

## Original Research Article

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## Standardization of Predrying Treatments for the Production of Papaya Fruit Powder and Its Utilization in the Development of Instant *Halwa* Mix

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### ABSTRACT

#### Keywords

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Papaya fruit was used for the production of best quality powder by using low cost technology. Various treatments were standardized prior to drying of the shreds of papaya and among these treatment T<sub>2</sub> i.e. by steam blanching of shreds for 3 minutes and dipping in 0.2 per cent KMS followed by immediate cooling. The pre-treated shreds were then dried in mechanical dehydrator at 55±2 °C and then converted into powder by grinding in mixer cum grinder. The powder prepared by treatment T<sub>2</sub> had high β-carotene (4403.58 µg/100g) and ascorbic acid (55.48 mg/100g) content as compared to other pre-treatments. Further the powder was prepared by best selected pre-treatment and stored for six months. With increase in storage period of six months, there was very less degradation in nutritional components such as ascorbic acid (from 55.48 to 46.12 mg/100 g) and β-carotene (from 4400.73 to 3786.33 µg/100 g). After this the instant *halwa* mix was prepared by using papaya powder and sugar in a ratio of 1:1. It was found to have better nutritional as well as sensory attributes and was most acceptable by the panellist.

### Introduction

Papaya (*Carica papaya* L.) belongs to the family Caricaceae and is one of the most important fruit cultivated throughout the tropical and subtropical regions of the world (Saran *et al.*, 2014). It is a fruit with orange-red, yellow-green and yellow-orange peel and rich orange pulp. It is highly perishable in nature with limited shelf life. It is 4<sup>th</sup> major fruit after Banana, Mango and Citrus grown in India which occupies an area of 136.1 thousand hectare with production of 6107.8 thousand million tonne with productivity of 44.9 MT/ha. In Himachal Pradesh, papaya is

cultivated over an area of 0.23 thousand hectare with a production of 1.11 thousand metric ton and productivity of 4.91 metric ton/ha (Anon, 2017). Papaya is a powerhouse of nutrients consumed throughout the world. It is a rich source of three powerful antioxidant vitamin C, vitamin A and vitamin E and also rich in various minerals (magnesium and potassium), B vitamin (pantothenic acid and folate) and fiber (Aravind *et al.*, 2013). The fruit is an excellent source of β-carotene that prevents damage caused by free radicals that may cause some forms of cancer. It is reported that it helps in the prevention of diabetic and heart disease. Papaya lowers high cholesterol

levels as it is a good source of fiber. Papaya helps in the digestion of proteins as it is a rich source of proteolytic enzymes. The fruit is regarded as a remedy for abdominal disorders. Even papain-a digestive enzyme found in papaya is extracted, dried as a powder and used as an aid in digestion (Aravind *et al.*, 2013). At unripe stage, the fruit is consumed as a cooked vegetable where papaya is widely grown (Mano *et al.*, 2009). Ripe papaya is consumed as a fresh fruit and is also used to make various processed products like jam, jelly, marmalade, puree, wine, nectar, juice, frozen slices, mixed beverages, ice-cream, powder, baby food, cooked in pie, pickled, concentrated and candied items (Saran and Choudhary, 2013). In addition, dehydration processes may be an efficient alternative for fruit storage, because the reduction of water activity is related to the decline of chemical and enzymatic reactions responsible for the deterioration of foods. However, conversion of this excellent fruit into powder form could be useful not only to minimize the post-harvest losses but also to retain the nutritional qualities in the processed products. The dehydrated papaya powder can be used for preparation of many food product formulations such as ready to eat fruit based cereal products, ice cream flavours, instant soup cubes *etc.* Thus new processed food products from papaya are highly desirable. So the present study will be carried out with the objective to study the effect of various pre-treatments on quality of papaya powder and its storage quality evaluation for the development of instant *halwa* mix.

### **Materials and Methods**

The study was conducted in the Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan (HP), India. Fully matured, firm ripe and healthy fruits of papaya were collected from the local market for the

preparation of papaya powder. The fruits were washed, peeled and then seeds were removed. Grating of peeled fruit was done to obtain papaya shreds. Three different pre-treatment (Table 1) namely Control (T<sub>0</sub>), steam blanching of shreds for 3 minute then dipped in 0.1 per cent KMS for 30 minute followed by immediate cooling (T<sub>1</sub>) and steam blanching of shreds for 3 minute then dipped in 0.2 per cent KMS for 3 minutes followed by immediate cooling (T<sub>2</sub>) were given prior to dehydration (55±2°C in a mechanical dehydrator) of papaya shreds. After drying, dehydrated shreds were converted into papaya powder by grinding in mixer cum grinder.

### **Packaging and storage**

The best treatment on the basis of physico-chemical analysis was selected for further storage studies. The packed powder was stored for a period of six months and was analysed at different intervals as 0, 3 and 6 months.

### **Recipe for the preparation of instant *halwa* mix from papaya powder**

Instant *halwa* mix was prepared from papaya powder of best pre-treatment. Papaya powder and powdered sugar was mixed in a ratio of 1:1 and the contents were packed in polyethylene bags. For the preparation of 70 g of *halwa*, different ingredients like ghee (15g) and water (75ml) were mixed to instant papaya *halwa* mix (40g) and for garnishing of *halwa* the ingredients like cashew (7g) raisins (6g) and coconut powder (2g) were also added (Muzzaffar, 2006).

### **Physico-chemical and sensory analysis**

Fresh papaya fruit, papaya powder and the *halwa* prepared from instant papaya *halwa* mix were analyzed for various physico-chemical parameters as per standard

procedures. Papaya powder made by using different treatment were analyzed for chemical *viz*; moisture, ash, TSS, acidity, fiber and pectin, sugars (reducing and total sugars), ascorbic acid, carotenoids and for sensory attributes. The total soluble solids in the fruits were measured with the help of hand refractometer. Moisture, ash, titratable acidity, ascorbic acid,  $\beta$ -carotene and pectin were determined by methods given by Ranganna (2009) while fiber content was measured as per method given by Gould (1978). Water activity of papaya powder during storage was estimated by computer based digital water activity meter (HW<sub>3</sub> model, Rotronic International, Switzerland), where direct measurements were taken at room temperature. Sensory quality parameters were evaluated by adopting 9-point hedonic scale (1= dislike extremely and 9 = like extremely) as mentioned by Ranganna (2009).

### **Statistical analysis**

The data pertaining to chemical characteristics obtained in this study were subjected to statistical analysis using CRD while those of sensory quality with RBD.

## **Results and Discussion**

### **Physico-chemical characteristics of fresh papaya fruit**

The general quality characteristics of papaya fruit analyzed in this study is presented in Table 2. It is indicated that the length and width of fruit was  $24 \pm 1.00$  and  $12.29 \pm 1.26$  cm, respectively. The average fruit weight was  $2.1 \pm 0.36$  kg. The papaya fruit contained  $85.67 \pm 0.85$  per cent moisture,  $9 \pm 0.81$  °B TSS and  $0.057 \pm 0.001$  per cent acidity. The  $\beta$ -carotene, ascorbic acid and fiber content of the fruit was found to be  $4156.99 \pm 7.71$   $\mu\text{g}/100$  g,  $60.0 \pm 0.20$  mg/100 g and  $1.72 \pm 0.09$  per cent, respectively. Hence, it is evident from the data

that papaya fruits used in the study were rich in vitamin A and vitamin C. The values for other parameters are given in Table 2. Similar results were also reported by Othman (2009) with certain variations which could be due to season and varieties.

### **Chemical characteristics of papaya powder prepared with different pre-treatments**

Papaya powder prepared by treatment T<sub>2</sub> (Steam Blanching of papaya shreds for 3 minutes then dipped in 0.2 percent KMS for 30 minutes) was found best on the basis of chemical analysis. The  $\beta$ -carotene and ascorbic acid content of T<sub>2</sub> treatment was found to be  $4403.58$   $\mu\text{g}/100$  g and  $55.48$  mg/100 g, respectively, hence indicating the maximum retention of these parameters. The higher retention of these chemical parameters in treatment T<sub>2</sub> might be due to higher concentration of KMS that had an increased antioxidant activity to prevent oxidation of  $\beta$ -carotene and ascorbic acid during blanching and drying (Gulzar *et al.*, 2018). Bajaj *et al.*, (1993) have observed the effect of blanching of fenugreek leaves in different solution and reported that the use of sulphite pre-treatment increased the retention of ascorbic acid content in dried samples compared to non-pretreated samples. Retention of ascorbic acid in sulphited samples was higher not only compared to non-pretreated samples of fenugreek leaves but also the highest one when compared to all pre-treatment. Mousa *et al.*, (2004) also indicated in his study that the retention of vitamin C in brinjal slices increased with increasing of KMS concentration. Similar trend of results have been also observed by Kumar *et al.*, (2018) in carrot roundels and they reported pre-treatment comprising of steam blanching followed by 2000 ppm KMS dip for 60 minutes was found best for carrot roundels on the basis of sensory and physico-chemical properties of dried roundels (Table 3).

**Effect of storage on chemical characteristics of papaya powder**

Papaya powder from best selected pre-treatment (T<sub>2</sub>) was evaluated for various physico-chemical parameters on initial day and during storage of 6 months at different intervals (Table 4). The yield of papaya powder and drying time for papaya shreds were 7.5 per cent and 9 hours, respectively. The powder contained 8.30 per cent moisture, 52.15 °B TSS, 0.77 per cent acidity, 3.30 per cent reducing sugars, 40.97 per cent total sugars, 4400.73 µg/100 g β-carotene and 55.48 mg/100 g ascorbic acid content.

It has been observed during the storage study (Table 4) that with increase in storage period of papaya powder, there was increase in moisture content (from 8.30 to 9.82 %), TSS (from 52.15 to 52.80 °B), reducing sugars (from 3.3 to 5.13 %) and total sugars (from 40.97 to 42.40 %). However, decrease in ash (from 10.27 to 9.90 %), ascorbic acid (from 55.48 to 46.12 mg/100 g), β-carotene (from 4400.73 to 3786.33 µg/100 g) and pectin (from 1.87 to 1.77 %). Decrease in β-carotene content during the storage might be due to its degradation because of auto-oxidation (Hymavathi and Khader, 2005). The decline in β-carotene content may also be attributed to thermo-labile and photosensitive nature, isomerization and epoxide forming nature of carotene (Mir and Nath, 1993). Increased TSS content during storage might be due to

conversion of left over polysaccharides into soluble sugars. Total sugars and reducing sugars probably increased due to degradation of starch and other polysaccharides (such as pectin) that led to the formation of sugars. The loss of ascorbic acid may be attributed to heat and light sensitivity of the ascorbic acid (Devidek *et al.*, 1990). The values for fibre content remained same as that of at 0 day with slight change after 3 months. The decrease in pectin content of powder might be due to its breakdown into simple compounds with increase in storage period, thereby leading to increase in total and reducing sugars.

The water activity (a<sub>w</sub>) of powder was recorded to increase from 0.27 to 0.38 in papaya powder during 6 months of storage. This indicated that there was less free water in the powder available for biochemical reactions, which would be advantageous for a longer shelf-life. Food with a<sub>w</sub> of less than 0.6 is considered to be microbiologically stable, indicating no growth of spoilage organisms and pathogens (Betts *et al.*, 2006).

Based on the results, all a<sub>w</sub> values for both of the powders were lower than 0.6, therefore, it indicated that the powder samples were microbiologically stable. Our results are in conformity with Wong and Lim (2016). They reported decrease in β-carotene and increase in water activity as well as moisture content of papaya powder during 7 weeks storage in PET and ALP packaging material (Fig. 1 and 2).

**Table.1** Standardization of pre-treatments for the preparation papaya powder

Treatments	Papaya powder
T <sub>0</sub>	Papaya shreds +Without blanching+ drying (50-55°C)
T <sub>1</sub>	Papaya shreds + Steam Blanching for 3 minute+dipping in KMS solution (0.1%) for 30 minutes+ drying (50-55°C)
T <sub>2</sub>	Papaya shreds + Steam Blanching for 3 minute +dipping in KMS solution (0.2%) for 30 minutes+ drying (50-55°C)

**Table.2** Physico-chemical characteristics of fresh papaya fruit

Parameter	Mean ± SD
Weight (kg)	2.10 ± 0.36
Length (cm)	24.00 ± 1.00
Breadth (cm)	12.29 ± 1.26
Moisture (%)	85.67 ± 0.85
TSS (°Brix)	9.00 ± 0.81
Acidity (%)	0.057 ± 0.001
Ascorbic acid (mg/100 g)	60.0 ± 0.20
Fiber (%)	1.72 ± 0.09
Reducing sugars (%)	2.3 ± 0.16
Total sugars (%)	6.59 ± 0.13
β-carotene (µg/100 g)	4156.99 ± 1.52
Ash (%)	4.30 ± 0.16
Pectin (%)	0.81 ± 0.01

**Table.3** Chemical characteristics of papaya powder prepared with different pre-treatments

Parameters	Treatments			CD <sub>0.05</sub>
	T <sub>0</sub>	T <sub>1</sub>	T <sub>2</sub>	
Moisture (%)	8.70	8.53	8.30	0.176
TSS (°Brix)	47.00	50.30	52.15	0.178
Acidity (%)	0.76	0.79	0.82	0.025
Ascorbic Acid (mg/100 g)	41.95	51.75	55.48	1.949
Fibre (%)	0.90	0.94	0.90	0.029
Reducing sugars (%)	3.07	3.47	3.49	0.118
Total sugars (%)	40.97	43.17	42.40	1.144
β-carotene (µg/100 g)	2971.47	3803.47	4403.58	4.897
Ash (%)	9.46	9.80	10.27	0.225
Pectin (%)	1.40	1.63	1.90	0.078

**Table.4** Effect of ambient storage on the chemical composition of papaya powder

Parameters	Storage period			CD <sub>0.05</sub>
	0 month	3 months	6 months	
Moisture (%)	8.30	9.30	9.82	0.193
Water activity (a <sub>w</sub> )	0.27	0.32	0.38	0.005
Ash (%)	10.27	10.15	9.90	N/A
TSS (°Brix)	52.15	52.67	52.80	0.139
Pectin (%)	1.87	1.80	1.77	N/A
Acidity (%)	0.77	0.74	0.69	0.023
Ascorbic Acid (mg/100 g)	55.48	50.82	46.12	0.506
Fibre (%)	0.90	0.90	0.89	N/A
Reducing sugars (%)	3.30	4.50	5.13	0.378
Total sugars (%)	40.97	43.17	42.40	1.144
β-carotene (µg/100 g)	4400.73	4121.30	3786.33	0.438

**Table.5** Chemical composition of instant *Halwa* prepared from papaya powder

Parameter	Mean $\pm$ SD
Moisture (%)	50.00 $\pm$ 0.49
Ash (%)	2.72 $\pm$ 0.18
TSS ( $^{\circ}$ Brix)	67.33 $\pm$ 2.51
Pectin (%)	1.03 $\pm$ 0.15
Acidity (%)	0.67 $\pm$ 0.02
Ascorbic acid (mg/100g)	40.26 $\pm$ 0.20
Fiber (%)	0.43 $\pm$ 0.15
Reducing sugars (%)	13.30 $\pm$ 0.43
Total sugars (%)	45.00 $\pm$ 0.18
$\beta$ -carotene ( $\mu$ g/100 g)	2225.57 $\pm$ 3.75

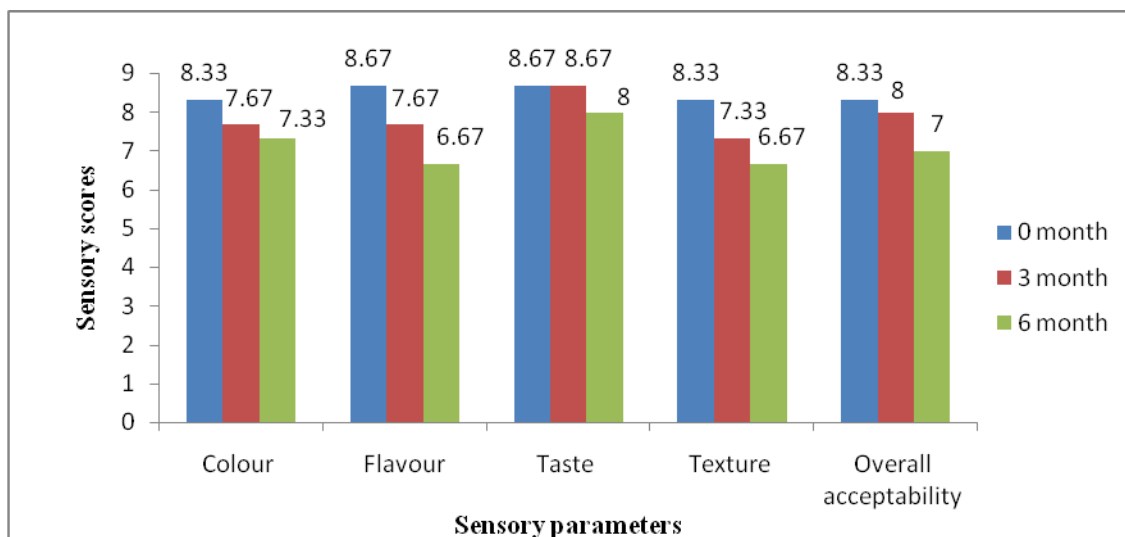
**Fig.1** (a) Papaya shreds after drying and prepared papaya powder (b) Papaya powder packed in polyethylene pouches and transferred in PET Jars



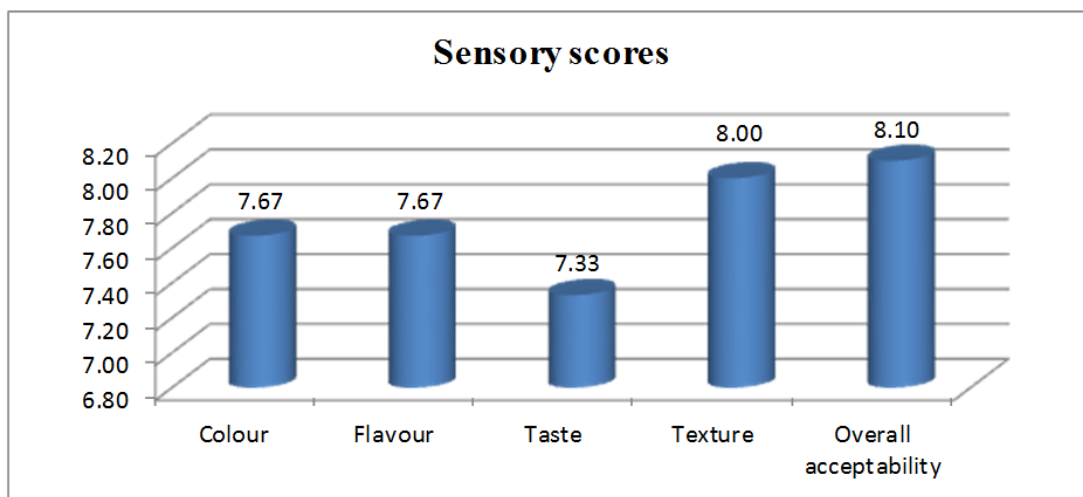
**Fig.2** Instant papaya *halwa* prepared from Instant *halwa* mix from papaya powder



**Fig.3** Effect of ambient storage on the sensory quality of papaya powder



**Fig.4** Sensory evaluation of Instant *Halwa* prepared from papaya powder



The data in Table 5 indicates the sensory quality attributes of papaya powder measured on 9-point hedonic scale for colour, flavour, taste, texture and overall acceptability. It was observed that with increase in storage period the quality attributes decreased but they were all above the acceptable limit.

The scores for colour, flavour, taste, texture and overall acceptability on initial day was 8.33, 8.67, 8.67, 8.33 and 8.33, respectively

which decreased to 7.33, 6.67, 8.00, 6.67 and 7.00, respectively after 6 months of storage. The decrease in colour scores might be due to non-enzymatic browning and degradation of  $\beta$ -carotene while the change in flavour and taste may be attributed to change in chemical composition of the powder during storage.

Overall changes in all the sensory parameters might have contributed to change in overall acceptability of papaya powder.

### Instant *halwa* from papaya powder

The best papaya powder treatment (T<sub>2</sub>) was utilized for the preparation of papaya instant *halwa* after the storage of powder for 6 months. The prepared papaya *halwa* was analysed for various chemical (Table 5) and sensory (Figure 3) parameters.

Instant *halwa* prepared from papaya powder with best treatment T<sub>2</sub> (Steam blanching for 3 minutes+ dipping in 0.2% KMS for 30 minutes) contained 50 ± 0.49 per cent moisture, 67.33 ± 2.51 °B TSS, 0.67 ± 0.02 per cent acidity, 13.30 ± 0.43 per cent reducing sugars, 45 ± 0.18 per cent total sugars, 2225.57 ± 3.75 µg/100g of β-carotene and 40.26 ± 0.20 mg/100g ascorbic acid. The sensory quality attribute measured on 9-point hedonic scale for instant *halwa* prepared showed that colour, flavour, taste, texture and overall acceptability rating was 7.67, 7.67, 7.33, 8.00, and 8.10, respectively (Fig. 4).

It was concluded that papaya fruit can be used for the production of best quality powder. The treatment T<sub>2</sub> (Steam blanching for 3 minutes+ dipping in 0.2% KMS for 30 minutes, followed by immediate cooling) was found best on the basis of the physico-chemical and sensory characteristics. Henceforth, this pre-treatment is recommended to preserve the nutritional value of the papaya fruit powder as the nutrient content did not degrade after the fruit thin shreds were mechanical dried into powders. The products were shelf stable for a period of six months at ambient temperature. Further various instant products like instant *halwa* can be prepared from dried powder.

On the basis of sensory evaluation, instant *halwa* which was prepared from papaya powder stored for 6 months was also liked by the panellist, because quality of the dried powder was retained better during 6 months of ambient storage condition.

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