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RESEARCH PAPER

Standardization of Pre-treatments for the Development of Intermediate Moisture Food Products from Papaya (*Carica papaya* L.)

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Abstract

In the present study, pre-treatments have been standardized for the preparation of intermediate moisture products from papaya *viz.* osmotically dried slices and candy. Out of various treatments tried, the pretreatment consisting of blanching of fruit slices for 1 minute with 0.2% citric acid followed by dipping in 0.2% KMS for 20 minutes was standardized. Osmotically dried papaya contained 5.6% moisture, 55°B TSS, 0.26% acidity, 16.4mg/100g ascorbic acid and 1395.46 µg/100g carotenoids whereas candied papaya contained 16.13% moisture, 46.8°B TSS, 0.12 % acidity, 16.5mg/100g ascorbic acid and 1543 mg /100gm carotenoids content. A slight increase in moisture and reducing sugar took place whereas decrease in total sugar, ascorbic acid and carotenoids was noticed during storage. The developed products remained shelf-stable for 6 months at ambient temperature with minimum changes in their physico-chemical and sensory attributes.

Keywords: Papaya, *Carica papaya* L., intermediate moisture foods, pre-treatments, osmotic dehydration

Papaya (*Carica papaya* L.), a member of the small family Caricaceae is cultivated in all the tropical and sub-tropical countries of the world. It is the fifth most important fruit crop in India with a production of 5639.30 thousand tons from an area of 133.36 thousand hectares (NHB, 2013). The commercial importance of fruit is due to its high nutritive and medicinal value being a rich source of antioxidants, carotenoids, vitamin C and vitamin B (Rajarathnam, 2010). Fruits provide plenty of soluble dietary fiber, which helps in the reduction of cholesterol and fats from the body and to get relief from constipation as well. Mineral composition of the papaya fruit mainly comprises of potassium and magnesium along with calcium, iron, manganese, phosphorus and zinc (Hardission *et al.* 2003). After ripening, the papaya fruit soften immediately leading to transportation losses up to 40 per cent, therefore fruit requires conversion into processed products, to ensure extended availability throughout the year. (Rajarathnam, 2010). But, perishable nature and flat odor of papaya limit its commercial processing, though different authors have reported its processing into various value added products *viz*. jam, jelly, beverages, dried products, etc. Further, osmotic drying help to improve some nutritional, organoleptic and functional properties of the fruit and vegetables (Sutar and Sutar, 2013). Enzymatic and oxidative browning is prevented

as the fruits pieces are surrounded by sugar, thus making it possible to retain colour (Chaudhari *et al.*, 1993). Moreover, use of various pretreatments prior to drying like blanching and chemical treatments with potassium metabisulphite, citric acid, etc. have been suggested by various authors for obtaining better quality dried products (Wiriya *et al.* 2009; Thakur *et al.* 2010; Gupta *et al.* 2011; Sharma *et al.* 2014). Therefore, the present study was undertaken to standardize various pre-treatments for the development of intermediate moisture products from papaya.

Materials and Methods

The studies were conducted in the Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan. Fully matured, firm and healthy fruits of papaya were selected for this study. Fruits were collected from the local market of Solan. Different value added products were prepared *viz.* osmotically dried papaya slices and papaya candy, using various pretreatments as detailed in Table 1.

Preparation of different intermediate moisture foods

1. ***Osmotically dried papaya slices:*** For the preparation of osmotically dried papaya slices, fruits were washed, peeled, seeds were removed and then, cut into slices followed by blanching (Lal *et al*., 1986). The slices were then, dipped in 70° Brix sugar syrup for overnight, drained-off and dried at a temperature of 50-55°C in a mechanical dehydrator. The unit operations used for preparation of osmotically dried papaya slices are illustrated in Fig. 1.

2. ***Papaya candy:*** Papaya candy was prepared by making cubes of fully ripened papaya according to standard procedure (Lal *et al.,* 1986). Various pretreatments were applied (Table 1) for optimization of best treatment. The unit operations used in the preparation of papaya candy are depicted in Fig. 1.

Analyses

Physico-chemical analysis: Fresh papaya fruit as well as different papaya products were analyzed for various physico-chemical and sensory parameters. Fruit length and width were recorded with vernier calipers while weight of the fruit was recorded by weighing the individual fruit in top pan balance. Parameters like moisture, ash, TSS, acidity, pectin, dehydration ratio, rehydration ratio, sugars (reducing and total sugars), ascorbic acid, carotenoid content and calcium were estimated as per the standard procedures (AOAC 1984; Ranganna, 1997), while, the fiber content was determined by the method given by Gould (1978).

Sensory analysis: Sensory quality parameters were determined by adopting a 9-point hedonic scale (1= dislike extremely and 9 = like extremely) as per standard procedure (Amerine *et al*. 1965).

Statistical Analysis: All the analytical parameters were recorded in triplicates and the mean values of each parameter were described. The data of quantitative estimation of biochemical characteristics were assessed by factorial CRD whereas the data pertaining to sensory evaluation were analyzed by RBD as described by Cochran and Cox (1967).

Results and Discussion

Proximate analysis of papaya fruits:

The general quality characters of papaya fruit used in this study are given in Table 1. The results revealed that length and diameter of fruit ranged from 20-23cm and 13.2-13.6 cm, respectively. The fruits weighed from 1.4-1.8 kg. It is evident from the data that papaya is rich in carotenoid (3304 μg/100g/) and vitamin C content (50.2 mg/100 g). The total soluble solids, total sugars and reducing sugars were recorded to be 9.6°B, 5.8% and 3.2%, respectively. However, the fruits contained meagre amount of acid content indicating its non-acidic nature (Table 1). Similar findings for various parameters of papaya were also reported in the literature (Othman, 2009; Rajarathnam, 2010).

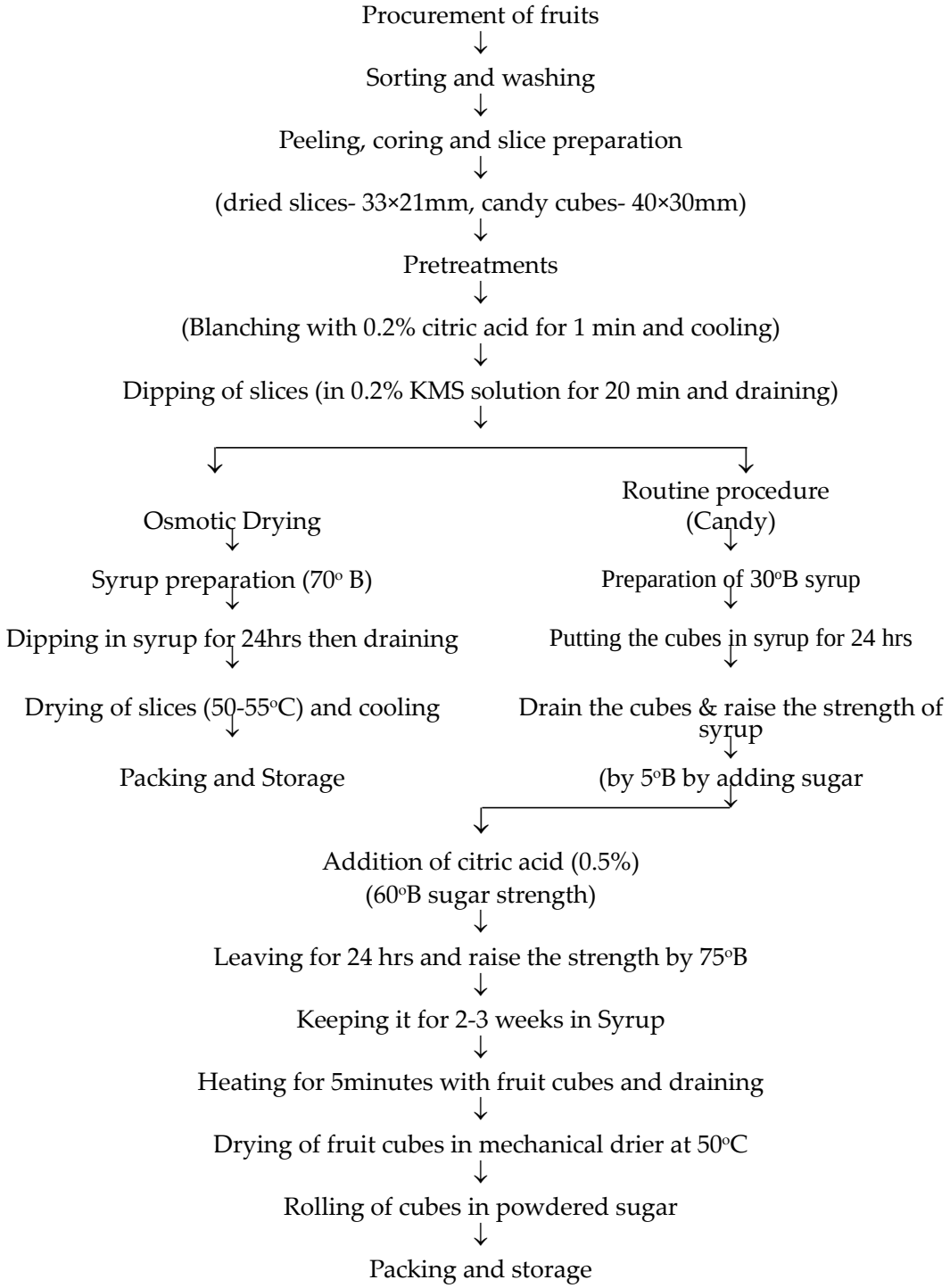

Fig. 1: Flow sheet for the preparation of osmotically dried papaya and candy

Table 1: Physico-chemical characteristics of fresh papaya fruit

Physical Parameters	Mean Values± SD
Weight, kg	1.5± 0.50
Fruit length, cm	22.5± 0.21
Fruit diameter, cm	13.8± 0.18
Moisture %	87.4 ± 1.05
Ash %	4.46 ± 0.08
TSS ^{o}B	9.6 ± 0.10
Acidity %	0.072 ± 0.02
Ascorbic acid (mg/100gm)	50.2 ± 2.56
Fiber %	1.05 ± 0.03
Reducing sugar %	3.2 ± 0.06
Total sugar %	5.8 ± 0.08
Calcium (mg/100gm)	33.8 ± 1.66
Carotenoids (µg/100gm)	3304 ± 2.6

Mean values are average of three replications

Sensory evaluation of intermediate moisture food products for optimization of pretreatments

Data presented in Fig. 2 and 3, pertaining to sensory evaluation of osmotically dried papaya slices and candy, revealed that the treatment T_2 (blanching of fruit slices for 1 minute with 0.2% citric acid followed by dipping in 0.2% KMS for 20 minutes) was found best amongst the various treatments due to higher score for appearance, taste and overall acceptability of the products. It might be due to the synergistic effect of blanching, citric acid dip, sulphiting, etc. (Sharma *et al.* 2014). Further, osmotic dehydration has been found in improving the at ractiveness of dried fruits and vegetables (Konopaca 2009; Sutar and Suta, 2013). Pretreatment like alkaline dip, sulphiting, freezing microbial treatment, high intensity electric field pulses, high pressure treatment and blanching have been at empted by various researchers to enhance the dehydration characteristics and minimize the adverse changes in the tissue during drying (Thonte and Patil 1988; Paull and Chen 1997; Rodrigues *et al.* 2003; Thakur *et al.* 2010; Priyadarshini 2013; Sharma *et al.* 2014).

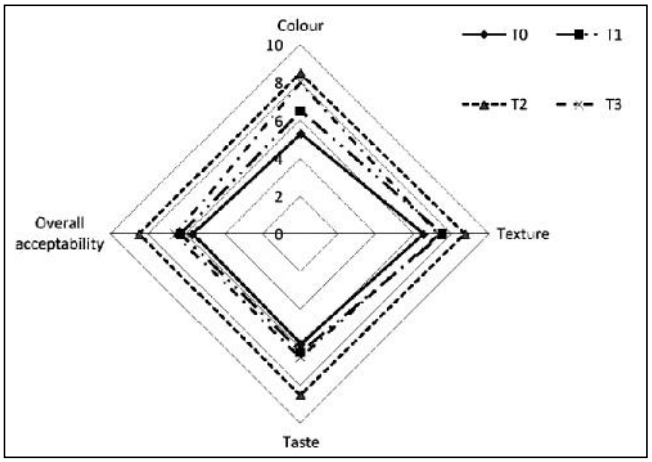

Fig. 2: Sensory evaluation of different osmotically dried papaya products

Treatments	Details
T0	Control (without any pretreatment)
T1	KMS dip (0.2%) for 20 minutes
T2	Blanching with Citric acid (0.2%) for one minute + KMS dip (0.2%) for 20 minutes
T3	Blanching with citric acid (0.5%) for one minute + KMS dip (0.5%) for 20 minutes

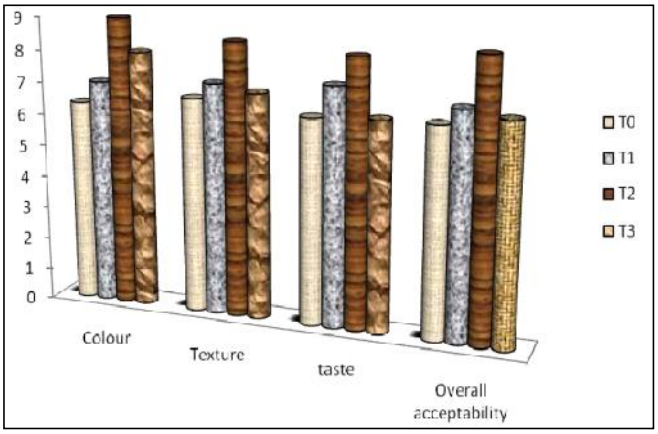

Fig. 3. Sensory evaluation of different papaya candied fruit

Treatments	Details
T0	Control (without any pretreatment)
T1	KMS dip (0.2%) for 20 minutes
T2	Blanching with Citric acid (0.2%) for one minute + KMS dip (0.2%) for 20 minutes
T3	Blanching with citric acid (0.5%) for one minute + KMS dip (0.5%) for 20 minutes

Effect of storage period on physicochemical characteristics of papaya based intermediate moisture food products

The osmotically dried papaya for its storage stability (Table 2) showed that at 0 day, the moisture content of product was found to be (5.96 %), ash content (0.88 %), TSS (55° B), total sugar (52.0 %), reducing sugar (17.2 %) and acidity (0.256 %). Drying causes great losses in vitamin C. Loss of vitamin and polyphenols after blanching treatment have also been reported by Selman (1994) and Sharma *et al.* (2014). The data also indicated that after 6 months of storage, the moisture content increased from an initial value of 5.96 % to 7.5 %, TSS decreased from 55°B to 54.1°B and reducing sugar increased from 17.5 % to 22.7%, however non-

Table 2: Effect of storage period on physicochemical characteristics of osmotically dried papaya and papaya candy

Parameters	Osmotically dried papaya					Candy				
	Storage period (months)					Storage period (months)				
	0	3	6	Mean	$CD_{0.05}$	0	3	6	Mean	$CD_{0.05}$
Moisture %	5.96	6.7	7.5	6.77	0.486	16.13	17.2	17.8	17.04	0.156
Ash %	0.88	0.80	0.76	0.813	NS	0.46	0.41	0.37	0.41	0.060
TSS °B	55.0	54.8	54.1	54.63	N	46.8	45.9	45.5	0.38	0.273
Acidity %	0.256	0.22	0.20	0.23	NS	0.123	0.11	0.19	0.14	NS
Ascorbic Acid (mg/100gm)	16.4	13.1	11.4	13.63	0.481	16.5	11.7	9.5	12.57	0.130
Fiber %	0.65	0.62	0.60	0.62	NS	0.44	0.38	0.31	0.38	0.068
Reducing sugar %	17.5	19.2	22.7	19.80	0.691	15.2	20.3	22.3	19.27	0.068
Total sugar %	52.0	49.9	47.2	49.70	NS	33.6	31.7	29.7	31.67	0.165
Calcium(mg/100gm	26.0	24.1	23.2	24.43	2.139	24.6	22.4	20.9	22.63	0.117
Carotenoids (µg/100gm)	1395.46	1129.4	1011.8	1178.9	2.139	1543	1128	899	1190	0.888

Table 3: Effect of storage period on sensory quality attributes of osmotically dried papaya and papaya candy

Parameters	Osmotically dried papaya					Candy				
	Storage period (months)					Storage period (months)				
	0	3	6	Mean	$CD_{0.05}$	0	3	6	Mean	$CD_{0.05}$
Color	9.0	8.1	7.5	8.20	0.355	9.0	8.2	8.0	8.40	0.586
Flavor	8.5	7.2	6.3	7.31	0.703	8.95	7.3	7.2	7.81	0.202
Taste	7.36	6.5	6.5	6.78	NS	7.5	7.6	7.3	7.46	NS
Texture	7.72	7.0	6.2	6.97	NS	7.72	7.5	7.0	7.40	NS
Overall acceptability	8.0	7.0	6.5	7.16	0.356	8.3	7.7	7.5	7.83	NS

significant variations were observed in ash, acidity, fiber and mineral contents of osmotically dried papaya. Similarly, data pertaining to storage stability of papaya candy (Table 2) revealed that af er 6 months of storage, the moisture content increased from an initial value of 16.13 to 17.8%, TSS decreased from 46.8 °B to 45.5 °B but reducing sugar increased from 15.2 % to 22.3 %. However non-significant variations were observed in ash, acidity, fiber and mineral contents of osmotically dried papaya. Further, as expected, a great loss in vitamin C content as well as in cartoenoid content took place during storage. Similar results have also been reported by Sharma *et al.* (2014).

The data of sensory quality at ributes for osmotically dried papaya and candy (Table 3) showed that though the scores for color, flavor, taste, texture and overall acceptability of dried papaya were decreased during storage at ambient condition but the products were rated "*liked very much*" even af er 6 months storage. Gupta *et al*. (2011) reported that there was variation in the color of amla shreds among different treatments. The colors of shreds blanched with 0.3% KMS was bet er (Light and green) which could be preferred for further industrial uses as compared to raw and other treated shreds. The reaction associated with color change during drying follow zero order reaction kinetics. Similar effects of pre-treatments on sensory quality at ributes have also been reported by Thonte and Patil (1988), Paul and Chen (1997), Rodrigues *et al.* (2003), Rai and Singh (2008), Konopaca (2009), Othman (2009) and Sharma *et al.* (2014) in different fruits and vegetables.

Conclusion

Conclusively, it emerges out that the best quality intermediate moisture products *i.e.* osmotically dried papaya and candy can be prepared from papaya using pretreatments consisting of blanching of fruit slices/cubes for 1 min with 0.2% citric acid, followed by immediate cooling and dipping in 0.2% KMS for 20 min. The developed products were shelf-stable for a period of 6 months at ambient temperature without an appreciable adverse changes in physico-chemical as well as sensory quality characteristics of the dried products.

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