Medicinal Plant Research 2024, Vol.14, No.3, 151-161
http://hortherbpublisher.com/index.php/mpr

Research Report Open Access

Peppermint Tea: Evaluating Its Digestive Benefits, Neuroprotective Effects, and Role in Modern Herbal Medicine

Yufen Wang, Guangman Xu
Traditional Chinese Medicine Research Center, Cuixi Academy of Biotechnology, Zhuji, 311800, Zhejiang, China
Corresponding author: guangman.xu@cuixi.org

Medicinal Plant Research, 2024, Vol.14, No.3 doi: 10.5376/mpr.2024.14.0013
Received: 18 Apr., 2024
Accepted: 21 May, 2024
Published: 05 Jun., 2024

Preferred citation for this article:
Wang Y.F., and Xu G.M., 2024, Peppermint tea: evaluating its digestive benefits, neuroprotective effects, and role in modern herbal medicine, Medicinal Plant Research, 14(3): 151-161 (doi: 10.5376/mpr.2024.14.0013)

Abstract Peppermint tea has been traditionally used for its medicinal properties, with a growing interest in its application in modern herbal medicine. This study evaluates the digestive benefits, neuroprotective effects, and broader therapeutic potential of peppermint tea by identifying its key bioactive compounds, such as menthol and flavonoids. Additionally, the mechanisms underlying peppermint tea's digestive benefits, including its ability to relax gastrointestinal muscles and influence bile flow, are examined in clinical studies, particularly for irritable bowel syndrome (IBS) and functional dyspepsia. The neuroprotective properties of peppermint tea, such as its modulation of neurotransmitter activity and potential role in preventing neurodegenerative diseases, are also assessed. A case study on clinical trials supports its efficacy and safety, with a review of long-term health benefits in diverse populations. This study highlights peppermint tea's integration into contemporary herbal practices, its safety profile, and potential for future therapeutic applications, offering insights into its role in modern herbal medicine.

Keywords Peppermint tea; Digestive health; Neuroprotection; Bioactive compounds; Herbal medicine

1 Introduction

Peppermint tea, derived from the leaves of the peppermint plant (*Mentha* × *piperita* L.), has been a staple in traditional medicine for centuries (Nayak et al., 2020). This perennial herb, belonging to the Lamiaceae family, is renowned for its strong aroma and distinctive flavor. Traditionally, peppermint has been utilized for its therapeutic properties, including the treatment of fever, colds, digestive issues, and inflammation of the oral mucosa and throat (Mahendran and Rahman, 2020). The essential oils and bioactive compounds in peppermint, such as flavonoids and phenolics, contribute to its wide range of medicinal applications (Gadaka et al., 2021).

In contemporary herbal medicine, peppermint tea continues to hold significant value due to its diverse pharmacological benefits. Modern research has highlighted its potential in improving digestive health, supporting the central nervous system, and enhancing respiratory function (Wei et al., 2023). The essential oils in peppermint, particularly menthol, are credited with these health benefits. Additionally, peppermint exhibits antioxidant, anti-inflammatory, antimicrobial, and anticancer properties, making it a versatile natural remedy (Figueroa-Pérez et al., 2018). The increasing demand for natural product-based medicines has further propelled research into the specific metabolites of peppermint and their mechanisms of action against various diseases.

This study systematically evaluates the digestive benefits, neuroprotective effects, and overall therapeutic potential of peppermint tea in modern herbal medicine. By synthesizing existing research findings, we aim to provide in-depth insights into the effective use of peppermint tea in promoting health and well-being. The study focuses on analyzing the bioactive compounds in peppermint tea with therapeutic potential and explores its prospects in developing new natural medicines with high efficacy and minimal side effects. We hope this study will further highlight the significance of peppermint tea in both traditional and modern medical practices, providing valuable guidance for future clinical applications and herbal therapies.

2 Bioactive Compounds in Peppermint Tea

2.1 Identification of key bioactive compounds

Menthol, a major component of peppermint essential oil, is a cyclic monoterpene alcohol known for its distinctive cooling sensation. It has been extensively studied for its anti-inflammatory, analgesic, and antimicrobial properties. Menthol's structure allows it to interact with the transient receptor potential melastatin 8 (TRPM8) receptor, which is responsible for the cooling sensation. Additionally, menthol has been shown to suppress inflammation by modulating various signaling pathways, including the AMP-activated protein kinase (AMPK) and nuclear factor kappa B (NF-κB) pathways, thereby reducing oxidative stress and the production of pro-inflammatory mediators (Goudarzi et al., 2023).

Peppermint tea contains several flavonoids, including eriocitrin, luteolin, and hesperidin. These compounds are known for their potent antioxidant and anti-inflammatory activities. Eriocitrin, the main phenolic compound in peppermint, has been shown to enhance antioxidant capacity and reduce oxidative stress. Flavonoids in peppermint tea contribute to its therapeutic properties by scavenging free radicals, inhibiting lipid peroxidation, Bimakrand modulating enzyme activities involved in inflammation and oxidative stress (Bimakr et al., 2011; Alaşalvar and Çam, 2020).

2.2 Extraction and analysis methods

Steam distillation is a conventional method used to extract essential oils from peppermint leaves. This technique involves passing steam through the plant material, which vaporizes the volatile compounds. The vapor is then condensed back into liquid form, separating the essential oil from the water. This method is effective in isolating menthol, menthone, and other terpenoids, which are key bioactive compounds in peppermint essential oil (Pavlić et al., 2020).

High-performance liquid chromatography (HPLC) and gas chromatography (GC) are commonly used to isolate and analyze bioactive compounds in peppermint tea. HPLC is particularly useful for identifying and quantifying phenolic compounds such as eriocitrin and rosmarinic acid (Çam et al., 2020). Gas chromatography coupled with flame ionization detection (GC-FID) is employed to measure the concentrations of menthol, menthone, and other volatile compounds. These techniques provide detailed profiles of the bioactive compounds present in peppermint tea, enabling the assessment of their therapeutic potential.

2.3 Synergistic effects of bioactive compounds

The interaction between menthol and flavonoids in peppermint tea can enhance its overall bioactivity. Menthol's ability to modulate sensory receptors and signaling pathways may complement the antioxidant and anti-inflammatory effects of flavonoids. This synergistic interaction can lead to improved therapeutic outcomes, such as enhanced anti-inflammatory effects and better management of oxidative stress.

The combined presence of menthol and flavonoids in peppermint tea contributes to its high antioxidant activity. Studies have shown that the total phenolic content and antioxidant capacity of peppermint tea are significantly enhanced by the presence of these compounds. The interaction between menthol and flavonoids can lead to a more effective scavenging of free radicals and inhibition of oxidative processes, thereby providing greater protection against oxidative stress-related conditions (Rehder et al., 2020).

By understanding the bioactive compounds in peppermint tea and their synergistic effects, we can better appreciate its potential health benefits and therapeutic applications in modern herbal medicine.

3 Digestive Benefits of Peppermint Tea

3.1 Mechanisms of action in the digestive system

Peppermint tea contains menthol, which has been shown to exert smooth muscle relaxant and anti-spasmodic effects on various parts of the gastrointestinal tract, including the lower esophageal sphincter, stomach, duodenum, and large bowel. This relaxation helps alleviate symptoms associated with gastrointestinal disturbances, such as cramping and discomfort (Scarpellini et al., 2023). Peppermint tea has also been found to influence bile flow,

which is crucial for the digestion and absorption of fats. The active compounds in peppermint can stimulate bile secretion, thereby enhancing digestive processes and improving overall gastrointestinal function (Begas et al., 2017).

3.2 Clinical evidence supporting digestive health

Several studies have demonstrated the efficacy of peppermint oil, a concentrated form of peppermint, in managing IBS symptoms (Onakpoya, 2020; Nee et al., 2021). A systematic review and meta-analysis found that peppermint essential oil is both efficacious and well-tolerated in the short-term management of IBS, providing significant relief from symptoms such as abdominal pain and altered bowel habits (Hawrelak et al., 2019). Another randomized controlled trial confirmed that small intestinal-release peppermint oil significantly reduced abdominal pain, discomfort, and IBS severity compared to placebo (Figure 1) (Weerts et al., 2019).

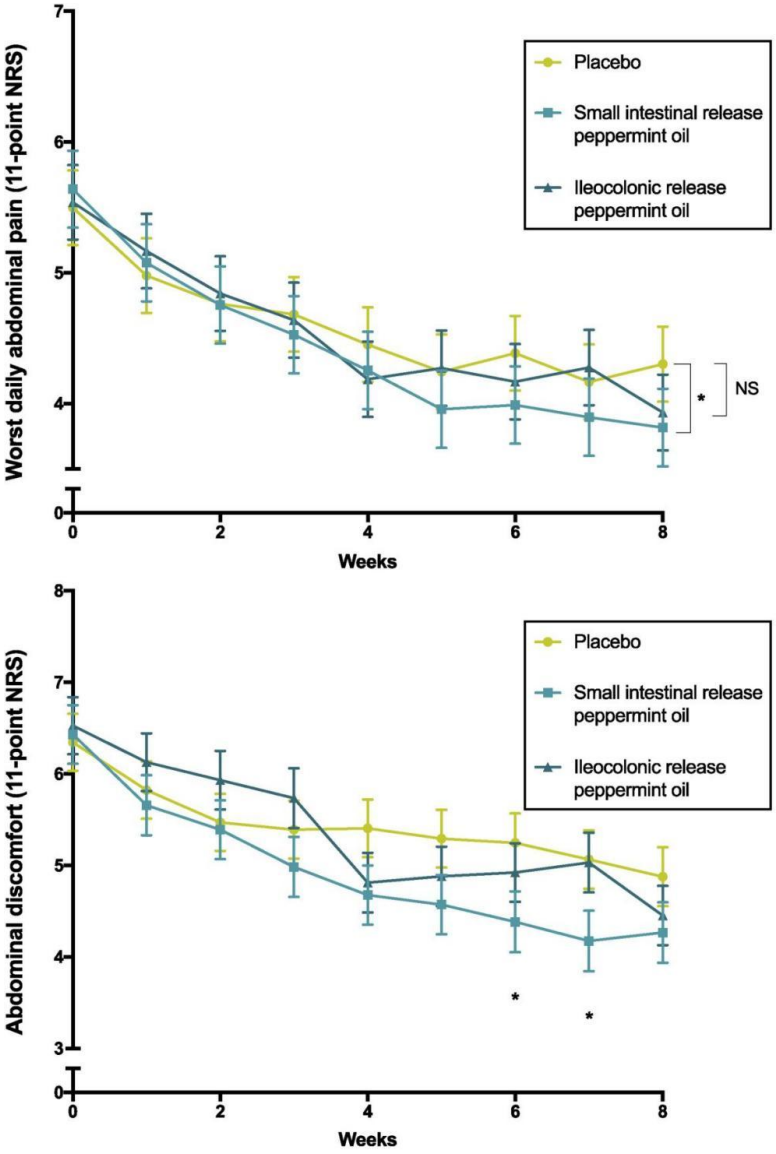

Figure 1 Abdominal pain and discomfort scores in the ITT-population (N = 189). Values are adjusted estimated marginal means derived from the linear mixed model, and bars represent standard errors. The small-intestinal–release peppermint oil group had significantly greater reduction in mean daily worst abdominal pain compared with the placebo group at week 8 (P= 0.016). The small-intestinal–release peppermint oil group also had significantly more reduction in abdominal discomfort compared with the placebo group (P= 0.020, and P= 0.009, at weeks 6, and 7, of treatment, respectively). The ileocolonic-release peppermint oil group did not differ significantly in reduction in abdominal pain and discomfort compared with the placebo group. Abdominal pain and discomfort was assessed weekly with an 11-point NRS in the digital diary. NS, not significant. *P < 0.25 (Adopted from Weerts et al., 2019)

The study of Weerts et al. (2019) illustrates the effect of peppermint oil formulations on abdominal pain and discomfort over an 8-week period. The small intestinal release peppermint oil significantly reduced both pain and discomfort compared to placebo, particularly noticeable at week 8 for pain and at weeks 6 and 7 for discomfort. The ileocolonic release peppermint oil did not show a significant difference from placebo. This suggests that peppermint oil targeting the small intestine may be more effective for relieving symptoms related to abdominal pain and discomfort in the studied population.

Peppermint tea has been traditionally used to alleviate symptoms of indigestion and bloating. Clinical studies have shown that peppermint oil can reduce the duration, frequency, and severity of pain in children suffering from functional abdominal pain, indicating its potential benefits for broader digestive health issues (Anheyer et al., 2017). Additionally, peppermint's muscle relaxant properties help in reducing bloating and discomfort associated with indigestion.

3.3 Applications in managing gastrointestinal disorders

Peppermint oil has been suggested as a treatment for functional dyspepsia due to its ability to relax gastrointestinal muscles and modulate gastrointestinal sensitivity. This makes it a promising alternative to traditional pharmacological treatments, offering a safer profile with fewer side effects. The herbal preparation STW 5, which includes peppermint, has shown pro-secretory effects that may contribute to its efficacy in treating functional dyspepsia (Allam et al., 2015).

While peppermint oil is beneficial for various gastrointestinal disorders, its use in treating GERD is more complex. The muscle relaxant properties of peppermint can potentially relax the lower esophageal sphincter, which might exacerbate GERD symptoms. However, its overall soothing effects on the gastrointestinal tract may still offer some benefits in managing mild cases of GERD when used cautiously.

In summary, peppermint tea and its active compounds have demonstrated significant digestive benefits through muscle relaxation, enhanced bile flow, and clinical efficacy in managing conditions like IBS and functional dyspepsia. These properties make it a valuable addition to modern herbal medicine for digestive health.

4 Neuroprotective Effects of Peppermint Tea

4.1 Interaction with the central nervous system

Peppermint tea, primarily through its active component menthol, has been shown to interact with the central nervous system by modulating neurotransmitter activity. Menthol can influence the release and uptake of neurotransmitters, which are crucial for maintaining neural communication and overall brain function. This modulation can potentially alleviate symptoms of neurological disorders by balancing neurotransmitter levels and improving synaptic plasticity.

The influence of peppermint tea on cognitive function and memory has been a subject of interest due to its potential neuroprotective properties. Studies suggest that the bioactive compounds in peppermint can enhance cognitive performance and memory retention. This is likely due to their ability to reduce oxidative stress and inflammation in the brain, which are known contributors to cognitive decline (Goudarzi et al., 2023).

4.2 Anti-inflammatory and antioxidant properties

Peppermint tea exhibits significant anti-inflammatory properties, which can be beneficial in reducing neuroinflammation. The anti-inflammatory effects are mediated through various pathways, including the downregulation of pro-inflammatory mediators and the suppression of oxidative stress. These actions help in reducing the levels of neuroinflammation markers, thereby protecting neural tissues from damage (Rahman et al., 2023).

The antioxidant properties of peppermint tea play a crucial role in enhancing the brain's defense mechanisms against oxidative stress. The bioactive compounds in peppermint, such as menthol, activate antioxidant pathways and increase the production of antioxidant enzymes. This helps in neutralizing free radicals and reducing oxidative

damage to neural cells, which is essential for maintaining cognitive health and preventing neurodegenerative diseases.

4.3 Potential role in neurodegenerative disease prevention

Animal studies have provided substantial evidence supporting the neuroprotective effects of peppermint tea. These studies demonstrate that peppermint can mitigate the effects of oxidative stress and inflammation in the brain, which are key factors in the development of neurodegenerative diseases. The activation of antioxidant pathways and the reduction of neuroinflammation markers in animal models suggest that peppermint tea could be a promising preventive strategy against conditions like Alzheimer's and Parkinson's diseases (Qi et al., 2017).

While human studies are limited, preliminary research indicates that peppermint tea may have beneficial effects on cognitive decline (Moss et al., 2016). The anti-inflammatory and antioxidant properties of peppermint are believed to contribute to its potential in slowing down the progression of cognitive impairments. Future clinical trials are needed to confirm these findings and to better understand the mechanisms through which peppermint tea exerts its neuroprotective effects in humans.

Peppermint tea shows promise as a neuroprotective agent due to its ability to modulate neurotransmitter activity, reduce neuroinflammation, and enhance antioxidant defenses. These properties make it a potential candidate for preventing and managing neurodegenerative diseases. Further research, particularly human clinical trials, is necessary to fully elucidate its benefits and mechanisms of action.

5 Role in Modern Herbal Medicine

5.1 Integration into contemporary herbal practices

Peppermint tea has been integrated into modern herbal medicine practices due to its well-documented therapeutic benefits. It is commonly used for its digestive properties, particularly in the management of irritable bowel syndrome (IBS). Studies have shown that peppermint essential oil, a key component of peppermint tea, is effective in alleviating IBS symptoms, making it a popular choice among herbal remedies for gastrointestinal issues (Hawrelak et al., 2019). Additionally, peppermint tea is often combined with other herbs, such as white tea, to enhance its anti-inflammatory and antibacterial effects, further solidifying its role in contemporary herbal practices.

5.2 Comparison with other herbal remedies

When compared to other herbal remedies, peppermint tea stands out for its efficacy and safety profile. For instance, while aloe vera and asafoetida have shown promise in treating IBS, their efficacy has not been as consistently replicated as that of peppermint essential oil. Moreover, peppermint oil has been found to be effective in reducing the duration, frequency, and severity of pain in children with functional abdominal pain, a benefit not as widely documented for other herbs (Anheyer et al., 2017). The combination of peppermint with other herbs, such as in the formula STW 5, has also demonstrated significant efficacy, highlighting its versatility and potency in herbal medicine (Pop et al., 2023).

5.3 Consumer trends and preferences

Consumer trends indicate a growing preference for natural and herbal remedies, with peppermint tea being a popular choice due to its pleasant taste and therapeutic benefits. The increasing interest in complementary and alternative medicine, especially among parents seeking treatments for their children’s gastrointestinal disorders, has further boosted the popularity of peppermint tea.

Additionally, the combination of peppermint with other herbs, such as white tea, has gained attention for its enhanced health benefits, aligning with consumer preferences for multifunctional and synergistic herbal products (Xia et al., 2020). This trend reflects a broader movement towards holistic and natural health solutions in modern society.

6 Case Study

6.1 Clinical trials on the efficacy of peppermint tea

Several clinical trials have investigated the efficacy of peppermint tea and peppermint oil in treating various conditions, particularly focusing on digestive disorders such as irritable bowel syndrome (IBS). A systematic review and meta-analysis identified that peppermint essential oil is both efficacious and well-tolerated in the short-term management of IBS symptoms (Hawrelak et al., 2019).

Another randomized controlled trial found that small intestinal-release peppermint oil significantly reduced abdominal pain, discomfort, and IBS severity compared to placebo, although it did not meet the primary endpoints for overall symptom relief (Weerts et al., 2019). Additionally, a network meta-analysis ranked peppermint oil as the most effective treatment for global IBS symptoms among traditional therapies, including soluble fiber and antispasmodic drugs.

6.2 Safety studies in diverse populations

Safety studies have shown that peppermint oil and peppermint tea are generally well-tolerated across different populations. A systematic review focusing on children and adolescents with gastrointestinal disorders found that peppermint oil effectively decreased the duration, frequency, and severity of pain in children suffering from undifferentiated functional abdominal pain, with no serious adverse events reported (Anheyer et al., 2017).

Another study on healthy volunteers consuming peppermint tea for six days found that while peppermint tea may alter the pharmacokinetics of clinically administered drugs, it did not significantly affect the activities of several metabolizing enzymes, indicating a favorable safety profile. Furthermore, a randomized controlled trial on breast cancer patients undergoing chemotherapy demonstrated that peppermint extract significantly reduced the severity of nausea, vomiting, and anorexia without any severe adverse effects (Figure 2) (Jafarimanesh et al., 2020).

The study of Jafarimanesh et al. (2020) illustrates the effects of an intervention on nausea, anorexia, and vomiting severity over four time points. In the intervention group, there is a noticeable reduction in symptoms compared to the control group, particularly after chemotherapy. Nausea and anorexia severity peaked and then decreased in both groups, with the intervention group showing a faster and more pronounced reduction. The frequency of vomiting episodes remained lower in the intervention group throughout the study, demonstrating the potential effectiveness of the intervention in alleviating chemotherapy-related gastrointestinal distress.

6.3 Long-term health benefits observed in peppermint tea consumers

Long-term consumption of peppermint tea has been associated with various health benefits. The inhibition of NAT2 enzyme activity observed in a study on healthy volunteers suggests that regular intake of peppermint tea may contribute to cancer chemoprevention (Begas et al., 2017).

Additionally, the broad spectrum of bioactive phytochemicals in peppermint, such as flavonoids and phenolics, provides antioxidant, anti-inflammatory, and antimicrobial effects, which can contribute to overall health and well-being (Mahendran and Rahman, 2020). While most clinical trials focus on short-term outcomes, the consistent findings of symptom relief and safety across different studies suggest that long-term consumption of peppermint tea could offer sustained health benefits, particularly for digestive health and symptom management in conditions like IBS (Black et al., 2019).

By integrating these findings, it becomes evident that peppermint tea and peppermint oil hold significant promise in modern herbal medicine, particularly for their digestive benefits and potential long-term health advantages.

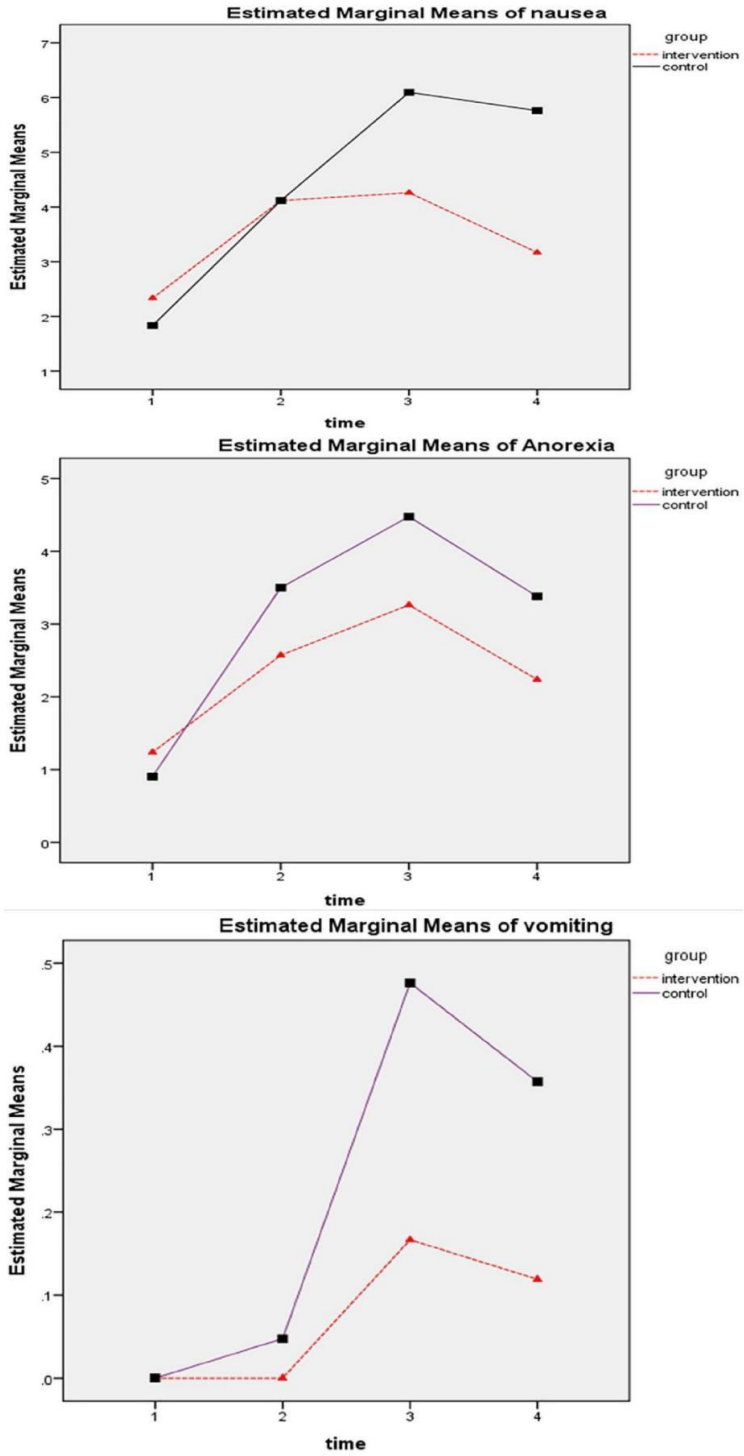

Figure 2 The mean scores of nausea severity (A), anorexia severity(B) and mean frequencies of vomiting episodes (C) at 4 time-points (before the intervention, and immediately, 24 and 48 hours after the chemotherapy) in the experimental and control groups (Adapted from Jafarimanesh et al., 2020)

7 Safety and Toxicology

7.1 General safety profile of peppermint tea

Peppermint tea is generally considered safe for most individuals when consumed in moderate amounts. However, some common side effects include heartburn and allergic reactions, particularly in individuals with a sensitivity to menthol. Additionally, peppermint tea may interact with certain medications, such as those used to treat acid reflux, and should be consumed with caution by individuals with gastroesophageal reflux disease (GERD) (Anheyer et al., 2017).

The safety of peppermint tea during pregnancy and lactation is a topic of ongoing research. While peppermint is commonly used to alleviate nausea and digestive issues during pregnancy, there is limited documentation on its safety. Some studies suggest that peppermint tea can be consumed in moderation, but it is recommended that pregnant and breastfeeding women consult with their healthcare provider before using peppermint tea to ensure it does not pose any risks to the mother or the developing fetus (Holst et al., 2011; Laelago, 2018; Sarecka-Hujar and Szulc-Musioł, 2022).

7.2 Allergic reactions and sensitivities

Allergic reactions to peppermint tea are rare but can occur, particularly in individuals with a known allergy to menthol or other components of the mint family. Symptoms of an allergic reaction may include skin rashes, headaches, and respiratory issues. It is important for individuals with known sensitivities to avoid peppermint tea and seek medical advice if they experience any adverse reactions (Poswal et al., 2019).

7.3 Long-term consumption and chronic effects

The long-term consumption of peppermint tea has not been extensively studied, and there is limited data on its chronic effects. While short-term use is generally considered safe, the potential impacts of prolonged use remain unclear. Some concerns have been raised about the possibility of peppermint tea affecting liver health and interacting with certain medications over time. Therefore, it is advisable to consume peppermint tea in moderation and consult with a healthcare provider for personalized advice, especially for individuals with pre-existing health conditions (Ahmed et al., 2017).

8 Concluding Remarks

Peppermint tea has been shown to offer a variety of health benefits, particularly in the areas of cognitive performance, digestive health, and anti-inflammatory effects. Studies have demonstrated that peppermint tea can significantly improve long-term memory and speed of memory, as well as increase subjective alertness in healthy adults. Additionally, peppermint essential oil has been found to be efficacious and well-tolerated in the short-term management of irritable bowel syndrome (IBS), providing relief from symptoms such as pain and discomfort. Peppermint tea also exhibits potential in altering pharmacokinetics of clinically administered drugs and promoting cancer chemoprevention through NAT2 inhibition. Furthermore, peppermint has shown promise in reducing the severity of nausea, vomiting, and anorexia in patients undergoing chemotherapy. Its anti-inflammatory properties are supported by evidence suggesting that peppermint can suppress inflammation through various biochemical pathways.

Future research should focus on conducting more rigorous and large-scale clinical trials to confirm the efficacy and safety of peppermint tea in various health conditions. While current studies provide promising results, the lack of replication and the limited number of human trials necessitate further investigation. Specifically, more research is needed to explore the long-term effects of peppermint tea consumption on cognitive performance and digestive health. Additionally, the potential interactions between peppermint tea and other medications should be thoroughly examined to ensure safe clinical applications. Investigating the synergistic effects of peppermint tea when combined with other herbal teas, such as white tea, could also open new avenues for developing effective functional foods with enhanced health benefits.

Peppermint tea holds a significant place in modern herbal medicine due to its wide range of therapeutic properties. Its ability to improve cognitive function, alleviate digestive disorders, and reduce inflammation makes it a valuable addition to the repertoire of natural remedies. As more scientific evidence emerges, peppermint tea could become a mainstream option for managing various health conditions, offering a natural and accessible alternative to conventional treatments. The integration of peppermint tea into daily health routines could contribute to overall well-being and preventive health care, reinforcing its role as a versatile and beneficial herbal medicine.

Acknowledgments

We are grateful to colleagues for their critically reading the manuscript and providing valuable feedback that improved the clarity of the text. We also thank to the two anonymous peer reviewers for their revision suggestions on this study.

Conflict of Interest Disclosure

The authors affirm that this research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

References

Ahmed M., Hwang J., Choi S., and Han D., 2017, Safety classification of herbal medicines used among pregnant women in Asian countries: a systematic review, BMC Complementary and Alternative Medicine, 17: 1-11.
https://doi.org/10.1186/s12906-017-1995-6
PMid:29137614 PMCid:PMC5686907

Alaşalvar H., and Çam M., 2020, Ready to drink iced teas from microencapsulated spearmint (*Mentha spicata* L.) and peppermint (*Mentha piperita* L.) extracts: physicochemical, bioactive and sensory characterization, Journal of Food Measurement and Characterization, 14(3): 1366-1375.
https://doi.org/10.1007/s11694-020-00386-4

Allam S., Krueger D., Demir I., Ceyhan G., Zeller F., and Schemann M., 2015, Extracts from peppermint leaves, lemon balm leaves and in particular angelica roots mimic the pro-secretory action of the herbal preparation STW 5 in the human intestine, Phytomedicine, 22(12): 1063-1070.
https://doi.org/10.1016/j.phymed.2015.08.008
PMid:26547528

Anheyer D., Frawley J., Koch A., Lauche R., Langhorst J., Dobos G., and Cramer H., 2017, Herbal medicines for gastrointestinal disorders in children and adolescents: a systematic review, Pediatrics, 139(6): e20170062.
https://doi.org/10.1542/peds.2017-0062
PMid:28562281

Begas E., Tsioutsiouliti A., Kouvaras E., Haroutounian S., Kasiotis K., Kouretas D., and Asprodini E., 2017, Effects of peppermint tea consumption on the activities of CYP1A2, CYP2A6, Xanthine Oxidase, N-acetyltranferase-2 and UDP-glucuronosyltransferases-1A1/1A6 in healthy volunteers, Food and Chemical Toxicology, 100: 80-89.
https://doi.org/10.1016/j.fct.2016.12.021
PMid:28011360

Bimakr M., Rahman R., Taip F., Ganjloo A., Salleh L., Salleh L., Selamat J., Hamid A., and Zaidul I., 2011, Comparison of different extraction methods for the extraction of major bioactive flavonoid compounds from spearmint (*Mentha spicata* L.) leaves, Food and Bioproducts Processing, 89(1): 67-72.
https://doi.org/10.1016/j.fbp.2010.03.002

Black C., Yuan Y., Selinger C., Camilleri M., Quigley E., Moayyedi P., and Ford A., 2019, Efficacy of soluble fibre, antispasmodic drugs, and gut-brain neuromodulators in irritable bowel syndrome: a systematic review and network meta-analysis, The Lancet Gastroenterology & Hepatology, 5(2): 117-131.
https://doi.org/10.1016/S2468-1253(19)30324-3
PMid:31859183

Çam M., Başyiğit B., Alaşalvar H., Yilmaztekin M., Ahhmed A., Sağdıç O., Konca Y., and Telci I., 2020, Bioactive properties of powdered peppermint and spearmint extracts: Inhibition of key enzymes linked to hypertension and type 2 diabetes, Food Bioscience, 35: 100577.
https://doi.org/10.1016/j.fbio.2020.100577

Figueroa-Pérez M., Pérez-Ramírez I., Enciso-Moreno J., Gallegos-Corona M., Salgado L., and Reynoso-Camacho R., 2018, Diabetic nephropathy is ameliorated with peppermint (*Mentha piperita*) infusions prepared from salicylic acid-elicited plants, Journal of Functional Foods, 43: 55-61.
https://doi.org/10.1016/j.jff.2018.01.029

Gadaka M., Muazu A., and Muhammad I., 2021, Phytochemicals and elemental analysis of methanol leave extract of peppermint tea (*Mentha Piperita* L.), Food Science and Quality Management, 108: 50-53.
https://doi.org/10.7176/FSQM/108-07

Goudarzi M., Radfar M., and Goudarzi Z., 2023, Peppermint as a promising treatment agent in inflammatory conditions: a comprehensive systematic review of literature, Phytotherapy Research, 38(1): 187-195.
https://doi.org/10.1002/ptr.8041
PMid:37850332

Hawrelak J., Wohlmuth H., Pattinson M., Myers S., Goldenberg J., Harnett J., Cooley K., Venter C., Reid R., and Whitten D., 2019, Western herbal medicines in the treatment of irritable bowel syndrome: a systematic review and meta-analysis, Complementary Therapies in Medicine, 48: 102233.
https://doi.org/10.1016/j.aimed.2019.03.301

Holst L., Wright D., Haavik S., and Nordeng H., 2011, Safety and efficacy of herbal remedies in obstetrics-review and clinical implications, Midwifery, 27(1): 80-86.
https://doi.org/10.1016/j.midw.2009.05.010
PMid:19782445

Jafarimanesh H., Akbari M., Hoseinian R., Zarei M., and Harorani M., 2020, The effect of peppermint (*Mentha piperita*) extract on the severity of nausea, vomiting and anorexia in patients with breast cancer undergoing chemotherapy: a randomized controlled trial, Integrative Cancer Therapies, 19: 1534735420967084.
https://doi.org/10.1177/1534735420967084
PMid:33118401 PMCid:PMC7605047

Laelago T., 2018, Herbal medicine use during pregnancy: benefits and untoward effects, Herbal Medicine, 2018: 103-119.
https://doi.org/10.5772/intechopen.76896

Mahendran G., and Rahman L., 2020, Ethnomedicinal, phytochemical and pharmacological updates on peppermint (*Mentha* × *piperita* L.)—a review, Phytotherapy Research, 34(9): 2088-2139.
https://doi.org/10.1002/ptr.6664
PMid:32173933

Moss M., Jones R., Moss L., Cutter R., and Wesnes K., 2016, Acute consumption of peppermint and chamomile teas produce contrasting effects on cognition and mood in healthy young adults, Plant Science today, 3(3): 327-336.
https://doi.org/10.14719/pst.2016.3.3.246

Nayak P., Kumar T., Gupta A., and Joshi N., 2020, Peppermint a medicinal herb and treasure of health: a review, Journal of Pharmacognosy and Phytochemistry, 9(3): 1519-1528.
https://doi.org/10.22271/phyto.2020.v9.i3y.11525

Nee J., Ballou S., Kelley J., Kaptchuk T., Hirsch W., Katon J., Cheng V., Rangan V., Lembo A., and Iturrino J., 2021, Peppermint oil treatment for irritable bowel syndrome: a randomized placebo-controlled trial, Official Journal of the American College of Gastroenterology, 116(11): 2279-2285.
https://doi.org/10.14309/ajg.0000000000001395
PMid:34319275

Onakpoya I., 2020, Small intestine-release peppermint oil is beneficial in the treatment of irritable bowel syndrome, BMJ Evidence-Based Medicine, 26(6): e10-e10.
https://doi.org/10.1136/bmjebm-2020-111403
PMid:32723767

Pavlić B., Teslić N., Zengin G., Đurović S., Rakic D., Cvetanović A., Gunes A., and Zeković Z., 2020, Antioxidant and enzyme-inhibitory activity of peppermint extracts and essential oils obtained by conventional and emerging extraction techniques, Food Chemistry, 338: 127724.
https://doi.org/10.1016/j.foodchem.2020.127724
PMid:32795878

Pop D., Pop R., and Farcău D., 2023, The use of fibers, herbal medicines and spices in children with irritable bowel syndrome: a narrative review, Nutrients, 15(20): 4351.
https://doi.org/10.3390/nu15204351
PMid:37892426 PMCid:PMC10610290

Poswal F., Russell G., Mackonochie M., MacLennan E., Adukwu E., and Rolfe V., 2019, Herbal teas and their health benefits: a scoping review, Plant Foods for Human Nutrition, 74: 266-276.
https://doi.org/10.1007/s11130-019-00750-w
PMid:31243622

Qi G., Mi Y., Wang Y., Li R., Huang S., Li X., and Liu X., 2017, Neuroprotective action of tea polyphenols on oxidative stress-induced apoptosis through the activation of the TrkB/CREB/BDNF pathway and Keap1/Nrf2 signaling pathway in SH-SY5Y cells and mice brain, Food & Function, 8(12): 4421-4432.
https://doi.org/10.1039/C7FO00991G
PMid:29090295

Rahman M., Sultana A., Khan M., Boonhok R., and Afroz S., 2023, Tea tree oil, a vibrant source of neuroprotection via neuroinflammation inhibition: a critical insight into repurposing *Melaleuca alternifolia* by unfolding its characteristics, Journal of Zhejiang University-SCIENCE B, 24(7): 554-573.
https://doi.org/10.1631/jzus.B2300168
PMid:37455134 PMCid:PMC10350368

Rehder A., Silva P., Xavier A., and Barrozo M., 2020, Optimization of microwave-assisted extraction of bioactive compounds from a tea blend, Journal of Food Measurement and Characterization, 15: 1588-1598.
https://doi.org/10.1007/s11694-020-00750-4

Sarecka-Hujar B., and Szulc-Musioł B., 2022, Herbal medicines—are they effective and safe during pregnancy? Pharmaceutics, 14(1): 171.
https://doi.org/10.3390/pharmaceutics14010171
PMid:35057067 PMCid:PMC8802657

Scarpellini E., Broeders B., Schol J., Santori P., Addarii M., Boccuto L., Carbone F., Abenavoli L., and Tack J., 2023, The use of peppermint oil in gastroenterology, Current Pharmaceutical Design, 29(8): 576-583.
https://doi.org/10.2174/1381612829666230328163449
PMid:36994979

Weerts Z., Masclee A., Witteman B., Clemens C., Winkens B., Brouwers J., Frijlink H., Muris J., Wit N., Essers B., Tack J., Snijkers J., Bours A., Ploeg A., Jonkers D., and Keszthelyi D., 2019, Efficacy and safety of peppermint oil in a randomized double-blind trial of patients with irritable bowel syndrome, Gastroenterology, 158(1): 123-136.
https://doi.org/10.1053/j.gastro.2019.08.026
PMid:31470006

Wei H., Kong S., Jayaraman V., Selvaraj D., Soundararajan P., and Manivannan A., 2023, *Mentha arvensis* and *Mentha* × *piperita*-vital herbs with myriads of pharmaceutical benefits, Horticulturae, 9(2): 224.
https://doi.org/10.3390/horticulturae9020224

Xia X., Lin Z., Shao K., Wang X., Xu J., Zhai H., Wang H., Xu W., and Zhao Y., 2020, Combination of white tea and peppermint demonstrated synergistic anti-bacterial and anti-inflammatory activities, Journal of the Science of Food and Agriculture, 101(6): 2500-2510.
https://doi.org/10.1002/jsfa.10876
PMid:33058206