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Processing and evaluation of osmodried mango slices – A micronutrient rich food

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SUMMARY :

Osmotic dehydration is a novel technique for the production of shelf stable, nutritious and tasty products. Mango is a fruit which is highly relished in both raw and processed form. Various studies have indicated that pretreatment of fruits prior to osmotic dehydration improved the quality of the product. Hence, an attempt was made to study the effect of various pretreatments in the quality characteristics of osmo dried fruits. Two varieties of mango namely Bangalora and Pairi were selected for the study. The fruits were washed, peeled, destoned and cut to slices. The slices were given four pretreatments *viz.,* soaking the fruit slices in a solution of citric acid, citric acid + KMS, ascorbic acid and ascorbic acid + KMS for 30 min. After pretreatment the fruit slices were soaked in the osmotic agent (sugar syrup) for 18 h followed by dehydration, cooling and packing. The dried fruit slices were packed in metallised polypropylene packs and subjected to shelf-life studies for a period of 180 days. Analysis of the physio-chemical qualities, microbial and sensory qualities of the fruit slices during storage, indicated that the osmo dried fruit samples pretreated with ascorbic acid +KMS and citric acid + KMS had retained highly acceptable qualities.

KEY WORDS : Mango, Pretreatment, Osmotic agent, Dehydration

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Mango known as "King of Asiatic fruits", originated in India is admired all over the world. In area of production and nutritive value no other fruit can compete with it. Fruits are perishable, seasonal and region specific. They are sometimes wasted in large quantities due to the absence of facilities and know how for proper handling, storage, distribution and marketing. Hence, fruit processing becomes critical as this would mop up surpluses at farm level and ensure fair price and also make them available at reasonable price for the consumer all through the year. Osmotic dehydration is a novel technique for the production of shelf stable, nutritious and tasty products. Osmo dried fruits serve as an excellent snack food and are very handy. These can

also be used in bakery products as food adjuncts. Moreover, dried fruits are nutritious as they are highly concentrated sources of sugar, vitamins and minerals (Shah *et al*., 2000). Generally the technology of fruit processing is determined by the properties of the raw material and the quality to be maintained. Studies of Amitabh *et al*. (2000); Sudhagar (2001); Vijayakumar (2002) and Gupta *et al*. (2002) have indicated that pretreatment of such as blanching or soaking in a solution containing citric acid or KMS improved the quality of osmo dried mango, papaya and pear. Hence, the present investigation was undertaken with the objective to study the effect of pretreatment on the nutritional, microbial and sensory quality of osmo dried fruit slices before and after storage.

EXPERIMENTAL METHODS

Two varieties of mango *viz*., Bangalora (V_1) and Pairi (V_2) were purchased from the local market. The other ingredients namely sugar, food grade citric acid, ascorbic acid, potassium meta bisulphite were purchased from the local stores. All the chemicals and glasswares used in the study were of standard companies (Merck and Borosil).

Fresh firm, about to ripe fruits of uniform size and shape without any blemishes were selected,washed, peeled, destoned and cut into slices (6 x 2 cm).

The following pretreatments were imposed.

T_1 Citric acid (0.5%)

T_2 Citric acid (0.4%) + KMS (0.1%)

T_3 Ascorbic acid solution (0.5%)

T_4 Ascorbic acid (0.4%) + KMS (0.1%).

For preparing the above solutions, the required chemicals were weighed and dissolved in the measured amount of water(1000 ml) and stirred. The solutions were filtered to remove any debris which would otherwise affect the quality of the product. The filtered solutions were used as soak solutions for pretreatments.

The sliced fruits were soaked in the respective solutions for a period of 30 minutes. The fruit slices that were not given any pretreatment served as control.

The proportion of ingredients used for the preparation of osmotic agent include sugar (600 g), water (400 ml), citric acid (10g) and KMS (100 mg).

Sugar was added to water and mixed thoroughly well. After adding sugar the contents were heated to 100 ^{0} C. Citric acid (3g) was added to sugar syrup (60^{o}Brix) while boiling to purify the sugar syrup. The brix of the syrup was checked using hand refractometer. The syrup was filtered through a clean muslin cloth and cooled to 50 ^{o} C.

The treated and control fruit slices were soaked in the osmotic agent separately. The fruit slices to osmotic agent ratio was 1:1. During the process of osmosis the temperature of the osmotic agent was maintained at 50^{o}C for the first two hours to facilitate effective osmosis. After 2 h the temperature of the osmotic agent was brought down to ambient condition. Citric acid (7 g) was added to the osmotic agent containing the fruit slice, followed by the addition of KMS(100 mg). The fruit slices were allowed to remain in the osmotic agent for 18 h.

After 18 h, the fruit slices were removed from the osmotic agent, arranged in trays and dried in a cabinet drier at 60^{O}C for 6 h and cooled before packing.

The dried fruit slices were surface coated with powdered sugar and packed in metallised polypropylene packs and stored at ambient conditions for shelf-life studies. The nutritional, microbial and sensory qualities were periodically analysed at regular intervals throughout the storage period of 180 days.

The following qualities of the stored osmo dried slices were periodically (once in 30 days) evaluated.

Moisture, TSS, acid content, reducing and total sugars, β-carotene, ascorbic acid and crude fibre were analysed using standard methods AOAC (2007). The total plate count was determined by serial dilution technique and plating method as given by Istavan Kiss (1974). The osmo dried fruit slices were assessed for colour, texture, flavour, taste and over all acceptability by a panel of 15 semi trained judges using nine point hedonic scale (Watts *et al*., 1989). The cost of preparation of the osmo dried mango slices were calculated using the fixed and the variable cost involved in the course of processing. The data obtained from two replications were subjected to statistical analysis by applying Completely Randomized Block Design (Gomez and Gomez, 1984).

EXPERIMENTAL FINDINGS AND ANALYSIS

The changes observed in the nutrient content of the osmo dried fruit slices during storage are presented in Table 1.

It could be inferred that the initial moisture content ranged from 15.70 to 16.90 for V_1 and 14.90 to 16.70 for

V_2 (g per 100g, respectively). After 180 days of storage a slight increase in moisture was observed in all the samples irrespective of the treatment and variety. Among the treatments the highest moisture level was observed in the To followed by T_1, T_3, T_2 and T_4 for both the varieties. The final moisture content ranged between 16.59 and 16.95 for V_1 and 15.83 and 16.75 (g per 100g for V_2, respectively). Statistically significant difference was noticed among the treatment, variety and storage period. Studies of Amitabh *et al*. (2000) indicated that the moisture content of osmo dried mango slices ranged from 11.00 to 13.99 which had increased from 11.65 to 14.29 with varied pretreatments.

The changes in the total soluble solids of the osmo dried fruit slices are presented in Table 1. There was no much difference in the TSS of the fruit slices within the treatment. However, significant differences were observed between the control and treatments and as well as within the varieties. Among the treatments the highest TSS was found in T_4 and lowest in T_1 irrespective of the variety. After 180 days of storage negligible loss of TSS occurred in the osmo dried slices. Vijayakumar (2002) reported that the TSS of osmo dried fruit slices to range between 62.5 and 65.7° Bx. He also stated that there was no much change in the TSS of the osmo dried mango slices during storage. The present investigation is in line with the above study.

A significant difference existed in the acid content among the treatments, varieties and storage period as it is evident from the Table 1. The highest acidity was exhibited by the samples treated with citric acid, followed by citric acid + KMS, ascorbic acid and ascorbic acid + KMS in both the varieties during the initial storage period. The acidity of the control samples were lesser than the treated samples irrespective of the variety. During storage a slight increase in the acidity was noted and the increase was more pronounced in T_0 and less in T_4. The final acidity of V_1 ranged from 0.681 to 0.869 and V_2 from 0.638 to 0.848 per cent, respectively. The osmodried mango slices had 0.45 and 1.37 per cent of acidity (Mishra and Tomar, 2000 and Amitabh *et al*., 2000). The values noted in the present study was more than the values reported by Mishra and Tomar (2000) and lesser than by Amitabh *et al.* (2000). This might be due to the variety and treatment used for the present study.

The total sugar content ranged from 60.85 to 62.19 g per 100 g initially. But after 180 days of storage the total sugar ranged from 60.00 to 61.52 g per 100 g for V_1. Similarly for V_2 the initial and final total sugars ranged from 62.50 to 63.52 and 63.08 to 63.48 g per 100 g, respectively. A significant difference was observed in the reduction of total sugars between the treatment, varieties

Table 1 : Quality characteristics of osmo dried mango during storage (per 100g)

Nutrients	Storage period	V_1					V_2					C.D. (P= 0.05)
		T_O	T_1	T_2	T_3	T_4	T_O	T_1	T_2	T_3	T_4	
Moisture(g)	Initial	15.70	16.00	16.80	16.40	16.90	14.90	16.00	16.55	16.38	16.70	0.31159**
	Final	16.59	16.90	16.90	16.78	16.95	15.83	16.25	16.60	16.42	16.75	
TSS (° Bx)	Initial	61.00	63.00	63.20	63.00	63.50	63.50	64.00	64.30	64.20	64.50	0.04438NS
	Final	60.80	62.50	63.20	63.00	63.00	63.55	64.50	64.30	64.20	64.50	
Acidity (%)	Initial	0.600	0.856	0.851	0.835	0.820	0.618	0.830	0.821	0.819	0.795	0.00107NS
	Final	0.618	0.869	0.826	0.845	0.822	0.638	0.848	0.834	0.832	0.805	
Total sugars (g)	Initial	60.85	61.48	62.00	61.73	62.19	62.50	63.28	63.45	63.38	63.52	0.02146**
	Final	60.00	61.13	61.85	61.52	62.08	62.28	63.08	63.38	63.23	63.48	
Reducing sugars (g)	Initial	12.30	15.15	15.36	15.25	15.58	13.25	16.60	16.83	16.71	16.85	0.21732**
	Final	13.08	15.48	15.62	15.50	15.73	14.73	17.03	16.98	17.12	16.93	
β carotene (µg)	Initial	1225	1720	1720	1800	1800	1136	1610	1610	1652	1652	0.19701**
	Final	985	1620	1635	1720	1740	835	1470	1510	1557	1580	
Ascorbic acid (mg)	Initial	8.25	9.00	9.40	11.00	11.63	6.07	7.20	7.31	9.38	9.43	0.00180**
	Final	7.68	8.94	9.31	10.96	11.56	5.43	7.12	7.20	9.33	9.34	
Crude fibre (g)	Initial	0.65	0.63	0.63	0.65	0.65	0.71	0.70	0.70	0.71	0.71	0.01806NS
	Final	0.64	0.62	0.63	0.64	0.64	0.64	0.69	0.70	0.69	0.71	

V_1- Bangalora., V_2- Pairi, T_0- Control, T_1- Citric acid, T_2- Citric acid + KMS, T_3- AA, T_4 – AA+ KMS NS- Non-significant

**indicate significance of value at P=0.05

and packaging materials. Amitabh *et al*. (2000) reported that the osmo dried mango slices had the total sugars in the range from 60 to 65 mg /100 g. They also observed a loss in the total sugars during storage. A similar trend was observed in the present study also.

Contrary to total sugars, there was a slight increase in the reducing sugars of the osmo dried mango slices during storage period. The increase was more in the control samples than in the treated ones. Of the treatments, T_4 showed the minimum increase followed by T_2, T_3 and T_1. The reducing sugar of V_2 was slightly more than V_1 during the initial storage period and same trend continued throughout the storage, which might be due to the varietal difference. The final reducing sugar content ranged from 13.08 to 15.73 for V_1 and 14.73 to 16.93 g per 100 g for V_2. The reducing sugar content of osmodried mango slices were 11.66 and 13.32 per cent (Mishra and Tomar, 2000) and 13.21 and 13.86 per cent (Vijayakumar,2002) before and after storage, respectively.

Osmo dried mango slices had an appreciable amount of β−carotene and the initial β−carotene ranged from 1225 to 1800 (V_1) and 1136 to 1652 (V_2). µ g per 100 g. A significant difference was noted in the β−carotene content between the control and the treatment. It was comparatively more in the treated samples irrespective of the varieties. This showed that pretreatment of fruit slices prior to osmo dehydration exert an influence in retention of β−carotene. During storage there was a reduction in the β−carotene and the reduction was more prominent in the control than treatment. Among the treatment samples T_4 showed the highest retention of β−carotene, while T_1 recorded the lowest retention. The final β−carotene content ranged from 985 to 1740 and 835 to 1580 µg per 100 g for V_1 and V_2, respectively. Vijayakumar (2002) indicated a reduction in the β−carotene content and reported the values ranged between 322.80 to 369.40 µg per 100 g as against the initial amount of 385 to 392.20 µg per 100 g.

Similar to β−carotene the pretreatments exerted a positive influence in the retention of ascorbic acid during processing of the osmo dried mango slices as seen from Table 1. The highest ascorbic acid was exhibited by T_4 (11.56 and 9.34) while the lowest was in T_0 (7.68 and 5.43 mg/ 100g) in both the varieties, which might be due to the difference in the pretreatments given. The same trend was maintained throughout the storage period. The ascorbic acid content after 180 days of storage ranged from 7.68 to 11.56 for V_1 and 5.43 to 9.34 mg per 100g for V_2, respectively. Vijayakumar (2002) had also reported a loss in ascorbic acid content during processing and storage of mango slices.

The initial crude fibre content for V_1 ranged from

Table 2 : Microbial load of mango during storage (cfu/ g)

Microbial load	Storage period	V_1					V_2				
		T_O	T_1	T_2	T_3	T_4	T_O	T_1	T_2	T_3	T_4
Bacteria × 10^{-6}	Initial	0	0	0	0	0	0	0	0	0	0
	Final	3.2	2.8	1.3	2.0	1.0	3.5	3.0	1.5	2.2	1.1
Fungi × 10^{-3}	Initial	0	0	0	0	0	0	0	0	0	0
	Final	1.2	1	0	1	0	1.3	1	0	1	0
Yeast× 10^{-2}	Initial	0	0	0	0	0	0	0	0	0	0
	Final	1	0.80	0	0.50	0	1	0.80	0	0.50	0

Table 3: Mean organoleptic scores of osmodried mango slices

Quality attributes	Storage period	V_1					V_2				
		T_O	T_1	T_2	T_3	T_4	T_O	T_1	T_2	T_3	T_4
Colour	Initial	8.0	8.0	9.0	8.5	9.0	8.0	8.0	9.0	8.0	9.0
	Final	7.0	7.5	8.8	8.0	8.9	7.0	7.3	8.6	7.8	8.8
Texture	Initial	8.0	8.5	9.0	8.5	9.0	8.0	8.5	9.0	8.5	9.0
	Final	7.2	8.0	8.8	8.1	8.8	7.0	7.8	8.6	8.0	8.7
Flavour	Initial	8.0	8.0	9.0	8.5	9.0	8.0	8.0	9.0	8.5	9.0
	Final	7.2	7.8	8.8	8.0	9.0	7.0	7.6	8.7	7.8	8.8
Taste	Initial	8.0	8.5	9.0	8.5	9.0	8.0	8.0	9.0	8.0	9.0
	Final	7.0	7.3	8.8	8.0	9.0	7.0.	7.5	8.5	7.2	9.0
Over all	Initial	8.0	8.0	9.0	8.5	9.0	8.0	8.0	9.0	8.5	9.0
acceptability	Final	7.0	7.5	9.0	8.0	9.0	7.0	7.5	9.0	8.0	9.0

0.63 to 0.65 and for V_2 ranged from 0.70 to 0.71 g per 100g. A non-significant difference was observed in the crude fibre between the treatments, varieties and storage period. During storage there was a slight reduction and the values ranged from 0.62 to 0.64 for V_1 and 0.64 to 0.71 for V_2 g per 100 g, respectively.

Table 2 gives information on the bacterial, fungal and yeast load of the osmo dried slices during storage. Initially there was no microbial load in all the treatments and varieties including the control. After 180 days of storage there was a slight increase in the bacterial load in all the samples, while no fungal and yeast colonies was found in T_4 and T_2 in both the varieties.

The mean organoleptic scores of the osmo dried mango slices is given in Table 3. During the initial storage period, the colour was bright yellow for the samples of T_1 to T_4 and dull yellow without browning for T_0 of V_1. For V_2 the colour of T_1 to T_4 was bright yellow with the red tinch and for T_0 it was dull yellow with a red tinch without browning. Among the treatments the samples of T_4 and T_2 obtained the maximum score for colour in both V_1 and V_2, which was maintained throughout the storage period. During storage there was a loss of the colour and a slight brown tinch appeared in the control samples in both the varieties. There was a reduction in the scores for colour during storage and the highest reduction was for T_0 and lowest in T_4 for both V_1 and V_2. The final values for colour ranged from 7.0 to 8.9 V_1 and 7.0 to 8.0 V_2. The treated osmo dried samples of both the varieties had soft and pliable texture which was highly acceptable, while the control samples were firm. During storage the highly acceptable texture was maintained only by the treated samples while the control samples became soggy irrespective of the variety. Of the treatments T_4 recorded the maximum score for texture as 8.8 (V_1) and 8.7 (V_2) after 180 days of storage. The highest scores for flavour and taste was obtained by T_4, T_2, T_3, T_1 and T_0 in both the varieties, which was maintained throughout the storage period. The samples of T_4 had highly acceptable mango flavour and sweet taste. The overall acceptability of the mango slices were of the order in which T_4V_1 was the highest followed by T_3V_1,T_4V_2, T_3V_2, T_2V_1, T_IV_1, T_2V_2, T_1V_2, T_0V_1 and T_0V_2 with the score ranging from 7.0 to 9.0 for V_1 and 7.0 to 9.0 for V_2, respectively. The results of the sensory evaluation revealed that osmo dried fruit slices of V_1 were more acceptable than V_2.

The unit cost of osmo dried mango slices (10 g) was Rs. 1.85, which was cheaper than sugar boiled confectioneries and chocolates.

Conclusion:

From the study it is concluded that Bangalora variety is more suitable for osmotic dehydration. Among the pretreatments, soaking of the fruit slices in a solution containing ascorbic acid + KMS and citric acid + KMS could be very effective in retaining the nutritional properties during storage. T he product scored highly acceptable sensory attributes.

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