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Drying characteristics of Safed Musli (*Chlorophytum borivilianum*) and its effect on colour and saponin content

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An experiment was carried out to adjudge the effect of different drying techniques of post harvest on colour and saponin content of Safed Musli (*Chlorophytum borivilianum*), a medicinal plant belonging to the family Liliaceae, has been traditionally used as adaptogenic drug. The present study was done on drying of fresh Safed Musli root in different condition like: shade, sun, solar and cabinet dryer. The moisture of about 62% is removed in 45 h when dried in shade and the temperature varies from 15 to 18°C, whereas in sun dried, the time taken was about 16.45 h and the temperature range is 25 to 30°C. Further less time that is, 5 h is required to dry the sample in solar cabinet dryer for 54 to 60% moisture loss and the temperature inside the cabinet was observed to be 39°C. But in cabinet drying for the loss of 65 to 70% moisture the time required was 4.45 and 3.30 h and the temperature lies in the range of 67 to 77°C and 64 to 74°C respectively. It was found that the minimum change in colour and saponin content was observed when dried in shade and maximum loss of saponin content was observed when dried in cabinet drier.

Key words: *Chlorophytum borivilianum*, drying, post harvest, saponin.

INTRODUCTION

Medicinal plants constitute a group of industrially important crops, which are of great value for domestic use and for export. Plant based drugs are being increasingly preferred in medicinal science. Forest of Madhya Pradesh are full of medicinal flora and other herbs of commercial importance, due to lack of post harvest knowledge and safe storage practices, a large quantity of produce get spoiled or sold rather in very less prices. Safed Musli is also gaining increasing acceptance as a vitalizer and health-giving tonic, a curative for pre-natal and post-natal problems, a restorative for immunity-improvement and as a remedy for diabetes and arthritis. A feasibility study was conducted for better returns in Safed Musli through processing. According to study, the reason for less processing is lack of knowledge, low quality of Safed Musli and unavailability of processing equipments.

There are about 175 species of *Chlorophytum* that have been reported worldwide. In other parts of the world, *Chlorophytum* is usually grown as an ornamental plant, but in India it has a reputation as a medicinal plant. A total of 13 species of *Chlorophytum* have been reported from India (Oudhia, 2001). In India it is grown in Madhya Pradesh, North Gujrat and Southern Rajasthan.

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In India 7 species viz, *Chlorophytum tuberosum, Chlorophytum arundinaceum, Chlorophytum breviscapum, Chlorophytum attenuatum, Chlorophytum laxum, Chlorophytum borrivillanium* and *Chlorophytum malabaricum* are commonly observed (Manjunatha et al., 2004). Out of these seven cultivated species only *C. borivilianum* is mentioned in Ayurveda as a medicine (Shariff and Chennaveeraiah, 1972).

Tuberous roots of *C. borivilianum* (commonly known as Safed Musli) belonging to the family Liliaceae. It posses immunomodulatory and aptogenic properties and are used to cure impotency, sterility and enhance male potency. Peeled and dried musli roots are considered as the wonder drug in ayurvedic system of medicine due to its aphrodisiac properties. The *Chlorophytum* roots having higher saponin content have high demand in international drug market (Manjunatha et al., 2004). Safed Musli is a rich source of over 25 alkaloids vitamins, minerals, proteins, carbohydrates, steroids, saponins and polysaccharides etc (Seth et al., 1991). Bordia et al. (1990) and Seth et al. (1991) reported that the major constituents of Safed Musli are carbohydrates (42%), protein (8 to 9%), root fibre (3 to 4%) and saponin (2 to 17%), alkaloids 25%, vitamins A, B, D, K and E and minerals 7 to 15%. The main active principles of roots are saponins and are stimulants, metabolic enhancers and have been shown to posses anti – tumour activity (Mimaki et al., 1996; Qiu et al., 2000). The economic part of the herb is root, rich in saponin which is considered to be the potent medicinal compound (Kothari and Singh, 2001). The cultivation of Safed Musli comes across a lot of constraints viz. high input costs, lack of technical guidance and lack of comprehensive package of practice. Due to, the lack of proper cultivation protocol, commercialization techniques and package of practice, the present work was planned to study the influence of different drying technique on Safed Musli roots and its effect on colour and saponin content. The main objective of drying is to reduce the moisture present at the time of harvest and for safe storage.

MATERIALS AND METHODS

Plant materials

The fresh Safed Musli root was procured from the Department of Plant Physiology, JNKVV Jabalpur during the year 2008 to 2009. It was then washed thoroughly with running water so that all dirt is removed. After washing the roots was manually peeled with the help of knife and the peeled root was then dried. The different drying conditions used for this study were shade, sun, solar and cabinet drier. Different dryers had variation in configuration; hence they were used to evaluate their suitability for Safed Musli drying. In case of cabinet drying a simple heat convector (Usha Lexus, make) was used as a source of heat and to blow heated air, the heat convector has provision for single and two coil separately and also for supplying of air at varying velocity from fan that is, 1.62 and 1.88 ms^{-1} respectively. During drying of the samples the observation like time and temperature were recorded with respect to moisture loss.

Grinding of the Safed Musli was done in the hammer mill to get the powder in the form of fine particle. The various observations were recorded during the experiment given below.

Moisture

Moisture content of fresh samples and after drying for all the samples was determined by using the standard method (AOAC, 2000).

Colour

The colour of dried Safed Musli for all the samples was determined using Hunter Colour Colorimeter at 65%10°C and the L, a, b values were recorded.

Saponin content

Saponin content of Safed Musli dried under different conditions was determined by HPTLC method (Rajpal, 2002). The fine powder of the root sample (5 g) was extracted in the soxhlet reflux extractor with 50 ml acetone for 24 h to remove lipids, pigments etc. Now change the solvent for methanol and continue extraction for at least another 24 h. Repeat the process 2 times with the methanol. Each of the extracts were combined, partially evaporated and concentrated to dryness under vacuum. After that the extracts were re-dissolved in methanol, combined in a 5 ml volumetric flask and adjusted to the final volume with methanol. Prior to use, all the samples were filtered through 0.45 µm filter.

Sample analyzed by HPTLC

Apply 10 µl of the reference and sample solutions on the different tracks on the silica gel plate (10 × 10 cm) of uniform thickness (0.2 mm thickness). Develop the plate in the solvent system up to a distance of 8 cm. Scan the plate using a Camag thin layer chromatography (TLC) Scanner at 366 nm for both reference and test solution tracks. Peak purity tests were carried out by comparing the peak areas and Rf (2.2) with those present in the reference and test solution tracks. Freshly prepared p-anisaldehyde reagent is used. After drying, the plate was heated at 110°C for 10 min to develop the colour of the spots.

Statistical analysis

All the results were statistically analyzed to estimate the significant difference between different drying conditions on the basis of color, moisture and saponin content.

RESULTS AND DISCUSSION

Effect of different drying condition on moisture content of Safed Musli

The moisture content of about 62% was removed in just 45 h and the temperature lies in the range of 15 to 18°C during this period when fresh peeled Safed Musli root was dried in shade. Whereas when the sample was sun dried the time taken was about 16.45 h and the

Table 1. Moisture depletion pattern of Safed Musli in different dried condition.

Dried in shade		Dried in sun		Solar cabinet dryer		
					Loss of moisture (%)	
Time (hours)	Loss of moisture (%)	Time (hours)	Loss of moisture (%)	Time (hours)	Cabinet I	Cabinet II
3.00	4.2	2.0	3.1	0.30	12	10
6.00	13.4	4.30	43.7	1.00	22	20
24.00	42.8	7.55	56.2	1.30	30	28
27.00	47.2	9.15	59.3	2.00	36	36
45.00	62.13	14.15	62.5	2.30	40	40
				3.00	44	48
				3.30	48	52
60.00	66.53	16.45	65.6	4.00	52	56.0
				4.30	52.8	58.0
				5.00	54.0	60.0

Table 2. Moisture depletion pattern of Safed Musli dried in cabinet dryer at different air velocity and temperature.

Time (hours)	Loss of moisture (%)				
	Air velocity 1.62 ms^{-1} and temperature 67 to 77°C		Time (hours)	Air velocity 1.88 ms^{-1} and temperature 64-74°C	
	Cabinet I	Cabinet II		Cabinet I	Cabinet II
1.15	20	20	0.30	05	05
1.45	45	30	1.00	25	20
2.30	50	58	1.30	45	35
3.15	55	65	2.00	55	55
3.45	60	67	2.30	65	58
4.15	65	70	3.00	68	65
4.45	65	70	3.30	70	69
5.15	68	70			

temperature range is 25 to 30°C which is just double as compare to shade drying temperature due to which the moisture is removed faster in sun drying than in the shade drying. Further, less time that is, 5 h is required to dry the sample in solar cabinet dryer for 54 to 60% moisture loss and the temperature inside the cabinet was observed to be 39°C which is furthermore as compared to the shade and sun drying (Table 1). It is worth to mention here that during solar drying the colour of the sample gets darker than shade and sun dried. This may be because in solar drying the temperature inside the cabinet raises up to 39°C result in fast drying and also the colour of the product gets darkened. The drying time was higher in shade as compared to other driers, may be due to the structural design of the other driers. The lesser time taken in solar drier is due to higher air temperature and lesser relative humidity inside the drier.

In case of samples dried in cabinet dryer at an air velocity of 1.62 ms^{-1} and temperature 67 to 77°C, it takes about 4.45 h to reduce moisture content of 65 to 70%, whereas when dried in cabinet dryer at air velocity of 1.88 ms^{-1} and temperature 64 to 74°C, the time required for same moisture loss is 3.30 h. This may be due to the change in air velocity that is, 1.62 and 1.88 ms^{-1} respectively and is given in the Table 2.

In case of samples dried in cabinet dryer at temperature ranging from 75 to 85°C with air velocity 1.62 ms^{-1} and at temperature ranging from 80 to 92°C with air velocity of 1.88 ms^{-1}, the time required for the loss of moisture of about 70% is same that is, 1.45 h in both the air velocity (Table 3). The rate of drying is more in first cabinet as compared to the second cabinet when dried with an air velocity of 1.62 ms^{-1} and at temperature 75 to 85°C. But did not show any significant effect on the moisture loss in first and second cabinet when dried in air velocity of 1.88 ms^{-1} and at temperature 80 to 92°C.

Effect of different drying condition on colour of Safed Musli

The value of lightness is more or less same in shade

Table 3. Moisture depletion pattern of Safed Musli dried in cabinet dryer at different air velocity and temperature.

Time (hours)	Loss of moisture (%)		Time (hours)	Loss of moisture (%)	
	Air velocity 1.62 ms^{-1} and temperature 75 to 85°C			Air velocity 1.88 ms^{-1} and temperature 80 to 92°C	
	Cabinet I	Cabinet II		Cabinet I	Cabinet II
0.30	20	18	0.30	20	20
1.00	38	35	1.00	50	50
1.15	55	55	1.15	68	65
1.30	60	58	1.30	70	70
1.45	70	70	1.45	70	70

Table 4. Hunter colour value of dried Safed Musli powder at 65/10°.

Different drying technique	Lightness	Yellow to red	Green to blue
Shade	80.26	0.83	10.93
Sun dried	75.31	2.67	13.68
Solar dried	73.99	2.76	13.30
Cabinet dried, one coil and one fan	77.90	1.26	12.45
Cabinet dried, one coil and two fan	79.09	1.06	12.29
Cabinet dried, two coil and one fan	78.42	0.99	10.55
Cabinet dried, two coil and two fan	79.74	0.80	9.93

Table 5. Saponin content in Safed Musli dried in different drying condition.

Drying condition	Saponin (%)
Shade	0.983
Sun	0.824
Solar	0.426
Cabinet 1 coil, air velocity 1.62 ms^{-1}	0.635
Cabinet 1 coil, air velocity 1.88 ms^{-1}	0.325
Cabinet 2 coil, air velocity 1.62 ms^{-1}	0.743
Cabinet 2 coil, air velocity 1.88 ms^{-1}	0.308

dried and cabinet dried sample whereas lightness decreases when dried in sun and solar dried sample as given in the Table 4.

Effect of different drying condition on saponin content of Safed Musli

The variation in saponin content of dried powder of Safed Musli was due to the difference of drying technique. The maximum saponin content was observed in the sample when dried in shade (0.983%) and minimum (0.308%) in cabinet dryer with air velocity of 1.88 ms^{-1} and temperature range 80 to 92°C. The shade drier hinders direct sunlight and gave the best results. This showed that the drying systems affected the saponin content. This observation if further substantiated by the findings as reported by Kumar et al. (2000) that due to size reduction of turmeric and drying system with covering materials gave better results.

Second best results that is, (0.824%) of saponin were observed when the sample was dried in sun. This may be due to the reason that in cabinet drying the temperature inside the cabinet is more that is, 80 to 92°C whereas in case of shade drying the temperature lies in the range of 15 to 18°C. This indicates that the loss of saponin content take place at higher temperatures (Table 5). The identification of saponin was confirmed by superimposing the UV spectra of samples and standards within the same R_f value as shown in the Figures 1 to 3. Fresh root recovery of the medicinal plant of Safed Musli was acceptable when stored at temperatures between 10°C and ambient but the saponin content decreased with the storage duration. Low storage temperature (2 to 5°C)

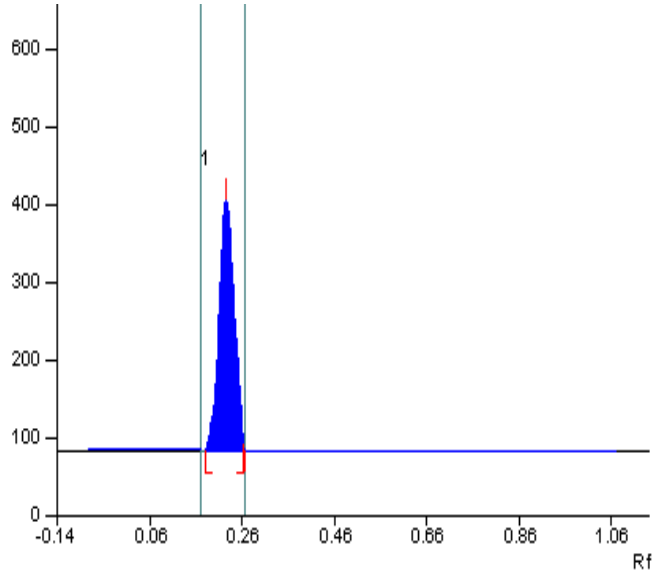

Figure 1. Saponin standard.

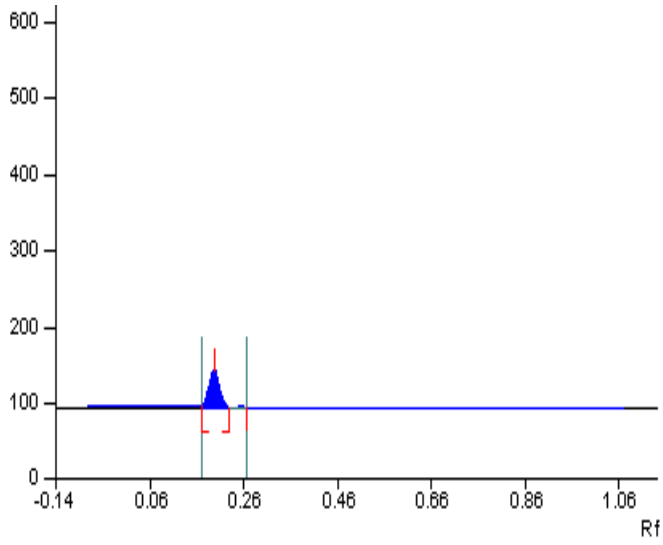

Figure 2. Shade drying.

maintained higher saponin content in roots (DARE / ICAR Annual Report, 2003-2004). Blunt end type roots are better for storage and saponin content (8.9%) than the tapering end types and the first week of December is the best for harvest of roots.

Conclusion

The lightness and saponin content was found to be maximum in shade drying of Safed Musli but drying times takes more when dried in shade than any other condition of drying. Maximum loss of saponin content was observed when dried in cabinet dryer in the temperature

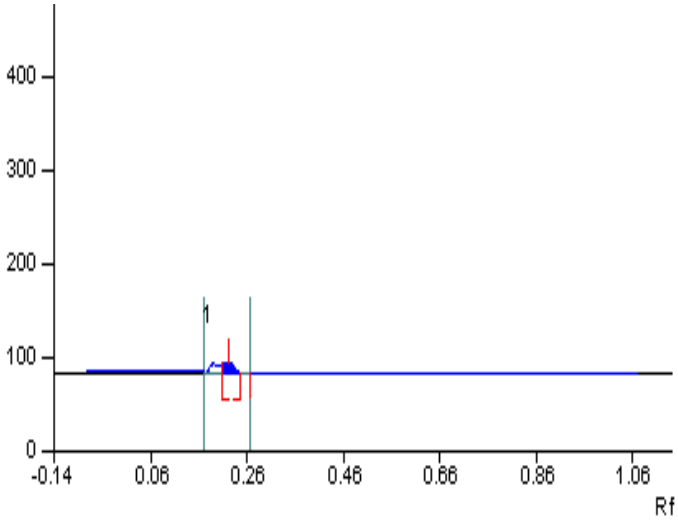

Figure 3. Cabinet drying.

range of 80 to 92°C with the air velocity of 1.88 ms^{-1}. Based on the results, it can be concluded that shelf life of Safed Musli can be enhanced and extended by making it into value added powder by employing traditional processing methods.

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