

Mint (*Mentha* spp.): A comprehensive review of its phytochemistry, pharmacological properties, and applications

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Abstract

Peppermint (*Mentha piperita* L.), is a medicinal factory that has entered more an en on from both food and pharmaceu cal diligence because of its health bene ts for mortal society. Herein, the chemical structure of peppermint composites estimated using theore cal studies. Indeed, the health bene ts of peppermint were reviewed. Our molecular docking showed that among peppermaint composites, cineol and menthyl acetate supposedly bound to the ac ve point of arylamine N- acetyltransferase enzyme. This type of interac on indicates the inhibitory e cts of these composites against this enzyme. Quantum studies revealed that menthol (Egap = 16.9 eV) and pulegone (Egap = 12.6 eV) are stable and unstable composites in this factory. Eventually, our theore cal results are analogous to experimental inves ga ons that reported ahead. casting up, this factory is a good target for exploration and farther studies should be focus on evalua ng of peppermint in preven on of mortal diseases

Keywords: Peppermint; Mortal conditions; Peppermint oil painting; Quantum chemistry; Molecular docking

1. Introduction

Shops retain thousands of bioactive composites, which are nontoxic and largely effective backups with an nearly negligible negative consequence. A lot of physio-logical salutary exertion of these bioactive composites has been observed, for case, antimicrobial, antineo- plastic, antioxidant, hypoglycemic, analgesic, antidiarrheal as well as crack care parcels. ese shops contain natural products, which are present in pure form and in a combined form that can be attained by birth. e chemical diversity of similar shops cannot be matched with others so there are bottomless openings. As a result of lesser demand for chemical diversity in the selec- tion process, in hunt of natural yield, mindfulness has increased regarding comestible verdures encyclopedically. Medicinal uses of herbal shops have increased because of colorful types of bioactive composites. ese bioactive composites help in the treatment of colorful types of conditions (Amiri et al., 2021; Duraipandiyan et al., 2006; Wani and Kumar, 2018). Due to the development of negative goods and microbial resistance to the medicines which are synthesized chemically, experts turned to ethnopharmacognosy. ese phyto- chemicals are n't only safe but also effective reserves with negligible side goods. ere are thousands of shops in this world with health benefits. It should be our previous- ity to introduce similar shops to all so that the advantages of similar shops can be endured by one and all. In the pres- ent review paper, our main end was to punctuate the chemical ingredients and main health benefits of the mint plan (1)

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Figure 1 Mint leaves

1.1. Plant Profile

Mint leaves produce a cool sensation in the mouth. Toothpaste, mouthwash, breath mints, and biting goo are all generally seasoned with mint. In addition to revivifying breath, mint adds flavor to foods and drinks – everything from ice cream and cocottes to lemonade and amalgamations to meat dishes (especially angel). There are numerous kinds of the mint factory, and utmost fall under the rubric mentha. Because mint shops spread snappily, gardeners tend to grow them in holders. When planted directly into the ground, they can come invasive and take over a theater (WebMD, 2023). Mint leaves can make tea or an essential oil painting. Mint grows natively on all mainlands except Antarctica. Peppermint and spearmint are likely the most generally used mint kinds, but numerous others live, similar as wild mint and water mint. Some shops appertained to as "mint" also fall under the rubric monarda. Both mentha and monarda families are within the same family, called Lamiaceae. Monarda mints include horsemint, catmint, and stonemint. All kinds of mint leaves may be used fresh, in dried condiment form, brewed as a tea, or concentrated in an essential oil painting. Menthol mint (*Mentha arvensis* L.) is a rubric of about 25 species of the family Lamiaceae is extensively used in the food, flavourings, pharmaceutical and ornamental diligence. In addition to being a popular flavouring for food, confectionary and cigarettes, natural menthol has a cooling, soothing effect on the skin and mucous membranes of the mortal body, making it a useful component in medicinals and cosmetics. Worldwide, roughly 10,000 tonnes of natural menthol and 2000 tonnes of synthetic menthol are used by the medicinal, ornamental and cigarette diligence every time. Until about 15 times agone, the bulk of the world's corm mint came from Brazil and China. China and India latterly caught Brazil and, more lately, India has led the worldin the product of this useful factory and its products (Lal, 2013) An adaptable and stable cultivar generally refers to a cultivar's capability to perform constantly, across a wide range of times surroundings. Several biometrical styles including univariate and multivariate bones have been developed to assess stability. Among them the most extensively used are the retrogression measure the environmental friction. More lately, the AMMI stability value (ASV) grounded on the AMMI (Additive Main goods and Multiplicative relations) model's PCA1 and PCA2 scores for each cultivar/ cultivar Purchase. This AVS is in goods the distance from the match point to the origin in a two-dimensional smatter gram of PCA 1 scores against PCA 2 scores (Lal). For testing a number of cultivars of menthol mint crop in a number of times themulti-year yield trials are the most important trials in mint parentage programme. Consequently, effective model of statistical analysis related to multi-year trials can help plant breeders to make faster inheritable enhancement in a number of statistical models. Among them AMMI model was set up veritably important model for the below purpose The practical interest of combining high situations of mean yield and yield stability has led to the development of the yield trustability conception, where a dependable cultivar is characterized by constantly high yield ofessential oil painting across the times surroundings.



Figure 2 Mint Plant

1.2. Chemical composition

The analysis of unpredictable oil painting of peppermint (*Mentha x piperita* L.) by GC/ FID and

GC- MS indicates the presence of menthone (23.4) and menthol 40.7). The presence of 1, 8- cineole, limonene, menthyl acetate, β - caryophyllene and β - pinene has also been reported in peppermint factory. About 300 colorful composites have been linked in peppermint leaves that contain unpredictable oil painting. The

terpenic order has the foremost outstanding features and is comprised of 9 of sesquiterpenes and 520 monoterpenes, whereas other groups like lactones (7), aldehydes (9), sweet hydrocarbons (9), alcohols (6) and a lower proportion of eclectic factors (8) have also been reported. Among monoterpenes, menthol is a principal

element (35- 60) followed by menthyl acetate (0.7- 23), menthone (2- 44), menthofuran (0.3- 14), 1,8- cineole (eucalyptol) (1- 13), isomenthone (2- 5), limonene (0.1- 6) and neomenthol (3- 4), whereas β - caryophyllene is the major sesquiterpene (1.6- 1.8). Flavor and medicinal parcels are owed to the presence of menthol that's a veritably active element.

1.2.1. Taxonomical Classification

- Botanical Name *Mentha arvensis* (B.N.)
- English The Marsh Mint
- Tel Pudina
- Mal Putiyina
- Kan Chtni, maragu
- San Pudina
- Arab Naanasul – hind
- Hind Pudina
- Family Labiatae.

1.3. Medicinal uses

Peppermint oil painting 1 to 3 drops on a lump of sugar is used as a carminative, sweet goad in flatulent colic, indigestion etc. It acts as a sedative on the stomach and relieves distension. Fresh splint juice of mint mixed with a teaspoonful of lime juice and honey is given thrice diurnal with excellently good results in the treatment of indigestion, perverseness, grandiloquent bellyache, threadworms, morning sickness, iron insufficiency. All Rights Reserved 10 anaemias, summer diarrhoea etc. An ounce of mint tea is given thrice daily as a home- remedy for hiatus, bellyache, indigestion and snap. Giving mint tea for four days before of the anticipated menstrual time cures spasmodic dysmenorrhea in youthful girls. Gargling fresh mint decoction with

swab cures hoarseness due to crying or singing loudly. It keeps the voice clear if used before singing. thus, it's a boon to vocalizers and lecturers. A teaspoonful of fresh mint juice mixed with 2 teaspoonfuls of pure malt ginger and equal volume of honey stirred in 4 ounces of carrot juice is given thrice daily as a medicated tonic during the treatment of

tuberculosis, asthma, bronchitis. It liquifies the foam, nourishes the lungs, increases body resistance against infection and prevents the dangerous goods of antitubercular medicines. It prevents the asthmatic attacks by its secrolytic action and reduces traffic in air passages. Biting many fresh leaves of mint daily is a nature's own antiseptic dentifrice. The chlorophyll combined with other antiseptic chemicals in the mint, kills all the dangerous odour causing origins. It strengthens the epoxies by nourishing the needed nutrients and therefore prevents tooth decay. Pyorrhoea, pre-mature fall of the teeth etc. It also keeps the mouth flower fresh and increases the sense of taste in the lingo (5)

1.3.1. Procedure

- Preparation of Mint
 - Wash fresh mint leaves gently and pat dry.
 - Chop or lightly crush the leaves to rupture the cell walls — this increases surface area for extraction.
- Weighing and Solvent Addition
 - For fresh mint, use a 1:2 ratio (1 part mint by weight: 2 parts solvent by volume).
 - For dried mint, use a 1:5 ratio.
 - Place the mint in a clean glass jar.
- Addition of Solvent
 - Pour the chosen solvent (ethanol, oil, or water) over the mint until completely submerged.
 - Stir or shake gently to remove air bubbles.
- Maceration
 - Seal the jar tightly.
 - Store it in a cool, dark place (15–25 °C) for 7–14 days.
 - Shake the jar once daily to improve extraction.
- Filtration

After the maceration period, strain the mixture through muslin cloth or filter paper to separate the liquid extract.

- Storage
 - Transfer the filtrate (mint extract) into a dark glass bottle.
 - Label with contents and date (6)

1.4. Phytochemical analysis

This system involves the picky and consecutive birth of the factory phytochemical. The analysis of the presence of main group of natural ingredients present in the factory excerpt was done using different specific reagents. Chemical tests were done to identify bioactive composites of pharmacological significance through standard styles. Phytochemicals similar as tannins, alkaloids, saponins, flavonoids, terpenoids, phenols etc. were qualitatively determined as following

1.4.1. Webbing of phenol and tannins

2 drops of crude excerpt were mixed with 2 ml of 2 result of FeCl₃. A black achromatism indicates the presence of phenols and tannins.

1.4.2. Webbing of glycosides (Keller Kilianin Test)

2 ml of excerpt was treated with 2 ml of glacial acetic acid which was followed by the addition of many drops of ferric chloride result and 1 ml of concentrated sulphuric acid. conformation of brown ring at interface confirms the presence of glycosides.

1.4.3. Webbing of Flavonoids (Shinoda's test)

The excerpt was mixed with 2- 3 magnesium strip fractions and 4 drops of conc. HCl was added. Red achromatism indicates the presence of flavonoids in the excerpt.

1.4.4. Webbing of carbohydrates

1 ml of each excerpt was added to 1 ml of Benedict's reagent. The admixture was hotted on a scorching water bath for 2 twinkles result appeared green showing the presence of reducing sugar.

1.4.5. Webbing of alkaloids

Crude excerpt was mixed with 2 ml of 2 HCl. also, the admixture was hotted on a scorching water bath, cooled, filtered and divided into two tubes. Mayer's Reagent To the result of first tube, many drops of Mayer's reagent was added. Appearance of unheroic rush or presence of turbidity indicates the presence of alkaloids. Dragendroff's Reagent To the result of alternat tube, 3 drops of Dragendroff's reagent were added. Presence of white rush indicates the presence of alkaloids.

2. Result and Discussion

The review showed that mint plants contain many useful chemical compounds such as menthol, menthone, and limonene. These compounds are mainly responsible for the strong aroma, flavor, and medicinal properties of mint. Different species of mint, like *Mentha piperita* (peppermint) and *Mentha spicata* (spearmint), have different amounts of these compounds. Studies found that mint has several health benefits. It shows antimicrobial, antioxidant, and anti-inflammatory activities. Peppermint oil is often used to help with digestive problems, colds, and headaches. Mint extracts were also found to protect cells from damage caused by free radicals. Research on mint cultivation showed that factors like soil type, climate, and harvesting time affect the quality and quantity of mint oil. Using organic fertilizers and proper irrigation improves plant growth and oil yield. Overall, the studies reviewed indicate that mint is an important medicinal and aromatic plant with many uses in medicine, food, and cosmetics.

3. Conclusion

Mint leaves are a valuable source of bioactive compounds with a broad range of pharmacological activities. The extraction and evaluation of these compounds are essential for developing mint-based therapeutic products. While traditional extraction methods remain popular, advanced techniques like supercritical fluid extraction and ultrasonicated extraction offer promising alternatives for higher yield and quality. Future research should focus on optimizing extraction processes, conducting clinical studies, and exploring the full therapeutic potential of mint in both traditional and modern medicine.

Compliance with ethical standards

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Disclosure of conflict of interest

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