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Review Article

Production, economics, properties and industrial uses of essential oil of patchouli (*Pogostemon cablin*): A review

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Abstract

Patchouli, botanically known as Pogostemon cablin Benth., belongs to the family Lamiaceae and is renowned for its significant medicinal and aromatic attributes. The primary purpose of its cultivation is to obtain its valuable essential oil, which is obtained by distillation of leaves and tender herbs. Patchouli and its essential oil have various medicinal and aromatic properties, which are used in pharmaceuticals, cosmetics, aromatherapy, food flavor, toiletries, perfumery and agarbatti production. Patchouli essential oil is a highly demandable produce in national and international markets, but the production of its oil is very low compared to global demand and the demand is increasing every year. Hence, to fulfill the global demand it is necessary to increase production by adopting improved cultivation practices and primary processing. The objective of this study is to collect secondary data on improved cultivation practices, varieties, production, uses, properties, export and import in India and global market aspects of patchouli. As more than 80% of patchouli oil is imported from other countries to fulfill our demand, it is an urgent need to popularize the cultivation and processing of patchouli among the farmers as an import substitution of this oil to save the Indian currency and supply the quality oil to the desired industries.

Keywords: Patchouli, Essential oil, Cultivation, Enhancement production, Import substitution.

Introduction

Patchouli, botanically known as *Pogostemon cablin*, is a medicinal and aromatic plant belonging to the family Lamiaceae (Bhaskar *et al*., 2000). It was first documented in the Philippines in 1845 by botanist Pelletier-Sautelet and given the initial name *Pogostemon patchouli* (Bhaskar and Vasantha, 2000). In India, there are approximately 25 distinct species of *P. patchouli*, known by various names, is called "patcholi" in Hindi, "patchapan" or "patcha" in Marathi, "patchilla" in Malayalam, "pacchilai" in Tamil, "tamalapatra" in Sanskrit, and "patchetene" in Kannada (Swamy and Sinniah, 2016). It was introduced to India in 1941 and is now cultivated in various regions, including the coastal areas of Karnataka, West Bengal, Madhya Pradesh, South India, Assam, and the coastal regions of Gujarat. It is primarily carried out in coastal areas of states such as Tamil Nadu, Karnataka, Assam, and West Bengal. Tata Oil Mills initiated commercial patchouli cultivation in India in 1942, while systematic cultivation under CSIR-CIMAP began in 1962, as documented by Kumar *et al*., 1986. Patchouli cultivation in India has seen modest growth over the past five years and currently covers approximately 600 hectares of land with an annual production of 20 tons of patchouli oil. The Indian market requires approximately 220 metric tons of patchouli oil, valued at 33 crores, whereas the international demand stands at 1600 metric tons annually, with a total value above 240 crores (Kumar, 2004). It is worth noting that Indonesia is the primary supplier to India, accounting for over 80% of the total import value (ZAUBA, 2023). Since the increase in the demand of patchouli oil in both domestic and international markets, there is a significant opportunity to enhance production by expanding the patchouli crop area. It is also necessary to increase cultivation to reduce imports from other countries (Choudhri *et al*., 2023). There is great potential for large-scale patchouli oil production in Assam and neighboring states in northeastern India. This could offer a financially sustainable alternative to traditional agricultural practices and rotational farming, generating employment opportunities, especially for rural and tribal communities in the region (Tripathi *et al*., 2005).

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Morphological description

The plant is a fragrant herb or undershrub characterized by a branched, erect, or ascending structure with a quadrangular stem, reaching a height of 1 to 1.2 m (Angadi *et al*., 1995). The patchouli leaves measure 2 to 4 inches in length and 0.85 inches in width. Leaf margins exhibit slight lobes with crenate-serrate edges, and the dorsal surface of the leaf, along with the ribs, is abundant with hairs (Guenther, 1949). The leaves are single, arranged opposite each other in a crossed pattern, appearing pale to purplish green in open conditions but exhibiting a bright green hue when grown in shade (Angadi and Kumar, 1995). Patchouli plants produce spikes adorned with clusters of flowers, exhibiting an array of colors spanning from white to a subtle shade of pale purple. Certain blooms may present a whitish appearance tinged with hints of purple, emerging on both axillary and terminal spikes. The sepals intricately join to form a tubular structure with 2 or 5 irregular teeth, giving rise to a distinct 2-lipped corolla marked by a white hue complemented by purple streaks and featuring two lobes. Within the flowers, four stamens are present, and the ovary, deeply divided, houses a solitary ovule, culminating in a fruit containing four smooth ovoid nutlets (Cobley, 1976).

Production technology of patchouli

India, with its diverse agricultural landscape and suitable climate, has the potential to become a key player in patchouli production. Patchouli herb thrives in tropical climates, with major cultivation areas located in countries like Indonesia, Malaysia, Singapore, China, Brazil, and India. It is typically grown under the partial shade of areca nut and coconut plantations, making efficient use of available land. Moreover, patchouli can be conveniently cultivated in flood-free fallow or wastelands, which is an excellent way for farmers to generate additional income.

Agro climatic requirement

Patchouli is a tropical crop that can also adapt to sub-tropical conditions. It thrives in areas with 75% humidity. Ideal cultivation conditions include well-drained loamy soil with a pH that leans slightly acidic, within the range of 5.5 to 6.2. It prefers hot and humid environments, making partial shade from plants like rubber, coconut, or coffee beneficial, while complete shade should be avoided (Bhaskar and Kumar, 2000; Sujatha *et al.*, 2011). For optimal growth, patchouli necessitates an average temperature between 22 and 28°C. It performs best at elevations 500 m above mean sea level and receives 150 to 250 cm of evenly distributed annual rainfall, with at least 75% humidity throughout the year (Bhaskar, 1995). Encouraging patchouli cultivation in the coastal regions of southern states such as Karnataka, Tamil Nadu, Assam, and West Bengal is advisable.

Varieties

The breeding program of patchouli was started by CSIR-Central Institute Medicinal and Aromatic Plants, Lucknow in the early 1990s and developed varieties that have better yield and quality. The first variety of patchouli developed by CSIR-CIMAP was CIM-Samarth. This variety is known for its rapid growth and can be cultivated in both shaded and open-field conditions, having a herbage yield of 21.60 tons per ha and its oil yield was 80.70 kg per ha with 2.55% oil content in the leaves (Kalra *et al*., 2005). It also exhibited tolerance to various diseases. Recently, CSIR-CIMAP, Lucknow also developed a variety named CIM-Utkrisht, with higher production potential in comparison to CIM-Samarth. It was developed through intensive breeding efforts for higher patchouli alcohol (43 *vs.* 41% in the check) and superior herb and essential oil yield (110 *vs.* 56 liters/ha). The variety has regularly shown higher biomass and oil yield in field evaluation studies and a high concentration of patchouli alcohol in the oil. The average production of this variety was 110 liters/ha of essential oil and 63 q/ha of dry leaves. CIM-Utkrisht also met DUS requirements because it differs morphologically from existing patchouli varieties and can be easily recognized by its large, broad, dark green to light purple leaves, which contain unique fragrant compounds in the essential oil called ar-curcumene (8%) and γ-curcumene (21–26%) (Singh *et al*., 2019).

Propagation

Asexual reproduction through plant cuttings using stem cuttings is widely employed for cloning and preserving elite plant clones of various species. This technique ensures minimal genetic variation among propagated plants, ultimately enhancing output or yield (Hartmann and Kester, 2011; Stuepp *et al*., 2014). Patchouli plants seldom produce seeds, making large-scale cultivation dependent on vegetative propagation. Typically, this is accomplished by employing stem cuttings that are 10 to 12 cm in length; each cutting comprises 3 to 4 nodes. In patchouli, cuttings with leaves on the stems are favored for vegetative propagation because of their higher success rates in root development and shoot formation. According to Garbuio *et al*., 2007, the optimal practice for enhancing root development and stem growth in patchouli involves the utilization of stem cuttings sourced from the apical and medium regions. It is advised to select cuttings having two leaves, to facilitate improved rooting and robust stem development. For successful vegetative propagation of patchouli, a recent study suggested utilizing single nodes from the third and fourth leaves near the shoot tip. The right maturity of leaves is crucial for successful rooting and shoot development (Saravanan *et al*., 2015).

Planting and spacing

A nursery area of approximately 200 m^2 is sufficient for raising the plants needed for one hectare of cultivation. Typically, the nursery is established during the monsoon season. The cuttings require about 30 to 35 days to root and can then be transplanted to the main field. Transplanting can be carried out throughout the year, except during the peak summer, winter, and heavy rains. However, the best time for transplanting is from July to September. It is advisable to conduct the transplanting process, preferably in the evening. While the transplanted seedlings may experience initial drooping, they generally recover by the following morning (Tripathi *et al*., 2005). Approximately 40,000 cuttings are needed for planting on one hectare. The ideal spacing between patchouli plants depends on climatic conditions and soil conditions. In North East India, planting is done in rows with spacings of 60 × 45 or 60 × 60 cm. Closer spacing of 45 × 45 cm is ideal. On hilly terrain, contour planting with 50 × 100 cm spacing is advisable (Singh, 1996).

Nutrient requirement

During field preparation, it is recommended to apply approximately 4 to 6 tons of well-prepared compost per hectare or 5 tons of vermicompost per hectare. The application of inorganic fertilizers should be based on soil test results, considering the soil's fertility status. In general, patchouli crops require a substantial amount of urea and potassium, with a lower requirement for phosphorous. The recommended nitrogen, phosphorus, and potassium (NPK) ratio is 100:25:250 kg per hectare. Phosphorous and potassium should be applied during field preparation, while nitrogen should be divided into four split doses applied at equal intervals (Singh, 2011). For optimal growth and yields, a combination of soil orders by ultisol and mycorrhizal biofertilizer by *Glomus mosseae* is effective in enhancing various plant parameters, including number of leaves, plant height, root colonization, P_2O_5 absorption, stem, fresh weight, dry weight, number of branches, and oil content (Syafruddin *et al*., 2020).

Irrigation

Keeping an irrigation water to cumulative pan evaporation (IW:CPE) ratio of 1.0 has demonstrated significant enhancements in both oil yield and herbage without impacting the oil content, as indicated by Singh 1996 and Singh *et al*., 2002. To economize water usage, various surface irrigation systems were assessed in Bangalore, India, during 1996–97, as reported by Rao *et al*., 1998. Their findings revealed that adopting the alternate furrow irrigation method could potentially lead to substantial water savings, estimated to be around 50%.

Intercultural operations

To maintain a weed-free patchouli crop, it is essential to perform two weeding before the initial harvest and combine weeding and hoeing after each subsequent harvest. In the initial 2 to 3 months of crop growth, weed control can be achieved through either wheel hoeing, usually performed 2 to 3 times, or manual hand weeding. Additionally, it is crucial to conduct weeding about a month after each harvest.

Pests and diseases

Patchouli crops can be affected by major pests like leaf caterpillars and white flies. To manage these pests, chemical options like dichlorophos or monocrotophos can be employed. After 2 to 3 years of continuous patchouli cultivation, nematode issues may also emerge. To address nematode problems, carbofuran can be used at a rate of 15 to 20 kg per hectare. In terms of diseases, patchouli is susceptible to fungal issues like leaf blight, root rot, and wilt. To control these diseases, fungicides such as Bavistin, Captan, or Dithane M-45 can be applied at a concentration of 2 mL per liter of water. In cases of soil-borne diseases, drenching at 3 to 4 day intervals may be necessary. It is worth noting that patchouli's wilting disease, induced by *R. solani*, is effectively managed through the use of biological antagonistic agents. This includes a combination of *Gliocladium virens* and *Glomus aggegatum*, as demonstrated by Mishra *et al*.,2000.

Harvesting

The initial harvest of patchouli is typically conducted about 4 to 5 months after transplanting, as per CSIR-CIMAP guidelines. The timing of the harvest is critical for achieving a good, high-quality oil yield. Only mature patchouli leaves are selected for harvest, and they are shade-dried before undergoing steam distillation. Harvesting is recommended when the foliage transitions from a light green to a subtle shade of brown, accompanied by the distinctive aroma of patchouli, particularly noticeable in the morning. Subsequent harvests, occurring every 3 to 4 months, depend on these area conditions and agricultural practices. Typically, a patchouli crop can be sustained for around 3 years, with the initial 2 or 3 harvests from newly planted plantations yielding optimal results in both quantity and oil quality.

Harvesting involves the use of small, sharp shears or secateurs, with the harvested portion usually measuring between 40 and 60 cm. ensuring the preservation of 4 to 6 juvenile sprouting buds at the base is crucial for rapid regeneration during the harvest. Avoiding premature harvesting is essential, as it leads to reduced yield and inferior-quality oil (Ramya *et al*., 2013). In the rainy season, fungicides should be applied after harvesting.

Ideally, harvesting should take place during the drier months.

Post-harvest management

Drying

The harvested patchouli material is meticulously spread in thin layers and positioned in a shaded area. It is crucial to turn the material to ensure even and proper drying periodically. The quality of drying is a critical factor in obtaining the maximum yield and high-quality oil. Usually, the harvested herb needs to undergo a drying period in the shade with sufficient air circulation, lasting approximately three days. Under these conditions, the drying process typically results in an average essential oil yield of 2.5% upon distillation. However, the precise yield is contingent on factors such as available sunlight and atmospheric humidity. Thoroughly dried patchouli leaves acquire the distinctive patchouli aroma, which is less pronounced in fresh leaves, as noted by Farooqui *et al*., 2001.

Distillation

A notable benefit is that once the leaves are adequately dried and preserved, they can be conveniently utilized for distillation at a later time. It is crucial to emphasize that the essential oil is present in all parts of the patchouli plant, including the roots. However, research indicates that the highest-quality oil is found in the top leaves and tender twigs (Kumar, 2004). Generally, storing dry leaves for 4 to 6 months results in a higher oil yield with a superior aroma. For extracting essential oils from plants, steam distillation is the prevalent method for commercial cultivation. While other extraction techniques exist, such as microwave distillation, ultrasound extraction, supercritical fluid extraction, and hydro-distillation, steam distillation remains the preferred choice from a consumer perspective. Its simplicity and transparency ensure purity is guaranteed as the process solely relies on water (Ramya *et al*., 2013).

Oil recovery

The process of oil recovery from patchouli follows a gradual increase and reaches its peak between 6 to 8 hours of distillation. Initially, the oil fractions contain lower concentrations of patchouli alcohol, which then increase to optimal levels within 4 hours. This process typically yields around 2.0 to 2.5% of patchouli oil from dry leaves. If 1-ton of air-dried patchouli herb is subjected to distillation, the patchouli oil obtains approximately 20 to 25 kg. In the context of one hectare of land, it is estimated that the oil can obtain 60 to 100 kg through two harvests, translating to about 25 to 40 kg per acre (Rao *et al*., 1997; Souhoka *et al*., 2020).

Storage and packing of oil

Choosing a container for essential oils is crucial to avoid any physical or chemical interactions. For aroma therapists handling the small quantities of essential oil, neutral glass is the optimal choice. Larger quantities, however, may require metal containers, such as aluminum with an internally lacquered surface for amounts up to 10 kg, and internally lacquered steel drums for quantities exceeding 10 kg (Clarke, 2009).

Economics of patchouli

The cost of cultivation of patchouli typically falls within Rs. 30,000 to Rs. 35,000 per acre. This includes various expenses such as land preparation, seedlings or cuttings, fertilizers, pesticides, labor, and other associated costs. On the income side, patchouli cultivation has the potential to generate significant returns, with earnings of Rs. 70,000 to Rs. 75,000 per acre per year. The net profit, which is the difference between income and cost of cultivation, can amount to a substantial Rs. 40,000 to Rs. 45,000 per acre per year (Aus Gyanya 2023).

Marketing of essential oil

Patchouli is a highly demandable crop in national and international markets and India is one of the biggest producers and consumers in the world. Last 10 years, export and import data of patchouli essential oil are shown in Table 1. Patchouli essential oil is produced in significant quantities in Indonesia, contributing 80% of the global supply, which amounts to approximately 1200 metric tons annually (Lawrence, 2009). This production is distributed across different regions in Indonesia, with Sulawesi island accounting for 70%, Sumatra for 25%, and Java for 5% of the total output. The total value of this production is estimated to be around US $ 70 to 100 million (IFEAT, 2014).

Chemical composition of essential oil

Patchouli is the richest source of valuable essential oil, which is obtained from its different species and varieties. A study was conducted on *P. cablin* and *Pogostemon travancoricus* var. *travancoricus* and the result was obtained that 11 compounds from *P. cablin* oil and 13 from *P. travancoricus* var. *travancoricus* oil were reported. The oil of *P. cablin* was rich in patchouli alcohol (23.2%), α-guaiene (14.6%), seychellene (5.6), β-caryophyllene (4.5), β-patchoulene (4.2%), α-patchoulene (3.3%) and *P. travancoricus* var. *travancoricus* oil also possessed the same compounds but they were represented in meagre amounts of cadina-1,4-diene (11.2), calamenene (10.7), ledene (8.6), germacrene D (7.8), seychellene (5.3), α-patchoulene (3.4), isoledene (2.6), b-caryophyllene (2.0), β-patchoulene (0.3) (Sundaresan *et al.*,2009). The samples of patchouli plant were collected from Welulu Village, Kolaka Regency, Southeast Sulawesi Province. The results

Table 1: Import and export data of patchouli oil from the past 10 years

S. No.	Year	Export			Import		
		Value (In US $ Million)	*Share (%)*	*Growth (%)*	*Value (In US $ Million)*	*Share (%)*	*Growth (%)*
1.	2014-15	1.30	0.0004	-64.17	22.04	0.0049	52.88
2.	2015-16	0.19	0.0001	-85.03	27.91	0.0073	26.60
3.	2016-17	0.21	0.0001	7.97	24.06	0.0063	-13.80
4.	2017-18	0.53	0.0002	152.02	24.43	0.0052	1.55
5.	2018-19	0.55	0.0002	4.76	19.35	0.0038	-20.80
6.	2019-20	0.48	0.0002	-12.56	24.05	0.0051	24.30
7.	2020-21	0.71	0.0002	46.74	33.59	0.0085	39.66
8.	2021-22	1.06	0.0003	49.49	39.48	0.0064	17.53
9.	2022-23	0.41	0.0001	-61.18	28.53	0.0040	-27.72
10.	2023-24	0.32 (April-Sep)	0.0001	-	17.11(April-Sep)	0.0052	-

Source: Ministry of Commerce and Industry, GOI.

of GC-MS analysis showed that patchouli oil contained 13 chemical compounds, namely β-patchoulene (4.56%), cedr-8-ene (1.24%), trans-caryophyllene (7.96%), α-guaiene (18.61%), seychellene (5.70%), patchoulene (2.88%), eremophilene -guaiene (18.90%), cyclohexanone (1.10%), azulene (8.74%), globulol (1.88%), veridiflorol (4.39%), and alcohol patchouli (22.7%) (Souhoka *et al*., 2020).

Properties of essential oil

Patchouli oil is also used as traditional medicine for treating various ailments such as diarrhea, abdominal pain, colds, nausea, fever, vomiting, headaches, and snake bites and insects (Swamy *et al*., 2015). Patchouli oil is highly demanded in the industry for different applications in the flavor, fragrance, and pharmaceutical sectors (Swamy *et al*., 2016).

Antiviral activities

During screening for antiviral activity against influenza, traditional medicines containing herbs like patchouli were evaluated. The patchouli leaves demonstrated by methanol extract significant inhibition of influenza virus A/PR/8/34 (H1N1) at a concentration of about 10 μg/mL, reaching up to 99.8%. The estimated IC_{50} value for this inhibitory effect was 2.6 μM (Kiyohara *et al*., 2012). In the latest study, Wu *et al*., 2013, identified anti-influenza viral properties in patchoulol at a concentration of 10 μg/mL in an *in-vitro* setting. The research indicated that patchoulol not only bolstered the recognition and response of the innate immune system but also suppressed the expression of the IFN-α inflammatory factor, thereby mitigating inflammatory responses (Wu *et al*., 2013).

Antifungal activities

Da *et al*., 2023 reported that they highlighted the antifungal prowess of *P. cablin* oil against *Candida krusei* strains, revealing remarkable CFM and MIC values of 32 μg/mL. Furthermore, Adhavan *et al*., 2017, illustrated the potent antimicrobial efficacy of patchouli oil against a spectrum of microorganisms, encompassing both gram-negative and gram-positive strains. The oil demonstrated notable MIC values, with 25 mg/mL against *Streptococcus* mutants isolates and 12.5 mg/mL against *Shigella flexneri* and *S. aureus* in meticulous *in-vitro* studies.

Opportunistic infections and HIV/AIDS

In French medical facilities, essential oils were harnessed as potent antimicrobial agents to combat specific opportunistic infections caused by *Candida albicans*, *Cryptococcus neoformans*, methicillin-resistant *Staphylococcus aureus*, and *Herpes simplex* type I and II found in patients diagnosed with acquired immune deficiency syndrome (Buckle, 2002).

Antibacterial property

Patchouli oil exhibit antibacterial properties and are traditionally employed in treating common colds and fungal infections in herbal medicine (Ichikawa *et al*., 1989). Utilizing molecular docking technology and *in-vitro* antimicrobial testing, it has been demonstrated that patchouli oil exhibits robust antimicrobial effects. In particular, pogostone and (-)-patchouli alcohol exhibit robust antimicrobial properties (Yang *et al*., 2013). Patchouli oil demonstrated antimicrobial effects against enteric bacteria extracted from the fecal droppings of common house lizards (Singh *et al*., 2013).

Fibrinolytic activities and blood coagulation

The study specifically delved into scrutinizing the intricate aspects of fibrinolytic and blood coagulation activity across a spectrum of essential oils, prominently featuring patchouli. This investigation meticulously employed *in-vitro* enzymatic reactions, encompassing the processes of fibrin formation from fibrinogen induced by thrombin and subsequent fibrin resolution facilitated by urokinase. Results indicated that chamomile, eucalyptus, and neroli oils exhibited both

coagulation and fibrinolytic activities, while patchouli, citrus, pine, and frankincense oils demonstrated efficient hyperfibrinolysis (Sumi, 2003).

Gastrointestinal protective activity

The study revealed that a water extract derived from *P. cablin* adeptly maintains the membrane fluidity of intestinal epithelial cells by controlling serum nitric oxide and tumor necrosis factor levels. These results establish a practical basis for the protective effects of *P. cablin* on maintaining gastrointestinal integrity during trauma or surgical interventions, as demonstrated in the study by Xie *et al*.,2009.

Antithrombotic activities

Park *et al*., 2020 reported in their study the potential applications of the herbal medicine Sunghyangjunggisan (a traditional Korean herbal medicine formulation) and its constituent components (*Perilla frutescens, P. cablin, Aucklandia lappa, Ziziphus jujuba, Citrus unshiu Atractylodes macrocephala,* and *Arisaema amurensa*) as a ground-breaking anti-thrombotic agent. While, Sunghyangjunggisan did not inhibit *in-vitro* adenosine 5-diphosphate (ADP) and collagen-induced rat platelet aggregations, it notably impeded *ex-vivo* rat platelet aggregation. Additionally, this herbal medicine exhibited significant protective effects against death induced by pulmonary thrombosis in mice.

Anti-inflammatory and analgesic

The initiation of pain is triggered by the activation of nociceptors, which occurs in response to specific stimulus modalities. Pain, a prevalent symptom of numerous diseases, significantly affects normal life and physiological homeostasis. In mice, patchouli demonstrated a direct inhibition of acetic acid-induced writhing (pain), suggesting its *in-vivo* analgesic effect (Junren *et al.,* 2021). β-Patchoulene (β-PAE), extracted from *P. cablin* (patchouli oil), is a tricyclic sesquiterpene widely utilized in traditional Chinese medicine to address inflammatory conditions (Zhang *et al*., 2016).

Effects against skin diseases

Essential oils, with patchouli oil constituting 12% of the formulation, demonstrated notable efficacy in effectively controlling skin infections and mitigating issues related to odor in patients afflicted with conditions such as skin abrasions, torn skin, ulcers and pressure sores. The utilization of these essential oils resulted in a considerable reduction in the duration of the healing process. The application of essential oils significantly reduced the healing duration in these cases (Kerr, 2002).

Antioxidant activities

The study conducted by Wei *et al*., (2007) highlighted that patchouli oil not only displayed effective free radical scavenging activity but also impeded the oxidation process of hexanal to hexanoic acid. Moreover, *P. cablin* demonstrated notable protective effects against cell death induced by both necrosis and apoptosis triggered by hydrogen peroxide in the human neuroglioma cell line A172, suggesting its potential application in treating a spectrum of neurodegenerative disorders. Additionally, patchouli oil exhibited a preventive effect against photoaging by virtue of its antioxidative properties, contributing to the maintenance of skin structural integrity, particularly under UV irradiation, as observed in the study conducted by Lin *et al*. (2014).

Aromatherapy

Patchouli oil, a key component in aromatherapy practices, serves a multifaceted role by effectively alleviating tension, anxiety, and insomnia. The intoxicating and wine-like aroma it emits acts as an aphrodisiac, not only enhancing cognitive functions such as intelligence and concentration but also offering insights. In a study involving normal adult subjects, the fragrance inhalation was observed to induce a significant decrease in sympathetic activity, as gauged by measuring serum catecholamine content and monitoring fluctuations in blood pressure. Additionally, this versatile oil is utilized in spiritual contexts, particularly in the form of incense sticks, where it contributes to the establishment of a calming atmosphere (Haze *et al*., 2002).

Conclusion

As India is importing patchouli oil to fulfill its internal demand which is approximately 200 metric tonnes (about 25 million USD) annually. This amount may be reduced by popularization of cultivation of improved varieties of patchouli, especially in North Eastern areas of India and may also utilize land of orchards that have partial shade. The sustainable production of patchouli oil in India may contribute to creating an import substitution for the Indian economy and also enhance the income of the farmers.

This highlights the viability of patchouli farming as a profitable agricultural venture for farmers looking to diversify their income sources and benefit from the demand for this aromatic crop in various industries. The range in income and profit is influenced by factors such as local market conditions, crop management practices, and the quality of the produced patchouli oil, emphasizing the importance of good agricultural practices and market awareness in optimizing the financial returns from patchouli cultivation. The cultivation and utilization of patchouli hold immense promise for the economic upliftment of the farmers. The multifaceted applications and medicinal benefits of patchouli underscore its potential as a blessing for economically disadvantaged farmers in the specified region. Furthermore, the antimicrobial, anti-inflammatory, and anti-thrombotic activities observed in patchouli highlight its potential

as traditional medicine in modern healthcare system. The ability to combat various infections, protect gastrointestinal health, and exhibit antioxidant properties further underlines the diverse health benefits associated with this herb.

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Author Contribution

Ravi Kant Verma: Collection of data and primary writing work; Vipin Kumar: Data collection and analysis; Ravi Prakash Verma- Data collection writing of review; Ved Ram Singh: Provided data on varieties; Ramesh Kumar Srivastava: Conceptualization, review and editing.

Conflict of Interest

The authors declare that they have no conflict of interest.

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