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Standardization of drying technique for the production of powder from Shankhpushpi leaves

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Abstract
Shankhpushpi is a nootropic, perennial wild herb which is widely used in Ayurveda (Indian traditional medicine system) as one of the Madhya Rasayana to improve memory and intellect. The drying experiments were conducted with three different techniques i.e. hot air drying (40, 45, 50 °C), greenhouse drying and sun drying (control). It was found that hot air drying at 40°C was most suitable whereas, open sun drying was least suitable method of drying in terms of colour and phenol retention.

Keywords: Shankhpushpi, drying, hot air drying, greenhouse drying, colour, total phenol content

1. Introduction
Traditional systems of medicine has become a subject of great interest all over the world. Nowadays it has been surveyed that the market for herbal medicines has gradually increased in both developed as well as developing countries. Shankhpushpi is a nootropic, perennial wild herb which is widely used in Ayurveda (Indian traditional medicine system). In Ayurvedic texts, Shankhpushpi is mentioned as one of the Medhya Rasayana. Medhya Rasayanas as described in Ayurveda are a group of medicinal plants with benefits, specifically to improve memory and intellect. Medha in Sanskrit means intellect and Rasayana means therapeutic procedure that on regular practice will boost nourishment, health, memory, intellect and immunity [1]. The name Shankhpushpi has its root in Sanskrit which means conch shaped flower.

Drugs prepared from Shankhpushpi are mainly used for their therapeutic effects on the CNS disorders like nervous debility, memory enhancement, anxiety, neurosis etc. It is mainly used for the development of brain tonic [2]. The above biological changes in the human body are the result of the presence of various bioactive components such as alkaloids, flavonoids and coumarins in Shankhpushpi plants [3]. Various studies have found the presence of significant quantities of β-carotene, rutin, chlorogenic acid, and mangiferin in different varieties of Shankhpushpi [4]. Alkaloids such as convolvine, convolamine, phyllabine, convolidine, confoline, convoline, convosine and convolvidine act as major phytoconstituents [5]. Apart from these, flavonoids such as kaempferol, scopoletin (coumarin), phytosterols such as β sitosterol are also present in the herb [2].

It has been observed that the post-harvest operations performed on medicinal herbs have significant importance on their production chain because these operations determine the retention of the active components of these herbs and hence have a great impact on the quality of the final product and finally on their consumer acceptability. One of the earliest post-harvest operations and the most common way to preserve the quality of medicinal plants is drying. Generally, the traditional drying methods such as shade drying and open sun drying are practiced for medicinal herbs. These traditional methods of drying have several drawbacks pertaining to the drying of medicinal herbs.

Intensive solar radiations may result in adversely affecting the quality of the herbs by deterioration of colour, loss of volatile components as well as bioactive components. Drying in the open may also result in insect, bird, rodent and pest infestation and dust and dirt contamination. These do not achieve the required hygiene standards, product quality and also the consumer acceptability. To overcome the above mentioned drawbacks of traditional drying, mechanical dryers may be used for the drying of the medicinal herbs. For faster drying and more versatility in commercial scale, mechanical drying is the common technique for preservation.

In this study, Shankhpushpi leaves were dried by different drying techniques and at different drying temperatures for production of powder. The powder was then analysed for various physico-chemical parameters such as colour and phenol content for the assessment of their quality.

2. Materials and Methods

The Shankhpushpi plants (*Convolvulus microphyllus*) were procured from the Medicinal and Aromatic Plants Research Station, Anand Agricultural University, Anand, Gujarat. The plants were cleaned and sorted to remove dust, dirt and any foreign particles. The leaves were then sorted out from the whole plants for physico-chemical analysis.

The drying experiments were conducted with three different techniques i.e. hot air drying (40, 45, 50ºC), greenhouse drying and sun drying (control). Drying continued till constant weight of the sample was obtained. The dried sample was subjected to grinding operation in a pulverizer and further sieved to produce powder with uniform particle size. The powder was packed in aluminium coated HDPE pouches for further analysis.

The drying technique and temperature was standardized on the basis of total drying time, colour and total phenol content - of the final product.

2.1 Drying system: Around 3 kg of fresh sorted leaves were used for each drying experiment. The leaves were spread uniformly on the trays and placed in the dyers. The low temperatures were selected for drying, keeping in view the product quality as well as time required for drying. The following dryers were used in the study.

2.1.1 Mechanical drying

Hot air dryer- The drying experiments were performed in a cabinet type hot air dryer (Make: Narang Scientific Works Pvt. Ltd.). The dryer was set at desired temperatures of 40, 45 and 50ºC and air velocity of 1 m/s for minimum 30 min so as to achieve a steady state condition.

2.1.2 Natural drying

- Greenhouse dryer- The green house dryer is made of polypropylene plastic sheets and fitted with an exhaust fan at the top front side of the dryer. The exhaust fan helps in removing moisture from inside the drying chamber. The drying experiment was conducted during the day time from 8 AM to 5 PM.
- Open sun drying- The fresh samples were loaded on trays and the initial weight was recorded. Then the loaded trays were kept under open sun from 8 AM to 5 PM.

(a) **(b)**

Fig 1 (a): Hot air dryer **(b)** Greenhouse dryer

2.2 Moisture content

Moisture contents of fresh Shankhpushpi leaves and dried powder were analyzed using the AOAC method [6]. Values reported are the average of triplicate determinations.

2.3 Total drying time

During drying, the sample weight was recorded after every 1h before the change in weight becomes constant. The total time taken for the sample weight to become constant was recorded as the total drying time.

2.4 Colour analysis

Colour analysis is an important optical parameter to assess the quality of product derived from green leaves. It also plays an important role in the sensory preference of customers. The green colour of the leaves often change due to operations such as thermal treatment, change in pH etc, as these operations accelerate the degradation of chlorophyll in the leaves. Colour of the fresh leaves and powder was determined by ColorLab which uses a CIELAB scale (L* a* b*) for colour analysis. Instrument was first caliberated and then the samples were analysed for their L*a*b* values. Three trials were taken for each of the samples.

2.5 Total phenol content

Total phenol content of the sample was determined by the method described by [7]. 100 g of the sample was filled in a thimble and successively extracted using 500 ml methanol using the Soxhlet extractor for 8-10 hours. Then the extract was filtered and determined for phenols was done using Folin-Ciocalteau assay method. For every 1ml of extract, about 1ml of Folin-Ciocalteau reagent and 2 ml of 2.5% sodium carbonate were added. The mixture was mixed and allowed to stand for two hours in dark. Then, the absorbance of the solution was measured at 750nm. Quantification of total phenolic content was done using standard curve of gallic acid as a standard phenolic compound. Sample measurement was done triplicates and the mean was calculated in each case.

3. Results and Discussion

The results obtained from the study are represented in this chapter. The results of various analysis such as physico-

chemical properties of fresh as well as dried products, drying of fresh Shankhpushpi leaves, drying parameters and drying kinetics has been reported and discussed under this chapter.

3.1 Moisture content

The total moisture content of fresh Shankhpushpi leaves, which was analysed in a hot air oven was found to be 70.5% (w.b.) which is relatively high and can be categorised as perishable agricultural commodity, hence the need arises for its proper post- harvest operation for preservation and packaging. It was observed that the loss in moisture content was approximately 93.53 ± 0.42%. Percentage moisture content of Shankhpushpi leaves and powder has been listed in Table 1.

Table 1: Percentage moisture content of Shankhpushpi leaves and powder

Drying technique	% Moisture content
Fresh leaves	70.5 ± 1.98
Hot air drying (40ºC)	4.56 ± 0.02
Hot air drying (45ºC)	4.84 ± 0.06
Hot air drying (50ºC)	4.86 ± 0.04
Green house drying (28.9-56.2ºC)	4.97 ± 0.04
Open sun drying (25.5-36.1ºC)	4.22 ± 0.06

3.2 Total drying time

The total drying time required for the drying of fresh Shankhpushpi leaves at different temperatures and different drying techniques has been listed in the Table 2.

The graphical representation of variation of drying time with temperature and method of drying is shown in Fig 2. It was observed that with increase in temperature for hot air drying there was a decrease in drying time. The highest drying time (1140 min.) was recorded for open air sun drying, whereas the lowest drying time was recorded for hot air drying at 50 ºC (540 min.). Drying of the leaves at 40 ºC in a hot air dryer took 900 min. to reach the equilibrium moisture content.

Table 2: Total drying time for different drying technique

Drying Technique and temperature (ºC)		Drying time (min.)
Hot air drying	40	900
	45	660
	50	540
Green house drying	28.9-56.2	840
Open sun drying	25.5-36.1	1140

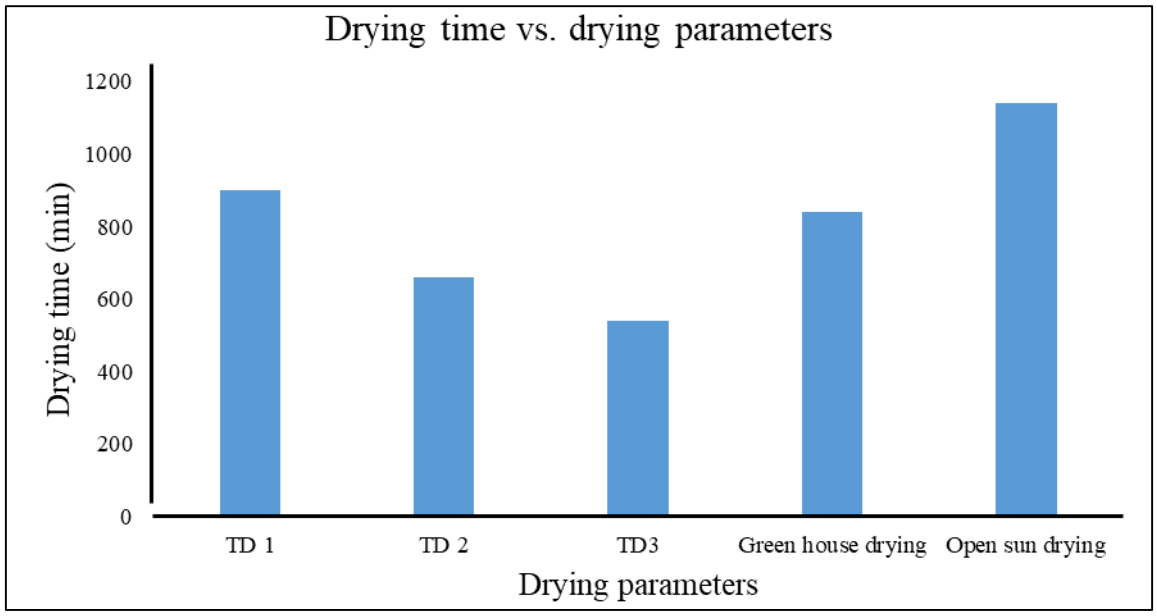

Fig 2: Drying time vs. drying parameters

3.3 Colour analysis

The hue angle value corresponds to whether the object is red, orange, yellow, green, blue or violet. When the hue angle is found to be between 90º and 180º, it indicates the colour lies in a very green-predominantly yellow region as in case of powder obtained from hot air drying at 40 and 45ºC, where hº was observed to be 92.71º and 90.97 º respectively. If hue angle is found to be less than 90º, it represents that the colour is shifting toward more reddish yellow region, which was observed in other powders obtained from different other drying treatments.

If hue angle ranges between 90º and 180º, as in case of powder obtained from hot air drying at 40 ºC, it was seen that yellow/blue coordinates (b*) were dominant at the red/green coordinates (a*). When hue angular momentum is toward 90º or less than 90º, as was observed in case of other powders obtained from different other drying treatments, it was seen that amount of yellowing was reduced and the colour moved into the red coordinate.

The yellow/blue coordinate values, chroma and hue angle was found to be decreasing with increase in air temperature. The samples were found to be losing their yellow hues slightly while shifting into reddish hues. The colour difference (ΔE) was observed to be increasing with increase in drying air temperature. This was attributed due to the direct effect of higher drying temperatures on heat-sensitive components such as pigment, amino acid, chlorophyll and vitamins [8]. Similar results were also observed during drying of basil leaves [9].

Table 3: Colour values of fresh Shankhpushpi leaves and powder

Drying technique	L*	a*	b*	C*	h°	ΔE
Hot air drying (40 °C)	46.05	-2.78	7.47	7.89	92.71	14.68
Hot air drying (45 °C)	48.42	0.11	7.50	7.52	90.97	17.50
Hot air drying (50 °C)	49.18	0.98	7.55	7.63	85.46	18.47
Green house drying (28.9-56.2)	49.25	0.96	7.56	7.61	85.79	18.53
Open sun drying (25.5-36.1)	51.16	1.00	7.89	7.52	82.19	20.40

3.4 Total phenol content

Total phenol content obtained for Shankhpushpi powder developed from subjecting the fresh leaves to various drying treatment has been given in Table 4. It was observed that lower the temperature higher was the phenolic retention in the powder. When the powder

Table 4: Total phenol content of fresh Shankhpushpi leaves and powder

Drying technique	Total phenol content (mg GAE/g)
Fresh harvest	19.23
Hot air drying (40 °C)	16.73
Hot air drying (45 °C)	14.81
Hot air drying (50 °C)	10.19
Green house drying (28.9-56.2)	10.57
Open sun drying (25.5-36.1)	9.807

Table 5: Reduction in phenol content of fresh Shankhpushpi leaves and powder

Drying technique	% Reduction of phenol
Hot air drying (40 °C)	13.01
Hot air drying (45 °C)	22.98
Hot air drying (50 °C)	47.01
Green house drying (28.9-56.2)	45.03
Open sun drying (25.5-36.1)	49.02

obtained from hot air drying, greenhouse drying and open sun drying was compared, it was found that the highest phenol content (Table 5) was observed in powder obtained from hot air drying at 40 °C (13% reduction of phenols) while powder obtained from open sun drying had lowest retention of phenols (49% reduction of phenols). Similar observation was reported by researchers [10] in case of effect of temperature and drying technique on the reduction of phenol content in thyme leaves.

4. Conclusion

The above study was conducted on the standardization of drying technique for the production of powder from Shankhpushpi leaves. The study was conducted on two different drying methods: mechanical and natural drying. Mechanical drying was conducted in hot air dryer at three different temperatures (40, 45 and 50°C), whereas the product was naturally dried in open sun and greenhouse dryer.

After various physical and chemical analysis of the fresh harvest as well as the products obtained after drying, it was observed that the powder obtained from drying at lower temperature (40°C) in case of mechanical drying yield better quality powder in terms of colour and phenolic content. The higher the temperature, the more was the deterioration of bioactive compounds as well as appearance (colour). The product dried in greenhouse dryer was found to be superior in terms of colour and % phenol retention when compared to open sun dried powder.

Hence it could be concluded that drying of medicinal herbs should be done in mechanical dryers at lower temperature for a better quality product.

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