Indian J.Dryland Agric. Res. & Dev. 2012 27(1) : 78-83

Effect of Storage on Chemical Parameters of Dehydrated Ber (*Zizyphus mauritiana* Lamk.)

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ABSTRACT : A study was conducted to assess the effect of storage on chemical parameters of dehydrated ber prepared by various treatments and drying methods. Dehydrated ber was prepared by subjecting the ber fruit to different pretreatments *viz*. blanching in boiling water for six minutes to check enzyme activity followed by one per cent potassium meta-bisulphite (KMS) dip for five minutes, sulphur fumigation for two hours @ 3.5 g kg^{-1} fruit and then drying by sun and oven methods. Moisture content of dried ber was maintained at about 14 per cent. The product was analyzed at an interval of two months upto six months of storage. An increasing trend was observed in reducing sugar, total sugar, tannin and ash whereas moisture and acidity showed a decreasing trend. After six months of storage, on the basis of sensory evaluation in oven dried method, no preservative + sulphur treated fruit (7.27) was found to be the best followed by no preservative + potassium meta-bisulphite (KMS) treated fruit (7.03).

Key words : Ber, dehyration, sun drying, oven drying, shelf life

Introduction

Ber (*Zizyphus mauritiana* Lamk.) is one of the important minor fruits of arid zone. It is a fruit of Indian origin, which finds a place in the ancient Indian scriptures (Pareek and Vashistha 1983). Ber is a hardy fruit tree and can grow well under wide range of soils and climatic conditions. It also exists in wild grooves which are wide spread in the warmer parts of India, Pakistan, Bangladesh, Srilanka, Central to Southern Africa and in Northern parts of Australia. The fruit is getting great impetus as a commercial crop in the North-Indian states of Punjab, Haryana, Rajasthan and rainfed subtropics of Jammu & Kashmir because of its potential for high yields and excellent economic returns to the growers. Total area under ber cultivation in India is around 20 thousand hectares with the production of 169828.8 Mt. The recent statistics of Jammu reveals that it occupies 4552 ha of land with a production of 6078 mt (Anonymous, 2006). The peak season for harvesting of ber in Jammu is mid March to mid April. Being a slack season for other kinds of fruits, ber sells readily at remunerative prices. With increased production of particular fruit in a season there is a glut in the market and the farmer is in loss due to low market price for his produce. Considering this and the fast increasing area under ber cultivation with high yielding varieties, methods of drying technology need to be developed to regulate price of fresh fruit. Drying of ber is an old method of preservation but product obtained may get spoiled due to adverse climatic pest conditions, infestation, animal and human interference. Although, newer drying techniques are developed for most of the fruits, air drying is still followed because of its simplicity and cost effectiveness. However, major problems with air drying are, considerable shrinkage caused by cell collapse following the loss of water, poor rehydration characteristics of the dried product and the unfavourable changes in colour, flavour, texture and nutritive value. To address these problems artificial dehydration technique is suggested. To improve the dehydration characteristics of the fruits a number of pre-drying treatments have been suggested.

Materials and Methods

Fully mature, golden yellow coloured fruits of ber variety '*Umran'* were purchased from the Vijaypur nursery, Department of Horticulture, Jammu located about 40 km N-E of Jammu. Fruits were transported to

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the pilot plant, Division of Post Harvest Technology, SKUAST-Jammu for dehydration of ber. The washed fruit was subjected to different pretreatments like blanching in boiling water for six minutes, Potassium metabisulphite (KMS) dip (one percent for five minutes) and sulphur fumigation @ 3.5 g kg^{-1} of fruit and their combinations. The treated fruits were divided into two lots, the one was dried in sun (33.2^{0}C) and the another was dried in oven at 55±2^{0}C. The dried fruits were packed in 250 g food grade jars and were stored at room temperature (20-40^{0}C) for a period of six months (May-October) and analyzed at interval of two months for

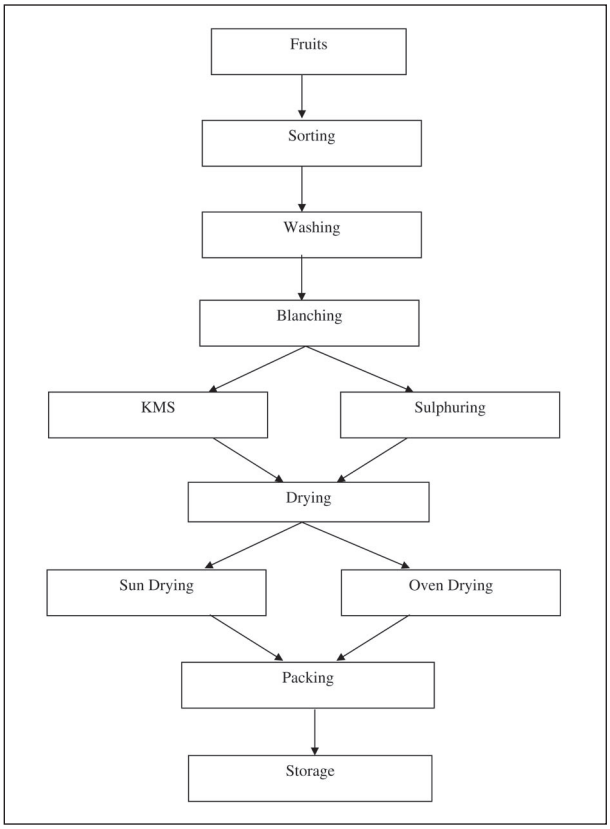

Fig. 1: Steps involved in dehydration of ber fruits.

chemical characteristics using standard methods (Ranganna, 1986 and AOAC, 1990). The data were analyzed statistically using three factor factorial completely randomized design (Gomez and Gomez, 1984).

The details of the treatment are as follows: T_1: No blanching + no preservative + sun drying, T_2: No blanching + sulphuring + sun drying, T_3: No blanching + KMS + sun drying, T_4: Blanching + no preservative + sun drying, T_5: Blanching + sulphuring + sun drying, T_6: Blanching + KMS + sun drying, T_7: No blanching + no preservative + oven drying, T_8: No blanching + sulphuring + oven drying, T_9: No blanching + KMS + oven drying, T_{10}: Blanching + no preservative + oven drying, T_{11}: Blanching + sulphuring + oven drying and T_{12}: Blanching + KMS + oven drying.

Results and Discussion

Sugars

A significant increase in reducing and total sugars content was observed during storage of dehydrated ber (Table 1). After two months of storage, no blanching + sulphuring + oven drying registered the maximum sugar content (24.71 %) whereas, no blanching + no preservative + sun drying registered the lowest reducing sugars content (24.17 %). After six months of storage, in oven drying method, the highest reducing sugars content (27.88 %) was recorded with no blanching + sulphuring which was followed by no blanching + KMS, blanching + sulphuring and blanching + KMS. In sun drying method, maximum reducing sugars were found in no blanching + sulphuring (27.58 %) while minimum reducing sugars content (27.36 %) was recorded in no blanching + no preservative treatment. Moreover, the interaction effects of blanching, preservative and drying methods were found to be significant at 5% level of significance upto only 4 months of storage period. The improvement in reducing sugars content was attributed to the gradual inversion of non-reducing sugars depending upon the length of storage time and temperature of the product. All the treatments showed a significant increase in reducing sugars during storage of six months and similar results have been obtained by Rao and Roy (1980) in dehydrated mango pulp, Mehta *et al.* (1982) in pineapple rings, Vaghani and Chundawat (1986) in Sapota, and Kumar (1990) in papaya.

In sun drying method, no blanching + no preservative recorded maximum total sugars content (64.17 %) after two months of storage period followed by no blanching + sulphuring, no blanching + KMS, blanching + sulphuring and blanching + KMS treatments. Blanching + no preservative treatment recorded the lowest value (62.48 %) of total sugars. However, in oven drying method, no blanching + no preservative recorded the maximum total sugars content (65.61 %) while as

Table 1 : Effect of different pre-drying treatments, drying methods and storage period on per cent reducing and total sugars, tannin and ash of dehydrated ber fruits

Treatments			Reducing and Total Sugars (%)* Storage periods (months)				Tannin and Ash (mg/100 g)** Storage periods (months)			
Drying methods	Pre-treatments		0	2	4	6	0	2	4	6
Sun drying	No Blanching	No Preservative	23.28 (63.36)*	24.17 (64.17)	25.28 (64.89)	27.36 (65.68)	1.35 (3.73)**	1.40 (3.82)	1.46 (3.87)	1.50 (3.93)
	No Blanching	Sulphuring	22.97 (62.04)	24.60 (63.67)	25.57 (65.23)	27.58 (66.59)	1.46 (3.23)	1.52 (3.31)	1.55 (3.37)	1.58 (3.42)
	No Blanching	KMS	22.82 (61.78)	24.55 (63.45)	25.54 (64.99)	27.50 (66.34)	1.38 (3.03)	1.46 (3.11)	1.50 (3.24)	1.55 (3.28)
	Blanching	No Preservative	22.72 (60.24)	24.42 (62.48)	25.50 (63.28)	27.50 (65.36)	1.34 (2.72)	1.39 (2.80)	1.44 (2.86)	1.49 (2.92)
	Blanching	Sulphuring	22.80 (60.73)	24.52 (62.86)	25.52 (63.58)	27.48 (65.46)	1.39 (3.00)	1.44 (3.08)	1.49 (3.16)	1.51 (3.26)
	Blanching	KMS	22.75 (60.74)	24.50 (62.85)	25.51 (63.57)	27.46 (65.42)	1.38 (2.98)	1.42 (3.08)	1.48 (3.18)	1.51 (2.87)
Oven drying	No Blanching	No Preservative	23.84 (64.88)	24.46 (65.61)	25.56 (66.38)	27.64 (67.09)	1.44 (3.78)	1.46 (3.89)	1.50 (3.97)	1.52 (4.00)
	No Blanching	Sulphuring	23.58 (63.64)	24.71 (65.17)	25.68 (66.67)	27.88 (67.94)	1.54 (3.26)	1.55 (3.38)	1.58 (3.45)	1.60 (3.48)
	No Blanching	KMS	23.54 (62.39)	24.58 (63.95)	25.74 (65.45)	27.74 (66.69)	1.47 (3.20)	1.50 (3.32)	1.55 (3.40)	1.58 (3.35)
	Blanching	No Preservative	23.38 (61.24)	24.50 (63.38)	25.56 (64.18)	27.62 (66.46)	1.38 (2.80)	1.41 (2.88)	1.46 (2.96)	1.50 (3.05)
	Blanching	Sulphuring	23.42 (61.46)	24.54 (63.56)	25.63 (64.28)	27.72 (66.58)	1.42 (3.04)	1.49 (3.10)	1.54 (3.18)	1.54 (3.28)
	Blanching	KMS	23.40 (61.45)	24.55 (63.54)	25.60 (64.26)	27.68 (66.53)	1.41 (3.02)	1.48 (3.12)	1.52 (3.20)	1.53 (3.24)
CD (P=0.05)										
Interaction effect										
Blanching× Drying			0.02 (0.02)	0.03 (0.01)	0.01 (0.02)	0.05 (0.01)	0.01 (0.02)	NS (0.01)	0.01 (0.01)	NS (0.16)
Blanching× Preservative			0.02 (0.02)	0.03 (0.01)	0.02 (0.02)	0.06 (0.01)	0.01(0.02)	0.02(0.02)	NS (0.02)	0.02(0.19)
Preservative× Drying			0.02(0.02)	0.03(0.01)	0.02 (0.02)	0.06 (0.01)	NS (0.02)	NS (0.02)	NS (0.02)	NS (0.19)
Blanching× Preservative× Drying			0.03 (0.03)	0.05 (0.02)	0.02 (0.03)	NS (0.02)	NS (0.03)	0.02 (0.03)	NS (0.02)	NS (0.27)

* Figures in parentheses shows the values of total sugar,** Figures in parenthesis shows the values of ash

blanching + no preservative recorded the minimum total sugars content. After six months of storage period the highest total sugars content was found in no blanching + sulphuring treatment in sun drying method while as in oven drying method, no blanching + sulphuring treatment recorded the highest total sugars content. Similarly, the lowest total sugars content was recorded in blanching + no preservative treatments of sun and oven drying methods. There was a significant increase in total sugars content during storage irrespective of different treatments. And all the treatments differed significantly at 5% level of significance as far as interaction between blanching, preservative and drying methods was concerned. Similar increase in total sugars was been reported by Pawar *et al.* (1992), Mali (1997) and Waskar *et al.* (2003) in dried fig fruits.

Tannin and Ash

During storage, the tannin content as tannic acid, increased in both the drying methods (Table 1). An increase in tannin content was observed in no blanching + no preservative, no blanching + sulphuring, no blanching + KMS, blanching + no preservatives, blanching + sulphuring and blanching + KMS. The tannin content was increased from lowest initial levels during storage in both the methods of drying. The overall mean effect of different preservatives, blanching treatment and drying methods also showed an increasing trend in tannin content during storage. A significant difference was observed among these treatments. Increase in tannin content was also reported by Tripathi *et al.* (1988) in dehydrated aonla and Mehta (1995) when aonla fruit was sundried as well as ovendried.

Similarly, the ash content also increased significantly in all the stored products irrespective of different drying methods. A significant difference was observed between the interactions of preservatives, blanching treatments and drying methods. An increasing trend in ash content was also observed while comparing the overall mean effects of different preservatives, blanching and drying methods during storage. Increase in ash content is reported by Waskar *et al.* (2003) in dried fig. Pawar *et al.* (1992) and Mali (1997) reported a gradual increase in ash content in dried fig during storage.

Moisture content and acidity

After two months of storage, no blanching + sulphuring + oven drying treatment recorded highest moisture content closely followed by no blanching + KMS + oven drying treatment whereas blanching + no preservative + sun drying treatment recorded the lowest moisture content (Table 2). After four months of storage, no blanching + sulphuring + oven drying had the highest moisture content whereas blanching + no preservative + sun drying registered the lowest moisture content. Similarly, after six months of storage no blanching + sulphuring + oven drying treatment recorded the highest moisture content whereas no blanching + no preservative + sun drying recorded the lowest moisture content. However, non-significant differences have been observed in blanching, drying and preservative interactions. The decrease in moisture content might be due to the natural dehydration of product during storage at room temperature. These results were in accordance with those observed by Banga and Bawa (2002) in grated carrots and Pardeshi *et al.* (2001) in peas. Gadakh *et al.* (1999) reported that moisture content in ber decreased rapidly during initial stage of drying.

There was a gradual decline in titra - table acidity with the advancement of storage period (Table 3). Among the sun drying treatments the maximum titra-table acidity of 1.16 percent was found in no blanching + sulphuring and the minimum acidity content of 1.09 percent was observed in blanching + no preservative and in blanching + KMS treatments. Whereas, in oven drying method, minimum acidity content of 1.09 percent was recorded in blanching + KMS followed by 1.10, 1.13, 1.14, 1.16 and 1.17 percent in ascending order of preference after two months of storage. With the increase in storage period, percent, acidity decreased in the same fashion after 6 months of storage. The interaction between blanching, preservative, drying and their combinations were found non-significant during storage. The decrease in acidity during storage was in conformity with the findings of Khurdiya (1980) in dehydrated ber. Dabhade and Khedkar (1980) 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 2 : Effect of different pre-drying treatments, drying methods and storage on percent moisture, acidity and mean score evaluation of overall acceptability of dehydrated ber fruits

Treatments			Moisture and Acidity (%)* Storage periods (months)				Mean Score Evaluation Overall Acceptability Storage periods (months)			
Drying methods	**Pre-treatments**		**0**	**2**	**4**	**6**	**0**	**2**	**4**	**6**
Sun drying	No Blanching	No Preservative	14.00 (1.20)*	13.14 (1.15)	12.68 (1.11)	12.40 (1.11)	7.38	7.00	6.63	5.80
	No Blanching	Sulphuring	14.04 (1.18)	13.21 (1.16)	12.78 (1.10)	12.55 (1.06)	8.50	8.13	7.40	7.54
	No Blanching	KMS	14.03 (1.17)	13.19 (1.13)	12.66 (1.07)	12.57 (1.04)	8.30	7.97	7.23	6.00
	Blanching	No Preservative	14.01 (1.12)	12.64 (1.09)	12.64 (1.06)	12.45 (1.02)	7.87	7.54	6.90	6.13
	Blanching	Sulphuring	14.02 (1.14)	12.65 (1.10)	12.65 (1.08)	12.47 (1.05)	8.20	7.87	7.00	6.50
	Blanching	KMS	14.01 (1.14)	12.65 (1.09)	12.65 (1.07)	12.52 (1.06)	8.07	7.80	6.86	6.37
Oven drying	No Blanching	No Preservative	14.00 (1.22)	13.16 (1.17)	12.69 (1.14)	12.43 (1.11)	7.70	7.30	7.00	6.27
	No Blanching	Sulphuring	14.05 (1.20)	13.26 (1.16)	12.84 (1.11)	12.65 (1.07)	8.70	8.30	8.16	8.00
	No Blanching	KMS	14.04 (1.18)	13.22 (1.14)	12.69 (1.09)	12.62 (1.05)	8.50	8.16	7.60	7.58
	Blanching	No Preservative	14.02 (1.13)	13.16 (1.10)	12.68 (1.07)	12.48 (1.03)	8.10	8.06	7.30	6.60
	Blanching	Sulphuring	14.03 (1.16)	13.21 (1.13)	12.68 (1.09)	12.60 (1.06)	8.40	8.06	7.53	6.90
	Blanching	KMS	14.02 (1.15)	13.20 (1.09)	12.67 (1.08)	12.58 (1.07)	8.00	8.00	7.37	6.73
CD (P=0.05)										
Interaction effect										
Blanching× Drying			NS (NS)	0.01(NS)	NS (0.01)	NS (NS)	NS	NS	NS	NS
Blanching× Preservative			NS (NS)	0.01 (NS)	0.02 (0.01)	0.02 (0.02)	0.02	0.19	0.20	0.53
Preservative× Drying			NS (NS)	0.01(NS)	NS (NS)	0.02	0.02	NS	NS	NS
Blanching× Preservative× Drying			NS (NS)	NS (NS)	0.02(NS)	NS (NS)	0.23	NS	NS	NS

* Figure in parenthesis shows the value of acidity

Overall acceptability

The overall mean score of sun dried products were in the order of no blanching + sulphuring > no blanching + KMS > blanching + sulphuring > blanching + KMS > blanching + no preservative and no blanching + no preservative, while as in oven dried ber no blanching + sulphuring > no blanching + KMS > blanching + sulphuring > blanching + KMS > blanching + no preservative and > no blanching + no preservative after six months storage (Table 4). Overall acceptability of sun dried dehydrated ber showed a non-significant reduction in the mean score of 22.1 % in blanching + no preservative and minimum of 11.3 % in no blanching + sulphuring. Similarly, oven dried ber showed a reduction of maximum and minimum of 18.9 and 16.4 % in blanching + KMS and no blanching + sulphuring treatments, respectively. Similar reduction in overall acceptability had been reported by Singh (1992). The overall acceptability of the oven dried fruit recorded higher score than sun dried fruit because of less browning, shrinkage and hardening.

Conclusion

Oven dried ber fruits were rated better as compared to sun dried for their flavour and other sensory attributes. However, sulphuring + oven dried ber was scored the best.

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