Effect of Drying Methods on Quality Characteristics of Curry (*Murraya koenigii*) Leaves

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Abstract— *Different drying methods viz., Sun drying, shade drying and tray drying (temperature 45, 55 and 65 0C) were used for dehydration of curry (Murraya koenigii) leaves for optimal retention of color and its constituents. It was observed that the time required for tray drying was less (27%), when compared to sun and shade drying. Tray dried (550C) curry leaves had maintained nutritional constituents up to acceptable limit with superior green color and a more porous and uniform structure than those obtained from sun and shade drying. Dehydrated curry leaves showed good consumer acceptance as well as shelf life.*

Keywords— Drying, Curry leaves, Minerals, Vitamin, Dryer.

I. INTRODUCTION

Murraya koenigii, commonly known as *curry* leaf or *karipatta*in Indian dialects, belonging to family Rutaceae which represents more than 150 genera and 1600 species (Satyavati *et al*. 1987). A number of chemical constituents from every part of the plant have been extracted. The most important chemical constituents responsible for its intense characteristic aroma are P-gurjunene, P-caryophyllene, P-elemene and O-phellandrene. The plant is rich source of carbazole alkaloids (kumar *et al*., 1999). The leaves are a good source of vitamin A and calcium. It is perennial leaf vegetable and primarily used in providing a flavour in the Indian cooking (Khatoon *et. al.,* 2011). *Murraya koenigii*is widely used in Indian cookery for centuries and have a versatile role to play in traditional medicine. The plant is credited with tonic and stomachic properties. Bark and roots are used as stimulant and externally to cure eruptions and bites of poisonous animals. Green leaves are eaten raw for cure of dysentery, diarrhoea and for checking vomiting. Leaves and roots are also used traditionally as bitter, anthelmintic, analgesic, curing piles, inflammation, itching and are useful in leucoderma and blood disorders (Nadkarni, 1976 and Kirtikar and Basu, 1981).

Limited research work on dehydration of curry leaves has been documented. Khartoon *et. al.* (2011) and Gopalan and Sastri (2004) reported some organoleptic and nutritive properties of dehydrated curry leaves. Das *et. al.* (2011) reported antioxidant effect of curry leaf powder. Dwivedy *et. al.* (2012) examined effect of drying methods on quality characteristics of medicinal Indian borage leaves.

Dehydration is one of the feasible methods of preservation. Research needs to be done to explore the possibility of employing dehydration techniques for processing to minimize the losses and to make them available for consumption in the off-season. Therefore, the present investigation was undertaken to study the effect of different drying methods on nutritional and sensory quality of curry leaves. The process of dehydration, heat application result in changes in the quality specially, the concentration of nutrients, sensory changes like color, texture and flavor. It is essential to test the quality of processed produce to ensure the utilizability for nutritional benefit.

II. MATERIALS AND METHOD

Curry (*Murraya koenigii*) leaves were procured from a local market. The stems as well as extraneous foreign material were removed. Fresh, green, un-damaged curry leaves were selected whereas, insect infested, bruised, discolored, decayed and wilted leaves were discarded before washing the leaves. The stalks of the leaves were cut from the main branches and the leaves were washed thoroughly three to four times with tap water to remove all the adhering dust, dirt particles. The curry leaves were then blanched in boiled distilled water containing 0.1 per cent magnesium oxide for 15-20 seconds. Leaves were then spread on filter paper. (Sakhale *et al.* 2007 and Lakshmi and Vimala, 2000).

2.1 Drying of curry leaves

The curry leaves were dehydrated by sun drying, shade drying at room temperature and in tray dryer. The air - dried leaves were placed on cotton sheets and then covered with the cheesecloth to keep off dust and insects. The cotton sheets were placed in a direct sunlight on a roof away from animals, traffic and dust and turned occasionally to assure even drying. The leaves were brought indoor at nights as the temperature during night falls down.

2.2 Shade drying

In shade drying also, the air - dried leaves were spread on cotton sheets but instead of keeping them on the roof the leaves were kept in the room (32.5 ± 1^0C) only. The room selected for shade drying was well ventilated. Natural air current was used for shadow drying the leaves.

2.3 Tray drying

In tray drying the selected drying temperatures were 45, 55, and 65 ^{0}C. The air dried leaves were loaded on the trays forming one single layer and were dried in the tray dryer by forced air technique. The tray dryer was preheated to selected temperature and then the loaded tray was added to dryer. The dehydrated curry leaves samples then were packed in polyethylene bag of 100 gauges immediately after drying process and were used for quality evaluation.

2.4 Colour determination

Samples were analyzed for change of colour after dehydration. The surface colour of the curry leaves was assessed with a Premier Colour Scan Instrument (Make: BYK Gardner Instruments, Germany). The colour of curry leaves was expressed as L* (Lightness), a* (Greenness), b*(Yellowness) on Hunter scale parameters.

2.5 Treatment details

Treatment code	Treatment details
A_1B_1	Blanched sun drying
A_1B_2	Control sun drying
A_2B_1	Blanched shade drying
A_2B_2	Control shade drying
A_3B_1	Blanched tray drying at 45 ^{0}C
A_3B_2	Control tray drying at 45 ^{0}C
A_4B_1	Blanched tray drying at 55 ^{0}C
A_4B_2	Control tray drying at 55 ^{0}C
A_5B_1	Blanched tray drying at 65 ^{0}C
A_5B_2	Control tray drying at 65 ^{0}C

2.6 Data analysis

The result obtained were subjected to analysis of variance (ANOVA) and Duncan's test using SPSS 13 (SPSS Inc., USA) software and analysis of regression using Microsoft Excel 2007 (Microsoft Crop., USA).

III. RESULTS AND DISCUSSION

The study was conducted to examine the effect of pretreatment on drying of curry leaves (blanched and without blanched) with different drying methods (sun, shade, and tray drying). The effect was also examined on drying behavior and quality of curry leaves. Curry leaves were dried from initial moisture content to approximately equilibrium moisture content.

3.1 Chemical Constituents and Quality Parameters of Dehydrated Curry Leaves

3.1.1 Moisture content

The moisture content (% d.b.) of dehydrated curry leaves samples varied between 4.13 to 6.09 %. The minimum (4.13%) value of moisture content was obtained in case of tray drying at 55 ^{0}C for blanched curry leaves sample.

3.1.2 Ascorbic acid

It was observed from Table 1 that values of ascorbic acid contents varied between 2.23 to 3.56 mg/100g.The blanched tray drying sample at 55 ^{0}C temperature has given significantly higher value of ascorbic acid content (3.56 mg/100 g) followed by control sample at 55^{0}C temperature (2.90 mg/100 g). Ascorbic acid retention was better in 0.1 percent magnesium oxide blanching prior to drying. These results are in confirmation with Lakshim and Vimala (2000) for amaranth, curry and gogu leaves.

3.1.3 Calcium content

The retention of calcium content (Table 1) was found to be maximum (46.65 mg/L) in case of blanched tray drying samples at 55 ^{0}C and minimum (18.23mg/L) content was found in control shade drying method. It was noted that tray dried curry leaves sample shows greater retention of calcium content when compared with other drying methods. The similar results were reported by Sakhale and Pawar (2007) for cabbage drying and Rajeswari *et al.* (2013) for drying of amarathis leaves.

3.1.4 Iron content

The iron content varied from 0.609 to 1.340 mg/L. The maximum iron content (1.340 mg/L) was found in blanched tray drying sample at 55 ^{0}C and minimum (0.609 mg/L) in control sun drying method. The maximum retention of iron content was reported in tray dried curry leaves samples when compared with other methods of drying. The similar result reported by Sakhale and Pawar (2007) for cabbage, Rajeswari *et al.* (2013) for drying of amarathus leaves and Singh et al., (2014) for curry leaves.

3.1.5 Rehydration ratio

It was observed from the Table 1 that rehydration ratio varied from 3.36 to 4.35. The maximum rehydration ratio (4.35) was found in blanched sun drying sample and minimum (3.36) in control sun drying method. The similar results showed by Rajeswari *et al*. (2013) for drying of amaranth leaves.

3.1.6 Colour determination

The positive values of L* represented the whiteness. The positive values of a* indicates redness and negative value indicates greenness. Tray drying at 45 ^{0}C for control curry leaves sample showed the higher (23.545) value of L* than other methods and tray drying at 55 ^{0}C for blanched curry leaves showed the lesser value (22.078) of L*. In tray drying at 55 ^{0}C for blanched curry leaves samples a* value was -4.654 it means that greenness of curry leaves was maintained during the drying process.. The positive value of b^* indicates yellowness and negative value indicate blueness of leaves. From this study tray drying at 45 ^{0}C for control curry leaves sample showed the greater value (12.412); this means that the yellowness of curry leaves. It was observed from the colour scanning data that the blanching with magnesium oxide (0.1%) gave better results of colour in final product. The similar results were reported by Maharaj and Sanket (2000) for dehydration of dasheen leaves and Porntewabancha and Siriwongwilaichat (2010) for drying of lettuce leave.

3.1.7 Statistical analysis of drying data

Inverse quadratic Dave, (1971) was tested to fit the drying data of moisture ratio versus time for all the methods of drying. The data indicates (Table 2) Inverse quadratic Dave best fit model for each method of drying and value of coefficient of determination (R^2).

$$(M.R.) = a + (b \times t) - (c \times t^2) \qquad (1)$$

where,

M.R.= Moisture Ratio, a, b, and c = Model constants and t = time, h

TABLE 1
EFFECT PRETREATMENT AND DRYING METHODS ON QUALITY PARAMETERS OF DEHYDRATED CURRY LEAVES

Treatment	Ascorbic acid (mg/100g)		Calcium content (mg/L)		Iron content (mg/L)		Rehydration ratio	
A_1B_1	2.46		19.03		0.781		4.35	
A_1B_2	2.23		18.23		0.609		3.36	
A_2B_1	2.83		22.08		0.833		4.25	
A_2B_2	2.46		20.22		0.789		3.84	
A_3B_1	2.90		25.38		0.961		3.51	
A_3B_2	2.50		20.30		0.799		4.27	
A_4B_1	3.56		46.65		1.340		3.93	
A_4B_2	2.90		31.85		1.036		3.99	
A_5B_1	2.36		36.51		1.112		4.01	
A_5B_2	2.28		46.01		1.186		3.61	
Source	S.E.(±)	C.D. at 5 %	S.E. (±)	C.D. at 5 %	S.E. (±)	C.D. at 5 %	S.E. (±)	C.D. at 5 %
A	0.040346	0.119821	0.461614	1.370923	0.025921	0.07698	0.125984	NS
B	0.063792	0.189453	0.729875	2.167619	0.040984	0.121717	0.199198	NS
A × B	0.090216	NS	1.0322	3.065477	0.05796	0.172133	0.281709	NS

The moisture ratio decreased from initial value of one to almost zero for all the treatments. It is readily seen from the Table 2 that the values obtained for treatment **A_5B_2** provides excellent fit to the experimental data on drying of curry leaves with coefficient of determination as 0.999.

TABLE 2 DRYING MODEL TESTED FOR DIFFERENT DRYING METHODS

Treatments	Inverse quadratic Dave model	R^2	F-test	RMSE
A_1B_1	$MR = 0.009\ t^2 - 0.187\ t + 1$	0.998	HS	0.0663
A_1B_2	$MR = 0.006\ t^2 - 0.163\ t + 1$	0.998	HS	0.0443
A_2B_1	$MR = 0.001\ t^2 - 0.072\ t + 1$	0.999	HS	0.0389
A_2B_2	$MR = 0.000\ t^2 - 0.051\ t + 1$	0.999	HS	0.0325
A_3B_1	$MR = 0.022\ t^2 – 0.302\ t + 1$	0.996	HS	0.0353
A_3B_2	$MR = 0.016\ t^2 – 0.259\ t + 1$	0.998	HS	0.0242
A_4B_1	$MR = 0.051\ t^2 - 0.449\ t + 1$	0.997	HS	0.0255
A_4B_2	$MR = 0.031\ t^2 - 0.348\ t + 1$	0.996	HS	0.0283
A_5B_1	$MR = 0.144\ t^2 - 0.747\ t + 1$	0.995	HS	0.0302
A_5B_2	$MR = 0.068\ t^2 - 0.518\ t + 1$	0.999	HS	0.0325

*S=Significant, HS= highly significant

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