ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com
Journal DOI: 10.21474/IJAR01

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

A study on dehydration of *Houttunia cordata* leaves and retention of its quality characteristics during storage.

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Manuscript Info

Manuscript History:

Received: 12 May 2016
Final Accepted: 19 June 2016
Published Online: July 2016

Key words:

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Abstract

Dehydration is a simple and useful technique for preservation of perishable foods such as green leafy vegetables. *Houttuniya cordata* Thunb. is an ethnobotanically important plant of North eastern region of India. The leaves of *Houttuniya cordata* are used as vegetables either cooked or raw. It posses various pharmacological functions and is also rich in micronutrients. The present study is aimed to increase the shelf life of this leafy vegetable and thus increasing the consumption to reduce micronutrient deficiencies. Four methods of drying was applied where cabinet and microwave drying resulted in retaining more quality parameters than sun drying and shade drying methods. The rate of drying was faster in microwave drying. The storage study by using two types of packaging materials i.e. HDPE and PP pouches revealed that HDPE packed greens showed better retention in quality parameters such as rehydration ratio, retention of pigments than PP pouches. Hence dehydrated *Houttuniya cordata* leaves by using microwave or cabinet drying techniques can be stored upto 6 months by using HDPE pouches.

Introduction:-

Houttuniya cordata Thunb. of Saururaceae family is a flowering plant native to Japan, Korea, China and Southeast Asia and grows mostly in shady place [1]. It is known for its use as herbal medicine as it posses pharmacological functions such as anti-bacterial, anti-tumour, anti-microbial, anti-inflammatory properties [2-5]. The root and young leaves have been used as vegetable in many eastern Asian countries.

Drying is a simple, user-friendly technique which removes moisture of the product to an extent and thus increases the shelf life of the product. For this purpose, in the present study the leaves of *H. cordata* were dehydrated by using different drying methods such as sun drying, shade drying, cabinet drying and microwave oven drying and retention of quality characteristics during storage was observed.

Materials and methods:-

Collection of sample:-

The fresh leaves of *H. cordata* were collected from local market of Jorhat city and were placed in sterile poly-bag to prevent loss of moisture during transportation to the laboratory.

Preparation of sample:-

The collected samples were washed properly in running tap water and finally distilled water. They were drained completely and surface moisture was dried using filter paper. The samples were then dried using four different drying methods namely sun drying, shade drying, cabinet drying and microwave oven drying. Cabinet drying was done at 60° C using Mevish cabinet dryer while microwave drying was done at 450w and 100% power using Samsung ce13501 model. For the drying curve, the weights of the samples were taken after definite interval. The dried samples were packed in 200 gauge high density polyethylene (HDPE) and 100 gauge polypropylene bags and stored at ambient conditions (21.0-36.5 °C and 76-90% RH) for 6 months. Samples were analyzed at 3 month intervals.

Moisture content of samples was obtained by drying at 105° C in an oven using method of AOAC (2000) [6]. Chlorophyll was extracted in 80% acetone and the absorption at 663nm and 645nm were read using a spectrophotometer. The amount of chlorophyll is calculated using absorption coefficients [7]. One gram of sample was soaked overnight in ethanol (20 ml) and non-enzymatic browning was expressed in terms of optical density values at 420 nm. The rehydration ratio of dehydrated GLVs was estimated as per methods of Patil *et al.*, 1978 [8].

Results and discussion:-

Drying curves:-

The drying curves for *H. cordata* in four different methods of drying were plotted between moisture content against time. The time was in minute and the moisture content was in percentage (Figures 1-4).

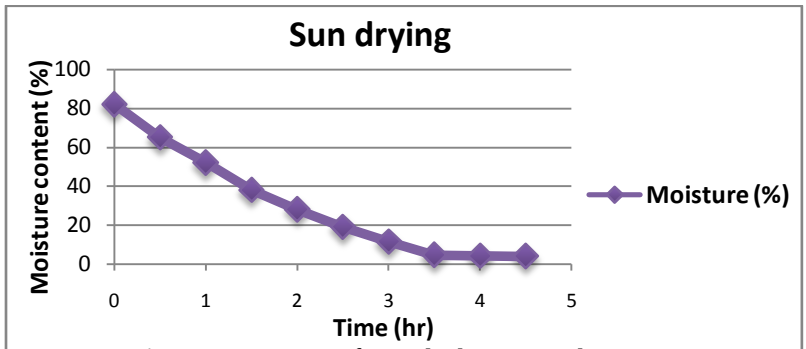

Fig 1:- Drying rate of sample during sun drying

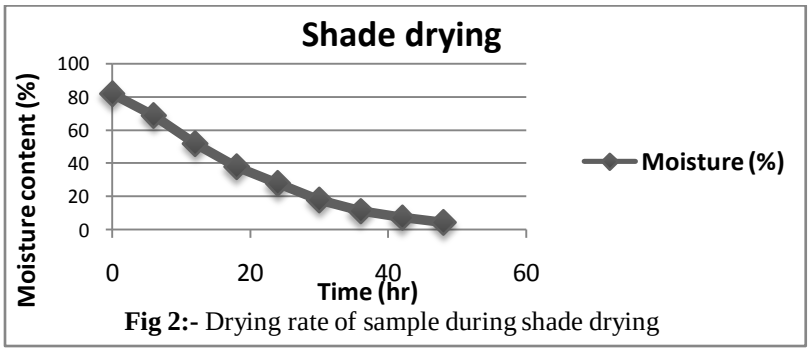

Fig 2:- Drying rate of sample during shade drying

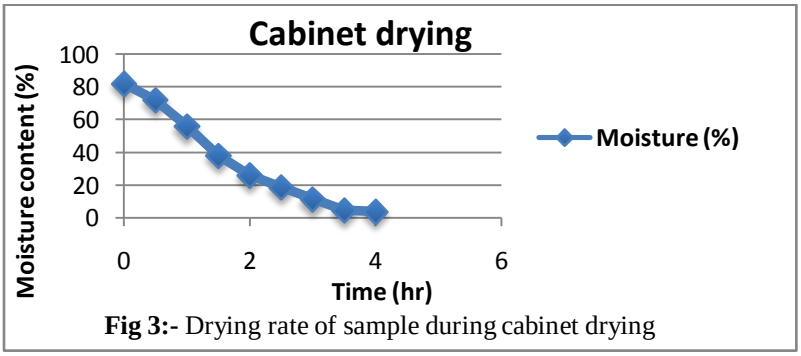

Fig 3:- Drying rate of sample during cabinet drying

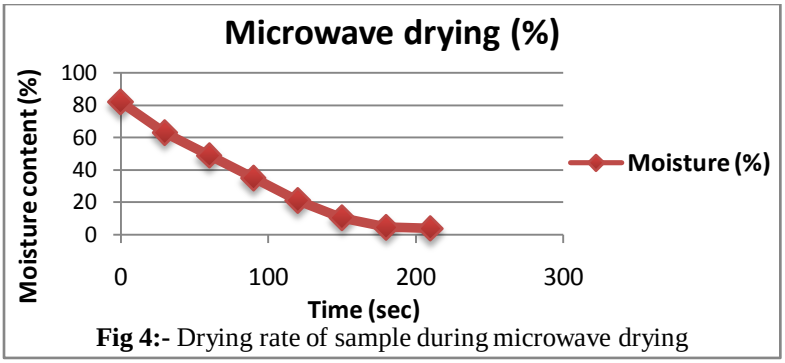

Fig 4:- Drying rate of sample during microwave drying

Microwave drying took minimum time to obtain constant weight while shade drying took maximum time. Sun drying and cabinet drying took similar time but the disadvantage of sun drying is that it is affected by adverse weather conditions.

Changes in physical characteristics:-

To visualize the effect of different drying techniques on physical parameters of *H. cordata*, the parameters like time taken for drying, yield per 100 g of fresh leaves, moisture content after dehydration by different methods and their rehydration ratio were also observed and presented in Table 1.

Table 1:- Changes in physical characteristics of *H. cordata* leaves after dehydration

Drying methods	Sun dried	Shade dried	Cabinet dried	Microwave dried
Time taken for drying (hr)	4.50 ± 0.15	46.00 ± 1.20	4.10 ± 0.07	3.50 ± 0.20 (min)
Yield (g) (per 100g of fresh leaves)	12.38 ± 0.34	13.52 ± 0.41	12.82 ± 0.39	13.03 ± 0.52
Moisture content (g/100g)	4.96 ± 0.38	5.87 ± 0.26	4.66 ± 0.28	4.68 ± 0.12
Rehydration ratio	4.04 ± 0.46	4.13 ± 0.22	4.42 ± 0.33	4.79 ± 0.18

The time taken for drying of green leafy vegetables to dry to crispness varied among different drying methods**.** Shade drying took maximum time among the drying methods whereas microwave drying took quite less time. Similar results were reported by Rajeswari (2010) where microwave drying took minimum time as compared to cabinet drying [9]. The yield obtained by shade drying was highest whereas least per cent yield was observed by drying under sun among all the drying methods. Sakhale and Pawar (2007) reported that the yield of dried curry leaves was found maximum (44.40%) in shade drying with intermediate values in the sun and tray drying methods which is similar to the present study [10]. Variations in the yield were basically due to higher moisture content of shade dried leaves as compared to sun and tray dried leaves. Rehydration ratio indicates the capacity of dehydrated leafy vegetables to absorb the moisture. Lowest rehydration ratio was observed in sun dried green leafy vegetables except few which exhibited lowest value in shade drying. Karva *et al.* (2010) also reported that *Amaranthus paniculatus* leaves dried under sun exhibited lowest rehydration ratio of 4.10 followed by shade drying (4.92) and hot air oven (4.98). Rehydration ratio of microwave dried green amaranthus was found highest (5.29). Microwave drying resulted in lower level of moisture content (3.64-4.66 g/100g) than other drying methods. Shade dried green leafy vegetables retained highest amount of moisture (5.34-6.87 g/100g) which may be due to high humidity content in air of the region [11].

Pigment content of dehydrated samples:-

The maximum chlorophyll content of *H. cordata* was seen in shade dried samples while carotene content was maximum in microwave dried samples. The retention of chlorophyll content in shade dried samples might be due to no heat treatment. Cabinet and microwave dried greens also showed good retention of pigments. Figure 5 shows retention of pigments after drying.

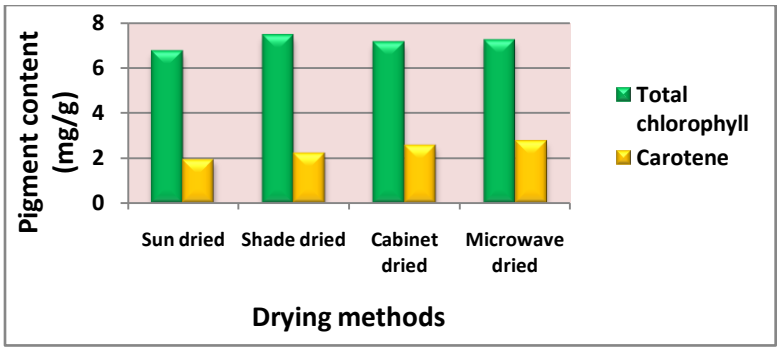

Figure 5:- Retention of pigment after drying

Storage study of dehydrated greens:-

Two type of packaging material was used to study the retention of quality characteristics during storage, which were 200 gauge high density polyethylene (HDPE) and 100 gauge polypropylene bags and stored at ambient conditions (21.0-36.5 ° C and 76-90% RH) for 6 months. The storage study of dehydrated *H. cordata* leaves was done for cabinet dried and microwave dried samples as sun dried and shade dried samples showed less retention in quality characteristics than the other two methods.

Moisture content during the storage period:-

There was gradual increase in moisture content during the storage period. Microwave dried samples packed in HDPE showed least increment of moisture while cabinet dried samples packed in PP pouches retained high moisture content. Table 2 depicts the effect of packaging material on moisture content of dehydrated samples. Seevaratnam *et al*. (2012) reported the moisture content of *Alternanthera sessilis* and *Amaranthus polygonoides* dried green leafy vegetable samples packed in different packaging materials increased gradually with increase in storage period. The rate of increase in moisture was low in samples packed in HDPE followed by PP. This might be due to high porosity of PP pouches than HDPE pouches [12].

Table 2:- Effect of packaging material on moisture content of dehydrated samples

Storage days	**Cabinet dried (g/100g)**		**Microwave dried (g/100g)**	
	HDPE	PP	HDPE	PP
0	4.66 ± 0.28	4.66 ± 0.28	4.42 ± 0.33	4.42 ± 0.33
60	5.35 ± 0.43	5.71 ± 0.34	5.13 ± 0.21	5.61 ± 0.41
120	6.42 ± 0.31	6.85 ± 0.27	6.37 ± 0.40	6.77 ± 0.25
180	7.67 ± 0.22	8.05 ± 0.46	7.42 ± 0.31	7.92 ± 0.38

Rehydration ratio during the storage period:-

The rehydration ratio of dehydrated green leafy vegetables decreased on storage and was also observed variation in different packaging materials. Highest rehydration ratio was observed in HDPE packaged dehydrated greens and lowest in PP pouch packaged greens. As more moisture permeates through PP pouches than HDPE pouches, this leads to decrease in rehydration ratio of the dehydrated greens. Singh and Sagar (2010) reported similar observation while studying rehydration ratio of dehydrated curry leaves and drumstick leaves during storage in different packaging materials. The rehydration ratio was more in leaves packaged in HDPE films as compared to PP which might be due to less absorption of moisture by HDPE films [13].

Table 3:- Effect of packaging material on rehydration ratio of dehydrated samples

Storage days	**Cabinet dried (mg/g)**		**Microwave dried (mg/g)**	
	HDPE	PP	HDPE	PP
0	4.68 ± 0.12	4.68 ± 0.12	4.79 ± 0.18	4.79 ± 0.18
60	4.34 ± 0.15	4.04 ±0.13	4.52 ± 0.11	4.12 ± 0.10
120	3.94 ± 0.12	3.56 ± 0.11	4.03 ± 0.08	3.88 ± 0.06
180	3.52 ± 0.04	3.11 ± 0.10	3.73 ± 0.08	3.32 ± 0.07

Retention of pigments during the storage period:-

There was gradual decrease in both chlorophyll and carotene pigment content of the dehydrated samples on storage. Microwave dried samples packed in HDPE showed least decrease of both the pigments while cabinet dried samples packed in PP pouches retained less pigment content. Table 4 and 5 shows the retention of pigments (chlorophyll and carotene) of dehydrated leaves.

Table 4:- Effect of packaging material on retention of chlorophyll of dehydrated samples

Storage days	Cabinet dried (mg/g)		Microwave dried (mg/g)	
	HDPE	PP	HDPE	PP
0	7.13 ± 0.31	7.13 ± 0.31	7.21± 0.24	7.21 ± 0.24
60	5.78 ± 0.22	5.44 ± 0.27	6.03 ± 0.43	5.64 ± 0.31
120	4.92 ± 0.40	4.65 ± 0.35	5.53 ± 0.27	4.93 ± 0.23
180	4.53 ± 0.21	4.02 ± 0.20	4.84 ± 0.18	4.33 ± 0.14

Table 5:- Effect of packaging material on retention of carotene of dehydrated samples

Storage days	Cabinet dried (mg/g)		Microwave dried (mg/g)	
	HDPE	PP	HDPE	PP
0	2.55 ± 0.13	2.55 ± 0.14	2.73 ± 0.11	2.73 ± 0.19
60	2.17 ± 0.17	1.93 ± 0.09	2.34 ± 0.18	2.12 ± 0.15
120	1.54 ± 0.11	1.21 ± 0.10	1.66 ± 0.13	1.21 ± 0.08
180	1.03 ± 0.08	0.84 ± 0.06	1.15 ± 0.12	0.93 ± 0.04

Non-enzymatic browning during the storage period:-

Packaging materials had a significant effect on browning of samples during storage in both cabinet and microwave drying methods. There was a steady increase in Non enzymatic browning (NEB) values which was more in samples packed in PP pouches. At the end of 6 months, the NEB value was lowest in HDPE pouch packed microwave dried samples (1.20 g/ml) and highest in PP pouch packed cabinet dried samples (1.52 g/ml).

Table 6:- Effect of packaging material on non-enzymatic browning of dehydrated samples

Storage days	Cabinet dried (g/ml)		Microwave dried (g/ml)	
	HDPE	PP	HDPE	PP
0	0.87	0.87	0.82	0.82
60	1.09	1.18	0.98	1.03
120	1.16	1.29	1.05	1.22
180	1.33	1.52	1.20	1.41

Conclusion:-

Among all the type of drying methods microwave drying requires minimum time and energy and is also good for domestic purpose, but it does not allow bulk drying so it is not feasible for drying in a large scale or for commercial purpose. Moreover, the other drying characteristics of cabinet dryer are found quite similar to that of microwave dried greens. Cabinet drying also permits large scale drying of green leafy vegetables. Dehydration also increases shelf-life of the greens. Hence, cabinet drying can be used for commercial purpose. Among the packaging materials, HDPE packaging was found better than PP packaging as it retained more quality parameters than PP packages.

Acknowledgements:-

I am highly thankful to Dr. N.N. Sharma, Professor and Head, department of Agronomy for providing laboratory facilities and support during the research.

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