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Meta-Analysis Open Access

Tea Oil and Their Role in Human Health: A Meta-Analysis

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Abstract The primary goal of this study is to evaluate the health benefits of tea oil, focusing on its potential therapeutic effects and mechanisms of action in human health. The analysis revealed several key findings. Tea oil, rich in unsaturated fatty acids and bioactive compounds such as catechins and tea polyphenols, exhibits significant antioxidant, anti-inflammatory, and lipid-lowering properties. Studies have shown that tea oil can improve glucose and lipid levels, and modulate gut microbiota in diabetic models. Additionally, tea oil has demonstrated potential neuroprotective effects through its anti-inflammatory and immunomodulatory actions. Clinical trials and observational studies suggest that regular consumption of tea oil may reduce the risk of cardiovascular diseases and improve metabolic health. The findings of this study suggest that tea oil holds considerable promise as a natural therapeutic agent for various health conditions, including cardiovascular diseases, diabetes, and neuroinflammation. Further high-quality clinical trials are needed to substantiate these benefits and elucidate the underlying mechanisms.

Keywords Tea oil; Human health; Antioxidant; Anti-inflammatory; Lipid-lowering; Neuroprotection; Cardiovascular health

1 Introduction

Camellia oleifera Abel, commonly known as the tea oil tree, is a subtropical evergreen shrub or small tree predominantly cultivated in China and Southeast Asian countries. Historically, it has been valued for its high nutritional and medicinal properties, making it a staple in these regions. The primary regions of production include the provinces of Hunan, Jiangxi, and Guangxi in China, where the cultivation of *Camellia oleifera* has been a traditional practice for centuries (Luan et al., 2020).

The extraction process of tea oil from *Camellia oleifera Abel* involves cold pressing the seeds, which preserves the oil's nutritional and therapeutic properties. This oil is primarily used in culinary applications, skincare products, and traditional medicine. Its high content of unsaturated fatty acids and antioxidants makes it a valuable ingredient in various health and wellness products (Shen et al., 2022; Zhong et al., 2023).

In recent years, there has been a growing interest in plant-based oils due to their potential health benefits. Tea oil, particularly from Camellia species, has garnered attention for its rich composition of bioactive compounds, including polyphenols, flavonoids, and unsaturated fatty acids (Saeed et al., 2017; Teixeira and Sousa, 2021). These compounds are known for their antioxidant, anti-inflammatory, and antimicrobial properties, which contribute to the oil's therapeutic potential.

Tea oil has been shown to have several health benefits, making it relevant in nutrition, skincare, and traditional medicine. It is used to improve cardiovascular health, enhance skin hydration and elasticity, and treat various skin conditions. Additionally, its anti-inflammatory properties make it a valuable component in managing chronic diseases and promoting overall wellness (Wang et al., 2017a; Teixeira and Sousa, 2021).

This paper aims to conduct a comprehensive meta-analysis of the existing literature on the health benefits of tea oil, with a particular focus on *Camellia oleifera Abel*. By synthesizing data from various studies, this paper seeks to provide a detailed understanding of the therapeutic properties of tea oil and its applications in modern health and wellness practices. The scope of this analysis includes evaluating the nutritional composition, bioactive compounds, and clinical efficacy of tea oil in promoting human health.

2 Chemical Composition and Bioactive Compounds of *Camellia oleifera* Oil

2.1 Fatty acids profile

Camellia oleifera oil is rich in essential fatty acids, particularly oleic acid and linoleic acid. The fatty acid composition of cold-pressed *Camellia oleifera* oil has been analyzed using 1H-NMR, revealing that oleic acid constitutes approximately 75.75% of the total fatty acids, while linoleic acid accounts for about 6.0% (Salinero et al., 2012). These levels are comparable to those found in olive oil, which is well-known for its health benefits. Additionally, another study confirmed that oleic acid is the major component of *Camellia oleifera* oil, making up 52.89% of its composition (Lee et al., 2019). The presence of these unsaturated fatty acids is significant as they are known to contribute to cardiovascular health and possess anti-inflammatory properties (Su et al., 2014).

2.2 Antioxidants and polyphenols

Camellia oleifera oil is also notable for its antioxidant and polyphenolic content. Various pretreatment methods of camellia seeds, such as hot air, steam, and puffing, have been shown to influence the phenolic profile and antioxidant capacity of the oil. These treatments can increase the tocopherol and total sterol content, enhancing the oil's antioxidant properties (Wang et al., 2022). The phenolic compounds in Camellia seed oils include benzoic acids, cinnamic acids, flavanols, flavonols, flavones, and dihydroflavonoids, with phenolic acids being the most abundant class (Wang et al., 2017a). These compounds are known for their bioactivity, including anti-inflammatory and anti-carcinogenic effects, which contribute to the overall health benefits of the oil.

2.3 Other bioactive components

In addition to fatty acids and polyphenols, *Camellia oleifera* oil contains other bioactive components such as squalene, vitamins, and minerals. Squalene, a natural antioxidant, is present in significant amounts and is known for its skin-protective and anti-aging properties (Kurasiak-Popowska et al., 2019). The oil also contains various vitamins, including tocopherols (vitamin E), which are potent antioxidants that protect cells from oxidative damage (Wang et al., 2022). Furthermore, the presence of essential minerals enhances the nutritional value of the oil, contributing to its health-promoting properties.

3 Health Benefits of Tea Oil

3.1 Cardiovascular health: effects on blood pressure, cholesterol levels, and heart disease risk

Tea oil, derived from the seeds of *Camellia sinensis*, has been shown to have significant cardiovascular benefits. Regular consumption of tea and its bioactive compounds, such as epigallocatechin gallate (EGCG) (Figure 1), can enhance nitric oxide bioavailability, which helps in lowering blood pressure and improving endothelial function (Dludla et al., 2020; Keller and Wallace, 2021). Additionally, tea oil has been found to reduce levels of oxidized low-density lipoprotein (LDL) and C-reactive protein, markers associated with oxidative stress and inflammation, thereby potentially lowering the risk of coronary artery disease (CAD) (Cao et al., 2019; Dludla et al., 2020). The flavonoids present in tea oil also contribute to reducing hyperlipidemia and hypertension, further supporting cardiovascular health (Fang et al., 2019; Li et al., 2019).

3.2 Anti-inflammatory and antioxidant effects: reductions in inflammation and oxidative stress

Tea oil is rich in polyphenols and other bioactive compounds that exhibit strong antioxidant and anti-inflammatory properties. These compounds help in reducing oxidative stress by neutralizing free radicals and inhibiting lipid peroxidation (Dludla et al., 2020; Shang et al., 2021). The anti-inflammatory effects are mediated through the inhibition of pro-inflammatory cytokines such as TNF-α and IL-6, and the downregulation of NF-κB signaling pathways (Keller and Wallace, 2021; Shang et al., 2021). These mechanisms collectively contribute to the reduction of chronic inflammation and oxidative stress, which are underlying factors in many chronic diseases, including cardiovascular diseases and cancers (Cao et al., 2019; Shang et al., 2021).

3.3 Skin health and anti-aging properties: skin hydration, elasticity, and anti-aging benefits

Tea oil has been found to have beneficial effects on skin health, primarily due to its antioxidant properties. The polyphenols in tea oil help in protecting the skin from oxidative damage caused by UV radiation and environmental pollutants. Additionally, the anti-inflammatory properties of tea oil can reduce skin inflammation

and improve skin conditions such as acne and eczema. Regular application of tea oil can enhance skin hydration and elasticity, thereby reducing the appearance of wrinkles and other signs of aging (Shang et al., 2021). The bioactive compounds in tea oil also promote collagen synthesis, which is crucial for maintaining skin structure and firmness.

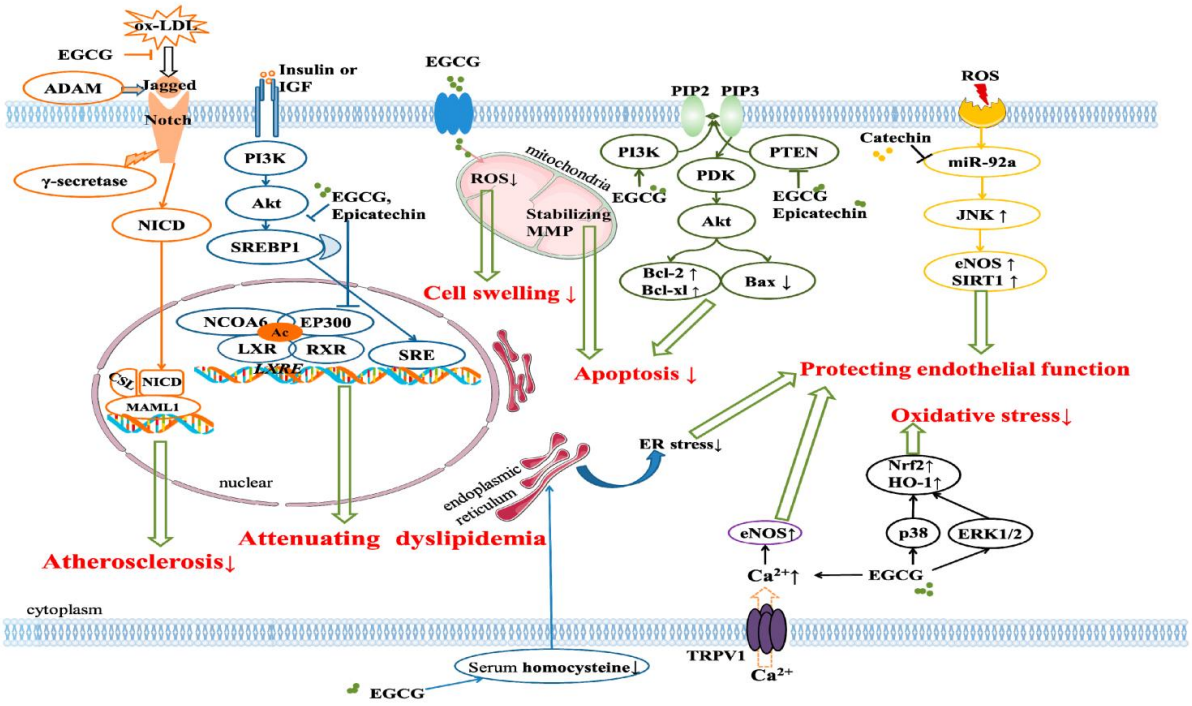

Figure 1 Signaling pathways involved in the protective effects of tea bioactive compounds against cardiovascular diseases (Adopted from Cao et al., 2019)

Image caption: Epigallocatechin-3-gallate (EGCG) reduced atherosclerosis by inhibiting the activation of the Notch receptor induced by oxidized-LDL. EGCG and epicatechin could attenuate dyslipidemia through regulating the SREBP1 pathway. EGCG could reduce the reactive oxygen species level in mitochondria and stabilize the mitochondrial membrane potential, thus attenuating cell swelling and apoptosis of endothelial cells. EGCG and epicatechin could reduce the apoptosis of cardiac cells through regulating the PI3K pathway. EGCG could protect endothelial function through alleviating endoplasmic reticulum stress. EGCG and catechin could elevate the endothelial nitric oxide synthase (eNOS), thus protecting endothelial function. EGCG could reduce oxidative stress by regulating the p38 MAPK and ERK1/2 pathways. Abbreviations: ADAM, A-Disintegrin-And-Metalloprotease; NICD, Notch intracellular domain; PI3K, phosphatidylinositol-3-kinase; Akt, α serine/threonine-protein kinase; SREBP, sterol regulatory element binding transcription factor; LXR, liver X receptor; RXR, retinoid X receptor; NCOA6, nuclear receptor coactivator 6; PTEN, phosphatase and tensin homolog; PDK, phosphoinositide dependent kinase; Nrf, nuclear factor E2-related factor; HO-1, heme oxygenase-1; TRPV, transient receptor potential vanilloid type (Adopted from Cao et al., 2019)

3.4 Digestive and immune health: effects on gastrointestinal and immune system health

Tea oil has been shown to have positive effects on digestive health by promoting the growth of beneficial gut microbiota and inhibiting the growth of pathogenic bacteria. The anti-inflammatory and antioxidant properties of tea oil also help in reducing gastrointestinal inflammation and oxidative stress, which can improve overall gut health (Shang et al., 2021). Furthermore, the bioactive compounds in tea oil can enhance immune function by modulating immune cell activity and cytokine production, thereby strengthening the body's defense mechanisms against infections and diseases.

4 Comparative Analysis with Other Plant Oils

4.1 Olive oil vs. *Camellia oleifera* oil: comparative nutritional and health benefits

Camellia oleifera oil, commonly known as tea seed oil, and olive oil are both renowned for their health benefits, but they exhibit distinct nutritional profiles and health impacts. *Camellia oleifera* oil is rich in oleic acid, which constitutes about 52.89% of its composition, and has been shown to have significant anti-asthmatic effects by

modulating inflammatory cells and cytokines such as IL-4 and IL-5 (Lee et al., 2019) (Figure 2; Table 1). This oil also contains high levels of monounsaturated fatty acids, vitamin E, and polyphenol antioxidants, which contribute to its health benefits, including reducing oxidative stress and boosting immunity (Seyis et al., 2019).

In comparison, olive oil is also high in monounsaturated fats, particularly oleic acid, and is well-known for its cardiovascular benefits. However, tea seed oil has a higher smoke point and contains fewer saturated fatty acids than olive oil, making it a preferable option for high-temperature cooking (Seyis et al., 2019). Additionally, tea seed oil has a milder flavor and is less "oily," which can be advantageous for culinary uses where a lighter oil is desired.

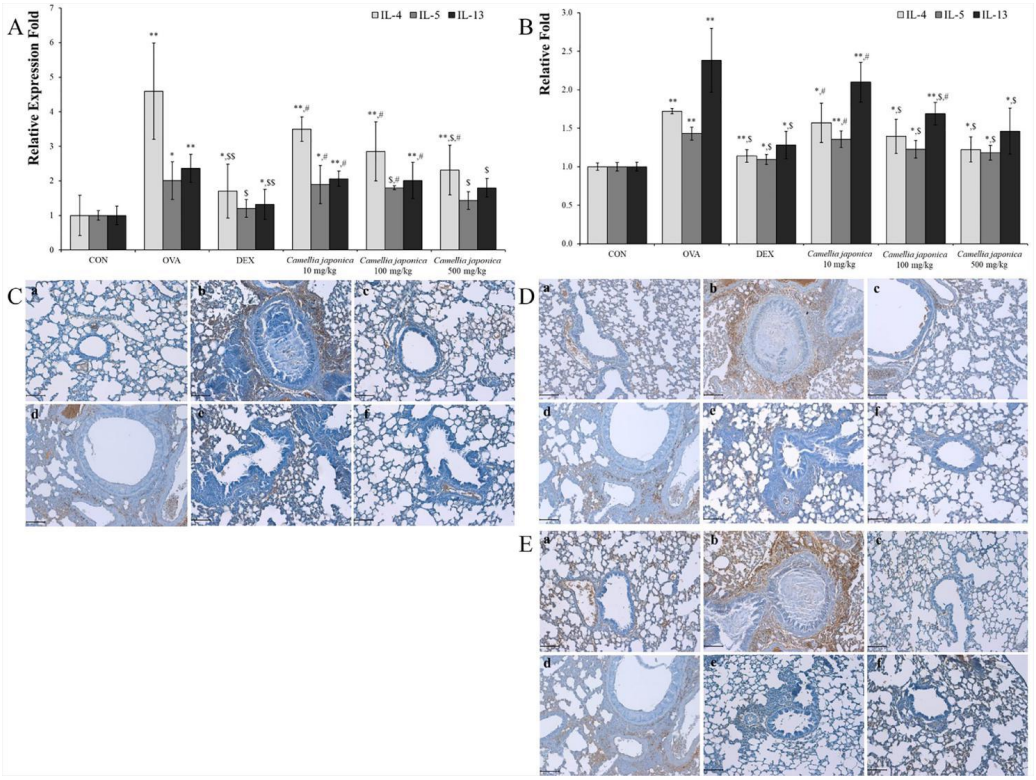

Figure 2 *C. japonica* oil dramatically inhibited not only cDNA levels but also protein expressions in all Th2-related cytokine such as IL-4, IL-5, and IL-13 (Adopted from Lee et al., 2019)

Image caption: (A) C. japonica oil significantly and dose-dependently suppressed the genes' levels of Th2-related cytokine such as IL-4, IL-5 and IL-13 and especially the IL-5 level decreased from in 100 mg/kg *C. japonica* oil treatment. *C. japonica* oil using with 100 mg/kg treatment perfectly controlled Th2-related cytokine such as IL-4, IL-5, and IL-13, not only (B) in the quantitative point of view, but also (C-E) in the qualitative point of view. a, vehicle control; b, asthma induction; c, dexamethasone; d, 10 mg/kg/day *C. japonica* oil; e, 100 mg/kg/day *C. japonica* oil; f, 500 mg/kg/day *C. japonica* oil. Each bar represents the mean ± SEM (n = 8). *p < 0.05 vs. control; **p < 0.001 vs. control; $p < 0.05 vs. asthma induction; $$p < 0.01 vs. asthma induction; #p < 0.05 vs. dexamethasone. Scale Bar = 100 μm. Magnification, × 200 (Adopted from Lee et al., 2019)

Table 1 The quantitative score chart of histopathological changes in the lung (Adopted from Lee et al., 2019)

	Mucous hypersecretion (0–3)	Epithelial cell hyperplasia (0–3)	Inflammatory cell infiltration (0–3)
CON	0.1 ± 0.35	0.4 ± 0.52	0.1 ± 0.35
OVA	2.9 ± 0.35*	2.8 ± 0.46**	2.9 ± 0.35**
DEX	0.3 ± 0.46$$	0.6 ± 0.52$$	0.6 ± 0.52*,$$
Camellia japonica 10 mg/kg	2.8 ± 0.46**,##	2.9 ± 0.35**,##	2.6 ± 0.52**,##
Camellia japonica 100 mg/kg	1.5 ± 0.76**,$$,##	2.4 ± 0.52**,##	1.9 ± 0.83**,$,#
Camellia japonica 500 mg/kg	0.4 ± 0.52$$	0.4 ± 0.52$$	0.52 ± 0.53$$

Note: Each score explains the means ± standard deviation (N = 8); *:p < 0.05 vs. Control; **: p < 0.001 vs.control; $: p < 0.05 vs. asthma induction; $$: p < 0.01 vs. asthma induction; #: p < 0.05 vs. Dexamethasone; ##; p < 0.01 vs. dexamethasone (Adopted from Lee et al., 2019)

4.2 Other traditional oils: brief comparisons with other oils like sunflower and coconut oils

When comparing *Camellia oleifera* oil to other traditional oils such as sunflower and coconut oils, several differences in nutritional content and health benefits emerge. Sunflower oil is predominantly composed of polyunsaturated fatty acids, particularly linoleic acid, which is beneficial for heart health but less stable at high temperatures compared to the monounsaturated fats in tea seed oil. Coconut oil, on the other hand, is high in saturated fats, which can raise cholesterol levels and potentially increase the risk of heart disease, although it is also praised for its antimicrobial properties and medium-chain triglycerides that can boost metabolism (Wang et al., 2017b).

Camellia oleifera oil stands out due to its balanced fatty acid profile, which includes a significant amount of oleic acid and lower levels of saturated fats compared to coconut oil. It also contains beneficial compounds such as squalene and various phytosterols, which are known for their antioxidant properties and potential to lower cholesterol levels (Wang et al., 2017b). Furthermore, the presence of unique polyphenols in tea seed oil, similar to those found in green tea, adds to its health-promoting properties, making it a versatile and healthful alternative to other traditional oils (Wang et al., 2017a; Teixeira and Sousa, 2021).

5 Consumer Perception and Market Trends

5.1 Market analysis of *Camellia oleifera* oil: overview of market trends, demand, and consumer preferences

Camellia oleifera oil, commonly known as tea seed oil, has been gaining traction in various markets due to its numerous health benefits and versatile applications. The oil is rich in unsaturated fatty acids, particularly oleic acid, and contains significant amounts of antioxidants such as Vitamin E and polyphenols, which contribute to its health-promoting properties (Lee and Yen, 2006; Wang et al., 2011; Seyis et al., 2019). The growing awareness of these benefits has led to an increase in demand, particularly in health-conscious consumer segments.

The market for *Camellia oleifera* oil is expanding not only in traditional markets like China and Japan but also in Western countries where consumers are increasingly seeking natural and healthful alternatives to conventional cooking oils (Seyis et al., 2019; Teixeira and Sousa, 2021). The oil's mild flavor and high smoke point make it a preferred choice for cooking, while its applications in cosmetics and skincare products further drive its market growth (Seyis et al., 2019; Zhu et al., 2020). Additionally, the oil's use in industrial applications, such as machinery lubricants and rust prevention, adds to its market versatility (Seyis et al., 2019).

5.2 Barriers to consumption: factors affecting consumer adoption, including awareness and price

Despite its growing popularity, several barriers affect the widespread adoption of *Camellia oleifera* oil. One of the primary challenges is the lack of consumer awareness about the oil and its benefits. Many consumers are more familiar with other oils like olive oil and coconut oil, which have been marketed extensively (Seyis et al., 2019; Teixeira and Sousa, 2021). This lack of awareness can be attributed to limited marketing efforts and the relatively recent introduction of *Camellia oleifera* oil to non-Asian markets.

Price is another significant barrier. The production of *Camellia oleifera* oil involves labor-intensive processes, and the yield from tea seeds is relatively low compared to other oilseeds, leading to higher costs (Wang et al., 2011; Zeng et al., 2014). This makes the oil more expensive than many of its counterparts, which can deter price-sensitive consumers.

Moreover, the availability of the oil can be inconsistent due to the seasonal nature of tea seed harvesting and the limited number of regions where *Camellia oleifera* is cultivated (Wang et al., 2017a; Shen et al., 2022). This can lead to supply chain issues and further drive up prices, making it less accessible to a broader audience.

6 Case Studies of *Camellia oleifera* Oil Usage

6.1 Historical use in traditional medicine: examples from east Asian medicinal practices

Camellia oleifera oil, has a rich history in traditional East Asian medicine, particularly in countries like China, and Korea. Historically, it has been used for its purported health benefits and healing properties. In Japan, Tsubaki oil was commonly used to treat burns and wounds due to its anti-inflammatory and antimicrobial properties (Teixeira

and Sousa, 2021). Traditional Chinese medicine also utilized Camellia oil for its ability to nourish the skin and hair, promoting a healthy and youthful appearance (Seyis et al., 2019). Additionally, in Korea, the oil was often applied to the scalp to prevent hair loss and to maintain hair health, leveraging its rich content of oleic acid and other beneficial fatty acids (Seyis et al., 2019; Teixeira and Sousa, 2021).

6.2 Contemporary applications: current use in wellness, skincare, and dietary supplements

In modern times, *Camellia oleifera* oil has found a variety of applications in wellness, skincare, and dietary supplements. Its high content of monounsaturated fatty acids, particularly oleic acid, makes it a popular ingredient in skincare products aimed at moisturizing and protecting the skin (Figure 3). The oil is often included in formulations for night creams, serums, and lotions due to its ability to penetrate deeply into the skin and provide long-lasting hydration (Seyis et al., 2019). Additionally, its antioxidant properties, attributed to the presence of polyphenols and Vitamin E, help in reducing oxidative stress and combating signs of aging (Seyis et al., 2019; Zhong et al., 2023).

In the wellness industry, *Camellia oleifera* oil is used in aromatherapy and massage oils, where its light texture and pleasant aroma enhance relaxation and stress relief (Seyis et al., 2019). Furthermore, the oil is incorporated into dietary supplements for its potential health benefits, including boosting immunity and supporting cardiovascular health due to its favorable fatty acid profile (Seyis et al., 2019; Zhong et al., 2023). The oil's versatility extends to culinary uses as well, where it is valued for its mild flavor and high smoke point, making it suitable for cooking and salad dressings.

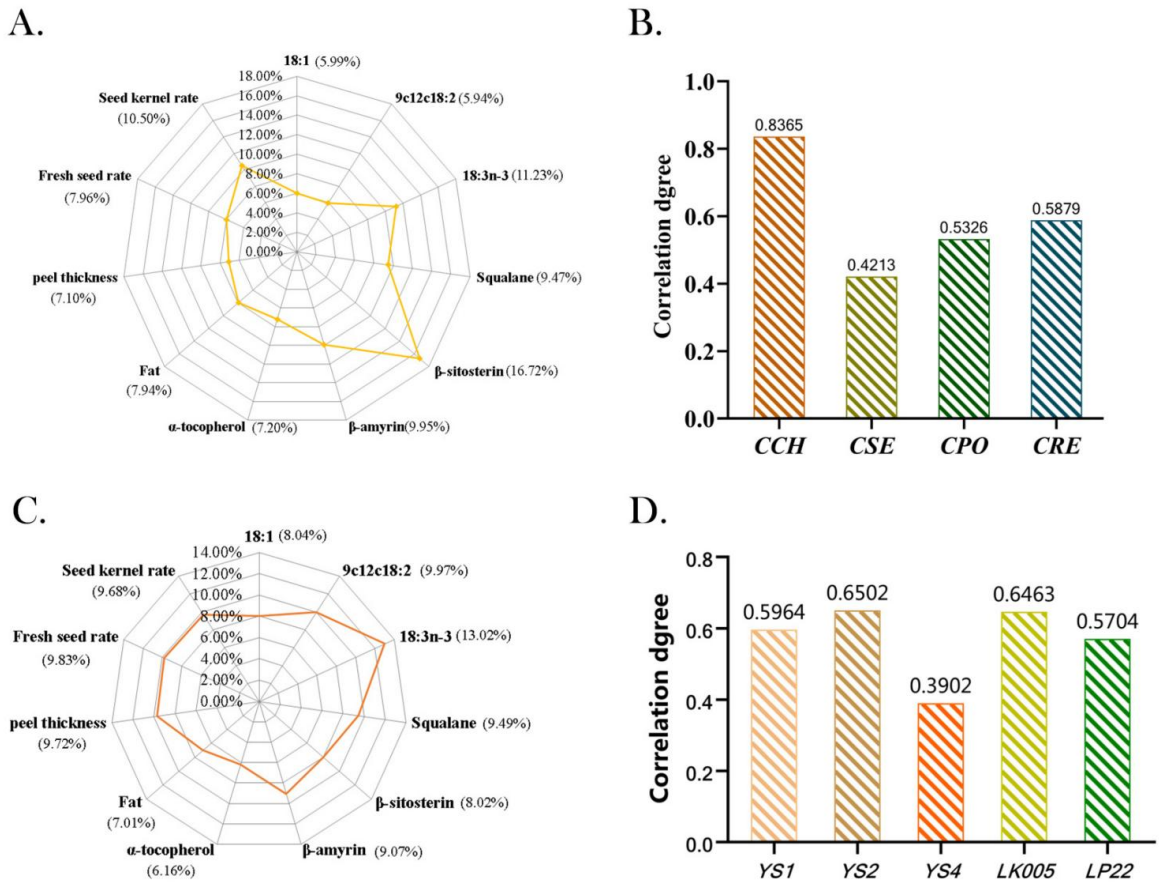

Figure 3 (A). The weights of nutrients in four ROC (Red-flowered oil-tea camellia) oils calculated according to the gray correlation coefficient method. (B). Correlation degrees of four ROC oils. (C). The weights of nutrients in five clones of *Camellia chekiangoleosa* Hu. oil, calculated according to the gray correlation coefficient method. (D). Correlation degree of five clones of *Camellia chekiangoleosa* Hu. oil. YS-1, YS-2, YS-4, LK005 and LP22 all represent clone varieties of *Camellia chekiangoleosa* Hu., and CPO, CSE and CRE fruit materials were mixed samples of 5 clones. CCH: *Camellia chekiangoleosa*; CPO: Camellia polyodonta; CSE: Camellia semiserrata; CRE: Camellia reticulata (Adopted from Zhong et al., 2023)

7 Discussion

7.1 Comparison with previous studies

The findings of this study align with and expand upon previous research on the health effects of tea oil. For instance, the antimicrobial and anti-inflammatory properties of tea tree oil (*Melaleuca alternifolia*) have been well-documented in various studies. Tea tree oil has been shown to be effective in reducing dental plaque and treating periodontitis when used in oral mouthwashes and gels, respectively (Kairey et al., 2023). Additionally, its efficacy in managing skin infections and conditions such as acne and methicillin-resistant Staphylococcus aureus (MRSA) has been noted, although more high-quality trials are needed to substantiate these claims (Carson et al., 2006; Kairey et al., 2023). The neuroprotective potential of tea tree oil through its anti-inflammatory and immunomodulatory actions has also been highlighted, suggesting its broader therapeutic applications (Rahman et al., 2023). Furthermore, the health benefits of tea oil, including its anti-tumor, lipid-lowering, and anti-inflammatory effects, have been corroborated by studies on its high unsaturated fatty acid content and other bioactive components (He et al., 2011; Lin et al., 2018; Shang et al., 2021).

7.2 Mechanisms of action

The health benefits of tea oil can be attributed to several biological mechanisms. The antimicrobial action of tea tree oil is primarily due to the membrane-toxicity of its monoterpenoid components, which disrupt the cell membranes of pathogens (Cox et al., 2001). Its anti-inflammatory effects are linked to the modulation of immune responses, which can help in reducing inflammation and promoting healing (Carson et al., 2006; Rahman et al., 2023). Tea oil's neuroprotective effects are thought to be mediated through its anti-inflammatory and immunomodulatory properties, which can inhibit neuroinflammation and protect against neurodegenerative diseases (Rahman et al., 2023). Additionally, the antioxidant properties of tea polyphenols and catechins in tea oil contribute to its ability to neutralize free radicals and protect cellular structures (He et al., 2011; Shang et al., 2021). These mechanisms collectively underpin the diverse health benefits of tea oil, ranging from antimicrobial and anti-inflammatory effects to neuroprotection and cardiovascular health.

7.3 Practical applications and limitations

Tea oil holds significant potential for practical applications in various health domains. Its use in oral care products, such as mouthwashes and gels, can help in managing dental plaque and periodontitis (Kairey et al., 2023). Topical applications of tea tree oil can be effective in treating skin infections and conditions like acne and MRSA, although care must be taken to avoid high concentrations that may cause irritation (Carson et al., 2006; Kairey et al., 2023). The potential neuroprotective benefits of tea oil suggest its use in formulations aimed at preventing or managing neurodegenerative diseases (Rahman et al., 2023). However, the current research has several limitations. Many studies have small sample sizes, and there is a need for more high-quality, large-scale clinical trials to confirm the therapeutic efficacy and safety of tea oil (Carson et al., 2006; Kairey et al., 2023). Additionally, the variability in the composition of tea oil products and the lack of standardization pose challenges for consistent application and efficacy (Carson et al., 2006; Rahman et al., 2023). Future research should focus on addressing these limitations and exploring the full therapeutic potential of tea oil through well-designed studies and standardized formulations.

8 Conclusion

Tea oil, derived from the seeds of oil tea plants, has been shown to possess numerous health benefits due to its rich composition of bioactive compounds. The high content of unsaturated fatty acids, particularly oleic acid, contributes to its cardiovascular protective effects, including the prevention of coronary heart disease and the delay of atherosclerosis. Additionally, tea oil contains significant amounts of catechins and tea polyphenols, which exhibit strong antioxidant properties, helping to eliminate free radicals and protect cellular structures. The anti-inflammatory and antimicrobial properties of tea oil have also been well-documented, making it effective in treating skin conditions and infections. Furthermore, tea oil has demonstrated potential in regulating lipid and glucose levels, which is beneficial for managing conditions such as diabetes and hyperlipidemia. Overall, the diverse bioactive components in tea oil contribute to its multifaceted health benefits, including anti-tumor, liver and heart protection, and immune regulation.

Despite the promising health benefits of tea oil, several gaps in knowledge remain that warrant further investigation. Future research should focus on conducting large-scale, high-quality randomized controlled trials to substantiate the therapeutic efficacy of tea oil in various health conditions. Specifically, more studies are needed to explore the molecular mechanisms underlying the anti-inflammatory and antimicrobial actions of tea oil, as well as its potential side effects when used in higher concentrations. Additionally, research should aim to identify the optimal dosages and formulations of tea oil for different therapeutic applications. Investigating the long-term effects of tea oil consumption on metabolic health and its impact on gut microbiota could provide valuable insights into its role in managing chronic diseases such as diabetes and cardiovascular disorders. Finally, exploring the synergistic effects of tea oil with other natural compounds and its potential use in combination therapies could open new avenues for its application in integrative medicine.

The findings from this study highlight the potential of tea oil as a valuable addition to public health strategies aimed at improving overall health and preventing chronic diseases. Given its rich composition of unsaturated fatty acids, antioxidants, and anti-inflammatory compounds, incorporating tea oil into dietary guidelines could help reduce the risk of cardiovascular diseases, diabetes, and certain cancers. Public health authorities should consider promoting the consumption of tea oil as part of a balanced diet, emphasizing its benefits for heart health, metabolic regulation, and immune support. However, it is essential to provide clear guidelines on the safe and effective use of tea oil, including recommended dosages and potential contraindications, particularly for individuals with specific health conditions or those who are pregnant. Educating the public about the proper use of tea oil and its potential health benefits can empower individuals to make informed dietary choices that support their long-term health and well-being.

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Conflict of Interest Disclosure

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

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