and antitumorigenic, indicating its utility in the prevention or treatment of several diseases. Furthermore, we may say that Mentha piperita is a promising plant that may offer low-cost alternative strategy for the use in Medicine and in food industry.

KEYWORDS: Mentha piperita, phytochemicals, glycaemia, lipids, free radicals.

INTRODUCTION

Herbal medicinal compounds are used all over the world as the most natural way to intake of phytochemicals. The use of natural products that are rich in bioactive substances is growing along with the demand for plants containing wide range of antioxidant properties and bioactive molecules capable of neutralizing free radicals slowing the progress of many chronic diseases associated with oxidative stress.\(^{[1,4]}\)

Among the diversity of plants, Mentha piperita (Lamiaceae family) is one of the herbs most widely used worldwide, with a long history of safe use in medicinal preparations. Its leaf is used as a remedy for common cold, inflammation of the mouth, pharynx, liver, as well as disorders in the gastrointestinal tract such as nausea, vomiting, diarrhea, cramps, flatulence and dyspepsia. It is also used as antioxidant, antimicrobial, antiviral, anti-inflammatory, and anti-carcinogenic.\(^{[5-13]}\) plant is known for having several phytochemicals, including polyphenols that are highly effective antioxidants and are less toxic than the synthetic ones. This property makes it of great interest to the Food Industry, since the phenolic compounds retard the oxidative degradation of lipids improving the quality and nutritional value of food.\(^{[2,3]}\)

It is also of great interest for Medicine due to its medicinal activities as antinociceptive, anti-inflammatory, antimicrobial and antioxidant properties. The presence of flavonoids such as eriocitrin, narirutin, hesperidin, luteolin-7-O-rutinoside, isorhoifolin, diosmin, rosmarinic acid, and 5, 7-dihydroxycromone-7-O-rutinoside exert anti-allergic effects.\(^{[14,15]}\) Figure 1 shown the main properties of this plant.
Due to the expansion in the research about the potential use of plants with broad applications and benefits, the aim of this review is to show that several studies have demonstrated the presence of many different chemical compounds in *Mentha piperita* and their pharmacological effects.

**METHODS**

This review was based on a literature survey of papers which used experimental studies involving in vitro or with humans and/or animals. For this research we used the Scielo databases, PMC, PubMed and LILACS. For search of articles the following descriptors were used: *Mentha piperita*, properties of *M. piperita*, *M. piperita* applications.

**COMPOSITION OF THE ESSENTIAL OIL**

The essential oil of *Mentha piperita* contains acetaldehyde, amyl alcohol, menthyl esters, limone, phellandrene, pinene, pugelone, and dimethyl sulfide, alpha-pinene, sabinene, ocimene, gamma-terpinene, terpinolene, alpha- and beta-thujone, citronellol, menthol, menthone, menthofuran, menthyl acetate, isomenthone and other compounds capable of producing the above mentioned effects of this plant.\[^7, 13, 15\]

**COMPOSITION OF THE LEAVES**

In the extract of the leaves of *M. piperita* are present mainly flavonoids and phenolic acids and some of the compounds are menthol, menthone caffeic acid, acetaldehyde, amyl alcohol, menthyl esters, limonene, pinene, cardial glycosides, phellandrene, cadinene, pugelone, and dimethyl sulfide. The constituent features include alpha-pinene, sabinene, terpinolene, ocimene, diterpenes, gamma-terpinene, steroids, fenchene, alpha- and beta-thujone, coumarin, citronellol, carotenes, tocopherols, betaine, choline, saponin, tannins, and other components.\[^7, 8, 15-16\]

**ANTIOXIDANT PROPERTIES**

Lack of antioxidants in organism, promotes the oxidative stress due to the presence of free radicals, which in turn causes a variety of pathological conditions. Antioxidants, which are an integral part of biologically active substances, are of great interest. They can reduce mutagenic influence, regulating the oxidation process of free radicals. According to literature, a number of biologically active substances, which are produced by plants and have antioxidant activity, are known. They include α-tocoferol (vitamin E), tannins, ascorbic acid (vitamin C), β-carotene, a number of protein compounds with enzymatic activity, flavonoids, polysaccharides, terpenoids, polyphenol compounds and etc. *Mentha pipertita* have antioxidant properties due to presence of several bioactive substances.\[^17\]

The antioxidant properties of *Mentha pipertita* are important to prevent inflammation process and dyslipidemia as well as several chronic degenerative diseases as diabetes and cardiovascular diseases (Table 1).
Table 1: Metabolic effects of *M. piperita*.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Effect</th>
<th>Comment</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>M. piperita</em> juice in diabetic Wistar rats</td>
<td>Decrease the glycaemia, cholesterol, LDL-c, VLDL-c and triglycerides in the offspring of diabetic rats.</td>
<td>Mentha juice may help prevention of diabetes and its complications in diabetic rats offspring.</td>
<td>Barbalho et al[12]; Figueroa-Pérez et al[9]; David et al[10]</td>
</tr>
<tr>
<td>supplementation with <em>M. piperita</em> in Wistar rats</td>
<td>Reduction of blood levels of cholesterol, triglycerides, LDL-c and glucose.</td>
<td><em>M. piperita</em> may prevent diabetes and its complications.</td>
<td>Mesbahzadeh et al[18]</td>
</tr>
<tr>
<td>Menthol and menthone from leavein rats infected by <em>Schistosoma mansoni</em></td>
<td>Immunomodulatory and anti-inflammatory action in murine model.</td>
<td>Mentha piperita leaves exhibit an immunomodulatory and antiparasitic effect in the experimental murine model of schistosomiasis.</td>
<td>Zaia et al[19]</td>
</tr>
</tbody>
</table>

**ANTIMICROBIAL EFFECTS**

The constituents of the essential oil of *M. piperita* have different modes of action in bacteria and eukaryotic cells. They exhibit strong bactericidal properties, and in eukaryotic they modify apoptosis and differentiation, interfere with the post translational modification of proteins and induce or inhibit certain liver detoxifying enzymes.[4]

Antibacterial activity of plants may be attributed to the presence of phenolic compounds that behave as pro-oxidants because they undergo high oxidation, so instead of eliminating the reaction of free radical chain, they lead to generation of superoxide and quinones. The most easily oxidized phenolics such as quercetin and gallic acid have pro-oxidant activity but tannins, due to the high molecular weight have little pro-oxidant activity.[20]

According to Shehadi et al[21], the bioactivity found in different compounds of plants are generally attributed to the presence of secondary metabolites which produce physiological actions. The extracts can be categorized into several classes among which are terpenoids, flavonoids and phenolics that are known to be active against bacteria, viruses and protozoa.

The antimicrobial effects of the essential oil can be attributed to their mechanisms of action within the cell membrane. The implications of this mechanism involves lysis and loss of membrane integrity due to changes that determine the output of ions (hydrogen, potassium and calcium), causing damage in the essential cell survival processes. Menthol and menthone present in the essential oil components of *M. piperita* is responsible for the antimicrobial activity.[5]

**OTHER EFFECTS**

According to Ferreira et al[8], menthol is one of the main components of the essential oil of *M. piperita* that produce anti-cancer activity inducing cell death, either by necrosis or apoptosis (in Caco-2 cell line). The cytotoxicity associated with essential oil has been attributed to various effects such as the production of reactive species, change in fluidity and membrane permeability, tubulin polymerization, imbalance in ion transport, and inhibition of protein function.

Rodriguez Fragnoso et al[11] noted that *M. piperita* relaxes the lower esophageal sphincter, which is useful as an antispasmodic agent by taking double contrast barium and in patients with dyspepsia. It acts by inhibiting the spontaneous peristaltic activity, reducing the total gastrointestinal transit and gastric emptying by lowering basal tone in the intestinal tract, reducing low frequency waves in the esophagus, and small intestine by slowing the peristaltic movements and inhibiting responses induced by potassium depolarization. Other biological effects of *M. piperita* are found in table 2.

Table 2: Other effects of *Mentha piperita* in different models.

<table>
<thead>
<tr>
<th>Part of the plant</th>
<th>Compounds</th>
<th>Effects</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herbal preparation with MP leaves in humans</td>
<td>-</td>
<td>Decreased anion secretion via activation of two epithelial chloride channels. These were the cAMP-dependent cystic fibrosis trans membrane conductance regulator and calcium-activated chlo-ride channels.</td>
<td>Allam et al[22]</td>
</tr>
<tr>
<td>MP extracts leaves in fish</td>
<td>Potassium, calcium, iron, manganese and magnesium. Vitamin A, C and E.</td>
<td>Dose-dependent increases in growth, immune (in skin, mucus and blood serum) and hematological parameters, as well as in amylase activity and in the number of lactic acid bacteria.</td>
<td>Adel et al[23, 24]</td>
</tr>
</tbody>
</table>
Barbalho et al. World Journal of Pharmaceutical and Medical Research

<table>
<thead>
<tr>
<th>Essential oil of the leaves in stored minced beef meat</th>
<th>Menthol (33.59%) and iso-menthol (33%)</th>
<th>Decrease in TBARS values.</th>
<th>Smaoui et al[25]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essential oil in <em>Musca domestica</em> and <em>Anopheles stephensi</em></td>
<td>Menthol and menthone</td>
<td>Substantial larvicidal activity against housefly and <em>Anopheles stephensi</em>.</td>
<td>Chauhan et al[26]</td>
</tr>
<tr>
<td>Leaves in excision wound model</td>
<td>decarboxyrosemarinic acid galactoside</td>
<td>Increase the cellular proliferation and collagen synthesis at the wound site (healing activity); decrease the levels of lipid peroxides and increase of the antioxidant enzymes superoxide dismutase, catalase and glutathione peroxidase</td>
<td>Rais and Ali[27]</td>
</tr>
<tr>
<td>Essential oil in the plant and in chocolate</td>
<td>In plant: peppermint: menthol (30.35 %), menthone (21.12 %), and others; in Chocolate mint: menthol (28.19 %) and menthone (15.53 %).</td>
<td>The antimicrobial activity of peppermint against <em>E. coli</em>, <em>Streptococcus aureus</em> and <em>Pseudomonas aeruginosa</em> was stronger than that of the chocolate mint. For the anti-oxidation test, peppermint showed better properties, however, for the scavenging NO radical activity and as anti-inflammatory, chocolate mint was superior to peppermint.</td>
<td>Tsai[28]</td>
</tr>
<tr>
<td>Essential oil in <em>Clostridium perfringens</em></td>
<td>Oxygenated compounds, especially oxygenated monoterpenes and phenylpropanoids.</td>
<td>Oxygenated monoterpenes and phenylpropanoids might be responsible for the antimicrobial activity.</td>
<td>Radaelli et al[29]</td>
</tr>
<tr>
<td>Leaves calves and piglets</td>
<td>-</td>
<td>Therapeutic option for gastrointestinal and respiratory diseases in calves and piglets.</td>
<td>Ayrle et al[30]</td>
</tr>
</tbody>
</table>

TBARS: Thiobarbituric acid reactive substances.

CONCLUSION

Studies with *Mentha piperita* has demonstrated the presence of a wide variety of bioactive compounds that represent a rich resource in phytochemicals of great interest to to treat several pathologies. Some of the beneficial biological effects show that this plant may play an important role as anti-oxidant, antiinfective, anti-inflammatory, antimicrobial, anti-carcinogenic, antiviral, anti-allergic and antitumorigenic, indicating its utility in the prevention or treatment of several diseases. Furthermore, we may say that *Mentha piperita* is a promising plant that may offer low-cost alternative strategy for the use in Medicine and in food industry.

REFERENCES


