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Effect of drying conditions on rehydration ratio of dried mint leaves

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Abstract
The proper use of cabinet tray dryer helps to reduce the losses and improves the quality of product. The experiments were conducted to develop dehydrated mint leaves so as to enhance the availability of mint leaves during off season. In the present study, fresh mint leaves were categorized in to untreated leaves (control) and blanched treated in boiled water for 1 min. the leaves were dried at 1.5,3.0,4.5 kg/m^2 loading density with three levels of temperature (45 ^{0}C, 55 ^{0}C, 65 ^{0}C) under cabinet tray dryer. Untreated mint leaves were also dried as control samples. Experiments were also conducted to study the effect of drying conditions on rehydration ratio of dried mint leaves. The rehydration ratio decreased with the decrease in temperature and reported maximum at maximum temperature and the rehydration ratio for untreated samples was more than blanched treated samples.

Keywords: Loading density, temperature, mint, drying, ascorbic acid

Introduction

Drying is a process of heat and mass transfer simultaneously where the heat energy is applied to the product to increase the temperature of the product and to vaporize the moisture present in the product through provision of latent heat of vaporization. Dehydration also brings about substantial reduction in weight and volume; resulting into less expense towards packaging, storage and transportation costs and also enables storability of the product under ambient temperature [15]. Drying is the major processing technique practiced for the preservation of vegetables which can be accomplished with little capital and produces shelf stable food products The lower water content slows the rate of enzymatic action and overall deterioration rate, and makes products less susceptible to decay. Drying process should be undertaken in closed equipment to improve the quality of the product (7). Industrial dryers should be used to achieve consistent quality of the product. Industrial dryers are rapid and provide uniform and hygienic dried product (4). A number of studies for drying of fruits and vegetables have been reported by various authors [1, 5, 6, 9, 10, 11, 12, 14, 23]. The green leafy vegetables can be successfully preserved by dehydration technology, since the dehydration industry need not depend on imports for raw materials. The green leafy vegetable powders certainly have the potential to enter processed food industry and can compete in the dehydrated foods market. The degradation of naturally occurring colour pigments and water soluble vitamins in the food during thermal processing is a major problem.

Mint leaves (*mentha spicata L.)* are a common name for members of the Labiatae (Laminaceae Family). It is a large family of annual or perennial herbs and widely grown all over the world to reap its special herbal characteristics. Mint leaves are very popular in Mediterranean regions and represent a dominant part of the vegetation. Mint leaves are known for refreshing, antiseptic, antiasthma tic, simulative, diaphoretic, stomachic, and antispasmodic features. Mint leaves are used in both fresh and dried form in different cuisines. Various authors [17, 21, 22] have indicated the use of mint leaves in a variety of dishes such as vegetable curries, chutney, fruit salads, vegetable salads, salad dressing, soups, desserts, juices, sherbets etc. Mint is also very popular in India and mainly cultivated in southern parts of Himalayan range including Uttar Pradesh, Punjab, Himachal Pradesh, Haryana, and Bihar. [13] worked on nutritive value of dehydrated green leafy vegetables powders. Green leafy vegetables powders were prepared using dehydration technology. The green leafy vegetables used were mint (Mentha spicata), amaranth (Amaranthus gangeticus), curry leaves (Murraya koenigii and gogu (Hibiscus cannabinus). All the four green leafy vegetables were blanched before drying after establishing the conditions for blanching including blanching time, temperature and blanching treatment solution. Drying was done by sun-drying and cabinet- drying and the nutritive value of the powders was determined. It was found that in spite of considerable losses in vitamins, green leafy vegetable powders retained good amounts of proteins, fibre and minerals (Ca, Mg, Fe) and fair amounts of ascorbic acid and β-carotene. Losses of ascorbic acid content from green leafy vegetables ranged from 69 to 85% due to sun drying and 51 to 63% due to cabinet drying. Loss of β-carotene from green leafy vegetables after drying was found to range from 24 to 40% in sun dried leaves and 6 to 25% in cabinet dried leaves. Hot air, solar, convective- microwave, vacuum microwave drying methods Have been employed for drying of mint, the quality is compromised due to degradation of chlorophyll content and other volatile matters [3, 16, 19, 20]. In this study attempt was made to find out the VMD characteristics of spearmint leaves and the energy consumption in the process. The data will be useful in designing dryer and drying conditions for obtaining dehydrated mint leaves**.** The dried mint should have a bright green colour. Therefore it should be dried quickly in order to inactivate the enzyme chlorophyllase which breaks down the chlorophyll and turns the leaf yellow [8]**.** However, temperatures above 60 ^{0}C will remove the volatile oils reducing flavor [2]**.**

Materials and methods

The mint was procured from the nearest farmer's field, Meerut for the purpose of experiment, during crop season of 2013-2014.Fresh Mint leaves were sorted, Trimmed and washed thoroughly in fresh water to remove roots, stem and soft stem from the rest parts. Care was taken to avoid bruised and discoloured leaves. It was observed that loading density (weight of sample per unit area) was mostly preferred for drying of leafy vegetables. Hence, it was decided to use sample with a variable loading density of 1.5, 3.0 and 4.5 kg/m^2. Blanching of leaves (1:5 ratio, leaves: water) as pretreatment for 1 min was performed. Untreated mint leaves were dried as fresh leaves. Pretreated samples were exposed to three levels of loading density viz. 1.5, 3.0 and 4.5 kg/m^2. The leaves were weighed and loaded in aluminium trays and then kept for drying in the cabinet tray dryer at 45, 55 and 65 ^{0}C. The time interval for drying of mint leaves was decided on the basis of literatures available, which was fixed to thirty minutes**.**

The level of each variable was selected on the basis of earlier research work and experiments. Blanching of leaves (1:5 ratio, leaves: water) as pretreatment for 1 min was performed. Untreated mint leaves were dried as fresh leaves. Pretreated samples were exposed to three levels of loading density viz. 1.5, 3.0 and 4.5 kg/m^2. The leaves were weighed and loaded in aluminium trays and then kept for drying in the cabinet tray dryer. Experiments were also conducted to study the effect of drying conditions on ascorbic acid (vitamin c). The ascorbic acid content was estimated by dissolving 50 mg of HPO_3, 2,6 – dichlorophenol indophenol dye visual titration method [18].

Results and Discussion

Effect of drying conditions on rehydration ratio of dried mint leaves

The rehydration ratios of mint leave samples were analyzed to regain original shape. This characteristic was expressed in the form of rehydration ratio and moisture content in rehydrated samples. Rehydration studies were conducted at different temperatures and treatment under different loading densities (1.5 kg/m², 3.0 kg/m², 4.5 kg/m²) for a period of 05 and 15 minutes as shown in Table 1. The table indicated that rehydration ratio decreased with the decrease in temperature from 65 ^{0}C to 45 ^{0}C and was observed maximum at 65 ºC (5.582). [23] reported similar results with rehydration ratio, and found concurrent increase in rehydration ratio with drying air temperature. Prolonged drying periods, with low temperature drying, induce increased thermal disruption of the cell organization, reducing the rehydration ratio and coefficient of rehydration. Therefore, the lower rehydration ratio may probably due to cellular breakdown of the mint leaves during drying. Rehydration ratio increased with time of rehydration from 5 to 15 min. in each case of drying condition. [24] found that all the rehydration parameters increased with increase in time of rehydration. Table 1. showed that rehydration ratios for untreated samples were more than blanched samples under each case of drying temperature and loading densities. Table 1 showed the rehydration ratio in rehydrated sample for different loading densities of 1.5, 3.0 and 4.5 kg/m^2 at different temperature under cabinet tray dryer. It is clear that loading density does not affect much to rehydration ratioThe results of statistical analysis (ANOVA) for rehydration ratio at 05 and 15 minutes rehydration time have been presented in table 2 and 3. It shows that drying temperature, loading density and treatment were insignificant at 5% level of significance.

Table 1: Experimental data for rehydration ratio of dried mint leaves

Temperature	Loading density		Treatment	W1 (g)	W2 (g)	Rehydration (W2/W1)	
				5 min	15 min	5 min	15 min
45 ºC	1.5 Kg/m²	UT	1	5.221	5.523	5.221	5.523
		BT	1	5.022	5.213	5.022	5.213
	3.0 Kg/m²	UT	1	5.443	5.622	5.443	5.622
		BT	1	5.285	5.322	5.285	5.322
	4.5 Kg/m²	UT	1	5.432	5.685	5.432	5.685
		BT	1	5.331	5.387	5.331	5.387
55 ºC	1.5 Kg/m²	UT	1	5.441	5.551	5.441	5.537
		BT	1	5.125	5.242	5.125	5.242
	3.0 Kg/m²	UT	1	5.421	5.587	5.421	5.587
		BT	1	5.182	5.223	5.182	5.223
	4.5 Kg/m²	UT	1	5.534	5.695	5.534	5.695
		BT	1	5.212	5.261	5.212	5.261
65 ºC	1.5 Kg/m²	UT	1	5.486	5.572	5.486	5.572
		BT	1	5.286	5.288	5.286	5.288
	3.0 Kg/m²	UT	1	5.573	5.591	5.573	5.591
		BT	1	5.223	5.252	5.223	5.252
	4.5 Kg/m²	UT	1	5.582	5.618	5.582	5.618
		BT	1	5.262	5.291	5.262	5.291

W1= Weight of dehydrated mint leaves taken for rehydration.
W2= Drained weight of rehydrated mint leaves.

Table 2: ANOVA for rehydration ratio of dried mint leaves at 5 minutes

Source of Variation	DF	Sum Of Squares(SS)	Mean Sum Of Squares(MSS)	F- Calculated Value	F-Tab*Value
Temperature	2	0.04	0.02	0.14	3.8853
Loading Density	2	0.42	0.21	1.47	3.8853
Treatment	1	0.00	0.00	0.03	4.7472
Error	12	1.73	1.73		

* = Significant at 5% level of significance

Table 3: ANOVA for rehydration ratio of dried mint leaves at 15 minutes

Source of Variation	DF	Sum Of Squares(SS)	Mean Sum Of Squares (MSS)	F- Calculated Value	F-Tab*Value
Temperature	2	0.19	0.09	0.77	3.8853
Loading Density	2	0.15	0.07	0.60	3.8853
Treatment	1	0.06	0.06	0.45	4.7472
Error	12	1.47	0.12		

* = Significant at 5% level of significance

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