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A REVIEW ON PEPPERMINT OIL

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Peppermint oil is obtained from the leaves of the perennial herb, *Mentha piperita* L. and *M. arvensis* var. *piperascens* a member of the Labiatae family. This family includes many well-known essential oil plants such as spearmint, basil, lavender, rosemary, sage, marjoram and thyme. This is a well known and important medicinal plant widely used in several indigenous systems of medicine for various therapeutic benefits viz. analgesic, anesthetic, antiseptic, astringent, carminative, decongestant, expectorant, nervine, stimulant, stomachic, inflammatory diseases, ulcer and stomach problems. The present review is an up-to-date and comprehensive analysis of the chemistry, pharmacology, analysis, and uses of Peppermint oil.

Keywords : Mentha piperita, Mentha arvensis, peppermint oil, Irritable Bowel Syndrome.

INTRODUCTION

Peppermint oil is obtained from the leaves of the perennial herb, *Mentha piperita* L. and *M. arvensis* var. *piperascens* a member of the labiatae family. It is a colourless, pale yellow or pale greenish-yellow liquid having characteristic odour and taste followed by a sensation of cold, freely soluble in ethanol (70%). The solution may show an opalescence.[1] The oil is found on the undersides of the leaves, is extracted by steam distillation and is generally followed by rectification and fractionation before use.[2]

India is world's largest producer and exporter of mint oil. Mint oil and its constituents and derivatives are used in food, pharmaceutical and perfumery and flavouring industry. Its main constituent, menthol, is used in the manufacture of lozenges, toothpastes, pain balms, cold balms, Dabur Pudin Hara, etc. The basic raw material for mint oil is leaves of a plant *Mentha arvensis.*[3] The oil is used for treating certain stomach disorders like indigestion, gas problem, acidity, etc. It is the main ingredient of ayurvedic medicines like Daburs 'Pudin Hara'. The oil is a natural source of menthol, which is the main ingredient of cough drops and ointments like Vicks Vaporub, etc.

STANDARDS[1]

Peppermint Oil contains not less than 4.5 per cent w/w and not more than 10.0 per cent w/w of esters, calculated as menthyl acetate, $C_{12}H_{22}O_2$, not less than 44.0 per cent w/w of free alcohols, calculated as menthol, $C_{10}H_{20}O$, and not less than 15.0 per cent w/w and not more than 32.0 per cent w/w of ketones, calculated as menthone, $C_{10}H_{18}O$.

EXTRACTION OF PEPPERMINT OIL

Peppermint oil is extracted from the whole plant above ground just before flowering. The oil is extracted by steam distillation[4] from the fresh or partly dried plant and the yield is 0.1 - 1.0 %.

Supercritical fluid extraction was performed by I. Gãinar *et al* [5] and was compared with that of peppermint oil isolated by hydrodistillation. The oil extracted under SFE-1 conditions had a higher content of menthone, menthol, 1, 8-cineole and piperitone compared with the SFE-2 conditions, and a lower content of menthyl acetate, α-caryophyllene and α-cadinene. The compounds mainly responsible for the peppermint fragrance (oxygenated monoterpenes) amounted to 79.2% for SFE-1 compared with 74.4% at SFE-2 conditions. In contrast, sesquiterpenes were only 7.7% for SFE-1 and 11.6% for SFE-2. The hydrodistilled oil possessed the higher percentage of terpene acetates, 12.5% against 12.0% for SFE-1.

Recently on new method was developed by Farid Chemet *et al.*[6] for the extraction of essential oils that is much more faster as compared with the conventional hydrodistillation process.

CHEMICAL CONSTITUENTS [7]

Various constituents of peppermint oil as per monographs of Internation Pharmacopoeia are limonene (1.0-5.0%), cineole (3.5-14.0%), menthone (14.0-32.0%), menthofuran (1.0 -9.0%), isomenthone (1.5-10.0%), menthyl acetate (2.8-10.0%), isopulegol (max. 0.2%), menthol (30.0-55.0%), pulegone (max. 4.0%) and carvone (max. 1.0%). The ratio of cineole content to limonene content should be minimum two. Chemical structures of these constituents were given in Fig.1.

EVALUATION

International Pharmacopoeia monograph[7]

Relative density : 0.900 to 0.916.

Refractive index : 1.457 to 1.467.

Optical rotation : -10° to -30°.

Acid value : maximum 1.4, determined on 5.0 g diluted in 50 ml of the prescribed mixture of solvents.

Fatty oils and resinified essential oils : Complies with the

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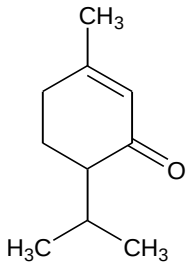
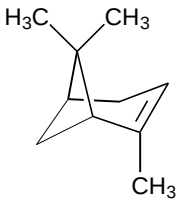
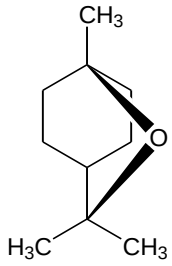


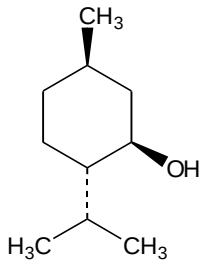
Piperitone



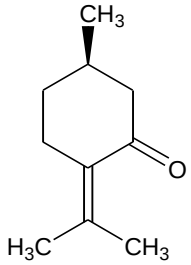
α-pinene



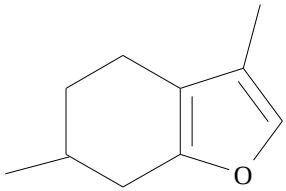
1,8, cineole



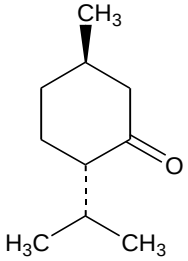
Menthol



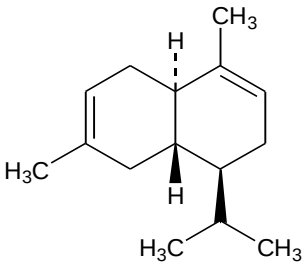
Pulegone



Menthofuran



l-menthone



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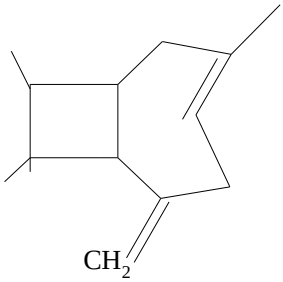
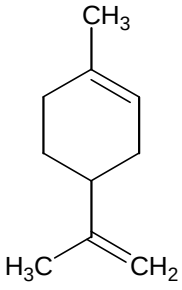
Cadinine



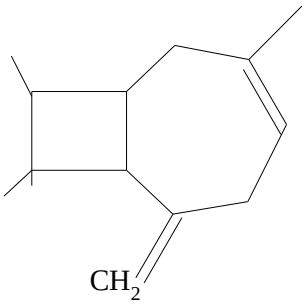
Caryophylline



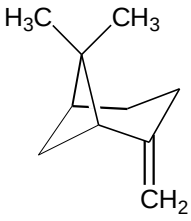
limonene

CH_3COOCH_3

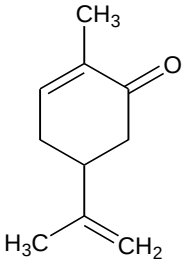
Methyl acetate



Isocaryophyllin



α-pinene



Carvone

FIGURE 1. Various chemical constituents of peppermint oil.

test for fatty oils and resinified essential oils.
Chromatographic profiling of peppermint oil can be done with Gas chromatography with flame ionization detector.

Evaluating Peppermint Oils by Chiral GC/MS [8]

Often, a product is adulterated to increase desirable properties of the natural oil or to avoid costly manufacturing of all- natural oil. Adulteration usually is accomplished by adding a similar but cheaper oil, such as cornmint oil (Mentha arvensis), or by diluting the oil with various solvent oils. Adulteration and quality consistency of peppermint oil fuels concern over compromised quality, but also introduces health safety issues; for example, there is potential for an allergic reaction to an added unnatural compound or excess of a natural component. Despite the value of identifying and quantifying major components like menthol, methone and methyl acetate, dependable identification and quantification is difficult because each of these is represented by several stereoisomers. Menthol, for example, has three chiral centers, for a total of eight stereoisomers, making chromatographic separation difficult. For this GC/MS method was published by Julie Kowalski optimized to following conditions claiming detection of major components important to the quality of peppermint oil product, thus providing manufacturers and buyers with consistent profiles with which to confirm and track product quality.

Column: Rt-ãDEXsa™ 30m x 0.25mm ID, 0.25ìm
Inj.: 1.0ìL neat, split (split ratio 1:150)
Inj.: temp.: 230°C
Carrier gas: helium, constant pressure
Flow rate: 35 cm/sec. at 100°C
Oven temp.: 40°C to 120°C @ 5°C/min. to 135°C @ 3°C/min. to
200°C @ 5°C/min.
Det: MS

Spectroscopic study of Mentha oils[8]

The visible fluorescence and excitation spectra of Mentha oils (Japanese mint oil, peppermint oil and spearmint oil) have been recorded. Different physical constants which are characteristic of the fluorescent molecules have been calculated for all three oils. Results reveal that the same group of organic compounds dominate in the oils of peppermint and spearmint, whereas some different compound is present in Japanese mint oil. Study also demonstrated that the fluorescence intensity of these oils is comparable to that of Rhodamine 6G dye in methanol solution and suggests that Mentha oils may be a useful lasing material in the 450-600 nm wavelength range.

Estimation of Menthone, Menthofuran, Menthyl Acetate and Menthol in Peppermint Oil by Capillary Gas Chromatography[10]

Support-coated open-tubular (SCOT) glass capillary column (43 m x 0.5mm I.D.) coated with SP-1000 was fitted into an aluminium support cage. A Packard-Becker 419 gas chromatograph equipped with dual flame ionization detectors and dual injectors was used. The injection port temperature was 190°C and detector temperature 190°C. The multilinear temperature programmer was used as follows. Initial temperature of 64°C was held for 3 min, then the temperature was raised at 0.5°C/min to 80°C, then at 5°C/min to the final temperature of 155°C, with an isothermal hold of 12 min at 155°C. The carrier gas was helium at a flow-rate of *cu.* 2 ml/mm with nitrogen (18 ml/min) as make-up gas. Air flow was 300 ml/min and hydrogen flow 30 ml/min. The velocity of the carrier gas was about 21.5 cm/sec whilst the capacity ratio (k) of the column was 6.5 using docosane at 185°C.

Quantitative determination of Pulegone by Gas-Liquid Chromatography

Various methods for the estimation of the pulegone was found in the literature. It was due to one problem that pulegone has a retention time,[11] according to the columns employed, that is either very near to that of menthol (main component), with consequent overlap or very similar to those of isomenthol and some sesquiterpene hydrocarbons (e.g. cadinene and caryophyllene).[12-14]

USES

Hot flushes in women

A single-blind randomised control crossover study[15] was performed to look at the effects of a peppermint and neroli hydrolat spray on hot flushes in women being treated for breast cancer. Only 18 of the 44 patients (41%) preferred the hydrolat spray to a plain water spray, which was less than the 80% required to offer this spray as a standard suggestion for hot flush management. However a small number of those choosing it found it extremely helpful. Both sprays appeared to lessen hot flush annoyance. Previous chemotherapy appeared to be a factor influencing the choice of spray.

Irritable Bowel Syndrom

Small intestine bacterial overgrowth and lactose intolerance are associated with increased gas production, which may sometimes trigger abdominal discomfort and bloating which are also considered also the cardinal symptoms in IBS.[16-17] Furthermore, a high prevalence of celiac disease has been observed in patients with bloating and diarrhoea and positive H_2-lactose breath test. In these patients the symptoms related to lactase deficiency seem to be the only

manifestation of celiac disease18. Basing themselves on these data, some authors suggest that these diseases should be previously excluded in clinic therapeutic trials with investigational drugs that affect IBS19. Peppermint oil has been tested in children[20] and adults[21] with IBS, with conflicting results. A recent meta-analysis on this topic concluded that the role of peppermint oil has not yet been established beyond a reasonable doubt.[22] In this regard one double blind study by L. Marzio *et al.*[23] 57 patients with irritable bowel syndrome were treated with peppermint oil (two enteric-coated capsules twice per day or placebo) and 4 weeks treatment with peppermint oil improves abdominal symptoms in patients with irritable bowel syndrome.

Antimicrobial and anti-plasmid activities[24]

The antimicrobial activities were determined on the Gram (+) Staphylococcus epidermidis and the Gram (?) Escherichia coli F'lac K12 LE140, and on two yeast Saccharomyces cerevisiae 0425 ä/1 and 0425 52C strains. The antiplasmid activities were investigated on E. coli F'lac bacterial strain. Each of the oils exhibited antimicrobial activity and three of them antiplasmid action. The interaction of peppermint oil and menthol with the antibiotics was studied on the same bacterial strain with the checkerboard method. Eexperiments proved the antiplasmid activity of peppermint oil and its main constituent, menthol, which means that menthol-containing substances are potential agents that could eliminate the resistance plasmids of bacteria. The main point of this menthol-induced plasmid elimination is a special mechanism of action. The compound preferentially kills the plasmid-containing bacteria due to their increased sensitivity to menthol.

Postoperative Nausea

Tate[25] demonstrated that inhalation of peppermint oil vapors significantly reduced postoperative nausea and the requirement for pharmacologic antiemetics following gynecologic surgery. Inhalation of isopropyl alcohol vapors is a South American folk remedy for nausea. More recently, its use has been advocated for transport-related nausea1 as well as for PONV in children and adults.[26] Winston et all[27] found that isopropyl alcohol inhalation relieved PONV more rapidly than ondansetron 4 mg IV, but a placebo group was not studied. A randomized, doubleblind, placebo-controlled study[28] on 33 surgery patients indicate that initial treatment of postoperative nausea with aromatherapy reduces patients' subjective perception of nausea and IV antiemetic use in the PACU by nearly 50%.

Against herpes simplex virus[29]

This essential oil is capable to exert a direct virucidal effect on HSV. Peppermint oil is also active against an acyclovir resistant strain of HSV-1 (HSV-1-ACVres), plaque formation was significantly reduced by 99%. Considering the lipophilic nature of the oil which enables it to penetrate the skin, peppermint oil might be suitable for topical therapeutic use as virucidal agent in recurrent herpes infection.

Larvicidal and mosquito repellent action[30]

Oil of Mentha piperita L. (Peppermint oil), a widely used essential oil, was evaluated for larvicidal activity against di•erent mosquito species: Aedes aegypti, Anopheles stephensi and Culex quinquefasciatus by exposing IIIrd instar larvae of mosquitoes in enamel trays 6′ 4 inch2 size filled to a depth of 3 inch with water. The oil showed strong repellent action against adult mosquitoes when applied on human skin. Percent protection obtained against An. annularis, An. culicifacies, and Cx. quinquefasciatus was 100%, 92.3% and 84.5%, respectively. The repellent action of Mentha oil was comparable to that of Mylol oil consisting of dibutyl and dimethyl phthalates.

Treatment of Nervous Disorders and Mental Fatigue

Peppermint and its EO are believed to be effective in the treatment of nervous disorders and mental fatigue (Tisserand, 1993),[31] suggesting that they may exert some psychoactive actions. The specific hypothesis used to test for such pharmacological actions was guided by reports that it may be effective in the treatment of mental fatigue (Tisserand, 1993), suggesting that the oil might possess a similar action to psychostimulants. Study by Toyoshi Umezu *et al.*[32] determined the effects of peppermint oil on behavior in mice. The present study revealed that intraperitoneal administration of natural peppermint oil, which is used for medicinal purposes in aromatherapy, caused a significant dose dependent increase in ambulatory activity. This result demonstrated that peppermint oil produces an apparent effect on behavior in mice.

Indigestion[33]

Adding few drops of peppermint essential oil in a glass of water and drinking it after meal gives relief from indigestive properties. This oil acts as carminative and helps effectively in removing the gas.

Other Uses

· It was also reported that peppermint oil is effective against type I allergic reactions.[34-35]

- 1: 20 dilution (5.0%) of concentrated peppermint water has now been shown to exhibit considerable fungistatic but not fungicidal activity against strains of *Aspergik niger* and *Penicillium ckysogenum.*[36]
- One interesting study concluded that peppermint oil can indeed reduce daytime sleepiness. However, the mechanisms by which peppermint oil has its effect and the applicability of these findings to situations in everyday life will require further empirical investigation.[37]
- Peppermint oil was reported to have a relaxing effect in patients with colonic spasms.[38]
- One recent study by J. A. Reed *et al.* results is that peppermint scent can be used as an effective adjunct to decrease appetite, decrease hunger cravings, and consume fewer calories, which may lead to weight reduction and greater overall health.[39]
- The use of peppermint oil given orally can cure certain internal ailments such as gallstones or ureteric stones. The doses of them sometimes exceed 45 ml/day in France and Germany.[40]
- Headlice: Phenols, phenolic ethers, ketones, and oxides (1, 8-cineole) appear to be the major toxic components of these essential oils *when* used on lice. Aldehydes and sesquiterpenes may also play a role.[41]
- In vapor therapy, peppermint oil can help to increase concentration and to stimulate the mind, as well as sorting out coughs, headaches, nausea and also has value as an insect repellant.[42]
- External usage of peppermint oil gives relief from pain. The existence of calcium antagonism in peppermint oil helps in removing the pain. It has wonderful cooling properties and reduces the fever also.[42]
- A mouthwash with peppermint oil included can help with bad breath and gum infections.[42]
- When included in a cream or lotion, it will help to ease the sting of sunburn, reduce redness of inflamed skin, reduce itchiness and cools down the skin with its vasoconstrictor properties.[42]
- The oil gives cooling effect on your head and helps in removing the dandruff and lice.[42]

GENOTOXICITY

Anderson and Jenson[43] (1984) found no mutagenicity of peppermint essential oil in the salmonella/ microsomes assay. Essential oil of *menthe spicata L.* appeared to be slight genotoxic.[44] In human lymphocytes peppermint oil was found to be cytotoxic and induced chromosomes aberrations only when inhibition of mitotic activity was 70 % or higher. Peppermint may be classified as "high toxic clastogen", which induces chromosomes aberrations by secondry mechanism associated with cytotoxicity.[45] On the other hand, peppermint essential oil does not behave like a "typical elastic clastogen" because it is mutagenic in *D. melanogaster* somatic mutation and recombinant test in vivo.[46] The component of peppermint oil that causes genotoxicity is yet not fully understood.

SIDE EFFECTS

Case report of 58 years women smoked heavily changed to menthol containing cigarettes. After three months she became irritable and quarrelsome, in contrast to her former placid good-natured state, and had gastrointestinal upset with occasional vomiting. Her speech became thick and she developed a tremor of the hand and an unsteady gait. On one occasion mental confusion and depression occurred and she was admitted to hospital with a toxic psychosis that was considered to be due to menthol addiction. Within 17 days of the withdrawal of menthol cigarettes, she became normal in every respect without specific treatment.[47]

One more case report of acute lung injury[48] following IV injection of peppermint oil by 18 year old women developed fulminant pulmonary edema, presumably due to direct toxicity and a resultant increase in pulmonary vascular permeability.

CONTRAINDICATIONS[49]

Obstruction of bile ducts, gall bladder inflammation, severe liver damage. In case of gallstones, to be used only after the consultant of physician.

PRECAUTIONS

Peppermint oil is non-toxic and non-irritant in low dilutions, but sensitization may be a problem due to the menthol content.It can cause irritation to the skin and mucus membranes and should be kept well away from the eyes. It should be avoided during pregnancy and should not be used on children under seven.[49]

Peppermint oil in any form is not recommended for those with hiatal hernia, gallbladder disease or while pregnant or nursing.[33]

Overdose symptoms of peppermint oil [50] are Slow breathing, Rapid breathing, Abdominal pain, Diarrhea, Nausea, Vomiting, Blood in urine, No urine production, Convulsions, Depression, Dizziness, Twitching, Unconsciousness, Uncoordinated movement and Flushing.

DOSAGE [51]

Internal

Average daily dose: 6-12 drops

For inhalation: 3-4 drops in hot water

For irritable colon: Average single dose 0.2 ml
Average single dose 0.6 ml in enterically coated form.

External

Some drops rubbed in the affected face areas.
In semi-solid and oily preparations 5-20 %
In aqueous-ethanol preparations 5-10 %
In nasal ointments 1-5 % essential oil.

ADULTRATION [52]

Peppermint oil can be adulterated by addition of much cheaper cornmint oil (Mentha arvensis).

INTERACTIONS

Augment peak plasma concentration (C_{max}) of felodipine and the AUC and C_{max} of dehydrofelodipine but did not alter the half-life ($t_{½}$)[53].

STORAGE[7]

Store in well-filled, tightly-closed, light-resistant containers in a cool place.

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