Compositional profiling of Mentha piperita

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ABSTRACT
Antimicrobial properties of aromatic plants are being used to develop drugs and food preservatives as the natural sources always pose less hazards as compare to synthetic ones. In this context, essential oils have gained attention owing to the presence of phenolic compounds. The essential oil of Mentha piperita is a potential candidate that exhibit antimicrobial, antioxidant and radical-scavenging activities. Present research was an attempt to explore the raw materials for the proximate like moisture, fat, protein, fiber, ash & NFE. Proximate composition of peppermint was 84.41±0.48, 2.75±0.52, 2.72±0.27, 6.12±0.60, 3.12±0.36 and 0.79±1.78 of moisture, crude protein, crude fat, crude fiber, ash and NFE, respectively. Principle active constituents in peppermint oil are monoterpenes mainly menthone, menthol and their derivatives (e.g. isomenthone, acetylmenthol, neomenthone, pulegone & menthofuran).

Key words: Mentha piperita, proximate composition, active constituents.

INTRODUCTION
Millions of people around the world are subjected to severe food safety issues due to contaminated food. According to World Health Organization (WHO) food safety issue is “Reduction in the economic productivity and widespread health related issues are major problems (WHO, 2007). Medicinal and preservative properties of aromatic plants are being used since ancient times. These aromatic plants also provide a particular characteristic flavour to the foods (Marino et al., 2001).

Essential oils from medicinal and edible plants, herbs, and spices are gaining significant spotlight in the world of science used as an alternative to chemical preservative to reduce food-borne pathogens proliferation in foods as well as to extend shelf life of the processed food products by retarding the activity of food spoiling agents (Baydar et al., 2004, Rota et al., 2008; Oke et al., 2009). Nowadays, the natural sources of medicine are being used to develop drugs as they always pose less hazards as compare to costly synthetic drugs, owing to the antimicrobial (Gordon & David, 2001).

Belonging to family Labiatae peppermint (Mentha piperita) is native from Asia and Europe, mostly present along the mountains and sea coasts of Brazil. Peppermint essential oils are mostly used as anti-congestive and expectorant to cure respiratory diseases and also have an antispasmodic activity on vascular and digestive system especially in folk medicines. It is best known because of its antibacterial activity (Sousa et al., 2010).

Peppermint contains 88.2 % moisture and 1% oil. Ascorbic acid, β-carotene and Total iron content in peppermint is 23.9, 4.3 and 50.6 mg/100 g respectively. (Singh et al., 2001). Essential oil of peppermint comprises about 1% of herb in which principal active constituent is monoterpenes mainly menthone, menthol and their derivatives (e.g. isomenthone, acetylmenthol, neomenthone, pulegone & menthofuran). Menthol inhibits bacteria because of broad spectrum of strong
antibacterial activity (Pattnaik et al., 1997). Escherichia coli, Bacillus cereus, Staphylococcus aureus, Enterococcus faecium, Bacillus subtilis & Klebsiella pneumoniae are some bacterial strains against which peppermint is known to be strongly effective. Antiviral and fungicidal activities are also shown by peppermint. Against herpes, influenza and other viruses it is a strong virucidal (Niculae et al., 2009).

Different studies revealed that peppermint essential oil is effective against headache, common cold, symptoms of irritable bowel syndrome, dyspepsia, nausea, ailments of skin, respiratory system, immune system, nervous system and digestive system. Its analgesic effect is being employed in pain killers. Due to its larvicidal activity peppermint oil is being used as mosquito repellent and also has antinematodal properties. Peppermint is commonly used in foods for flavour and due to its essential oil functional properties it is used in skin care products and cosmetics (Scavroni et al., 2005). It possesses chemopreventive and antimutagenic properties (Samarth et al., 2006).

**MATERIALS & METHODS**

The study was conducted in the Food Safety and Nutrition Research Section, National Institute of Food Science and Technology, University of Agriculture, Faisalabad. The materials used and protocols followed are described as under;

**Procurement of materials**

Peppermint leaves were obtained from Metro cash and carry, Faisalabad and Reagents & standards were purchased from Merck (Merck KGaA, Darmstadt, Germany) and Sigma-Aldrich (Sigma-Aldrich Tokyo, Japan).

**Proximate analysis of samples**

Analysis for moisture, ash content, crude protein, crude fat, crude fiber and nitrogen free extract (NFE) of ground peppermint leaves were carried out according to their respective methods (AOAC 2006). All the tests were carried out in triplicates.

**Moisture content of samples**

Moisture content of peppermint leaves was determined by drying the sample in Air Forced Draft Oven (Model: DO-1-30/02, PCSIR, Pakistan) at 105±5°C till constant weight achieved according to AOAC (2006) Method No. 934-01.

**Crude protein of samples**

Protein content of peppermint leaves sample was determined using Kjeldal Apparatus (Model: D-40599, Behr Labor Technik, Gmbh-Germany) as per procedure described in AOAC (2006) Method No. 984-13. As per this procedure, ground peppermint leaves were digested with conc. H₂SO₄ by using digestion mixture (K₂SO₄:FeSO₄:CuSO₄ as 100:5:10) until the color was transparent greenish. The digested material was then diluted up to 250 ml in volumetric flask. 10 mL of 40% NaOH with 10mL of digested sample were taken in distillation apparatus whereas liberated ammonia was collected in a separate beaker containing 4% boric acid solution, using methyl red as an indicator. Consequently, ammonium borate was formed that was used for nitrogen determination in sample. Thus percentage of nitrogen in sample was estimated by titrating the distillate against 0.1 N H₂SO₄ solution till light golden coloration. Crude protein content was calculated by multiplying nitrogen percent (N %) with factor (6.25).

N (%) is equal to

\[
\text{N (\%)} = \frac{\text{Vol. of 0.1N H}_2\text{SO}_4 \times 0.0014 \times \text{Vol. of dilution (250mL)}}{\text{Vol. of distillate taken \times Weight of sample}}
\]

\[
\text{Crude protein (\%)} = \text{Nitrogen (\%)} \times 6.25
\]

**Crude fat of samples**

Crude fat content was determined using hexane as solvent in Soxlet apparatus (Model: H-2 1045 Extraction Unit, Hoganas, Sweden) following the protocol of AOAC (2006) Method No. 920-39.

**Crude fiber of samples**
Crude fiber in fat free samples was estimated by digesting firstly with 1.25% H₂SO₄ for 30 min and then with 1.25% NaOH solution through Labconco Fibertech (Labconco Corporation Kansas, USA) as described in AOAC (2006) Method No. 978-10. Afterwards, sample was filtered and washed with distilled water. The residue was weighed and placed in muffle furnace at temperature of 550-650°C till grey or white ash was obtained. The crude fiber percentage was estimated according to the following expression.

**Total ash of samples**

Ash in each dry sample was determined by direct incineration in a Muffle Furnace at 550-600°C after charring, till grayish white residue following Method No. 942-05 as described by AOAC (AOAC, 2006).

**Nitrogen free extracts (NFE) of samples**

NFE in peppermint leaves samples was calculated according to the given expression:

\[ \text{NFE} \% = 100 - (\text{Crude Protein} \% + \text{Crude Fiber} \% + \text{Crude Fat} \% + \text{Ash} \% + \text{Moisture} \%) \]

**RESULTS AND DISCUSSION**

Mentha piperita is a medicinal plant that is cultivated throughout Asia, Europe and North America. Peppermint essential oil is used in aelopathic medicines, mouth washes and oral preparation like dental creams and toothpastes. Oil of Mentha piperita was used in conventional medicine as well as food preservative due to their strong antibacterial, antifungal and anti-yeast activity. This essential oil is also used to attenuate skin maladies, circulatory system, digestive system, nervous, immune system and respiratory system. Current research was an effort to investigate the effect of peppermint oil in combating food illnesses and food spoilage issues. For the purpose, peppermint was analyzed for compositional aspects while peppermint essential oil was subjected to antimicrobial and antioxidant assays as well as used in formulating a bakery product followed by 15 days storage study. The collected data was then subjected to statistical analysis to test the level of significance and final results are discussed below:

**Proximate and mineral analysis of samples**

The raw material was procured to compositional analysis to determine the quality attributes of peppermint. Ground peppermint leaves were assessed for their chemical composition by investigating various parameters and findings are presented in Table 1. According to the results obtained, peppermint contained 84.41±0.48% moisture, 2.75±0.52%, 2.72±0.27%, 6.12±0.60%, 3.12±0.36% and 0.79±1.78% of moisture, crude protein, crude fat, crude fiber, ash and NFE, respectively. According USDA Basic Report: 02064, the proximate composition of peppermint is as: moisture 78.65 g/100 g, protein 3.75 g/100 g, lipids 0.94 g/100 g, sugars 14.89 g/100 g, fiber 8.0 ash 1004 mg/100 g and calories 70 kcal/100 g.

Furthermore, according to Singh et al. (2001) Peppermint contains 88.2% moisture. Total iron content Ascorbic acid and β-carotene in peppermint is 50.6, 23.9 and 4.3 mg/100 g respectively. Essential oil of peppermint comprises about 1% of herb in which principal active constituent is monoterpenes mainly menthone, menthol and their derivatives e.g. isomenthone, acetylmenthol, neomenthone, pulegone & menthofuran. Menthol inhibits bacteria because of broad spectrum of strong antibacterial activity (Pattnaik et al., 1997).

Major minerals found in peppermint leaves are 33 g/kg K, 15.3 g/kg Ca, 5.8 g/kg Mg and lower amounts of Na and other minerals like 12 mg/kg Cu, 51 mg/kg Zn and 188 mg/kg Mn, 239 mg/kg Fe. Trace minerals are as 941 μg/g Cr, 477 μg/g Al, 325 μg/g I and 147 μg/g Se are also present (Lozak et al., 2002).

Padmini et al. (2010) revealed that mineral contents are a crucial part of the inhibitory mechanism against microorganisms and are also related to the activity of effective active components and phytochemical constituents. Various studies have proved that biologically active constituents and micronutrients hinder growth and interfere with metabolism of microorganisms responsible for their destruction. Results of research revealed mineral contents of peppermint exhibited the presence of essential minerals like sodium, magnesium, potassium, calcium,
chromium, iron, cobalt, copper, zinc and selenium in adequate amount. The mineral content was rich in the peppermint. These minerals are as: Ca 255.95 ± 9.01 ppm, Mg 3.90 ± 0.14 ppm, Na 147.57 ± 4.68 ppm, K 15.56 ± 0.51 ppm, Fe 2.03 ± 0.052 ppm, Cu 0.88 ± 0.045 ppm, Se 0.26 ± 0.008 ppm, Cr 0.19 ± 0.009 ppm, Co 0.25 ± 0.012 ppm and Zn 0.79 ± 0.025 ppm.

Table 1: Composition of peppermint

<table>
<thead>
<tr>
<th>Constituents</th>
<th>Quantity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>84.41±0.48</td>
</tr>
<tr>
<td>Crude protein</td>
<td>2.75±0.52</td>
</tr>
<tr>
<td>Crude fat</td>
<td>2.72±0.27</td>
</tr>
<tr>
<td>Crude fiber</td>
<td>6.12±0.60</td>
</tr>
<tr>
<td>Ash</td>
<td>3.12±0.36</td>
</tr>
<tr>
<td>NFE</td>
<td>0.79±1.78</td>
</tr>
</tbody>
</table>

Values are expressed as means ± standard deviation

It is evident from various research studies that minerals take active part in enhancing antimicrobial properties of plant extracts and essential oils. In 1949, different studies proved that zinc plays a major role in intensifying antibacterial effects of essential oils. Mechanism behind zinc ion antibacterial potential is that, zinc ion binds into bacterial membrane, resulting into a prolonged lag phase, thus, disturbing the growth cycle. Such perturbations cause up rise in organism’s generation time. As a result, completion of cell division of each organism takes longer time to complete. Manganese also plays a vital role in different enzyme systems and is essential component of many biological systems. Manganese is involved in conducting different biochemical activities like bone formation, energy production and protein metabolism. This mineral not only showed a highly remarkable bactericidal activity but also participated in elevating the potentials of antibiotics against various bacterial strains.

Other mineral like copper has been found to raise bacterial death rate while iron has been reported to play a major role in reduction of infections and maternal health maintenance (Beal et al., 2003).

REFERENCES


