Research Article

Effect of Treatments on Ber Slices under Green House Type Solar Dryer and their Quality Characteristics of Ber Powder

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Abstract

A study was undertaken to evaluate the effect of different pretreatments and packaging material on physico chemical quality of developed ber powder .The study of this research, dehydrated ber powder was prepared under green house type solar dryer with pretreatments. The ber slices were treated by dipping in the solution of Potassium metabisulphite and sodium benzoate (1:4 ratios) for 15 min. and distilled water for 15 min. (control). The effect of three pre-drying treatments on quality of green house type solar dried ber powder was analyzed by determining acidity, pH, optical density, vitamin-C and total soluble solids. After drying samples were packed in LDPE (low-density polyethylene) and glass jars at room temperature condition.

Keywords: Drying methods, dried ber, KMS, Sodium benzoate, packaging material

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Introduction

Ber is a tropical and subtropical fruit native to the northern hemisphere. It belongs to the genus *Ziziphus* of the family Rhamnaceae and order Rhamnales. There are two major domesticated jujubes, *Z. mauritiana* Lam. (Indian jujube or ber) and *Z. jujuba* Mill (Chinese or common jujube). Among two, former is commonly cultivated throughout the northwest of India and in the arid parts of South India [1, 2]. It is popularly called the king of arid zone fruits [3, 4]. The area under cultivation with this fruit is 8.7lakh ha with an annual production of 8.9lakh tones in India [5]. About 125 varieties of ber are available in India. A few of these varieties are known for taste, size, amount of pulp and higher yields.

The cultivars Umran, Kathapal and Gola are the most promising varieties of ber in North India. Ber fruit have a high nutritive value, being a rich source of vitamin C, A, and B complex, and also of Ca, K, Br, Rb, and La [6]. In general, the fruit contain 81-83% moisture, 17.0% carbohydrates, 0.8% protein, 0.07% fats, 0.76-1.8% iron, 0.03% each of calcium and phosphorus, 0.02 mg/100g carotene and thiamine, 0.020-0.038 mg/100g riboflavin, 0.7-0.9 mg/100g niacin, 0.2-1.1 mg/100g citric acid, 65-76 mg/100g ascorbic acid, about 22 g/100g sugar, about 1.3 g/100g fiber, about 0.2 g/100g fat with a calorific value of 104/100g [7]. Galactose, fructose and glucose are the major sugars found in ber fruit [8]. p-Hydroxybenzoic, caffeic, ferulic and p - coumaric acids are the most abundant phenolic compounds in ber with oncentrations of about 366, 31, 20 and 19 mg/kg dry mass, respectively, whereas vanillic acid is the least abundant with a concentration of about 2.5 mg/kg. [9] analyzed several ber varieties from Spain for fatty acid and carotene contents.

Material and Methods

The pre-treated and untreated ber slices were dried in the green house type solar dryer (length 5.0 m × width 3.0 m and height 2.3 m, dryer frame 38 mm square MS pipe, 75 % transparency 200ì UV stabilized LDPE poly film).The ber slices were placed uniformly on drying trays (35 cm length × 30 cm width × 5.0 cm height size wooden framed with perforated stainless steel base). Weight losses (moisture content) of sample during drying process was determined, after each 1 hour interval and continued until no further weight changes were observed then after cooling at room temperature, the dried ber flakes were grind by using blender to produce ber powder. The ber powder was packed in LDPE pouch and glass jars for further investigation or analytical research.

Physicochemical Properties

Acidity

This was determined using Pearson's method 1981. Distilled water was neutralized using phenolphthalein and 0.1M NaOH. Two gram of the sample will be weighed into a conical flask and 90ml of the neutralized water and two drops of phenolphthalein indicator was added to it and this was titrated against 0.1M NaOH.

Calculation

$$\text{Acidity (\%)} = \frac{\text{Titre} \times 0.1 \times 0.064 \times 100}{\text{Weight of sample taken} \times 1000}$$

pH Measurement

10g of ber powder were taken along with 50ml distilled water homogenized in a mixer grinder. The ground sample was filtered and the pH was determined by dipping the combined glass electrode of a digital pH meter (Elico, LI-127, Indian Make) into the filtrate.

Optical Density (enzymatic browning)

Optical density was determined using the method as recommended by [10]. 5 gm. of sample taken and mixed well in 100 ml of 60% alcohol. Kept for 12 hours in a refrigerator and filtered using No. 1 whattman filter paper. The instrument, Digital Spectrophotometer (Elico, SLI -71 Model**)** was calibration knob for O.D. to 0 value at 440 nm wavelength. Filtrate was then inserted similarly and reading was recorded. Browning index was expressed in terms of optical density (O.D.).

Mathematically, O.D. of the medium is given by formula,

$$\text{Optical Density} = \frac{\log I_0}{I_t}$$

Where, I_0 = Intensity of the incident light, I_t = Intensity of light transmitted through the medium.

Ascorbic Acid Percentage

Take sample and dissolve and after that weighing the 10 g of powder blend with 3% HPO3 and make up 100 ml with HPO3 filter end point to pink color. The formula used is given below:

$$\text{Vitamin C \%} = \frac{\text{Titrate value x dye factor x volume made up}}{\text{Adequate of extract taken x weight of volume}} \text{ X } 100$$

Total Soluble Solids (TSS °Brix)

Total soluble solids value is defined as the percentage concentration amount of sugar and soluble minerals present in any food or substances. TSS (°Brix) of ber powder was measured by Hand Refractometer, which is based on the principal of the total refraction. Using the method recommended by [10]. A drop of sample was placed on the prism and the observation was taken in front of sunlight. The visible scale showed a dark line indication measuring TSS in degree "°Brix".

Statistical Analysis

The data obtained from the various experiments were recorded during the course of study and subjected to statistical analysis as per method of "Analysis of variance" by Factorial Randomized Block Design (factorial R.B.D.). The significance and non-significance of data obtained from various experiments were judged with the help of F (Variance ratio) table. The significance difference between the means was tested against the critical difference at 5 % level of significance [11]. AXEL software was used for analyze the recorded data.

Results and Discussion

Physicochemical Properties

Acidity of ber powder

The experimental data for changes in acidity are shown in **Table 1** and ANOVA values are shown in **Tables 2** and **3**. Acidity of ber powder samples decreased with storage period. It is also found that acidity of KMS treated samples is higher than that of treated with Sodium benzoate and untreated samples. It is also showed that the acidity of samples packed in glass jars is higher as compared to the LDPE pouch after storage of 120 days. The decrease in acidity during storage was in conformity with the finding of [12] in dehydrated ber. [13] reported a decrease in acid content of mango powder during storage at room temperature. They also reported heavy leaching losses in acidity during blanching in 'Totapuri' and seedlings of mango. This decrease in acidity could be attributed to the bio-conversion of acids to sugars.

Table 1 Change in Acidity of the samples of dehydrated ber powder under green house drying method

Acidity (g/100g)						
Storage Period (days)	**LDPE**			**Glass Jar**		
	UT	**KMS**	**SB**	**UT**	**KMS**	**SB**
0	1.27	1.30	1.17	1.27	1.30	1.17
30	1.20	1.23	1.13	1.18	1.23	1.12
60	1.08	1.11	1.06	1.12	1.14	1.10
90	1.03	1.05	1.00	1.05	1.09	1.01
120	0.93	1.01	0.96	0.96	1.02	0.98
UT=Untreated, KMS= Potassium Metabisulphite, SB= Sodium Benzoate						

Table 2 ANOVA for the change in acidity under green house drying method in LDPE

Source	**D.F.**	**S.S**	**M.S.**	**F-Cal**	**Significance**		
Replications	4	0.01				CD	0.055
Treatment	2	0.15	0.08	54.75	0.000021	SE (d)	0.024
Error	8	0.01	0.00			SE (m)	0.017
Total	14	0.18				CV	3.379

Table 3 ANOVA for the change in acidity under green house drying method in glass jars

Source	**D.F.**	**S.S**	**M.S.**	**F-Cal**	**Significance**		
Replications	4	0.01				CD	0.061
Treatment	2	0.12	0.06	34.72	0.000114	SE (d)	0.026
Error	8	0.01	0.00			SE (m)	0.019
Total	14	0.15				CD	0.061

pH of ber powder

The experimental data for changes in pH are shown in **Table 4** and ANOVA values are shown in **Tables 5** and **6**. Results revealed that the pH of samples increased after 30, 60, 90 and 120 days of storage period in case of all samples. Similar pattern of decreasing trend was reported by [14] Reason behind that the increases pH is due to decreases acidity. However, this increase was more pronounced in case of samples packed in LDPE as compared to glass jars. The pH is more increase at storage period in LDPE packaging material samples as compared to glass packaging material samples because of production of more acids in glass jar as compared to LDPE packaging material because of higher population of these microorganisms. As a result of imperfect sealing of cap this would have allowed ingress of oxygen for their growth and activity.

Optical density of ber powder

The experimental data for changes in browning index are shown in **Table 7** and ANOVA values are shown in **Tables 8** and **9**. Data were taken for browning index after a time interval of 30, 60, 90 and 120 days of storage period indicated that in case of all pretreatments, the values of browning index increased. The increase in optical density during storage was in conformity with the finding of [15] in Indian gooseberry powder. The increase in browning

index were found highest for samples packed in LDPE packaging material as compared to glass jars. The probable reason may be attributed to higher rate of maillard non-enzymatic browning reaction which would have occur among organic acids [10] produced in higher amount in these samples.

Table 4 Change in pH of the samples of dehydrated ber powder under green house drying method

pH						
Storage Period (days)	**LDPE**			**Glass Jar**		
	UT	**KMS**	**SB**	**UT**	**KMS**	**SB**
0	4.49	4.39	4.37	4.49	4.39	4.37
30	4.53	4.46	4.44	4.54	4.48	4.44
60	4.61	4.58	4.56	4.56	4.54	4.53
90	4.66	4.62	4.62	4.62	4.60	4.58
120	4.69	4.64	4.67	4.66	4.61	4.65

Table 5 ANOVA for the change in pH under green house drying method in LDPE

Source	**D.F.**	**S.S**	**M.S.**	**F-Cal**	**Significance**		
Replications	4	0.01				CD	0.101
Treatment	2	0.10	0.05	11.03	0.005018	SE (d)	0.043
Error	8	0.04	0.00			SE (m)	0.030
Total	14	0.15				CV	1.490

Table 6 ANOVA for the change in pH under green house drying method in glass jars

Source	**D.F.**	**S.S**	**M.S.**	**F-Cal**	**Significance**		
Replications	4	0.01				CD	0.089
Treatment	2	0.07	0.03	9.49	0.007732	SE (d)	0.038
Error	8	0.03	0.00			SE (m)	0.027
Total	14	0.11				CV	1.328

Table 7 Change in optical density of the samples of dehydrated ber powder under green house drying method

Optical Density						
Storage Period (days)	**LDPE**			**Glass Jar**		
	UT	**KMS**	**SB**	**UT**	**KMS**	**SB**
0	0.067	0.060	0.064	0.067	0.060	0.064
30	0.071	0.062	0.065	0.071	0.062	0.064
60	0.074	0.067	0.068	0.073	0.065	0.066
90	0.079	0.070	0.072	0.077	0.069	0.069
120	0.081	0.072	0.075	0.078	0.070	0.072

Table 8 ANOVA for the change in optical density under green house drying method in LDPE

Source	**D.F.**	**S.S**	**M.S.**	**F-Cal**	**Significance**		
Replications	4	0.00				CD	0.001
Treatment	2	0.00	0.00	3.57	0.077837	SE (d)	0.003
Error	8	0.00	0.00			SE (m)	0.002
Total	14	0.00				CD	0.001

Table 9 ANOVA for the change in optical density under green house drying method in glass jars

Source	**D.F.**	**S.S**	**M.S.**	**F-Cal**	**Significance**		
Replications	4	0.00				CD	0.001
Treatment	2	0.00	0.00	1.99	0.198425	SE (d)	0.003
Error	8	0.00	0.00			SE (m)	0.002
Total	14	0.00				CV	7.937

Ascorbic acid of ber powder

The experimental data for changes in Vitamin-C content are shown in **Table 10** and ANOVA values are shown in **Tables 11** and **12**. Vitamin-C content of all ber powder samples with different pre-treatments decreases invariably after storage period of 30, 60, 90 and 120 days. The reason behind this is the ascorbic acid content decreased during storage due to oxidation of ascorbic acid to dehyroascorbic acid. This is due to oxidation or exposure of atmosphere oxygen. The loss of Vitamin-C is more in samples packed in LDPE packaging material as compared to glass jars. It is also found that samples which are pre-treated with KMS had maximum Vitamin-C content as compared to other treated samples.

Total soluble solids of ber powder

The experimental data changes in total soluble solids (TSS °Brix) are showed in **Table 13** and ANOVA values are shown in **Tables 14** and **15**. Results show that for all samples the total soluble solids increases with storage period. Similar pattern of increasing trend was reported by [16]. It is also found that the samples treated with KMS had higher total soluble solids followed by treated with SB and untreated samples. Total soluble solids of samples packed in glass jars were found to be more increasing as compared to samples packed in LDPE after 120 days of storage period.

Table 10 Change in Vitamin C of the samples of dehydrated ber powder under green house drying method

Vitamin C (mg/100g)						
Storage Period (days)	**LDPE**			**Glass Jar**		
	UT	**KMS**	**SB**	**UT**	**KMS**	**SB**
0	31.30	34.00	32.20	31.30	34.00	32.20
30	30.10	31.15	31.85	30.20	33.25	31.92
60	29.05	31.05	29.75	29.05	31.09	29.98
90	27.80	30.45	28.45	27.85	30.90	28.70
120	26.45	28.20	26.85	26.68	28.85	27.00

Table 11 ANOVA for the change in Vitamin C under green house drying method in LDPE

Source	**D.F.**	**S.S**	**M.S.**	**F-Cal**	**Significance**		
Replications	4	12.13				CD	2.136
Treatment	2	33.67	16.84	8.09	0.011968	SE (d)	0.912
Error	8	16.64	2.08			SE (m)	0.645
Total	14	62.44				CV	4.822

Table 12 ANOVA for the change in Vitamin C under green house drying method in glass jars

Source	**D.F.**	**S.S**	**M.S.**	**F-Cal**	**Significance**		
Replications	4	7.61				CD	2.533
Treatment	2	35.78	17.89	6.12	0.024437	SE (d)	1.082
Error	8	23.40	2.92			SE (m)	0.765
Total	14	66.79				CV	5.663

Table 13 Change in total soluble solids of the samples of dehydrated ber powder under green house drying method

Total soluble solids (^{0}Brix)						
Storage Period (days)	**LDPE**			**Glass Jar**		
	UT	**KMS**	**SB**	**UT**	**KMS**	**SB**
0	17.10	17.30	17.21	17.10	17.30	17.21
30	18.19	18.37	18.27	18.25	18.35	18.41
60	20.21	20.42	20.29	20.37	20.55	20.47
90	22.24	22.44	22.34	22.42	22.59	22.52
120	23.30	23.45	23.40	23.48	23.61	23.56

Table 14 ANOVA for the change in total soluble solids under green house drying method in LDPE

Source	D.F.	S.S	M.S.	F-Cal	Significance		
Replications	4	7.13				CD	0.966
Treatment	2	71.61	35.81	84.10	0.000004	SE (d)	0.413
Error	8	3.41	0.43			SE (m)	0.292
Total	14	82.15				CV	3.214

Table 15 ANOVA for the change in total soluble solid under green house drying method in glass jars

Source	D.F.	S.S	M.S.	F-Cal	Significance		
Replications	4	7.23				CD	0.979
Treatment	2	75.91	37.95	86.91	0.000004	SE (d)	0.418
Error	8	3.49	0.44			SE (m)	0.296
Total	14	86.63				CV	3.237

Conclusion

It was concluded that Acidity of ber powder samples decreased with storage period. It is also found that acidity of KMS treated samples is higher than that of treated with Sodium benzoate and untreated samples. Data were taken for browning index after a time interval of 30, 60, 90 and 120 days of storage period indicated that in case of all pretreatments, the values of browning index increased. Vitamin-C content of all ber powder samples with different pre-treatments decreases invariably after storage period of 30, 60, 90 and 120 days. Vitamin-C content of all ber powder samples with different pre-treatments decreases invariably after storage period of 30, 60, 90 and 120 days. The loss of Vitamin-C is more in samples packed in LDPE packaging material as compared to glass jars. It is also found that samples which are pre-treated with KMS had maximum Vitamin-C content as compared to other treated samples.

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