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Nutritionally Effective Papaya Powder Prepared by Tray Drying Technique

Sudhirkumar B. Vinzuda[1*], Neeraj Seth[2], Pankaj Gupta[3], K. R. Jethva[4], K. L. Dabhi[5], & F. G. Sayyad[6]

[1*]Ph. D. Scholar, Department of Processing & Food Engineering, College of Agricultural Engineering & Technology, Anand Agricultural University, GODHRA-389001, GUJARAT, INDIA, Mob. /WhatsApp: 9327364132 (WhatsApp)
Email: sudhirvinzuda@aau.in,
[2]Professor, Department of Processing & Food Engineering, College of Agricultural Engineering & Technology, Anand Agricultural University, GODHRA, GUJARAT, INDIA
[3]Professor & HOD, Department of Farm Machinery & Power Engineering, College of Agricultural Engineering & Technology, Anand Agricultural University GODHRA, GUJARAT, INDIA
[4]Associate Professor, Department of Food Plant Operations, College of Food Processing Technology & Bio-Energy, Anand Agricultural University, ANAND, GUJARAT, INDIA
[5]Associate Professor, Department of Farm Machinery & Power Engineering, College of Agricultural Engineering & Technology, Anand Agricultural University, GODHRA, GUJARAT, INDIA
[6]Associate Professor & Unit Head, Polytechnic in Agricultural Engineering, Anand Agricultural University, DAHOD, GUJARAT, INDIA

Abstract:
Papaya (*Carica papaya* L.) is a tropical fruit having importance due to its high nutritional and medicinal value. The papaya, papaw or pawpaw is the fruit of the plant *Carica papaya*, in the genus of Carica. The botanical name of papaya, is *Carica papaya* L. belong to the family Caricaceae. Using standardized optimum conditions of the foaming pulp of papaya, it can be achieved nutritionally effective papaya powder prepared by tray dryer. The standardized optimum condition of foamed papaya pulp *viz.* foam expansion, foam density and foam stability was observed as 74.76%, 0.512 g/cc and 98%, respectively. The highest score of the biochemical parameters *viz.* total sugar, reducing sugar, β-carotene, ascorbic acid, crude protein and moisture content was found at 70ºC of drying temperature and 9 mm of drying thickness in tray dried papaya powder.
Keywords: Tray dryer, Total sugar, β-carotene, Ascorbic acid, Crude protein, Moisture content, Nutraceutical

I. INTRODUCTION

Papaya (*Carica papaya* L.) is a fruit important because of its medicinal and high nutritional value. The papaya, papaw or pawpaw is the fruit of the plant *Carica papaya*, in the genus of Carica. The botanical name of papaya, is *Carica papaya* L. belong to the family *Caricaceae*. It is native to the tropics of the Americas, and was first cultivated in Mexico several centuries before the emergence of the Mesoamerican classic cultures. Papaya is the most economically important fruit in the *Caricaceae* family. Brazil stands out as the world's biggest producer, it supplying 25% of the world demand. The other followed by Mexico at 14%, Nigeria at 11%, India & Indonesia at 10%. The other papaya growing nation includes Venezuela, China, Peru, Congo and Ethiopia (Shashikalabai *et al.,* 2016).

Papaya is a rich source of three powerful antioxidant vitamin C, vitamin A and vitamin E. Papaya is well known for its exceptional medicinal and nutritional properties throughout the world. The Papaya is the most economically important fruit in the *Caricaceae* family. India is the second largest producer of fruits and vegetables in the world after China. As per the latest estimates by Central Institute of Post Harvest Engineering and Technology (CIPHET), Ludhiana, the wastage of fresh horticultural produce is upto 18% due to poor post harvest management practices (Shashikalabai *et al.,* 2016). Therefore, there is huge scope for processing of fruits and vegetables. This wastage can be easily prevented by adopting various stages of collection to processing and preservations of perishables. At the same time, there is market glut during harvesting season and farmers are forced to sell their produce at throw away prices, sometimes, which will not meet even harvesting cost of the produce. So, food processing industries can help avoid market glut. Nowadays, pulp converted into powder form using different drying techniques.

The value added products from papaya are papaya juice, papaya snacks/desserts, papaya milk shake, papaya medicine, ice-cream, jam, jellies, papaya candy and papaya pickles (Milind & Gurditta, 2011). Total quantity of production of the papaya depends on processing methods, the products like papaya squash, papaya sauce, papaya toffee, puree, tutti-fruity, freeze dried chunk, dried rolls, dried slices and papaya nectar are prepared (Shashikalabai *et al.,* 2016).

Papaya (*Carica papaya* L.) is well known for its nutritional and medicinal properties throughout the world. Papaya is considered as a nutraceutical fruit due to its multifaceted medicinal properties. The prominent medicinal properties of papaya include uterotonic, anti-hypertensive, diuretic, free radical scavenging activities, anti-tumor, anti-fungal, anti-bacterial, anti-fertility and wound-healing (Milind & Gurditta, 2011). It protects against skin damage, wrinkling, sagging and other sagging skin damage and reduce these signs of damage. Papaya fruit help with digestion and reduce inflammation. It potentially protects against prostate cancer. It promotes long life.

Therefore, development of low cost processing and packaging methodologies to produce shelf-stable and convenience products are the prime requirements of present competitive market (Sarker *et al.,* 2014). Fruits and vegetables contain nearly 70 to 95% of moisture, which make them highly perishable. Papaya presents high moisture content 85-90% (Shashikalabai *et al.,* 2016). Water removal is the main task while preserving the food, reducing the moisture contents to a level, which allows safe storage over an extended period of time (Lenart, 1996).

In local and foreign markets, the demand for dehydrated papaya is rising rapidly, with the majority of it being utilized to prepare convenience foods. Because of this, better methods of processing and preserving this crucial crop need to be developed. From this perspective, drying is an acceptable approach since it reduces the volume and transportation costs, allowing for the delivery of a high-quality product at an affordable price. Therefore, farmers will be able to maximize their harvest and production. Therefore, drying is the most appropriate and relatively inexpensive approach to meet the needs (Mozumder *et al.,* 2012).

Among various methods of preservation, foam mat drying is an alternate technique to mitigate the post-harvest losses and enhance keeping quality. It is one of the simple techniques of drying where liquid concentrate is transformed into suitable foam with the help of foaming agents. Foam mat drying is an appropriate method for heat sensitive and thick materials as compared to drum and spray drying due to better reconstitution property of final dried material. By using the foam mat papaya pulp, nutritionally effective papaya powder was prepared by the conducting the various experiments as per showing in Table 1. The different experiments were performed using the tray drying technique.

II. MATERIALS AND METHODS

It was procured Greenberry variety of papaya from the local market of the Anand, Gujarat, India, for conducting the experiments of different foaming properties of papaya pulp. The experimental design was used FCRD (Factorial Completely Randomized Design) for the experiments. On the basis of receiving the optimized condition of foaming of papaya pulp, I have conducted the experiments as per the design FCRD (Factorial Completely Randomized Design), which is showing in Table 1. Experiment were conducted as per various drying temperature *viz.* 60, 65 & 70ºC with drying thickness of 3, 6 & 9 mm, display in the Table 1. Then, I have done experiments as per its standard protocols and methods for the tray foam mat dried papaya powder. Now, it will be discussing for nutritionally effective papaya powder prepared by tray drying technique.

Experimental Design for Tray Drying Technique

Whey protein isolate (WPI) was selected as foaming agent and glycerol monostearate (GMS) was selected as stabilizer. The optimum condition obtained for the foam mat drying *viz.* concentration of whey protein isolate 10% (w/w), concentration of glycerol monostearate 4% (w/w) and whipping time 20 min, at maximum desirability, was selected for the conducting the experiments of tray drying technique.

Following set of experiments were planned and conducted for tray drying experiments.

A. Independent variables		
First factor	:	Drying temperature (I) with three levels I_1 : 60°C I_2 : 65°C I_3 : 70°C
Second factor	:	Drying thickness (P) of three levels
		P_1 : 3 mm P_2 : 6 mm P_3 : 9 mm
Treatment combinations	:	9
No. of repetitions	:	3
Experimental design	:	Factorial Completely Randomized Design (FCRD)

Table 1: Treatments combinations for tray drying of foamed sample

Treatment	Combinations	Details
T_1	I_1P_1	60°C drying temperature + 3 mm drying thickness
T_2	I_1P_2	60°C drying temperature + 6 mm drying thickness
T_3	I_1P_3	60°C drying temperature + 9 mm drying thickness
T_4	I_2P_1	65°C drying temperature + 3 mm drying thickness
T_5	I_2P_2	65°C drying temperature + 6 mm drying thickness
T_6	I_2P_3	65°C drying temperature + 9 mm drying thickness
T_7	I_3P_1	70°C drying temperature + 3 mm drying thickness

T_8	I_3P_2	70°C drying temperature + 6 mm drying thickness
T_9	I_3P_3	70°C drying temperature + 9 mm drying thickness

B. Dependent variables

Bio-chemical Parameters	:	Total sugar, reducing sugar,β-carotene, ascorbic acid, crude protein, pH & moisture content

Procedure

The foam mat tray dried papaya powder was prepared as per using the standardized optimum condition as per above mention. The different experiment was taken according to the Table 1, at different drying temperature with different drying thickness. The different biochemical parameters *viz.* total sugar, reducing sugar, β-carotene, ascorbic acid, crude protein, pH and moisture content was analyzed by standard procedure as the recommended by the researchers and scientists.

2.1 Determination of Total Sugar

Total sugars were determined using the phenol-sulphuric acid method as described by Dubois *et al.* (1956). Take 0.1 gram of sample was extracted with 10 mL of 80 % alcohol and incubated for 2 hrs. Followed by centrifuged at 10,000 rpm for 10 min. From that supernatant was taken as a sample. Analytical grade glucose was used as a standard. A 0.1 mL of sample was taken in another test tube and the volume was made up to 3 mL with distilled water, followed by the addition of 5 % phenol. After 3 min of incubation at room temperature, 5 mL of conc. H_2SO_4 was added; incubate 10 min at room temperature and 20 min in the cold water bath. Similarly, 0.5, 1.0, 1.5, 2.0 and 2.5 mL of the working glucose standard solution (0-100 µg) were pipetted into a series of tubes instead of samples. After the appearance of brown colour, absorbance was measured by spectrophotometer at 490 nm. Sugar content was determined by using the following formula,

$$\text{Total sugar (g/100 g)} = \frac{\text{Graph factor} \times \text{Reading} \times \text{Total vol.} \times 100 \times 10^{-6}}{\text{Taken vol.} \times \text{Sample wt.}} \quad \dots (1)$$

2.2 Determination of Reducing Sugar

Reducing sugars were estimated as a method suggested by Miller (1959). A 0.1 gram of sample extracted in 10 mL 80 % methanol. The supernatant was collected and used as a sample, Pipette out 0.1 to 0.2 aliquot from the sample extract and standard made from glucose working solution 20 to 100 µg take 0.5, 1.0, 1.5, 2.0 and 2.5 pipette out into a series of test tubes. 1 mL of alkaline copper tartrate reagent was added to each tube. All tubes were kept in boiling water for 10 min to cool them down. 1mL of arsenic-molybdic acid reagent was added to all the tubes. Volume was made to 10 mL with distilled water. Read the absorbance of blue colour by spectrophotometer at 540 nm after 10 min. The amount of reducing sugars was calculated in the samples.

$$\text{Reducing sugar (g/100 g)} = \frac{\text{Graph factor} \times \text{Reading} \times \text{Total vol.} \times 100 \times 10^{-6}}{\text{Taken vol.} \times \text{Sample wt.}} \quad \dots (2)$$

2.3 Determination of β-carotene

β-carotene was determined using method descried by Mishra & Gupta (1998). 0.1 gram of sample was weighed and dispersed it in 50 mL of water saturated n-butanol (n-butyl alcohol 6: water 2 v/v) to give a homogeneous suspension. Samples were mixed gently and allowed it to stand overnight (16 hours) at room temperature under dark. Again mixed and filtered using the filter paper (whatman no.1) into a 100 mL volumetric flask. Optical density of the clear filtrate was measured at 440 nm, using the spectrophotometer. In the following formula, we have taken molar extinction coefficient as per Beer- Lambert law equation. Unfiltered water-saturated n-butanol was used as a blank. β-carotene content was calculated as follows,

$$\beta - \text{carotene (mg/100 g)} = \frac{\text{Reading} \times \text{Total vol.} \times 100}{\text{Molar extinction coefficient} \times \text{Taken vol.} \times \text{Sample wt.} \quad \times 10} \quad \dots (3)$$

2.4 Determination of Ascorbic acid

Ascorbic acid was estimated using method reported by Ranganna (2000). Accordingly, 10 g of papaya powder was transferred to volumetric flask and volume was made up to 100 mL by adding 4% oxalic acid ($C_2H_2O_4$) solution. After

30 minutes, the suspension was filtered through whatman no.1 filter paper. From the filter 10 mL of aliquot was taken and titrated against standardized 2, 6-dichlorophenol indophenol dye solution. Titration was continued till the light pink colour persisted for 15 seconds. Initially, the dye solution was standardized by titrating against standard ascorbic acid solution. Ascorbic acid content was calculated using following equation,

$$\text{Ascorbic acid (mg/100 g)} = \frac{\text{Titre x Dye factor x Total vol. x 100}}{\text{Aliquot of extract taken for estimation x Sample wt.}} \quad \text{... (4)}$$

Dye solution was prepared using 50 mg of the 2, 6-dichlorophenol indophenol in approximately 150 mL of hot glass distilled water containing 42 mg of sodium bicarbonate. The distilled water added to make the volume to 200 mL. Then dye solution used for the titration.

2.5 Determination of Crude Protein

Total nitrogen content or crude protein from papaya powder was estimated by using the standard Micro kjeldahl method by AOAC (1970). The crude protein percentage was calculated after multiplying kjeldahl nitrogen by a conversion factor of 6.25. A 40 mg of papaya powder sample was taken in the glass digestion tubes. Add 1 gram catalyst mixture (99.0 g of K_2SO_4, 4.1 g of HgO and 0.8 g of $CuSO_4$) and 2 mL concentrated H_2SO_4 and were added to the tubes. Then the tubes were transferred on an electric burner for digestion until the solution is colourless. Thereafter 10 mL of double-distilled water followed by 10 mL of sodium hydroxide-sodium thiosulphate ($NaOH+Na_2S_2O_3$) solution was added to the digestion tubes because of which the whole solution turned black. 10 mL of 4% boric acid was added to a 250 mL conical flask, along with 2 drops of methyl-red-bromocresol green indicator. Then the digestion tube containing the solution was steam distilled in the kelplus machine and trapping the ammonia in the boric acid, causing the solution in the conical flask to turn green. This solution was titrated with 0.02 N H_2SO_4. The amount of total protein was calculated as,

$$\text{N (\%)} = \frac{(\text{mL of H2SO4 detrmination} - \text{mL blank}) \times \text{Normality} \times 14.007 \times 100}{\text{sample weight (mg)}} \quad \text{... (5)}$$

Crude protein (%) = % N x 6.25

2.6 Determination of pH

The pH is defined as logarithm of the reciprocal of hydrogen ion concentration in gram per litre. It is of importance as a measure of the active acidity which influences the flavour of a product and affects the processing requirements. The pH of papaya powder generally ranges between 4.0 to 6.0 indicating it is mildly acidic. The pH is defined as a negative logarithm to the base 10 of H+ ion activity of concentration. The pH can be measured directly using digital pH meter. Firstly, 10 g of sample was weighed followed by macerate with 100 mL of water, after that the mixture was to stand for 30 minutes and transferred to the supernatant in a beaker. Before measuring pH, the pH meter was calibrated with standard buffer solution (Ranganna, 2000).

2.7 Determination of Moisture Content

During experimental research, hot air oven (Make: NOVA Instruments Private. Ltd., Ahmedabad, India) (Plate 1) was used to determine the moisture content of the papaya pulp & papaya powder samples. Moisture content of the fresh papaya pulp sample was determined by taking representative triplicate samples. The moisture of each sample was computed.

Plate 1 Determination of moisture content in hot air oven

The papaya pulp samples were taken in the petridishes and kept into the hot air oven. The drying air temperature in the chamber was measured directly using thermocouple based temperature indicator provided in the unit. The papaya pulp samples were dried in oven at 105°C for 24 h in uncovered pre-weighed petridishes (Plate 1). After drying, petridishes were covered with a lid and cooled in desiccators containing silica gel before weighing (Ranganna, 2000). Moisture content of whole sample was calculated using the following expression

$$Moisture\,content, \%\,db = \frac{W_2 - W_3}{W_3 - W_1} \times 100 \qquad \text{... (6)}$$

$$Moisture\,content, \%\,wb = \frac{W_2 - W_3}{W_2 - W_1} \times 100 \qquad \text{... (7)}$$

III. Results and Discussion

Experimental Graphs of Biochemical Parameters of Tray Dried Papaya Powder

3.1 Total sugar of tray dried papaya powder

The total sugar of tray dried papaya powder varied from 22.20 to 49.76 g/100 g (Table 2). It can be observed from Fig. 1 that total sugar of tray dried papaya powder increased with increase in temperature and thickness. The maximum total sugar 49.76 g/100 g was found at 70°C with 9 mm thickness and minimum total sugar 22.20 g/100 g was found at 60°C with 3 mm thickness. The sugar content such as sucrose generally showed an increasing trend with increasing concentrations of different foaming agents. This increase can be attributed to the inherent sugar content of foaming agents that also contributed towards the total sugar content of the sample (Kadam *et al.,* 2011a). Similar increase in total sugar by using glycerol monostearate as a foaming agent in foam mat dried papaya powder (Shivani *et al.,* 2019). It can be observed from Table 3 that the effect of different drying temperature and thickness have a significant effect ($P<0.05$) on the total sugar in tray dried papaya powder and the interaction between drying temperature and thickness was also significant ($P<0.05$).

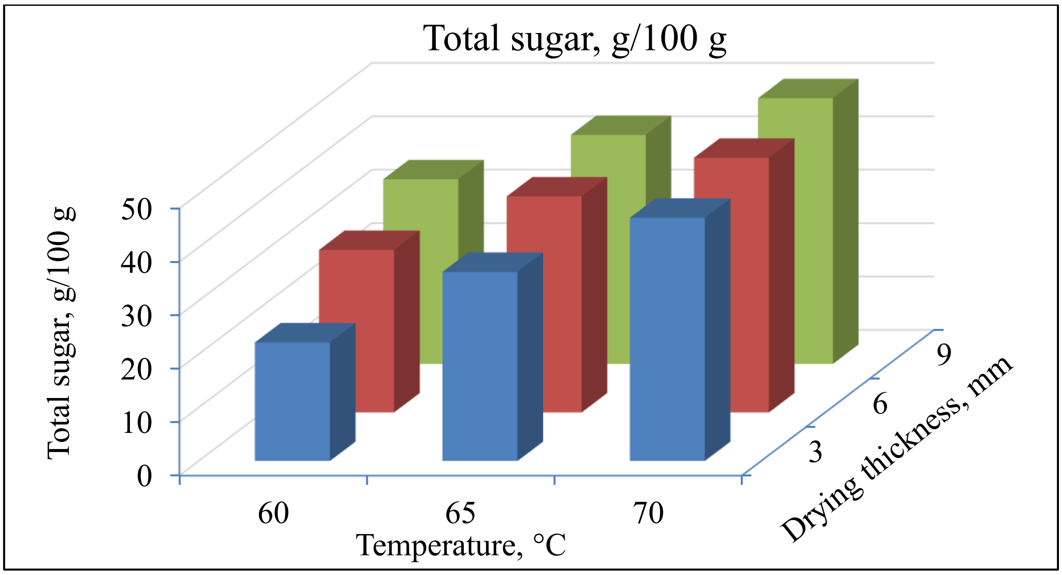

Fig. 1: Total sugar with respect to drying temperature and thickness

3.2 Reducing sugar of tray dried papaya powder

The reducing sugar of tray dried papaya powder varied from 16.99 to 41.43 g/100 g (Table 2). It can be seen from Fig. 2 that reducing sugar of tray dried papaya powder increased with increase in temperature and thickness. The maximum reducing sugar 41.43 g/100 g was found at 70°C with 9 mm thickness while minimum reducing sugar 16.99 g/100 g was found at 60°C with 3 mm thickness. The reducing sugar content such as glucose, fructose generally showed an increasing trend with increasing concentrations of different foaming agents. The increase in reducing sugars are attributed due to polysaccharides hydrolysis (Shivani *et al.,* 2020). It can be observed from Table 3 that the effect of different drying temperature and thickness have a significant effect ($P<0.05$) on the reducing sugar in tray dried papaya powder and the interaction between drying temperature and thickness was also significant ($P<0.05$).

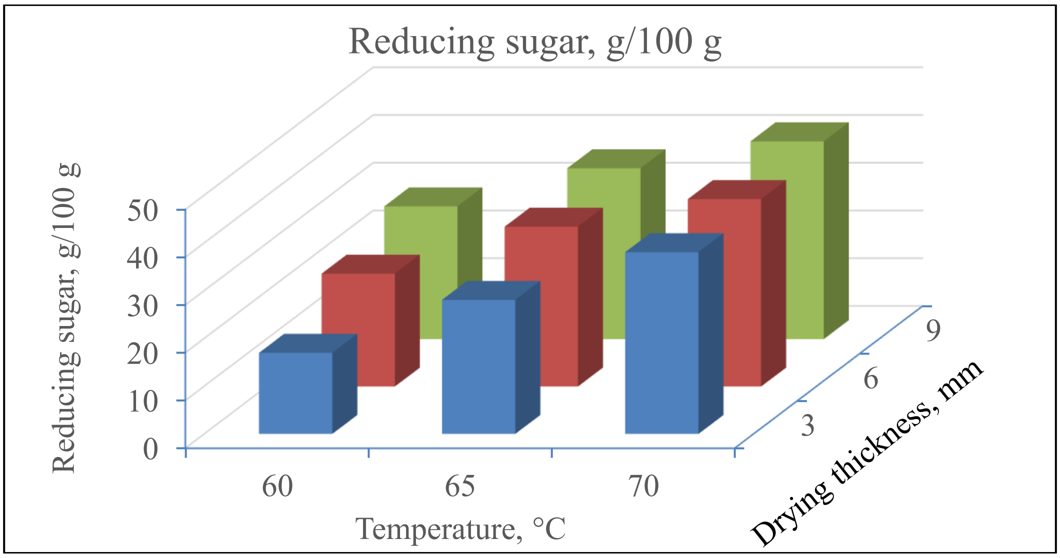

Fig. 2: Reducing sugar with respect to drying temperature and thickness

3.3 β-carotene of tray dried papaya powder

The β-carotene is a critical, high-value component in papaya powder, acting as a potent antioxidant. Due to the high bioavailability of carotenoids in papaya compared to other sources like carrots. β-carotene in papaya powder is highly efficient for promoting skin health, boosting immunity and maintaining vision (Kumar *et al.,* 2019).

The β-carotene of tray dried papaya powder varied from 11.11 to 19.34 mg/100 g (Table 2). It can be observed from Fig. 3 that β-carotene of tray dried papaya powder increased with increase in temperature and thickness. The maximum β-carotene 19.34 mg/100 g was found at 70°C with 9 mm thickness and minimum β-carotene 11.11 mg/100 g was found at 60°C with 3 mm thickness. The β-carotene was also observed by (Kandasamy *et al.,* 2012c) in the research work of foam mat drying of papaya pulp. It can be observed from Table 3 that the effect of different drying temperature and thickness have a significant effect ($P<0.05$) on the β-carotene in tray dried papaya powder and the interaction between drying temperature and thickness was also significant ($P<0.05$).

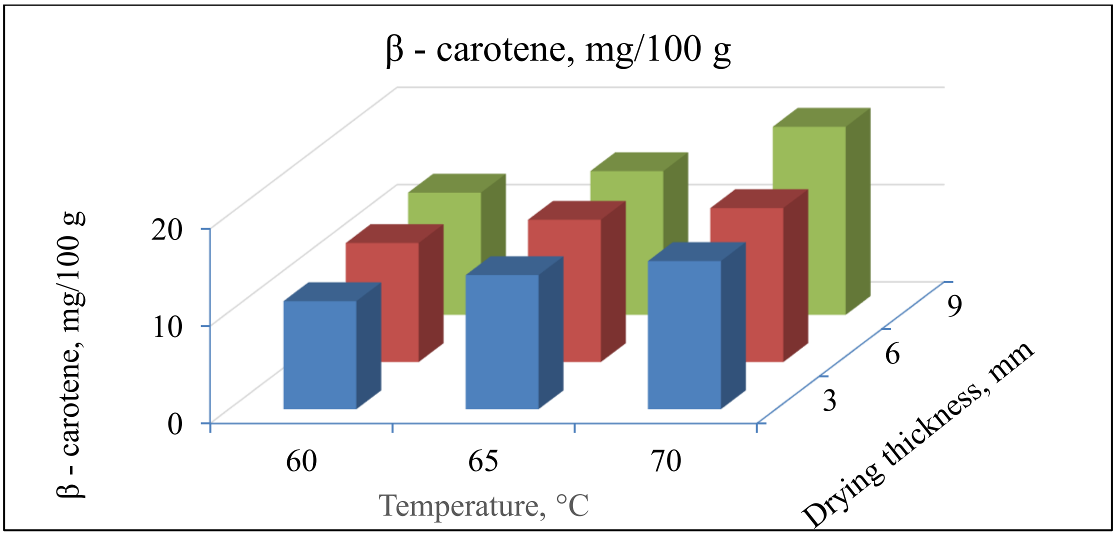

Fig. 3: β-carotene with respect to drying temperature and thickness

3.4 Ascorbic acid of tray dried papaya powder

The ascorbic acid of tray dried papaya powder ranged from 118.56 to 171.21 mg/100 g (Table 2). It can be observed from Fig. 4 that ascorbic acid of tray dried papaya powder decreased with increase in temperature and thickness. The maximum ascorbic acid 171.21 mg/100 g was found at 60°C with 3 mm thickness and minimum ascorbic acid 118.56 mg/100 g was found at 70°C with 9 mm thickness. Ascorbic acid is a heat sensitive vitamin. The decrease in the ascorbic acid content of dried powder could be attributed to its heat sensitive nature. Similar decline in ascorbic acid content was noticed in foam mat dried mandarin powder by (Kadam *et al.,* 2011a). Similar trend was also reported by Khodifad *et al.* (2017) that decrease in ascorbic acid with increase in temperature and thickness during the foam mat drying of custard apple. It was also observed by Dasgupta & Mohanapriya, 2019. It can be observed from Table 3 that the effect of different drying temperature and thickness have a significant effect ($P<0.05$) on the ascorbic acid in tray dried papaya powder and the interaction between drying temperature and thickness was found non-significant ($P>0.05$).

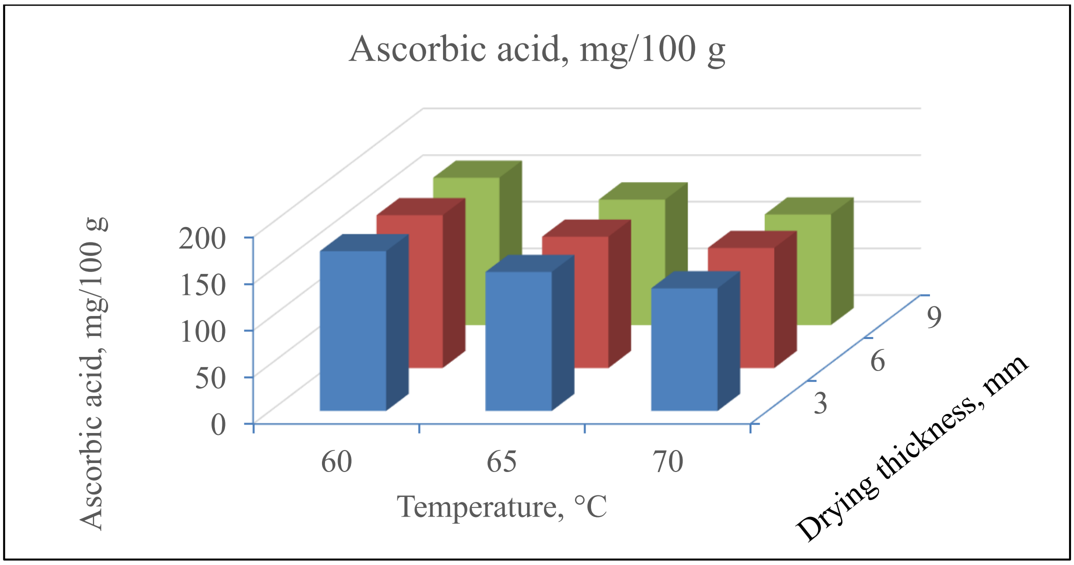

Fig. 4: Ascorbic acid with respect to drying temperature and thickness

3.5 Crude protein of tray dried papaya powder

The crude protein of tray dried papaya powder varied from 33.49 to 42.02% (Table 2). It can be observed from Fig. 5 that crude protein of tray dried papaya powder increased with increase in temperature and thickness. The maximum crude protein 42.02% was found at 70°C with 9 mm thickness while minimum crude protein 33.49% was found at 60°C with 3 mm thickness. The crude protein content generally showed an increasing trend with increasing concentrations of different foaming agents. Crude protein was also found by Ali *et al.* (2011) during the research work of the nutritional and medicinal values of papaya (*Carica papaya* L.). The crude protein content increased in the foam mat-dried powder, likely due to the contribution of protein from whey protein isolate, as reported by Kumar *et al.* (2022). It can be observed from Table 3 that the effect of different drying temperature and thickness have a significant effect (P<0.05) on the crude protein in tray dried papaya powder and the interaction between drying temperature and thickness was found non-significant (P>0.05).

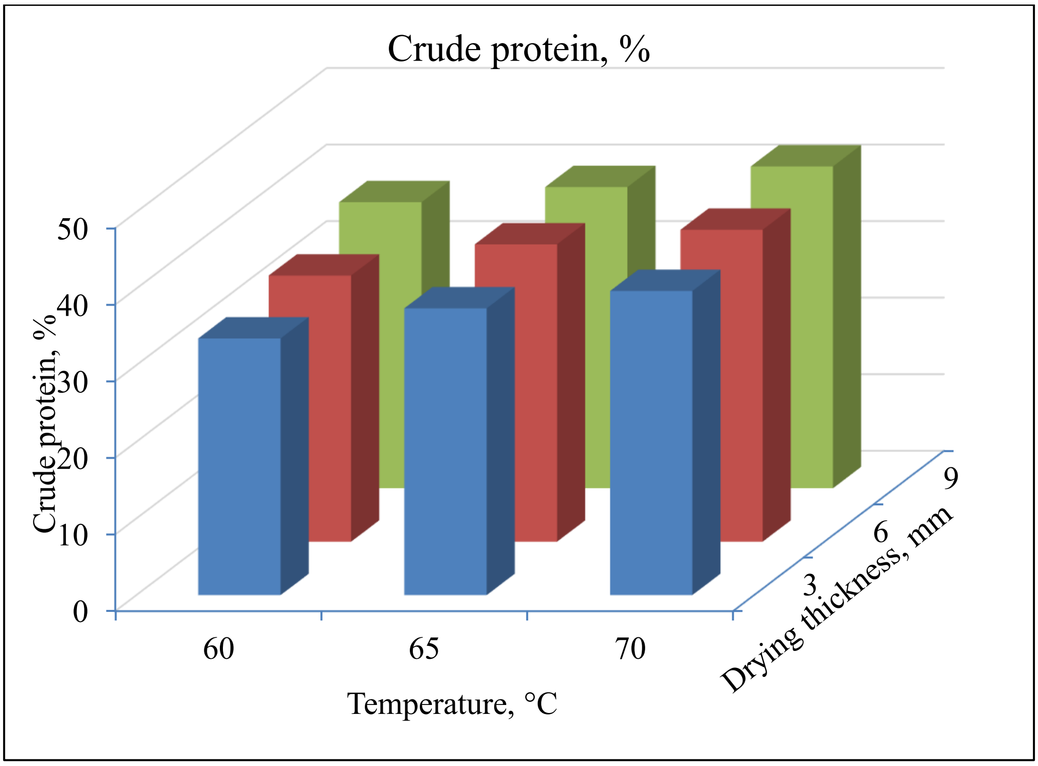

Fig. 5: Crude protein with respect to drying temperature and thickness

3.6 pH of tray dried papaya powder

The pH of tray dried papaya powder varied from 5.66 to 5.78 (Table 2). It can be observed from Fig. 6 that pH of tray dried papaya powder decreased with increase in temperature and thickness. The higher pH 5.78 was found at 60°C with 3 mm thickness and lower pH 5.66 was found at 70°C with 9 mm thickness. Similar trend was also reported by Khodifad *et al.* (2017) that decrease in pH with increase in temperature and thickness during the foam mat drying of custard apple. The pH was also decreased with increase in temperature and thickness was also reported by (Kandasamy *et al.,* 2012c) by using foaming agent as a glycerol monostearate. It can be observed from Table 3 that the effect of different drying temperature has a significant (P<0.05) and thickness have a non-significant effect (P>0.05) on the pH in tray dried papaya powder. The interaction effect of drying temperature and thickness on pH was also found non-significant (P>0.05).

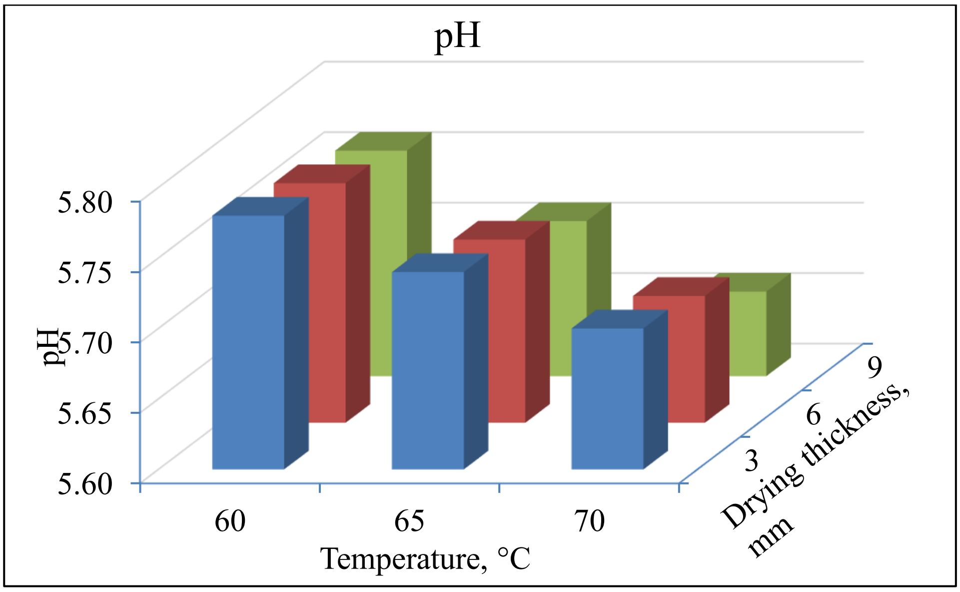

Fig. 6: pH with respect to drying temperature and thickness

3.7 Moisture content of tray dried papaya powder

The moisture content of tray dried papaya powder varied from 5.59 to 8.48% (db) (Table 2). It can be observed from Fig. 7 that moisture content of tray dried papaya powder decreased with increase in temperature and thickness. The maximum moisture content 8.48% (db) was found at 60°C with 3 mm thickness and minimum moisture content 5.59% (db) was found at 70°C with 9 mm thickness. The reduction in moisture content at higher temperatures can be attributed to faster heat transfer and a greater temperature gradient between the drying air and the sample, enhancing moisture removal (Bazaria & Kumar, 2016). It can be observed from Table 3 that the effect of different drying temperature and thickness have a significant effect ($P<0.05$) on the moisture content in tray dried papaya powder and the interaction between drying temperature and thickness was found non-significant ($P>0.05$).

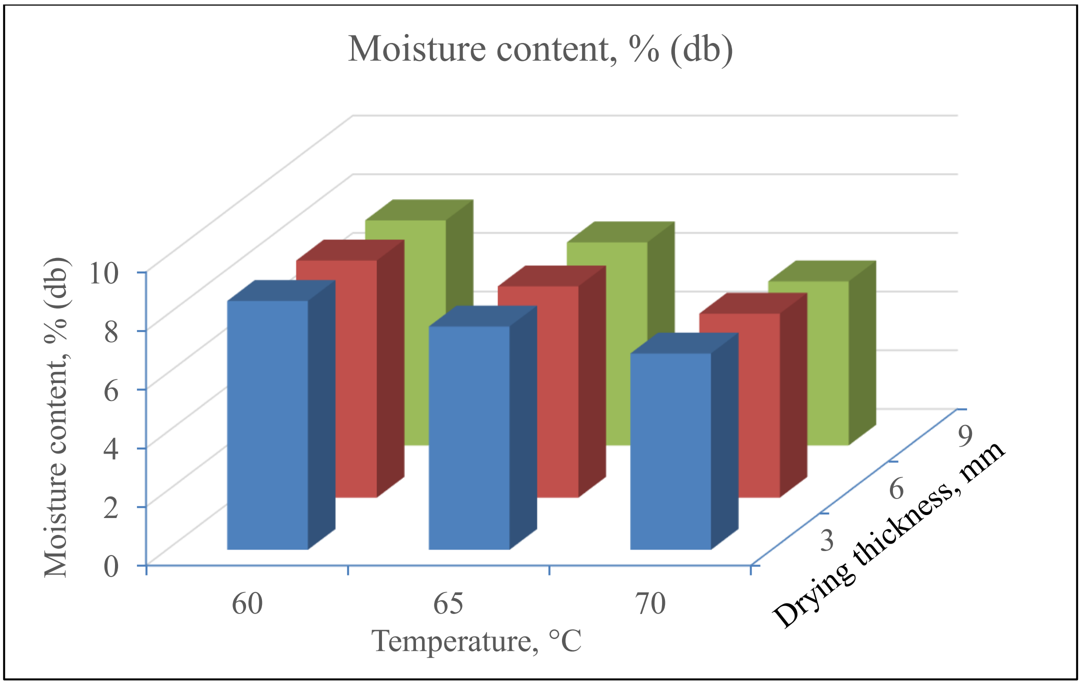

Fig. 7: Moisture content with respect to drying temperature and thickness

Table 2: Average value of biochemical parameters of tray dried papaya powder by different drying treatments

Sr. No.	Drying thickness (mm)	Tempt (°C)	Total sugar, g/100 g	Reducing sugar, g/100 g	β-carotene, mg/100 g	Ascorbic acid, mg/ 100 g	Crude protein, %	pH	Moisture content, % (db)
1	3	60	22.20	16.99	11.11	171.21	33.49	5.78	8.48
2		65	35.41	28.08	13.79	148.98	37.42	5.74	7.61
3		70	45.56	38.07	15.24	131.43	39.69	5.70	6.69
4	6	60	30.44	23.65	12.24	163.80	34.73	5.77	8.08
5		65	40.45	33.48	14.63	140.79	38.81	5.73	7.20
6		70	47.69	39.26	15.83	128.70	40.71	5.69	6.27
7	9	60	34.58	27.81	12.57	157.95	37.35	5.76	7.67
8		65	42.87	35.80	14.78	134.55	39.32	5.71	6.92
9		70	49.76	41.43	19.34	118.56	42.02	5.66	5.59

Table 3: ANOVA for different biochemical parameters of tray dried papaya powder

SV	Df	SS	MS	Cal F	Table F 5%	P-value	Test	RESULT	
Total sugar									
I	2	1564.93	7782.487	212.640	3.550	3E-13	*	S.Em.	1.108
P	2	296.621	148.311	40.303	3.550	2.25E-07	*	C.D.	3.291
IP	4	55.052	13.763	3.740	2.930	0.021971	*	C.V. %	4.95
Error	18	66.238	3.680						
Reducing sugar									
I	2	1275.725	637.862	186.631	3.550	9.231E-13	*	S.Em.	1.067
P	2	243.501	121.750	35.623	3.550	5.523E-07	*	C.D.	3.171
IP	4	47.020	11.755	3.439	2.930	0.0295864	*	C.V. %	5.85
Error	18	61.520	3.418						
β-carotene									
I	2	104.981	32.491	102.618	3.550	1.441E-10	*	S.Em.	0.413
P	2	21.806	10.903	21.315	3.550	1.792E-05	*	C.D.	1.227
IP	4	12.882	3.221	6.296	2.930	0.0023732	*	C.V. %	4.97
Error	18	9.207	0.512						

Ascorbic acid									
I	2	6617.050	3308.525	672.544	3.550	1.221E-17	*	S.Em.	1.281
P	2	825.080	412.540	83.860	3.550	7.546E-10	*	C.D.	NS
IP	4	30.025	7.506	1.526	2.930	0.2368145	NS	C.V. %	1.54
Error	18	88.549	4.919						

Crude protein									
I	2	143.635	71.817	24.250	3.550	7.8E-06	*	S.Em.	0.994
P	2	32.891	16.446	5.553	3.550	0.013232	*	C.D.	NS
IP	4	4.488	1.122	0.379	2.930	0.820652	NS	C.V. %	4.51
Error	18	53.308	2.962						
pH									
I	2	0.035	0.017	6.827	3.550	0.0062172	*	S.Em.	0.029
P	2	0.006	0.003	1.115	3.550	0.3495341	NS	C.D.	NS
IP	4	0.000	0.000	0.035	2.930	0.9974278	NS	C.V. %	0.88
Error	18	0.046	0.003						
Moisture content									
I	2	16.225	8.112	25.154	3.550	6.126E-06	*	S.Em.	0.328
P	2	3.418	1.709	5.299	3.550	0.0155036	*	C.D.	NS
IP	4	0.174	0.043	0.135	2.930	0.9673221	NS	C.V. %	7.92
Error	18	5.805	0.323						

IV. CONCLUSIONS

On the basis of biochemical characteristics (Shivani *et al.,* 2019), the highest score of the treatment will be optimized. Therefore, in tray drying of foamed papaya pulp, the highest score observed at treatment T_9 (70ºC of drying temperature with 9 mm of drying thickness) during the experimental work. The highest score of the biochemical parameters *viz.* total sugar, reducing sugar, β-carotene, ascorbic acid, crude protein, pH and moisture content was found 49.76 g/100 g, 41.43 g/100 g, 19.34 mg/100 g, 118.56 mg/100 g, 42.02%, 5.66 and 5.59% (db), respectively at 70ºC of drying temperature with 9 mm of drying thickness in tray dried papaya powder. Therefore, it can be concluded foam mat tray dried papaya powder have effective nutritional value.

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