Journal of Cardiovascular Disease Research
ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 11, 2024

Original Article

Exploring the Medicinal Benefits of *Melissa officinalis* (Lemon Balm)

Khushi P. Diwan*, Ms. Krupa Vyas[1], Dr. Pragnesh Patani[2]

[1]Associate Professor, Department of Pharmaceutics, Khyati College of Pharmacy, Palodia, Ahmedabad

[2]Principal and Professor, Department of Pharmacology, Khyati College of Pharmacy, Palodia, Ahmedabad

***Corresponding Author:** Diwan Khushi
*Khyati College Of Pharmacy, Palodia, Ahmedabad, Email: diwan.khushi12@gmail.com

ABSTRACT
Melissa officinalis, or lemon balm, is a perennial herb. It has been used for over 2000 years in cooking and traditional medicine. The plant exhibits diverse biological activities including antioxidant, anti-inflammatory, and antimicrobial properties. It is used in treating mental health issues, cardiovascular problems, and various cancers. *Melissa officinalis* is also valued in aromatherapy for reducing anxiety and stress. And its essential oil shows potential in treating conditions like herpes. It also improving quality of life in menopausal women and those with PMS. With its wide range of applications, *Melissa officinalis* officinalis is also used in cosmetics and aromatherapy for its calming effects.

Keywords: *Melissa officinalis*, Antioxidant, Aromatherapy, Anticancer, Anti-inflammatory, Menopausal symptoms.

1. INTRODUCTION

Melissa officinalis, also known as lemon balm, bee balm and honey balm [(1)]. It is a member of the *Lamiaceae* (mint) family [(1)]. lemon balm (*Melissa officinalis*) belongs to a genus that includes 5 species of perennial herbs native to Europe, Central Asia and Iran, Although *Melissa officinalis* originated primarily in Southern Europe, it is now naturalized around the world, from North America to New Zealand [(1)].

For over 2000 years, Melissa officinalis has been used in cooking for its flavor and in traditional medicine for treating mental, cardiovascular, and respiratory issues. It is also valued for its benefits as a memory enhancer, cardiac tonic, antidepressant, sleeping aid, and antidote [(2)]. *Melissa officinalis* has several biological activities including antioxidant, hypoglycaemic, hypolipidemic, antimicrobial, anticancer, antidepressant, anxiolytic, anti-inflammatory and spasmolytic properties [(2)].

Melissa officinalis has a hairy root system, which makes the plant more adaptable to different environmental conditions [(3)]. It is one of the easiest herbs to grow, and spreads [(3)]. It reducing the heart rate, antibacterial, anti-inflammatory, antivirus, antispasmodic, antioxidant, to a neurotherapeutic agent [(4)]. Fresh herbs contain phenolic compounds, ascorbic acid, carotenoids, flavonoids and terpenoids [(5)]. The major components among terpenoids and neral [(5)]. The average height of the matured plant extends between 70–150 cm. The leaves are dark greenish in colour and with a slight lemon scent that resembles the smell of mint [(6)].

In the summer, its small white flowers appear and full of nectar that attracts bees [(6)]. This plant is renowned in folk medicine for its antimicrobial properties, traditionally used to treat venomous stings, wounds, ulcers, and various infections, including scrofula, cold sores, and rabies. It is also applied

topically in disinfectants and anti-dandruff treatments [7]. There are three subspecies of *M. officinalis*: inodora (Bornm) and altissima (Sibth. & Sm.) Arcangeli or M. Romana Miller [8]. It was also reported that *M. officinalis* contains substances that inhibit protein biosynthesis in cancer cells [8].

The leaves of *M. officinalis* are utilized in traditional medicine to treat moderate abdominal disorders and biliary dyskinesia [9]. The *M. officinalis* essential oil mainly contains terpenic aldehydes (citral, geranial, neral, and citronellal) and terpenic alcohols (geraniol, linalool, and octen-3-ol-l) [9]. This study aimed to evaluate if aromatherapy with Melissa officinalis can safely and affordably reduce anxiety in cardiac patients [10].

M. officinalis exhibits central nervous system (CNS) acetylcholine receptor activity, with demonstrations of both nicotinic and muscarinic binding properties. [11]. Due to lemony smell and pretty white flowers, Lemon balms are extensively cultivated in gardens throughout the world and are commonly used today in perfumery, cosmetics and food industries [12]. The hot water extract of *Melissa officinalis* (MO) exhibited the highest anticancer activity on CRC cells [13].

Melissa officinalis may be recommended to improve the quality of life for menopausal women with sleep disturbances due to its potential calming effects, which can help alleviate anxiety and promote better sleep[14]. Lemon balm (Melissa officinalis) may offer protection against free radical damage in dementia by acting as an antioxidant. This means it can help neutralize harmful free radicals that contribute to oxidative stress and neuronal damage associated with dementia. By reducing oxidative damage, lemon balm might help preserve cognitive function and support overall brain health [15]. *Melissa officinalis* (lemon balm), both alone and in combination with Nepeta menthoides, has been shown to significantly enhance the physical and psychological quality of life in women with premenstrual syndrome (PMS). Lemon balm's calming effects help alleviate PMS symptoms such as anxiety and mood swings, while its combination with Nepeta menthoides may provide synergistic benefits, further improving overall well-being and reducing physical discomfort associated with PMS [16]. Essential oil derived from *Melissa officinalis* (MO), which has shown clinical benefit in treating agitation [17].

Clinical studies show that topical Melissa officinalis cream effectively alleviates herpes simplex virus (HSV) symptoms by directly inhibiting viral replication, reducing inflammation, soothing lesions, and enhancing local immune response, leading to faster healing and symptom relief [18].
lemon balm, has emerged as a promising natural “calming agent” for emotional distress and related conditions [19]. The Melissa officinalis Phyto complex is a cutting-edge cosmetic ingredient that protects the skin from UV rays, blue light, and oxidative stress by providing antioxidant defense and enhancing resilience, thereby reducing premature aging and supporting overall skin health [20].

1.2 TAXONOMY

Melissa officinalis, also known as lemon balm, bee balm and honey balm. It is a member of the *Lamiaceae* (mint) family.
The taxonomical classification of this plant is as follows: Kingdom: Plantae; Division: Tracheophyte; Subdivision: Spermatophyta; Class: Magnoliopsida; Superorder: Asteranae; Order: Lamiales; Family: Lamiaceae; Genus: *Melissa*; Species: *Melissa officinalis* [1].

***Figure* 1 "Melissa officinalis, from Flora of Germany, Austria, and Switzerland, Gera."**

1.3 GEOGRAPHICAL SOURCES

Plant species of the genus Melissa grow wild in North Africa (Morocco, Tunisia, Madeira, Canary Islands), Southern Europe and Asia (West and Central Asia, Caucasus, Pakistan), they also spread outside these areas [21]. Aromatic plants are rich in essential oils and occur mainly in the Mediterranean region, where the production of such oils is a profitable source of ecological and economic development [23]. *Melissa officinalis* L. is indigenous of Southern Europe, Mediterranean region, Western Asia and North Africa [24]. This species is now cultivated worldwide. In India lemon balm is cultivated in the Kashmir, Uttarakhand and some part of South India [25]. Melissa officinalis includes two subspecies: *subsp. officinalis*, the commonly cultivated lemon balm, and *subsp. altissima*, known as bush balm and naturalized in New Zealand. [26].

1.4 TRADITIONAL USES

Medicinal use of *M. officinalis* back to over 2000 years ago. In the European Traditional Medicine, *M. officinalis* was known as Melissophyllon, Melissa and Balm. Dioscorides (40–90 CE), the father of pharmacology, addressed the plant in his *De Materia Medica* as follows: 'A decoction of the leaves is good for those touched by scorpions, or bitten by harvest spiders or dogs'. He also recommended the plant for the treatment of amenorrhea, dysentery, suffocation caused by mushrooms [2].

1.5 SIDE EFFECTS

No side effects have so far been reported for the herb98 when used topically or orally in recommended doses (up to 30 days) in otherwise healthy adults and when consumed in amounts found in foods. Lemon balm has been assigned Generally Regarded as Safe (GRAS) status in the United States with a maximum level of 0.5% in baked goods [22].

2. PHARMACOLOGICAL STUDIES

According to many biological studies, plant extracts and volatile oils are known for many beneficial activities for the human body. *Melissa officinalis* is considered to be a medicinal plant due to the numerous pharmacological effects associated with its chemical composition (Table1).

Effects	Mode	Study	Type of extract	Reference
Antidiabetic	*in vivo*	The study found that essential oil from *Melissa officinalis* significantly improved glucose control and lipid profiles in type 2 diabetic mice by modulating key metabolic enzymes. This suggests that *Melissa officinalis* essential oil may be a promising natural treatment for managing type 2 diabetes.	Essential oil	[49]
	in vivo	An effective therapeutic strategy to treat human obesity and type 2 diabetes	Herbal extract	[50]
Anti-Alzheimer	*in vitro*	The study investigated the anti-Alzheimer's potential of Lamiaceae plant extracts in an in-vivo model, focusing on their effects on key enzymes like GSK-3β, β-secretase, and CK1δ. The results indicated that these extracts could improve cognitive function and modulate disease-related enzymes, suggesting their potential as novel treatments for Alzheimer's disease.	Methanol extract	[51]
Antispasmodic	*ex vivo*	The study found that a hydroethanolic extract of *Melissa officinalis* significantly reduced intestinal spasms and modulated basal motility in an ex vivo model. These findings suggest the extract's potential as a natural remedy for gastrointestinal disorders involving excessive contractions.	Hydro-ethanolic leaf extract	[52]
Antiviral	*in vitro*	The in vitro study evaluates *Melissa officinalis* for its antiviral properties by testing its ability to inhibit viral replication and activity in cultured cells. It aims to determine the extract's effectiveness against specific viruses and identify the mechanisms through which it may exert its antiviral effects.	Aqueous extract	[53]
Antifungal	*in vitro*	The study aimed to evaluate various Lamiaceae plant species for their potential as antifungal agents against human pathogenic fungi responsible for invasive infections. By preparing and testing plant extracts in-vitro, the research sought to identify effective antifungal compounds and assess their potential for developing new treatments.	Ethanol extracts	[54]
			Essential oil	[55]
Antibacterial	*in vitro*	The study successfully synthesized silver nanoparticles using a *Melissa officinalis* leaf extract and confirmed their antibacterial activity against various	Essential oil	[56]

		bacterial strains. This eco-friendly synthesis method highlights the potential of these nanoparticles for use in medical and antimicrobial applications.		

Some of the pharmacological activities may be connected with the polyphenolic compounds occurring in *Melissa officinalis*, which include phenolic acids and flavonoids[28]. Most studies have focused on *Melissa officinalis* leaf extracts, obtaining phenolic profiles correlated with antiproliferative [29], antiangiogenic [30], antiviral [31], antioxidant [32], anti-anxiety, anti-anxiety, antidepressant, anti-Alzheimer, neuroprotective, cardioprotective, antifungal and antibacterial effects [33].

2.1 Antiviral activity

Aqueous extracts of Folium Melissa inhibited the replication in simplex virus type 2, influenza virus A2 (Mannheim 57) and vaccinia virus at a concentration of 10% [34]. A dried aqueous extract of the leaves inhibited the replication of herpes simplex viruses in vitro at a concentration of 200mg/ml [35]. A condensed tannin isolated from an aqueous extract of the leaves inhibited haemagglutination induced by Newcastle disease virus or mumps virus; protected eggs and chick cell cultures from infection by Newcastle disease virus; and prevented haemagglutination by Newcastle disease, mumps and parainfluenza viruses 1, 2 and 3, but not by influenza viruses A and B [36]. A tannin free polyphenol fraction of an aqueous extract of the leaves was active against herpes simplex and vaccinia viruses in egg and cell culture systems [37]. Aqueous extracts of the leaves have also been reported to have activity against Semliki Forest virus, influenza viruses and mycoviruses in vitro [38].

2.2 Antispasmodic activity

An ethanol extract of the leaves inhibited histamine and barium-induced contractions of guinea-pig ileum *in vitro* (200mg/ml), while an aqueous extract was inactive. A 30% ethanol extract did not inhibit acetylcholine- and histamine-induced contractions in guinea-pig ileum in vitro at concentrations up to 10ml/ml [39]. The essential oil inhibited contractions in guinea-pig ileum, rat duodenum and vas deferens, and rabbit jejunum and aorta in vitro. The essential oil also exhibited smooth muscle relaxant activity in guinea-pig tracheal muscle (ED50 22mg/ml) and in an electrically stimulated ileum myenteric plexus/longitudinal muscle preparation [40].

2.3 Behavioural effects

Inhalation of the essential oil had a weak tranquillizing effect in mice. We utilized 6-week-old male C57 Bl/6 Jico mice obtained from Iffa-Credo, Lyon, France. Upon arrival, the mice were housed in colony cages (40 cm x 25 cm x 20 cm), matched for body weight, and maintained in an environment with a controlled ambient temperature of 22°C and a 12-hour light/dark cycle (lights on: 7 AM, lights off: 7 PM) [41] They had ad libitum access to food and water and were kept in collective cages for a minimum of 16 weeks [42].

Prior to the commencement of treatment and behavioural assessments, the mice were individually housed for at least 2 weeks, with continued access to food and water. Behavioural testing was conducted when the mice were at least 24 weeks of age [43].

2.4 Antioxidant Activity

The antioxidants are known to play an important role in protection against disorders caused by oxidant damage. Reactive oxygen species (ROS) production can overcome cellular antioxidant defenses and can lead to a condition termed oxidative stress [44]. It was revealed that essential oils of *Melissa officinalis* have good potential for antioxidant activity and can be used in lipid-containing foods. It is a rich source of antioxidants, in particular from the group of phenolic compounds [45]. 7 Its activity is comparable with synthetic antioxidants (BHA and BHT), and antioxidant activity is related to phenolic compounds like citronellal and neral [46].

In a study, water extracts of 6 different herbs of the Lamiaceae family dittany, lemon balm, mint, sage, siderites, and sweet marjoram were investigated for their antioxidative properties. The extracts were examined for their effect against lipid oxidation in comparison to a tea water extract. It showed that the extract of Melissa was rich in bound forms of phenolic compounds such as hydroxycinnamic acids and flavonoids, rosmarinic and caffeic acids [47]. The lemon balm extract has the ability to scavenge both synthetic and natural free radicals. This is of significant importance as it indicates that the extract may have the potential to prevent oxidative damage in vivo by preventing free radical– mediated oxidative stress [48].

3. CONCLUSION

In conclusion, *Melissa officinalis* including antioxidant, antimicrobial, anti-inflammatory, anxiolytic, and anticancer effects. The essential oil of *M. officinalis*, which contains key terpenoids like neral, citral, and geranial, enhances its therapeutic potential, notably in alleviating anxiety and improving sleep quality. The herb's efficacy extends to dermatological uses, such as treating cold sores and herpes simplex virus (HSV), and it has shown benefits in addressing conditions like premenstrual syndrome (PMS) and menopausal sleep disturbances. Notably, *M. officinalis* has been affirmed as Generally Recognized as Safe (GRAS) in the United States, reflecting its safety in both food and topical applications. Thus, *Melissa officinalis* represents a significant and versatile botanical resource, offering valuable therapeutic and commercial potential while continuing to merit further research for its diverse health benefits.

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