An introduction to patchouli (*Pogostemon cablin* Benth.) – A medicinal and aromatic plant: It's importance to mankind

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Abstract: Patchouli (*Pogostemon cablin* Benth.) is a plant from Lamiaceae family, well known for its medicinal and aromatic properties. Patchouli is grown for its essential oil. Patchouli essential oil is mainly obtained by steam distillation of the shade dried leaves. It is widely appreciated for its characteristic pleasant and long lasting woody, earthy, camphoraceous odour. It is especially notable as the essential oil extracted is internationally important and valuable, principally for the aromatherapy, perfumery, cosmetics, incense stick production and food flavouring industries. This review attempted to give an overview of the relationship between aromatherapy and essential oils, importance of patchouli, harvesting pattern of patchouli, basics behind drying and steam distillation of patchouli crop, as well as trends existing in the various markets for essential oil application and its importance to mankind.

Keywords: patchouli, aromatherapy, drying, steam distillation, essential oil, applications

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1 Introduction

Plants primarily used for their medicinal or aromatic properties in pharmacy or perfumery are defined as medicinal and aromatic plants in the European Union (Overwalle, 2006). Asia is well known throughout the world as 'the land of aromatic plants' because it possesses favourable climatic conditions suitable for the growth and development of such plants. Other names like 'the land of spices', 'the land of traditional perfumes', also indicate the popularity of aromatic plants in Asia. Such plants have been used commercially as spices and as sources of raw material for essential-oil industry from the dawn of history. Patchouli also possesses aromatic and medicinal properties (Chomchalow, 2002).

In India, old literature mentions numerous uses of essences obtained from plants in performing religious rite since prehistoric times. India is regarded as the traditional home of oriental perfumes (Sharma, 1996). At present, Chinese people have made use of more than 400 species of aromatic plants, not only from their flavour and fragrant properties, but also as medicines. China now produces more than 120 natural essential oils for domestic consumption as well as for export markets (Xiao, 1996). Aromatic plants possess odorous volatile compounds, which occur in specialized structures in the form of essential oil in one or more parts of the plant. Aromatic plants occur in nearly all vegetation covered regions of the world. A large number of plant species belong to family Lamiaceae, Asteraceae, Apiaceae, Zingiberaceae, Rutaceae etc., and are characterised by the presence of essential oils (Verma, 2012). These plant species are also sources of spices, plant based medicines, botanical pesticides, insect repellents, cosmetics, pharmaceuticals and herbal health drinks (Chomchalow, 2002).

The essential oils are usually complex mixture of terpenes and their oxygenated derivatives. The essential oils are practically insoluble in water, generally lighter

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than water, and possess characteristic odour. Aromatic plants which are being cultivated in different parts of the world for commercial production of essential oils are patchouli, orange, lemon, lime, mints, cedar, citronella, lemongrass, basil, eucalyptus, geranium, lavender, clove, rose (Rosa spp), tuberose, jasmine, sandalwood, vetiver, bergamot, coriander (Verma, 2012). Essential oils are highly concentrated, volatile, hydrophobic mixtures of chemicals extracted from plants. Essential oils are most commonly extracted by steam distillation, while organic solvent extraction is also sometimes used. Essential oils have characteristic flavour and fragrance properties, and many also possess other biological activities. For these reasons essential oils are used in many industries. Essential oils find extensive application in flavour, perfumery, cosmetic, and pharmaceutical industries. About 90% of global essential oil production is consumed by the flavour and fragrance industries. This is mostly in the form of cosmetics, perfumes, soft drinks and food. Therapeutically these are used as antiseptic, stimulant, carminative, diuretic, antihelmintic, analgesics, anti-rheumatic, and counter irritant (Rao et al., 2002). The largest consumer of essential oils is the USA, followed by western European countries like France, Germany and the UK, and Japan (Holmes, 2005). Approximately 3000 plants are used for their essential oils, with 300 of these being commonly traded on the global market (CBI, 2009).

Patchouli is a perennial, branched, aromatic herb with fragrant leaves. The patchouli plant was first described by botanist Pelletier-Sautelet in Philippines in 1845 and was named *Pogostemon patchouli*. It is believed to be a native of the Philippines. It grows wild in several parts of the world. It grows wild in Malaysia, Indonesia and Singapore as well. Patchouli was introduced to India during the year 1941 in Madhya Pradesh, Tamil Nadu, Kerala and Karnataka. In India, it is cultivated in coastal areas of South India, West Bengal, Assam, Karnataka, Madhya Pradesh and coastal regions of Gujarat. Commercial cultivation of this crop in India was first attempted by Tata Oil Mills in 1942. After the initial stray attempts to grow the crop, its systematic cultivation started in 1962 by CIMAP (Kumar et al., 1986). Since the demand for patchouli oil is increasing in domestic and international markets, there is huge scope to increase its production by increasing its area. Patchouli oil is a key constituent in exotic perfumes to which it gives a rich, spicy fragrance. It can also be used as a perfume in its own right. It has also good fixative properties, especially in soap perfumes (Farooqui and Sreeramu, 2001).

Patchouli is a tropical crop which can also be grown under subtropical conditions (Figure 1). It grows successfully up to an altitude of 800 – 1,000 m above the mean sea level. It prefers a warm and humid climate. The crop can be grown successfully under a fairly heavy and evenly distributed rainfall, ranging from 150-300 cm per annum. Patchouli requires deep, well-drained, fertile, slightly acidic, loamy soil, rich in humus and nutrients. It flourishes best in loose deep loamy soils, rich in organic matter which makes a loose friable texture. The pH value of the soil should range from 5.5 to 7.5 for good growth. It thrives well in coastal region having 80% – 90% relative humidity and well-drained, sandy loam soil with a pH value of 6.0 - 6.8 and a temperature of 20 – 35℃ (Anon, 2010a). Patchouli is grown for its essential oil which is found mainly in the leaves and a small quantity of oil is also present in the tender parts of the stem. The dry leaves of patchouli on steam distillation yield an essential oil called ‘oil of patchouli’. The leaves harvested and dried in shade have oil content in the range of 2.5% – 3.5% (Vijyakumar, 2004). Experiments have revealed that good quality patchouli oil can be produced from patchouli grown under Bangalore weather conditions (Sarwar et al., 1983). The world production of patchouli oil is around 800t per year. Java produces about 2/3 of the quantity followed by China and Malaysia. Cultivation in India has been meagre but the harvest in the last 5 years is around 600 hm^2, producing 20 t of oil per annum (Anon, 2010b) and the annual demand borders around 220 t (Vijyakumar, 2004). Its demand is growing at a faster pace than that for most of the other essential oils. Currently, India is producing a very meagre quantity of patchouli oil and thus is annually importing about 20 t of pure patchouli oil and 100 t of formulated oils (Anon, 2010a). Patchouli essential oil is

hence an important ingredient in many fine fragrance products like perfumery, soaps, cosmetic products, incense production and many fancy products. In very low concentration (2×10^{-6} kg kg^{-1}), the oil is used to flavour foods, beverages, candy and baked products (Bauer et al., 1997). The composition of the patchouli essential oil is complex like many essential oils, but unique because it consists of over 24 different sesquiterpenes, rather than a blend of different mono, sesqui and di-terpene compounds (Buré and Sellier, 2004; Dung et al., 1990). The sesquiterpene patchouli alcohol is the major constituent and is the primary component responsible for the typical patchouli note (Naf et al., 1981).

Figure 1 Patchouli (*Pogostemon cablin* Benth.)

2 Harvesting of patchouli

The first harvest of the crop is taken about 5 months after transplanting. The stage at which crop has to be harvested is very important for good yield and better quality of oil. Only matured patchouli leaves are harvested, shade dried and steam distilled. It has to be harvested when the foliage becomes pale green to light brownish and when the stand emits characteristic patchouli odour, which could be easily smelt by a passer-by, especially in the morning hours. Subsequent harvest can be taken after every 3-4 months depending upon the local conditions and management practices. The crop can be maintained for about 3 years. The first 2 or 3 harvests of newly planted plantation give good yield and high quality oil. Harvesting is done with the help of small sharp shear or secateurs. Usually the length of the harvested portion ranges from 40-60 cm. It is necessary to leave 4-6 juvenile sprouting buds at the basal region for fast regeneration, while harvesting. The crop should not be harvested prematurely as it gives less yield and oil of inferior quality (Anon, 2012).

3 Drying of patchouli herbage

The harvested material is spread out under shade in thin layers and is turned periodically to ensure proper drying. Proper drying is of great importance for obtaining maximum yield and oil of good quality. The harvested herb should be dried in shade allowing free air circulation for about 3d which yields an average of 2.5% essential oil upon distillation. It however, depends much on available sunshine and atmospheric humidity. Properly dried leaves develop characteristic patchouli smell which is less noticeable in fresh leaves (Farooqui et al., 2001). At some places fermentation is common practice but it produces an undesirable effect on the quality of the oil by causing a mouldy odour. Therefore, it is advisable to avoid fermentation (Leung and Foster, 1996). The drying characteristics of patchouli herbage were studied under various methods namely, in shade, tray dryer and in ASTRA Crop Waste Based Dryer. The initial drying bed thickness was uniformly maintained in all methods and the herbage was dried from 80% (w.b.) initial moisture to 11%-12% final moisture. Under Bangalore climatic conditions (21.0-24.4℃; 40%-81% R.H.), patchouli required 54 h of drying time in shade while in ASTRA dryer, it was just 14 h. In convectional tray dryer (electrical), the drying time at 30, 40, 50, 60 and 70℃ was 13, 12, 11, 7 and 6 h, respectively (Anitha, 2008). Drying characteristics of patchouli herbage in a

conventional tray dryer was studied. It showed that the drying temperatures of 30 – 50℃ did not influence the essential oil yield and the oil yield was similar to that of the shade dried sample (Pallavi et al., 2006). Mostly shade drying is preferred for the purpose of essential oil extraction, because of high risk of oil evaporation during sun or conventional drying as essential oil are highly volatile.

4 Steam distillation of patchouli essential oil

Patchouli is a farmer friendly crop because it is easy to handle, unlike other aromatic plants. Moreover, the leaves once dried and properly preserved can be used for distillation leisurely. The essential oil is found in all parts of the patchouli plant including the root, but experiments have shown that the top leaves and tender twigs contain the highest quality oil (Vijyakumar, 2004). Generally, dry leaves stored for 4–6 months produce more oil with superior aroma. Steam distillation is the common method used for the extraction of essential oils from plants. Although there are other extraction techniques (hydro distillation, microwave distillation, supercritical fluid extraction, ultrasound extraction), from the consumer point of view steam distillation remains the preferred process for the extraction of essential oils from plant materials. The simplicity, transparency of the process gives reassurance of purity since the process uses only water (Anon, 2011).

The steam distillation equipment consists of a boiler, distillation still, condenser and receiver. The distillation still is generally made up of mild steel with perforated bottom to support loaded herb for distillation. The herb should be evenly/tightly packed inside the still as otherwise steam channels may form during the distillation resulting in poor yield of essential oils. Water level in the boiler should be well maintained by frequent checking. Maintenance of high and low pressures i.e. 1.4–3.5 kg/m^2 produces better quality as more cell walls rupture in this process. The duration of the distillation varies from 6-8 h. The condenser cools the vapours received from the distillation still. It consists of many tubes made up of copper or stainless steel and mounted inside a jacket. The condenser is provided with inlet and outlet for circulation of cooling water. The hot vapours consisting of steam and essential oil vapours are cooled in the condenser tubes and the condensate flows out into the receiver. The essential oil vapour and spent steam that come out of the distillation still will be condensed back to liquid phase in the water cooled condenser and the condensate will be collected in the receiver tank. Steam distillation/condensate results in two separate products: the liquid distillate which contains the volatile, water soluble parts of the plant materials known as “hydrosol” and the volatile non water soluble material of the plant constituents known as the “essential oil” (Tannous et al., 2004). The condensate in the receiver tank should be allowed to stand for a sufficient time (overnight) so that the patchouli oil separates out as far as possible from the water layer. After reasonable separation in the receiver tank, the essential oil should be further separated from the water phase using a separating Funnel. The oil being lighter than water and insoluble floats on the top of the receiver and only water gets drained out. The oil will be still turbid. All traces of moisture needs to be removed from the oil by adding anhydrous sodium sulphate at the rate of 20–30 g/L and keeping the distillate mixture for 4–5 h, after which the oil is filtered through a Whatman filter paper to get clear essential oil. Moisture can induce polymerization of oil leading to loss in quality. The clear essential oil thus obtained should be stored in air-tight aluminium containers or colour glass bottles up to the brim and stored in cool dry place, away from light. On an average, 60 kg of oil/hm^2 is obtained in a year (Ramya, 2010; Anon, 2011a; Anon, 2013).

Essential oil yield and its quality by steam distillation technique were studied in a pilot scale steam distillation unit (Figure 2) at different ‘charge’ packing bed densities and distillation periods using shade dried patchouli herbage (cv. Johore). For different bed packing densities of the distillation still, the patchouli essential oil yields for 4, 5 and 6 h distillation were: 2.40%, 2.63% and 2.78% at 8 kg/m^3; 2.35%, 2.57% and 2.70% at 10 kg/m^3; and 2.06%, 2.52% and 2.60% at 12 kg/m^3, respectively (Ramya, 2010). Newly distilled patchouli oil (Figure 3) contains fresh, green, slightly harsh aroma. As the oil ages it mellows considerably, becoming

sweeter and more balsamic. Patchouli is one of very few oils that, like fine wine, improve with age. High quality patchouli oils emit a suave, fruity, wine-like top note when uncapped. Patchouli has a rich musky-sweet, strong spicy and herbaceous smell. It is very rich and long-lasting oil (Anon, 2011b). The aroma can be rather crude when the oil is young and grows more refined with age, as it becomes valued "vintage oil" (Anon, 2013a). It is non-toxic, non-irritant and non-sensitizing, but the smell of patchouli oil may be a little persistent for some people and large doses may cause loss of appetite in some individuals (Adusumilli and Gedu, 2005).

Figure 2 Pilot scale patchouli steam distillation unit

Figure 3 Patchouli essential oil

5 Special features of patchouli essential oil

Patchouli oil is an essential ingredient and used as a 'base' material in perfumery industry. Patchouli oil is perfume by itself. There is no synthetic substitute/chemical for patchouli oil, which increases its value and demand in the perfumery market. It mixes well with many essential oils including vetiver, rosemary, sandalwood, frankincense, bergamot, cedarwood, myrrh, jasmine, rose, citrus oils, clary sage, lemongrass, geranium and ginger, contributing a rich spicy aroma. This again enhances its unique value in international market. Patchouli is one of very few oils that, like fine wine, improve with age. As the oil ages it mellows considerably, becoming sweeter and more balsamic (Adusumilli and Gedu, 2005; Farooqui et al., 2001).

6 Application of patchouli

6.1 Perfumery

Patchouli oil is considered as an excellent base note in perfumery. Patchouli essential oil does much more than just providing a distinct and robust fragrance. The perfume industry has used patchouli in a number of the world's finest perfumes, using the oil for its warm soul feeling and sensual, woody, voluptuous notes. Patchouli is found in use in many famous perfumes such as Arpege, Tabu, Miss Dior, Opium, Paloma, Picasso, Ysatis and Angel (Singh et al., 2002). There is no synthetic chemical to replace the oil of patchouli, that further enhances its value and unique position in the perfumery market and there is a great demand for it in soaps, scents, body lotions, detergents, tobacco and incense manufacturing factories (Farooqui and Sreeramu, 2001). Patchouli is used widely in modern perfumery and modern scented industrial products such as paper towels, laundry detergents, and air fresheners (Anon, 2012b).

6.2 Therapeutics

The therapeutic properties of patchouli oil are antidepressant, antiphlogistic, antiseptic, aphrodisiac, astringent, cicatrisant, cytophylactic, deodorant, diuretic, febrifuge, fungicide, insecticide, sedative and tonic (Anon, 2012c). In aromatherapy, patchouli is used to calm nerves, control appetite and relieve depression and stress. In high dose, it can stimulate and in lower dose it is a sedative. It is used to sharpen intelligence and improve concentration (Shankaranarayan, 2002).

6.3 Medicine

In Chinese medicine, decoction from the leaves is used with other drugs to treat nausea, vomiting, diarrhea, cold and headaches (Leung, 1980). A related species *Pogostemon heyneaxhus* is reported to contain principles possessing anticancer activity (Purushothaman et al.,

1985). In Japan and Malaysia, it is used as an antidote for venomous snakebites and fresh leaves are used to heal burn (Anon, 2009). Patchouli oil is effective for fungal and bacterial infection and is of great help for insect bites. On the skin, patchouli oil is one of the most active and is a superb tissue regenerator, which helps to stimulate the growth of new skin cells. In wound healing, it not only promotes faster healing, but also helps to prevent ugly scarring when the wound heals (Anon, 2012c). Patchouli has traditionally been put medicinally to a great many uses. It's probably best known for its antiseptic qualities and its use to treat skin and scalp problems such as athlete's foot, dandruff, acne, dermatitis and to help heal wounds and scars. Patchouli essential oil is also used as a topical remedy for skin problems such as acne, eczema, inflamed, cracked, chapped and irritated skin. As an antifungal, patchouli oil has been used to treat athlete's foot. For the hair, patchouli oil has been used for dandruff and to aid oily hair a marked aroma-therapeutic response. For the nervous system, patchouli essential oil helps to reduce tension, insomnia and anxiety. It is also known as uplifting fragrance that helps to soothe and to bring about a sense of nourishment (Adusumilli and Gedu, 2005).

6.4 Household

The leaves and oil of patchouli are used for pot-pourri and used to scent fabrics. In Asia and South America it is often blended with anise and clove as a breath sweetener (Anon, 2012a). In addition to its medicinal and perfumery uses, patchouli repels insects (Anon, 2009). Especially, the patchouli plant is claimed to be a potent repellent against the *Formosan subterranean termite* (Yoshihiro et al., 1992).

6.5 Incense

Patchouli is an important ingredient in East Asian incense. Both patchouli oil and incense gained popularity during 1960s and 1970s in the US and Europe, mainly due to the hippie movement during those decades (Foster and Johnson, 2006). There is a potential for utilizing patchouli spent charge in incense stick manufacture after drying and pulverizing it into suitable particle size powder. The powder may replace sawdust powder up to 10% level which is currently used at 15% level, a raw material in incense stick production (Ramya, 2010).

6.6 Flavourings

Patchouli oil is extensively used as a flavour ingredient in major food products including alcoholic and non alcoholic beverages. Very low concentration (2 mg kg^{-1}) of oil is used for flavouring beverages, frozen dry desserts, candy, baked goods, gelatin, meat and meat products. In combination with sandal wood oil, it is used in blending of tobacco (Anon, 2012d).

7 Conclusions

Patchouli essential oil is a raw material of great importance in the perfumer's palette. Post harvest handling of the patchouli herbage play an important role in obtaining the patchouli essential oil both in terms of oil yield and quality. Although there are several techniques, steam distillation remains the preferred process for the extraction of essential oils from plant material from the consumer point of view. Patchouli has many facets. Patchouli can be beneficially made use in aromatherapy, perfumery, cosmetics, incense stick production and in food flavouring industries.

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