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A REVIEW ON: PHARMACOLOGICAL ACTIVITY OF THERAPEUTIC APPLICATION AND ESTIMATION OF MENTHA LEAF

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Abstract

It is widely cultivated for its leaves and essential oil, which are rich in menthol and used in food, medicine, cosmetics, and perfumery. In Ayurveda, mint is prescribed for digestive problems, respiratory ailments, and skin disorders. In Unani medicine, it is valued as a cooling and refreshing herb that balances the body's humors. Traditional Chinese medicine uses mint to relieve sore throat, fever, and headaches.Water requirement of mints is very high. Depending on soil and climatic conditions the crop is irrigated 6-9 times before the first monsoon. Essential oil from Mentha spicata (spearmint) has demonstrated potential in reducing the severity of IBS symptoms, particularly abdominal pain and bloating. Mint contains phenolic acids and flavonoids that contribute to its strong antioxidant activity, which helps neutralize free radicals and protect cells from oxidative stress. Mixed cultivation with mintAlthough mint is said to repel cabbage white butterflies and Colorado potato beetles, it is generally not advisable to plant this proliferating herb in vegetable beds. Once the cutting develops roots (this can take about a week in water), it's ready to be planted in a pot.

Introduction

Mentha commonly called mint or pudina) is a perennial aromatic herb belonging to the family Lamiaceae. It is widely cultivated for its leaves and essential oil, which are rich in menthol and used in food, medicine, cosmetics, and perfumery. Mentha, commonly known as mint, belongs to the family *Lamiaceae*. There are more than 25 species and many hybrids found in Europe, Asia, North America, and Australia. Mint plants have square stems, opposite leaves, and small purple, pink, or white flowers. The leaves contain glandular hairs that produce essential oils, giving mint its strong aroma and cooling effect.Important species include *Mentha arvensis* (Japanese mint), *Mentha piperita* (peppermint), *Mentha spicata* (spearmint), and *Mentha citrate* (bergamot mint). Mint grows well in fertile, well-drained soil with a slightly acidic pH (6.5–7.0). It prefers moderate temperatures (20–30 °C) and plenty of sunlight for good oil production. Cultivation is usually done by vegetative propagation with proper manuring, regular watering, and weeding. Harvesting is done about 100–120 days after planting, when the lower leaves start to turn yellow. After harvest, drying and steam distillation are carried out to get high-quality oil rich in menthol.1Mint contains important chemical compounds like menthol, menthone, carvone, pulegone, rosmarinic acid, and flavonoids. These substances give mint its medicinal properties. Their amount depends on the species, location, and growing conditions.Traditionally, mint has been used in many medicine systems. In Ayurveda, it helps with digestion, breathing problems, and skin diseases. In Unani medicine, it is known as a cooling herb that balances body humors. In Chinese medicine, it is used for sore throat, fever, and headache. People also use mint tea for indigestion, mint paste for inflammation, and mint vapors to clear nasal congestion.Today, mint is used widely in different industries. In pharmaceuticals, menthol from mint is used in cough syrups, lozenges, ointments, and pain relief creams. In cosmetics, it is found in toothpaste,

mouthwash, shampoos, and skincare products. The food industry uses it as a flavoring in drinks, sweets, and dishes. Its antimicrobial properties also help preserve food naturally [2].

Mint cultivation is an important agricultural activity worldwide. India, China, and the United States are the major producers of mint oil, which has great market value. Ongoing research on *Mentha* focuses on its medicinal benefits, new uses, and role in preventing lifestyle-related diseases.This report provides a comprehensive overview of the pharmacological activities of Mentha leaves, bridging traditional knowledge with modern scientific findings.

Fig 01: Mentha

Historical Development

India's historical mint development began with East India Company mints in Madras (1640), Bombay (1671), and Calcutta (1757), evolving from crude hammering to mechanized production, with standardized coins introduced by 1835 under British rule and modernizing with new facilities like the Noida mint in 1988 to meet growing demand. ` Early Mints and Company Rule & 17th Century: The East India Company established the first mints in India. 1640: The Madras Mint was set up. 1671: The Bombay Mint was established. 1757: The Calcutta Mint was opened to coin gold and silver for the Nawab of Bengal. Coin Marks: To distinguish coins from different mints, marks were introduced. "B" for Bombay and "C" for Calcutta were used. Standardization under the British 1835: Uniform coinage for the entire country was adopted, with coins featuring the portrait of the Britishmonarch, King William IV. Post-1857: After the Indian Mutiny, the British Crown took control, and the mints issued coins in the monarch's name. Modern Equipment: Both the Silver and Copper Mints in Calcutta were equipped with coining presses supplied by Boulton and Watt of Birmingham, England [3].

Plant Profile

Lamiaceae;Labiatae Mint Pudina, Putiha (Sanskrit) Pudina (Hindi & Kannada) Putina (Tamil) Podina (Telugu) :Mentha arvensis (Japanese mint) M. piperita (Peppermint) M. spicata (spearmint) M.citrata (Bergamot mint).

Antimicrobial Activity

Mint leaves have strong antimicrobial properties because of essential oils like menthol and menthone. These chemicals damage the cell membranes of microbes, causing the cells to leak and die. Research shows that mint extracts can stop the growth of harmful bacteria such as *E. coli*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa*, as well as fungi like *Candida albicans*. Because of this, mint is useful in treating infections, preserving food, and making cosmetic products [4].

Antioxidant Properties

Mint leaves are rich in antioxidants such as flavonoids, phenolic acids, and tannins. These compounds remove harmful free radicals and protect cells from damage. The antioxidants in mint may help reduce the risk of diseases caused by oxidative stress, like heart disease, diabetes, brain disorders, and aging. Drinking mint tea or using mint extracts regularly supports the body's natural defense system.

Anti-inflammatory Effects

Mint has strong anti-inflammatory effects mainly due to menthol and rosmarinic acid. These substances block the release of chemicals that cause inflammation, such as prostaglandins and cytokines. Studies have shown that mint helps reduce swelling, pain, and tissue damage. Because of this, it is helpful in conditions like arthritis, gastritis, and skin inflammation [5].

Analgesic and Antispasmodic Activity

Menthol, the main component of mint oil, activates cold-sensing nerves in the skin, giving a cooling feeling that helps reduce pain. Mint extracts also relax smooth muscles, which helps relieve muscle cramps and spasms. This explains why mint is traditionally used for headaches, stomach cramps, and intestinal spasms.

Carminative and Digestive Benefits

Mint leaves help in digestion by increasing bile flow and relaxing stomach muscles. They reduce gas, bloating, and indigestion, so they are often used as a carminative. Drinking mint tea can relieve digestive problems, nausea, and morning sickness [6].

Respiratory System Effects

Menthol in mint acts as a mild bronchodilator and expectorant. It opens up the airways, clears mucus, and relieves nasal congestion. Because of this, mint is used in cough syrups, inhalers, and lozenges. It helps in managing cough, cold, asthma, and bronchitis [7].

Hepatoprotective Activity

Studies show that mint extracts protect the liver from damage caused by toxins and certain medicines. This indicates that mint may help keep the liver healthy and support detoxification.Menthol-based creams and gels are widely used for itching, burns, and allergic reactions. The natural fragrance also adds to its cosmetic value.

Fig 02: Mentha oil

Varieties Japanese mint

CIMAP-MAS-1 and CIMAP-Hybrid-77, Shivalik, EC41911, Gombi, Himalaya, Kalka, Kosi, Gomati, Damroo, Sambhav,andSaksham Spearmint : CIMAP-MSS-1, CIMAP-MSS-5 and CIMAP-MSS-98, Punjab spearmint-1, Ganga, NeerKalka Bergamotmint :Kiran Peppermint:Kuk rail, Pranjal, Tushar

CULTIVATION

Propagation

Mints are propagated through the creeping stolons, suckers or runners. Stolons are obtained from previous years planting. One hectare of well established mint produces enough planting material for ten hectares. Best time for obtaining stolons is during the months of December-January.

Planting

In the plains, planting is done during winter months, whereas in temperate climate, planting is done in autumn or spring from last week of December to 1st week of March or from 1st week of January to 3rd week of February. Late planting always gives poor yield. Mints require thoroughly ploughed, harrowed fine soil. All the stubbles of weeds should be removed before the crop is planted.

The stolons are cut into small pieces (7-10 cm) and planted in shallow furrows of about 7-10 cm deep at a distance of 45-60 cm from row to row manually or mechanically.7Stolons are planted half way down on inner side of the ridges. Irrigation agriculture. Water requirement of mints is very high. Depending on soil and climatic conditions the crop is irrigated 6-9 times before the first monsoon. The crop requires three irrigations after monsoon.Japanese mints require fifteen irrigations require getting maximum yield. Weed growth causes about 60 per cent reduction in herb and oil yield. Hence, mints require weeding at regular intervals in the early stages of crop growth. Sin bar is effective as a post-emergence weedicide. 8Spray @ 1 kg per hectare. Organic mulch with a combination of 0.5 kg oxyfluorfen herbicide per hectare and weeding or preemergent herbicide at 1 kg per hectare and weeding has been found to give excellent weed control throughout the crop growth.

Plant protection Rust can be controlled by spraying 0.2% wettable sulphur or Kara thane. Stolon rot can be controlledby spraying of 0.2% Dithiane M-45 and 0 Major diseases: Rust, powdery mildew and stolon rot.

Major insects

Leaf roller, pyralid hairy caterpillar and termite

Schedule

1% brassicas.Leaf roller can be controlled by spraying systemic insecticide like monostrophes at 0.2%. Hairy caterpillar can be controlled by application of 5% Diplexer.Termites can be controlled by soil application of 3% heptafan @ 50 kg per hectare before planting [9].

Composition and Uses

apanese mint (M.arvensis)-Japanese mint is a primary source of menthol. The fresh leaves contain 4-6% oil. The main constituents ofthe oil are menthol (65-75%), menthone (7-10%) and menthyl acetate (12-15%) and terpenes (pipene, limonene and comphene). Peppermint (M.piperita) The fresh herb contains essential oils ranging from 0.4 to 0.6%. The constituents of peppermint oil are almost similar to Japanese mint oil. However, the menthol content is lower in peppermint oil and varies between 35-50%. Bergamot mint (M.citrate) Linalool and linalyl acetate are the main constituents of Bergamot mint oil. The oil is used directly in perfumes. Cosmetic preparations like scents, soaps, after-shave lotions and colognes also contain this oil.Spearmint (M.spicata) The principal constituent of spearmint oil is carvone (57.71%) and the other minor constituents are phellandrene, limonene, L-pinene and cinelole. The oil is used mostly as a flavouring in toothpastes and as food flavouring in pickles and spices, chewing gum and confectionery, soaps and sauces. Climatic requirements: It can be cultivated both in tropical and sub-tropical areas. The mean temperature between 20-40° C during major part of the growing period and rainfall between 100- 110 cm. (light showers at planting stage and ample sunshine at the time of harvesting) is ideal for its cultivation [10].

Soil: Well drained loam or sandy loam soils rich in organic matter having pH between 6 and 8.2 are ideally suited for its cultivation. It can also be cultivated on Rate followed by Seed planking are necessary to get a fine seedbed. The field should be free from stubbles both red and black soil. In case of acidic soil having pH less than 5.5, liming is recommended.

Land Preparation

Two or three ploughings and weeds. 11

Mints are propagated through the creeping stolons or suckers. In the case peppermint and bergamot mint, even runners are planted. Stolen are obtained from the previous year's planting. A hectare of well-established mint, on an average, provides enough planting material for ten hectares. About 400 kg stolons are required for planting one hectare of land. The best time for obtaining stolons is during the months of December and January.

Therapeutic Applications and Health Benefit

Mentha species, commonly called mint, have many medicinal uses. They are especially helpful for stomach problems like indigestion, gas, nausea, and irritable bowel syndrome (IBS). Mint also shows antioxidant, anti-inflammatory, antibacterial, and antiviral properties. In addition, it helps relieve pain, control blood sugar, heal wounds, and treat respiratory and skin conditions.12

Indigestion and Nausea: Mint is a well-known remedy for digestive problems. It helps reduce indigestion, nausea, and bloating by relaxing the stomach muscles and improving digestion.

Irritable Bowel Syndrome (IBS)

The essential oil from *Mentha spicata* (spearmint) can help reduce IBS symptoms such as stomach pain and bloating.

Flatulence: Mint acts as a carminative and antispasmodic. This means it helps relax the muscles of the digestive tract, reducing gas and discomfort [13].

Antioxidant and Anti-inflammatory Benefits

Mint contains flavonoids and phenolic acids that act as antioxidants. These protect the body's cells from damage caused by free radicals. Mint also helps reduce inflammation, making it useful in treating inflammatory conditions.

Antimicrobial and Antiviral Activity

The essential oil of *Mentha piperita* (peppermint) has strong antibacterial action, especially against bacteria like *Staphylococcus aureus*. Mint extracts and oils also show antiviral and antifungal properties, helping prevent and manage infections.

Pain Relief

Mint has natural pain-relieving (analgesic) properties. It can help reduce general body pain and menstrual cramps.

Respiratory Support

Mint decoctions and oils help in respiratory problems like cold, cough, and asthma. They clear nasal congestion and make breathing easier.

Antiallergic Effects

Mint has antiallergic properties, which may reduce symptoms of allergic reactions [14].

Skin and Wound Healing

Mint extracts are used in skincare for their cooling, soothing, and wound-healing effects. They help in treating minor wounds and skin irritations.

Cardiovascular and Metabolic Health

Studies suggest that mint may help protect the heart and control blood sugar levels, supporting cardiovascular and diabetic health.

Fig 03: Phytochemical Content

Estimation of Mentha Leaves

The estimation of mint (Mentha) leaves means studying and measuring their physical and chemical properties. This includes checking the amount of phytochemicals, minerals, and antioxidants, as well as physical features like leaf size, weight, and drying behavior. These tests are usually done in laboratories using instruments such as spectrophotometers and atomic absorption spectrophotometers (AAS).

BIOCHEMICAL ESTIMATIONS

Phytochemical Analysis

Studies on mint leaves identify and measure important plant compounds such as alkaloids, tannins, phenols, flavonoids, and steroids. These chemicals are extracted using solvents like ethanol, methanol, or hexane and measured using standard lab tests.

Mineral Content:Atomic Absorption Spectrophotometry (AAS) is used to find out the amount of essential and toxic minerals in different *Mentha* species. This helps in understanding their nutritional value and safety [15].

Antioxidant Activity

The antioxidant power of mint extracts is tested using methods like the DPPH assay. These tests show how well mint can neutralize harmful free radicals, which varies depending on the species and extraction method.

Essential Oil Content

The amount of essential oil in mint leaves is measured to check extraction efficiency. Studies show that the best oil yield is obtained at certain drying temperatures, proving that proper drying conditions are very important.

Physical Estimations

Leaf Dimensions

The length, width, and thickness of mint leaves are measured to study differences between varieties and to help in their classification and processing.

Density and Bulk Density

The density and bulk density of fresh and dried mint leaves are measured to check how suitable they are for packaging, storage, and industrial use.

Drying Kinetics

The drying process of mint leaves is studied by measuring moisture levels at different temperatures. This helps find the best drying conditions to keep the leaves' quality.

Colour Parameters

Color analysis instruments are used to measure changes in color, such as brightness and hue. These color changes are often more noticeable when the leaves are dried at higher temperatures [16].

Types and Varieties of Mint

There are around 20 - 30 species in total, most of which are native to the temperate zones of the northern hemisphere. Originally, mint comes from the Mediterranean region and the Near East. In Europe, there are several native mint species, such as water mint (Mentha aquatica), field mint (Mentha vulgaris), pole mint

(Mentha pulegium) and spearmint (Mentha spicata). Almost all native species can be used for teas, only the pole mint is poisonous and should therefore not be consumed. The best known of the mints is probably peppermint (Mentha x piperita). Its high menthol content gives it a particularly spicy, peppery and pungent taste. There are also several other mint varieties that offer special taste experiences. These include apple mint, nana mint, orange mint, pineapple mint, chocolate mint and many more. Find out more in our article on Mint Types and Varieties [17].

The Right Location &Soil Wild mint species can be found in damp locations in particular. This is why mints feel most at home in moist locations. They often cope well with shady conditions, but also like sunny spots. A nutrient-rich but welldrained soil is ideal, as mint is a medium feeder. The soil does not need to be deep, as mint tends to develop a shallow and wide root system. Otherwise, it is a fairly undemanding plant and grows like a weed in most gardens.

Planting Mint

How to Do It .The best time to plant mint is from April to June. This applies to pots and containers, but also to beds. It is now warm enough and usually not too dry or too hot for the plant to grow well. Normally, the plants or cuttings are planted directly, as most mints do not produce seeds at all (see "Propagation"). However, specialized growers are able to produce germinable seeds.18 To ensure that your mint plant has enough space to grow, you should keep a planting distance of 25 x 25 cm/9.8 x 9.8 in. Of course, you can also grow mint in a tub or pot!

Sowing & Propagating Mint Correctly The best time to sow mint is in March. Mint isa light germinator, which is why you should only cover the seeds lightly with soil. To increase the germination capacity of the seeds, you should proceed as follows: Mix the seeds with some bird sand optional: sterilize substrate (coconut fibres or potting compost) for 30 minutes at 150 - 180 °C/302- 356 °F in the oven Moisten the substrate sufficiently (with a spray bottle or watering spray) Start for Free FRÿD optional: sterilize substrate (coconut fibres or potting compost) for 30 minutes at 150 - 180 °C/302- 356 °F in the oven Moisten the substrate sufficiently (with a spray bottle or watering spray) Pour the seed-bird's sand mixture onto the substrate and press down; do not cover (light germinator).19Moisten again with a spray bottle A glass or plastic cover over the seed container keeps the moisture in better.

Place in a warm (over 20 °C/68 °F) and bright place (e.g., on the windowsill) Waterregularly The seeds should germinate after 14 to 16 days

Pricking and Planting Out Mint. Once the seedlings are 5 cm/2 in high, you can prick them out into small pots. This time you can mix potting compost with a little potting soil to give the young plants more nutrients. Depending on the outside temperature, the mint seedlings can be planted out in pots

Depending on the outside temperature, the mint seedlings can be planted out in pots or beds between April and May [19].

Mixed Cultivation With Mint Although mint is said to repel cabbage white butterflies and Colorado potato beetles, it is generally not advisable to plant this proliferating herb in vegetable beds. Mint is prolific and tends to crowd out its neighbors. Only plant mint in your vegetable or herb bed with a root or rhizome barrier to limit its growth [20].

Find examples and ideas for your mint planting plan here.

Cultivation and Propagation Of Mentha

To cultivate and propagate mint in water, take a healthy 4–6-inch mint cutting with no flowers, remove the bottom leaves, and place it in a jar of water with the nodes submerged and leaves above the waterline. Place the cutting in bright, indirect light, change the water every few days, and roots will form in 1-2 weeks. Once roots are well developed, transplant the cutting into soil to establish a new plant.

Steps for Propagation

Select a Cutting: Choose a healthy, 4-6-inch-long stem from a mature mint plant. Avoid stems that are flowering or have dried leaves

Prepare the Cutting: Strip off all the leaves from the bottom 2-3 inches of the stem, leaving only a few leaves at the very top. This encourages root growth from the nodes where the leaves were removed. 21

Place in Water: Put the prepared cutting into a jar or glass filled with water, ensuring that the stripped nodes are submerged.

Provide Light: Place the jar in a location that receives bright, indirect sunlight

Change Water Regularly: Change the water every 3-4 days to keep it fresh and prevent stagnation.

Wait for Roots: Roots should begin to appear from the nodes in about 5-7 days, developing into a well-established root system in 1-2 weeks.

Transplant to Soil: Once the roots are about two inches long, transplant the rooted cutting into a pot filled with potting soil. Care After Transplanting

Water: Water the new plant thoroughly after planting.

Pinching: Regular harvesting by pinching the top of the stems will encourage bushier growth and more flavourful leaves [22].

Fertilize: After a few weeks, you can add a water-soluble plant food or seaweed fertilizer to the water every 18-20 days for continued healthy growth.

How to Grow Mentha Leaf

To grow a Mentha (mint) plant, it's easiest to propagate from existing cuttings or nursery plants, as seeds are unreliable. Take a stem cutting, remove the lower leaves, and place it in water or moist soil until roots form. Once roots are established, plant the cutting in a wide, not-too-deep pot with good quality soil, as mint is an aggressive, invasive plant that thrives in containers.

How to Take Cuttings

Source a cutting: Obtain a cutting from a healthy mint plant. Prepare the cutting: Cut a 4-inch (10 cm) stem, removing any leaves that would fall below the water line. Promote root growth: Place the cutting in a glass of water or directly into moist soil.? Wait for roots: Roots should begin to appear in about a week [23].

Propagation: The easiest way to grow mint (Mentha) is by taking stem cuttings from an existing plant and rooting them in water or directly in soil. You should select a healthy, non-flowering stem, remove the lower leaves, and then place it in water or soil to develop roots. Once roots form, you can plant it in a pot with potting soil, water it, and it will grow into a new plant.

How to Grow Mint from a Cutting Take a Cutting

Select a healthy, 4-to-6-inch-long stem from an established mint plant.

Make the cut just below a leaf node (where a leaf meets the stem).

Remove all the leaves from the bottom part of the stem, leaving only 4 to 6 leaves at the top [22].

Start Rooting

In Water: Place the cutting in a transparent glass of water, ensuring the bottom two inches of the stem are submerged.24

In Soil: Alternatively, you can dip the cutting in rooting hormone and plant it in a pot of potting soil, or plant it directly in moist soil, keeping it in a semi-shaded area.

Care for the Cutting

Place the cutting in a window that receives plenty of sunlight. If rooting in water, change the water every 3 to 4 days to prevent rotting

Keep the soil moist if you rooted directly in soil.

Transplant to Soil

Once the cutting develops roots (this can take about a week in water), it's ready to be planted in a pot. Dig a hole in a pot with potting soil, place the rooted cutting, cover it with soil, and water it well.

Medicinal Plants of Mentha Leaf

Medicinal plants from the *Mentha* genus, such as spearmint (*Mentha spicata*) and peppermint (*Mentha piperita*), have many health benefits. They show antioxidant, antimicrobial, antiallergic, and anti-inflammatory properties. Mint is used to treat digestive problems, nausea, breathing difficulties, and pain. It contains active compounds like menthol, which provide cooling and healing effects. Mint also helps improve oral hygiene by reducing bad breath and can be included in the diet to help manage diabetes and obesity.

Key Mentha Species and Their Uses

Spearmint (*Mentha spicata*)

In traditional Iranian medicine, spearmint is used to treat digestive problems, strengthen the stomach, and act as a carminative (to relieve gas) and a mild sedative.

Peppermint (*Mentha piperita*)

Peppermint is a hybrid mint with a high amount of menthol. It is used for indigestion, colic pain, and has antifungal and anthelmintic (worm-killing) properties.

Pennyroyal (*Mentha pulegium*)

Pennyroyal is another species of *Mentha* known for its medicinal value and traditional uses.

Digestive Health

Mint supports digestion by reducing gas, bloating, and stomach pain. It helps improve overall digestive function.

Antioxidant Properties

Mint contains phenolic compounds and flavonoids that act as antioxidants, protecting the body from cell damage caused by free radicals.

Antimicrobial and Antifungal Effects

Mint has strong antimicrobial and antifungal properties that help fight harmful microorganisms.

Respiratory Relief

Mint helps ease breathing problems and provides relief from symptoms of asthma and other respiratory conditions [25].

Oral Health

Mint leaves improve breath freshness, strengthen gums, and help prevent tooth decay and cavities.

Conclusion

Mentha, commonly known as mint or pudina, is a fragrant perennial herb that belongs to the Lamiaceae family. It is widely grown for its leaves and essential oil, which are rich in menthol and used in food, medicine, cosmetics, and perfumes.The main species of mint include *Mentha arvensis* (Japanese mint), *Mentha piperita* (peppermint), *Mentha spicata* (spearmint), and *Mentha citrata* (bergamot mint). Mint grows best in fertile, well-drained soil with a slightly acidic pH (6.5–7.0). It requires moderate temperatures (20–30°C) and plenty of sunlight for maximum oil production.

Mint is mostly propagated vegetatively and needs proper manuring, regular watering, and timely weeding for healthy growth. The crop is usually harvested 100–120 days after planting, when the lower leaves start turning yellow. After harvesting, the leaves are dried and processed through steam distillation to produce high-quality essential oil rich in menthol.The *Mentha* genus includes more than 25 species and many hybrids, found widely across Europe, Asia, North America, and Australia. Mint plants have square stems, opposite leaves, and small purple, pink, or white flowers.

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Conflicts of Interest

The authors declare no conflicts of interest.

Author Contribution

All contribute equally

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Not Applicable

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