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REVIEW ARTICLE

LEMON BALM (*MELISSA OFFICINALIS L.*) AN HERBAL MEDICINAL PLANT WITH BROAD THERAPEUTIC USES AND CULTIVATION PRACTICES: A REVIEW

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ABSTRACT

Lemon Balm (Melissa officinalis L.) is an important medicinal plant in herbal medicine. The main constituent of the essential oil of the plant is citral (geranial and neral), citronellal and geraniol. Lemon balm has been traditionally used for different medical purposes as tonic, antispasmodic, carmiative, diaphoretic, surgical dressing for wounds, sedative-hypnotic strengthening the memory and headache. Lemon balm is also used as flavouring in ice cream and herbal teas, often in combination with other herbs such as spearmint. It is also frequently paired with fruit dishes or candies. Lemon balm is also known as a hormonal herb due to its antithyroid activity. The present review is an effort to give the detailed survey of literature on its medicinal properties and cultivation practices of the plant under study.

INTRODUCTION

Lemon balm (*Melissa officinalis* L.) belongs to the mint family and it is indigenous of Southern Europe, Mediterranean region, Western Asia, and North Africa. Lemon balm is now cultivated worldwide. Currently in India lemon balm is cultivated in Kashmir, Uttrakhand and some part of South India. There are two subspecies, *Melissa officinalis* subspecies *Melissa officinalis*, the common cultivated lemon balm; and *Melissa officinalis* sub species altissima, naturalized in New Zealand and known as bush balm. Although *Melissa officinalis* sub species officinalis is known for its lemon fragrance (Tucker, 2000). Melissa refers to honey or the honeybee because the plant is so attractive to bees, and officinalis means a plant that is officially used in medicine.

The Greeks called it “melisophyllon” with “meliso” meaning “bee” and “phyllon”, denoting “leaf.” The Romans referred to the plant as “apiastrum” from “apias”, to mean simply “bee”. Sixteenth-century gardeners rubbed the leaves on beehives in order to promote the production of honey. Lemon balm is a perennial bushy plant and is upright, reaching a height of about 1 m. The soft, hairy leaves are 2 to 8 cm long and either heart-shaped (Zargari, 1991). Melissa officinalis is used in herbal medicine (Meftahizade *et al*., 2010). Dried or fresh leaves and top aerial section of the plant which are consumed as a medicine, perfume, cosmetic and herbal tea industries.

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Lemon balm is a versatile culinary herb which can be used to flavor for different types of dishes, from beverages, to appetizers, desserts. It can be added to salads, sandwiches, soups, stews, butters, cheeses, fish, stuffings for poultry, egg dishes, vegetables, fruit cups, jams, jellies, sauces, herb vinegar, wine, fruits punch, cakes, custards, ice cream, cookies, and cheesecakes (Janina, 2003). Lemon balm has medicinal properties like carminative, digestive, diaphoretic antioxidant, antiviral, antidepressant and stimulant activity. (Belsinger, 2007) Externally, it is used to treat herpes, sores, gout, insect bites and other skin disease. Lemon balm is also used as an insect repellent (Belsinger, 2002). It is a prominent antimicrobial agent against food-borne pathogens and spoilage bacteria. In vitro testing has identified its anti-HIV activity against HIV-1 reverse transcriptase and antitumor activity (Bown, 2006).

Lemon balm is also used for treatment depression and sleeping disorder. Lemon balm has been used to treat irritability and nervousness in young girls and women, boost a lack of interest and energy. Typically, 20–50 g of the dried leaves are infused in 1.0 L of boiled water for 5–15 minutes, and three to four cups of this tea are taken daily (Araujo, 2003). Essential oil of lemon balm which is used in aromatherapy, oil of lemon balm is considered the therapeutic principle mainly responsible for most of the activities mentioned, but plant phenolics, especially rosmarinic acid, are also considered to contribute to the therapeutic potential of M. officinalis. The essential oil content in lemon balm ranged from 0.02% to 0.30%, which is quite low compared with other members of the Lamiaceae family.

Because of this, the production cost and price of the essential oil is very high in the market (Brickell, 1997). Lemon balm oil has contain potentially active components primarily include monoterpenoids and sesquiterpenes, in particular geranial, neral, citronellal, geranyl acetate, β-caryophyllene, caryophyllene oxide and 1, 8-cineole (Davis, 1997).

Botanical Description

Lemon balm is an erect herbaceous perennial plant with opposite pairs of toothed, ovate leaves growing on square, branching stems. Plant has a bushy appearance, its height can range from just under 8 inches to nearly 5 feet, and plant has a width of 12 to 24 inches (Small, 1997). Leaves may be smoothing hairy and plant's fruit is a tiny nutlet (Turhan, 2006). Lemon balm's small flowers are 2-lipped, grow in whorled clusters, and may be pale yellow, white, pinkish and infrequently purplish or bluish and non glandular hairs (Brickell, 1997). The plant is taxonomically classified as.

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Lamiales
Family	Lamiaceae
Genus	Melissa
Species	M. officinalis
Binominal name	Melissa officinalis

Fig. 1. Leaves of *Melissa officinalis*

Indian Names

Hindi	Billilotan
Urdu	Baranjiboya
English name	Balm, lemon Balm

Pharmacognosy

Roots

Lemon balm is a spreading herb with short roots. The top of the plant dies down in winter, but the root is perennial in nature.

Leaves

Lemon balm has pairs of broadly ovate or heart shaped toothed leaves at each node. The leaves are 30 to 50 mm long, shiny on top, wrinkled and deeply veined.

Flower

Lemon balm has small, white or yellowish to pale blue flowers in loose, small bunches emerging from the axils of the leaves that appear in late spring to mid summer.

Phyto-chemistry

Lemon balm essential oil, obtained from fresh or dried flower, leaf, and branches of this plant by water steam distillation or chemical extraction, is characteristic with fresh lemon odor, and light yellow colored. Its viscosity is lighter than that of water. The main components of the essential oil are 39% citronellal, 33% citral (citronellol, linalool) and 2% geranial. In addition, this oil contains three terpinene, phenol carbon-acid (rosmarinic acid), and flavonglychoside acids in low ratio.

There are also caffeic acid, several flavonoids (luteolin-7-O-glucoside, isoquercitrin, apigenin-7-Oglucoside and rhamnocitrin), rosmarinic acid, ferulic acid, methyl carnosoate, hydroxycinnamic acid, and 2- (3', 4'-dihydroxyphenyl)- 1,3-benzodioxole-5-aldehyde and some other aldehydes: beta-caryophyllene, neral, and geranyl acetate. Shalaby (1995) reported that the highest essential oil's ratio (0.14%) was obtained from the plants, cut in the beginning of blooming.

Pharmacology

Antiviral activity

Lemon balm has anti viral activity against herpes simplex virus type 2, influenza virus A2, influenza viruses and myxoviruses in vitro and vaccinia virus 1. In a study where tannin isolated from aqueous extract of the lemon balm leaves inhibited haemagglutination induced by newcastle disease virus or mumps virus. Aqueous extracts of the leaves have been reported to have activity against semliki forest virus (Burgett, 1980).

Antispasmodic activity

Antispasmodic activity has been found in lemon balm is due to presence of ethanol extract of leaves and essential oil. Lemon balm oil is very useful for mussels and joint pain. Lemon balm oil is also used for curing arthritis (Brendler, 2005).

Psychoneurological activity

Lemon balm has Psychoneurological activity. Treatment with lemon balm had shown to improve cognitive performance and mood reduces induced stress and anxiolytic effects in humans (Cunningham, 2000).

Gastrointestinal Tract

Traditionally lemon balm has been used for gastrointestinal tract disorders, to promote digestion. According to the German commission E monograph Melissa is indicated in functional gastrointestinal complaints especially for spasm in the digestive tract and flatulent dyspepsia and carminative properties (De Sousa, 2004.)

Antioxidant Property

Essential oil of lemon balm has been shown to have antioxidant properties which are due to the presence of mono and sesquiterpenes components, caffeic acid and flavonoids (Dobelis, 1986). Rosmarinic acid had an activity to protect the liver from damage with its antioxidant action. In some recent studies on lemon balm has shown that, it is useful in treating hyperthyroidism and Graves disease.

Cultivation

Climate and soil

Lemon balm is require sunny days for best growth and development. Plant performs well in moderate temperature. Lemon balm should be cultivated in temperate and subtropical region, it can survive moderate frost. It is required 300 to 1300 mm per annum range of rainfall for survival. Lemon balm grows well in fertile sandy loamy soil with rich organic matter. It is required well-drained soil with a pH of 5 to 7.5 for best performance of crop.

Propagation

Lemon balm can be propagated from soft wood cutting and seed. However, in commercial propagation, only soft wood cutting is used in practice. When raising sapling, cuttings are treated with IBA for 15 to 20 minuts. Cutting should be planted in mixture of soil, FYM and vermicompost in bed. These are kept in 60% shade. Cuttings are watered regularly. Saplings are ready for transplanting in 4-5 weeks. Study has shown that the combination of soil+ FYM+ vermicompost (1:1:1) is good for sapling preparation. It has been observed that the combination of soil+ FYM + vermicompost (1:1:1) is helpful for improving survival of cutting (85 %), number of branches (6), plant height (36 cm), number of leaves/plant (38), fresh weight/plant (1.95 g), dry weight/plant (0.98 g), number of root/plant (6) and root length (11.2 cm).

Fig. 2. Transplanting of lemon balm

Fig. 3. After one month of transplanting

Transplanting

The ideal time for planting of lemon balm is February to March in temperate region of India. Transplanting of Cuttings in the field with the spacing of 20-30 cm apart in the row, and 50-60 cm between the plants. In some study it has been observed that the Closer spacing will allow plants to cover the area sooner and will result in the highest yields with fewer weed problems. In another experiment conducted by C. Saglam *et al*. (2004) in Turkey, they found that the 40 cm distance between plant to plant and 20 cm distance between line to line are best for plantation. Lemon balm is perennial nature crop so it has about 10 years of life, but is usually replaced every 5 years with crop rotation with a legume crop to rejuvenate the soil.

Fertilizer requirements

Although, recommendations are not available for fertilization of lemon balm in India. In some study yield and oil content may be increased with nitrogen application several times during the growing season. Lemon balm responds well to additional applications of nitrogen during the growing season, usually applied after harvest to promote new shoot growth. Abbaszadeh, B *et al*. (2009) in Iran, the found that the nitrogen fertilizer had significant effect on biological yield, essential oil percentage, essential oil content, plant height and tiller number. Highest biological yield (6788 kg /ha) and plant height (61.63 cm) were produced by application of 90 kg N /ha and highest tiller number (32.6 tiller/plant), essential oil percentage (0.2577%) and essential oil content (16.05 kg/ ha) were obtained under application of 60 kg N/ha.

Irrigation

Weekly irrigation should be done for successfully growing of crop because of the water requirement of crop is very high. Always avoid water stagnation in the field and if possible the crop is irrigated with sprinkler system of irrigation.

Plant protection

Weed control

Effective weed control is essential for getting good yield. 5 to 6 weeding and hoeing are required for keeping the crop free from weeds. Some weed species are more harmful and can reduce the quality of the crop. *Amaranthus* spp. and *Datura* spp. can contaminate the crop severely.

Pest control

The major pest of this crop is whitefly, spider mite and thrips are observed. White fly suck the sap from the leaves of plant and excrete large quantity of honey dew which serves as a growth medium for sooty mould. Spider mites feed preferentially on the lower stem, and then move on to the upper section of the plant and on leaves. Leaves may later turn yellow and drop. Silk webbing may be present when the infestation is severe. Thrips also suck the sap of leaves, causing browning and dropping of leaves. They can also be performing as vectors of viral diseases. All above pest are controlled by spraying of Malathion 50 EC or Indosulphon 35 EC @ 1.50 liter per 1000 liter of water.

Fig. 4. Intercultural operation for weed management

Disease control

Lemon balm is susceptible to powdery mildew, which appears as a dusty-white to grey coating over leaf surfaces or other plant parts. It can be reduce by applying of wettable Sulphur or Dinocap (Kerathan or Thiowet) can also be used to control the disease @ 20-25 g per 10 liter of water at the initial stage of this disease. If needed two more sprays should be given at an interval of 15 days after first spray.

Harvesting

The aerial parts of plant are harvested after 6 month of transplanting. Best time for harvesting just before the flowers open when the concentration of volatile oil is at its highest. Harvesting is done by hand on a clear and warm day. Quality will be reduced if the leaves turn brown. In commercial cultivation foliage can also be cut with a mechanical cutter.

Fig. 5. Manual harvesting of plants

Fig. 6. Data collection after harvesting

Postharvest and handling

Drying and distillation

Ghasemi *et al*. (2013), they found that the the maximum essential oil content (0.43%) obtained in 48 hrs oven-drying while minimum content (0.03%) obtained from drying under microwave with the power of 500 W. Citral and Citronellal content percentage in shade-drying with an air flow fan were more than other drying methods, Finally they suggested that oven-drying method has better results compared to the other methods.

Generally lemon balm dry herb is dried in the shade to preserve the chemical composition of the plant. Too much direct sunlight will cause volatile oils to disappear. The volatile oil is obtained by steam distillation of the dried herb. The chemical properties of the dried plant material are also extracted by different methods. The crop can be steam distilled immediately after harvest.

Packaging

Dry leaves of lemon balm are stored in bags that allow air flow. Plastic bags can cause fungous growth if too much moisture is present. Essential oils can be packaged in bulk or smaller quantities. Smaller quantities are usually more expensive as extra handling and packaging materials are needed. Ceramic, dark-colored glass, fluorinated plastic and epoxy-coated aluminum containers are used. Essential oils are volatile and as such have to be handled with care.

Storage

The oil is subject to oxidation, and as a result, it should be stored in filled, sealed containers, out of light and kept cool. Keep it air tight and do not expose it to heat or heavy metals.

Fig. 7. Washing of plant with fresh water before drying

Fig. 8. Drying of leaves in shade

Marketing

This plant is mostly marketed for medicinal purposes and herbal tea as a dried product. The end producer will market it as medicinal extracts or as herbal tea. Fresh lemon balm is marketed as culinary herb.

Utilization

Lemon balm is one of the most expensive of the essential oils; Essential oils are sold in bulk to wholesalers, where it is packaged in smaller quantities, which are marketed to the aromatherapy, perfume and cosmetic industries. Uses of essential oil and dry herb are given below.

Cosmetic

The herb is used for skin and body care. Lemon balm hydrosol is added to clay masks for skin healing.

Culinary

Fresh leaves of lemon balm add a magical flavour to many dishes, oils, vinegars and herbal liqueurs. Fresh or dried leaves make a refreshing tea, either cold or hot. The fresh leaves and flowers are used for stuffing of vegetable, fruit salads, bean dishes, meat and fish.

Industrial

Lemon balm is used as an herbal tea other tea blends. Oil is used in perfume, leaves and flowers are also used in wine-making. Lemon balm is a traditional ingredient in Herbal liqueurs.

Fig. 9. Fresh lemon balm tea

Fig. 10. Dry leaves of lemon balm

Other

- Lemon balm attracts bees, and if it is rubbed on inside of empty beehives it will attract new bee swarms.
- It also attracts beneficial insects such as parasitic wasps and tachinid flies that prey on many common garden insect pests.

Conclusion

Medicinal plant is the most exclusive source of life saving drugs for majority of the world's population. They continue to be an important therapeutic aid for alleviating the ailments of human kinds. Lemon balm has been traditionally used for different medical purposes as tonic, antispasmodic, carminative, diaphoretic, surgical dressing for wounds, sedative-hypnotic, strengthening the memory, relief of stress and reduce headache, but in modern pharmacology is value in the management of mild to moderate Alzheimer's, against migraine and rheumatism, antitumor and antioxidant activities. Very little work has been done on the biological activity and plausible medicinal applications of the compounds and hence extensive investigation is needed to exploit their therapeutic utility to combat diseases. Although crude extracts of *Melissa officinalis* have good medicinal properties. Modern drugs can be developed only after extensive investigation of their bioactivity, mechanism of action, pharmacotherapeutics, toxicity, proper standardization and clinical trials.

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