Drying studies of patchouli spent charge – in special reference to its use in incense sticks production

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Abstract: The Patchouli (*Pogostemon cablin* Benth.) herbaceous medicinal plant is a member of the Lamiaceae family, and is grown for its essential oil extraction. Aromatic patchouli herbage after steam distillation of essential oil is currently a waste material that can be advantageously used in incense sticks production if dried and powdered to a suitable particle size. To use this waste spent charge (herbage after steam distillation) in the incense sticks production, drying study of this wet material was conducted. The drying characteristics of patchouli spent charge were studied under various methods, namely, tray, shade and sun drying. The initial drying bed thickness was uniformly maintained at 50 mm in all the methods and the spent charge was dried from 60%(wb) initial moisture to 8-9% final moisture. Under Bangalore climatic conditions (24.4-28°C; 25%-58% RH), patchouli spent charge required 46 h of drying time in shade while under sun, it took just 11 h of drying. In a convectional electrical tray dryer, the drying time at 50, 60 and 70°C was 10, 6 and 5 h, respectively.

Keywords: Patchouli, spent charge, drying, drying characteristics

Citation: Ramya, H. G., and V. Palanimuthu. 2013. Drying studies of patchouli spent charge –in special reference to its use in incense sticks production. Agric Eng Int: CIGR Journal, 15(3): 154−158.

1 Introduction

Patchouli is known to be one of the popular aromatic crops with immense commercial importance. The patchouli plant was first described by the scientist Pelletier Scutelet and named Pogostemon patchouli. In 1986, Holmes identified it as *Pogostemon cablin* Benth. a native of the Philippine islands. Patchouli (*Pogostemom Cablin* Benth.) is a member of laminaceae known for its aromatic property. It is the source of commercial patchouli essential oil available in domestic and international market (Ahmed, 2002). The essential oil of patchouli is one of the most widely used oils in the fragrance industry. Currently Indonesia is the largest producer in the world with a production exceeding 1,500 t of oil, and over 20,000 ha of forest and private areas are covered with this plant and the global requirement of patchouli is met mainly through production from Indonesia. Indian demand for patchouli oil is around 220 t valued around 33 crores while global demand is to the tune of 1,600 t of oil per annum with a value of 240 crores (Vijaykumar, 2004). The pleasant aroma and versatility of patchouli essential oil and its extensive usage in perfumery, cosmetics, beverage, agarbatti, soap and food industry have increased its market potentiality. There is no synthetic chemical to replace the patchouli essential oil. So, its unique market position in aroma (fragrance/perfumery) industry is further enhanced. Above figures indicate that there is a large potential for patchouli oil production in India. Now-a-days, the most preferred method employed to obtain patchouli essential oil is steam distillation (Farooqui and Sreeramu, 2001; Anonymous, 2010; Anonymous, 2008). India's available infrastructure and environment can provide an opportunity to gain a major part of the world market. The commercial cultivation of patchouli is slowly spreading in India in the states of Karnataka, Gujarat, Assam, Andhra Pradesh and Kerala. Among the above

Received date: 2012-10-24 **Accepted date:** 2013-06-27

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states Karnataka is a leading producer of patchouli. In northern districts of Karnataka, the area is spreading faster for patchouli cultivation. The districts of Uttar Kannada, Haveri, Dharwad, Belgaum and Bellary have recorded higher acreage in the cultivation front. Presently, the crop covers an estimated area of 81 ha in northern districts of Karnataka. Warm and humid places with fairly heavy and even distribution of rainfall are preferred by *Pogostemon cablin* Benth (Venugopal et al., 2004). Patchouli oil production could be a rural based, labour intensive, low cost agro-based cottage industry, which will give large-scale employment in rural and hilly areas. Patchouli, being a shade loving plant could easily be grown as an intercrop amidst fruit trees, arecanut and coconut plantations, etc. It can also be easily cultivated in flood free fallow or wastelands. This will provide some extra income for the farmers.

Drying is perhaps the oldest, most common and most diverse of chemical engineering unit operations. Over four hundred types of dryers have been reported in the literature while over one hundred distinct types are commonly available. It competes with distillation as the most energy-intensive unit operation due to the high latent heat of vaporization and the inherent inefficiency of using hot air as the (most common) drying medium. Drying is a complex operation involving transient transfer of heat and mass along with several rate processes, such as physical or chemical transformations, which, in turn, may cause changes in product quality as well as the mechanisms of heat and mass transfer. Physical changes that may occur include: shrinkage, puffing, crystallization and glass transitions. In some cases, desirable or undesirable chemical or biochemical reactions may occur which lead to changes in color, texture, odor or other properties of the solid product (Mujumdar and Devahastin, 2000). Dried herbs have great importance not only in culinary purposes, but also for the medicinal uses. Harvesting and drying herbs are not complicated. The key factor which is to be kept in mind is presence of volatile oil in it and is the most important part of the plant which is stored up mainly in the leaves as well as tender twigs which gives plant its aroma and fragrance. It is the key ingredient which must be preserved in the drying process (Anonymous, 1998; Joykumar, 1997). Removal of moisture from crop is usually referred to as drying. Henderson and Perry (1977) defined drying as the removal of moisture to a moisture content in equilibrium with normal atmospheric air to safe moisture content, that decreases quality damage from moulds, enzymatic action and insects to a negligible effect. Drying is the most fundamental method in the post-harvest preservation of medicinal and aromatic plants due to quick conservation of medicinal qualities of plant material in an uncomplicated manner (Muller and Heindl, 2006). Drying occurs by effecting vaporization of the liquid by supplying heat to the wet feedstock. As noted earlier, heat may be supplied by convection (direct dryers), by conduction (contact or indirect dryers), radiation or volumetrically by placing the wet material in a microwave or radio frequency electromagnetic field. Over 85% of industrial dryers are of the convective type with hot air or direct combustion gases as the drying medium. Over 99% of the applications involve removal of water (Mujumdar and Devahastin, 2000). Earlier drying studies were conducted for patchouli fresh herbage for the purpose of essential oil extraction. After distillation, spent charge/herbage was disposed off and to a lesser extent; it was used for manure purpose. But, no such drying studies were under taken for spent charge for any other utilities.

Incense sticks are manufactured by using wood powder, nuruva powder, charcoal powder and finally dipping them in chemicals for perfumery. Burning of such incense sticks has an adverse health effects on human beings to a little extent. Using of patchouli spent powder instead of traditional ingredients may be beneficial, as patchouli has medicinal properties. So, drying studies of patchouli spent charge was carried out so that it could be beneficially used in incense stick production.

2 Materials and methods

2.1 Drying studies of patchouli spent charge

After distillation of essential oil from shade dried patchouli herbage in the pilot scale steam distillation unit, the spent charge (herbage after distillation) was taken out and used for drying studies. Patchouli spent charge was dried by three different methods: i) Shade drying ii) Sun drying and, iii) Convective tray drying. In tray drying, three different drying temperatures namely, 50, 60 and 70°C were employed and the drying bed thickness (depth) of spent charge was kept uniformly at 50 mm. The trials were replicated thrice. During drying, periodic weight loss (at hourly intervals) of the samples were recorded using a sensitive electronic balance (Make: Essae-Teraoka Private Ltd., Bangalore, India) and the moisture contents at a given time were calculated from the final / initial moisture content of the samples that were estimated accurately by toluene distillation method (AOAC, 1995). Conventional shade and sun drying of patchouli was also carried out and the initial drying bed thickness of the spent charge was kept at 50 mm. During shade and sun drying, the ambient temperature varied from 24.4 - 28°C and the relative humidity varied from 25% - 58%. In shade, sun and tray drying, the samples were dried till the spent charge attained about 8% - 9% (wb) moisture content. Moisture content was determined as per the procedure outlined in AOAC Standards (1995). Results were compared with the presence of residual essential oil content in dried patchouli spent charge, in the laboratory by hydro-distillation technique (AOAC, 1995) using Clevenger's Apparatus.

3 Results and discussion

The drying characteristics of patchouli spent charge dried at different temperatures in a convective tray dryer are depicted in Figure 1 while the shade and sun drying characteristics of patchouli spent charge are given in Figure 2 and Figure 3, respectively. Under the moderate ambient conditions of temperature (24.4-28°C) and relative humidity (25%-58%) that prevailed at Bangalore during shade drying, the patchouli spent charge required about 46 h of drying time (for 50 mm bed thickness). This was much higher than the duration of shade drying (2-4 days) reported by Farooqi and Sreeramu (2001) for patchouli fresh herbage. Sun drying of the patchouli spent charge required about 11 h of drying time to dry from an initial moisture content of 60% (wb) to a final moisture content of 8-9% (wb) which was much less than shade drying time of 46 h under the same ambient conditions. The effect of direct sun light in enhancing the drying rate was quite obvious. Shobha (2009) reported 12 -14 h of sun drying for *methi* leaves was almost under similar ambient conditions.

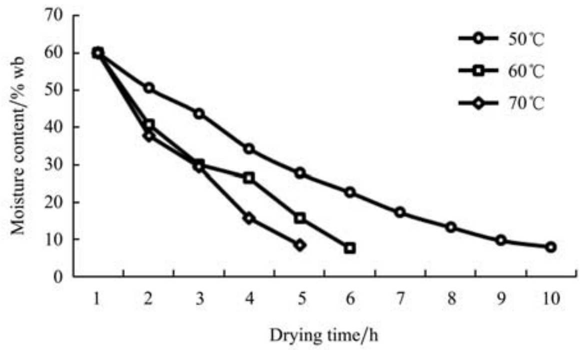

Figure 1 Drying characteristics of "patchouli spent charge" in a convective tray dryer

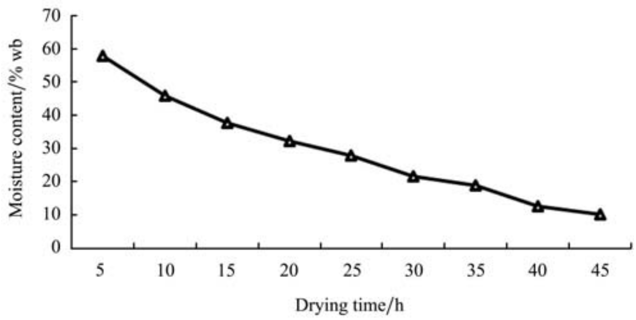

Figure 2 Drying behaviour of "patchouli spent charge" in shade drying

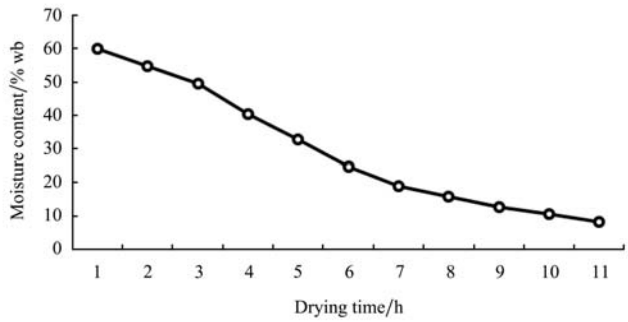

Figure 3 Drying behaviour of patchouli spent charge in sun drying

In the tray dryer, the total drying time required to dry the patchouli spent charge from a moisture content of about 60% (wb) to 8%-9% (wb) was found to vary considerably. For 50 mm initial drying bed thickness, the drying period required at 50, 60 and 70°C drying temperatures were 10, 6 and 5 h, respectively. The influence of drying temperature on tray drying time of spent charge was clearly discernible. Similar results were reported by Raghavan et al., (1995) in drying fresh Indian thyme and by Chiumenti et al., (1996) in drying *Salvia offinalis*. Further, in a convective tray dryer, the movement of relatively hotter drying air that carried the evaporated moisture from the material also helped in improving the drying rate. The moving drying air also aided the heat transfer process from the medium to the drying material which is necessary for the vaporization of moisture in the material. This is exactly the reason why the material dries faster in a convective tray dryer than in an oven.

The residual oil content of patchouli spent charge dried under various drying methods was estimated by hydro-distillation technique using Clevenger's apparatus. The residual oil content of dried patchouli spent charge was about 0.2% to 0.7%, higher value was observed in shade dried sample. Sun and tray dried spent charge samples had very low residual essential oil which was less than 0.5%. Shade dried sample contained 0.5%-0.7%.

4 Conclusion

The spent charge after steam distillation of patchouli essential oil is used only for manure purpose at present. So, drying studies of patchouli spent charge was carried out, as there is a potential for utilizing this by-product in incense stick manufacture after drying and pulverizing it into suitable particle size powder. Patchouli spent charge required 46 h of drying time in shade while under sun, it took just 11 h of drying under Bangalore climatic conditions (24.4-28°C; 25-58% RH). In a convectional electrical tray dryer, the drying time at 50, 60 and 70°C was 10, 6 and 5 h, respectively. The residual essential oil content of shade dried spent charge was 0.5-0.7%. This ground shade dried patchouli spent charge can be advantageously used in incense sticks manufacture. The powder of this dried spent charge may replace sawdust/wood powder, a raw material in incense sticks production.

Acknowledgement

We thank "M/s Jewargi Agro Food Park, Hiriyur, Karnataka" for providing shade dried patchouli (cv. Johore) herbage for pilot scale steam distillation studies. We also thank Staff and non-staff of Department of Horticulture and AICRP on PHT Scheme, UAS, GKVK for extending co-operation during the course of our investigation.

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