D-5655
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RESEARCH ARTICLE Agricultural Science Digest

Studies on the Development and Evaluation of Tomato (*Lycopersicon esculentum*) Blended Papaya (*Carica papaya*) Chutney

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10.18805/ag.D-5655

ABSTRACT

Background: Papaya (*Carica papaya*) has a maximum loss of postharvest shelf life. Due to the higher respiration activity, these are prone to ripening within a short time frame; as a result, pathogens develop quickly and lead to enormous problems for papaya producers. Hence to minimize this postharvest loss and to preserve nutritional qualities, the present study was conducted to utilize papaya pulp to prepare a delicious papaya chutney with tomato (*Lycopersicon esculentum*) because of its unique flavour.

Methods: For chutney preparation, different combinations of papaya and tomato were used and their quality was analyzed based on biochemical (Total Soluble Solids, Titratable acidity, acid/Brix ratio, vitamin-C, total sugars, reducing sugars) and sensory attributes (colour, appearance, flavour, texture and consistency).

Result: The treatment T7 (50% papaya: 50% tomato) was found to be the best combination in terms of biochemical and sensory quality parameters. Chutney was yet in acceptable conditions even after 90 days of preparation.

Key words: Post-harvest, Processing, Quality, Storage.

INTRODUCTION

Papaya (*Carica papaya* L.) is a healthy and delicious fruit that can be eaten either in a fresh or processed form. It had 13.9 million tonnes of global production in 2020 and India alone contributed 43% of it (FAOSTAT, 2020). Gujarat andhra Pradesh, Karnataka, Madhya Pradesh and Tamil Nadu were the highest papaya-producing states in India (NHB 2017-2018). Papaya is well known for its numerous medicinal properties, which provide essential nutrients such as vitamins (A, C, E), riboflavin, folate, thiamine, niacin, calcium, iron, potassium and fiber. In addition, some minerals like magnesium (Mg) and potassium (K) are also present (Ali *et al*., 2011). Few findings proved that papayas contain more ascorbic acid (64 mg/100g) when compared to oranges (37 mg/100g) (Santiago-Silva *et al*. 2011). However, papaya is a perishable climacteric fruit with a maximum loss of postharvest shelf life (40-100%) (Gupta, 2022). Moreover, due to the higher respiration behavior, these are prone to quick ripening and difficult to maintain their quality throughout transportation and marketing (Emana *et al*., 2007, Ignacio *et al*., 2011).

Tomato is a non-starchy vegetable that naturally contains a powerful antioxidant known as lycopene (Bose *et al*. 2002). However, even some of the findings proved that the amount of lycopene in a fresh tomato is four times lower than its processed product (Shashikalabai *et al*. 2016). Nevertheless, the consumption of tomatoes in the processed form has been increasing today due to their wider availability, cost-effectiveness and unique taste (Burton and Reimers 2011).

In order to minimize the postharvest loss of papaya and preserve the nutritional qualities present in them, the present study has been conducted to prepare a delicious papaya chutney, a processed product made from different ingredients. In South Asian nations, these chutneys are most commonly used with different flavours and tastes like sweet, sour, spicy *etc*. (Kapoor, 2001). Processing in the form of chutney helps as an appetizer and provides the availability of the fruit even during the off-season; it also helps in the utilization of the various minor fruits which are not much known (Kumari *et al*. 2018), supplements the nutrition (Singhania *et al*. 2020); Controls the wastage (Madhushani *et al*. 2016); Also, various combinations of tomatoes were added to the papaya due to its unique flavour. Fewer attempts have been made to utilize papaya by making its different products, but they did not attain the commercial approaches; hence a new approach has been made.

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How to cite this article: Harshita, G.T., Singh, G., Kondle, R. and Kathayat, K. (2022). Studies on the Development and Evaluation of Tomato (*Lycopersicon esculentum*) Blended Papaya (*Carica papaya*) Chutney. Agricultural Science Digest. DOI: 10.18805/ag.D-5655.

Submitted: 16-08-2022 **Accepted:** 29-11-2022 **Online:** 07-12-2022

MATERIALS AND METHODS

The research was executed in 2022 at the Department of Horticulture, Lovely Professional University. Different combinations of papayas and tomatoes (100:00, 95:05, 85:15, 75:25, 65:35, 55:45 and 50:50) were taken as seven treatments, each being replicated thrice. To estimate the significance level, the data were analyzed for up to 90 days with a one-way analysis of variance (ANOVA), using a completely randomized block design.

The fresh and evenly ripened papayas and tomatoes of uniform size were collected from the field and blanched off; the pulp was prepared by peeling, cutting and mixing with water (1:1). For the chutney preparation, five tablespoons of mustard oil was boiled for 2 min. Then the papaya-tomato blends were added and boiled on a medium flame as per the required treatments in a different ratio. Soon after the boil starts, 2 tablespoons of sugar has been added and mixed well with a continuous stir. After the attainment of proper consistency, the remaining spice powders (1 teaspoon - red chilli powder, ¼ teaspoon cinnamon powder, ¼ teaspoon funnel, ¼ teaspoon clove, ¼ teaspoon cardamom, ¼ teaspoon black pepper, ½ table teaspoon black salt, ¼ table teaspoon cumin, ½ teaspoon chat masala) were mixed well until it attains 50° Brix. The prepared Chutney was cooled, packed (glass jars with 0.6 cm of headspace), labeled and finally stored in a refrigerator (4-5°C) for 90 days (Flow Chart 1).

Biochemical parameters like Total soluble solids (° Brix), Titratable acidity (%) (Ranganna, 2014), Acid: Brix ratio, Ascorbic acid (mg/100g) (Ranganna, 2014), Total Sugar (Anthrone method by Jayaraman 1981) and Reducing sugars were evaluated by DNSA reagent (3,5 Dinitro salicylic acid reagent) method (Miller, 1959). A panel of 5 judges evaluated the sensory parameters.

RESULTS AND DISCUSSION

Biochemical parameter

During the 90 days of the storage period, the biochemical parameters of papaya-tomato blend chutney differed significantly in each treatment, as shown in Table 1. TSS, Acid: Brix ratio, Total sugars and reducing sugars were increased. At the same time, Titratable acidity and Ascorbic acid decreased significantly.

The TSS of the chutney has increased throughout the storage period from 2.78 -7.37%. A higher per cent of the increase was observed in T2 (95: 05) with 7.37% and a lesser increment was observed in T7 (50:50) with 2.78%. The increase in TSS is because of the hydroxylation of the polysaccharides into the monosaccharide and soluble disaccharides, or because of the conversion of starch and other insoluble carbohydrates into sugars (Luh and Woodroof, 1975). A similar trend of TSS was found in other research, like in aonla-papaya chutney (Sachin. 2017). However, in the case of acidity, the trend decreased from the range of 23.91-7.25%. Here higher tomato pulp contributed to the higher acidic level in each treatment. A maximum of 23.91% decrease is found in T2 (95: 05) and a minimum in T7 (50: 50) with 07.25%. The decreased trend in acidity level resulted from the hydrolysis of polysaccharides and non-reducing sugars. In contrast, acid is employed to convert them to hexose sugars or reducing sugars. The same was observed in the case of Guava-Papaya blend chutney (Kumar *et al.,* 2020).

The data clearly illustrates the significant increasing pattern from 9.82-29.52% in the acid: Brix ratio. Throughout the storage period, the maximum percentage of the increase in acid: Brix ratio was found in T2 (95:05) and the minimum increase % was in T7 (50:50). This is due to a chutney's increasing TSS and decreasing acidity level. The strawberry

Addition of oil to a pan

↓

Addition of papaya-tomato blends (as per treatment ratio)

↓

Sugar was mixed with it

↓

Stirred continuously while cooking (to avoid roasting)

↓

Mixed all the spices and powder
(Red chilli, cinnamon, fennel, clove, cardamom, black pepper, black salt, cumin, chat masala)

↓

Cooked along with a continuous stirring (until it attains TSS of 50^0 Brix)

↓

Then cooled and added to a glass jar

↓

Finally, Stored it in the refrigerator (4-5 ^{0}C)

Flow Chart 1: Preparation of papaya-tomato chutney.

processed products also observed a similar trend (Khan *et al.* 2014). At the same time, the Ascorbic acid of blended chutney reduced dramatically from 9.52-3.24%. The decrease was maximum in T1 (100:00) with 9.52% and minimum in T7 (50: 50) with 3.24%. This decreasing trend is due to trapped oxygen accumulated within the glass bottle. When ascorbic acid reacts with oxygen, it produces a volatile and unstable dehydro-ascorbic acid (Nayak, 2012; Jakhar *et al.,* 2013) and then further broken down into keto-gluconic acid (Kuchi *et al.,* 2014). The same was observed in Guava-Jamun (Bhardwaj *et al.* 2016) and Gongura chutney (Kowsalya *et al*. 2018). The percentage of total sugars and reducing sugars were increased over a storage time. Among the treatments, total sugar percentages ranged from 42.40 to 46.36% and reduced sugars from 4.65 to 10.46%. The percent of the increase was maximum in T1 (100:00) and minimum in T7 (50: 50) in the case of both parameters. The conversion of insoluble polysaccharides into simple sugars led to a gradual rise in the sugar content.

Table 1: Effect of a different combination of papaya- tomato blend chutney on different biochemical parameters at different storage periods.

Treatments	Storage period (days)	TSS (°Brix)	Acidity (%)	Acid: Brix ratio	Ascorbic acid (mg/100g)	Total sugar (%)	Reducing sugar (%)
T1	0	50.04	0.35	142.97	44.51	43.56	26.55
	30	50.54	0.34	148.65	43.98	43.80	27.03
	60	52.24	0.32	163.25	42.17	45.03	28.28
	90	53.97	0.29	186.10	40.27	46.36	29.65
	% increase/decrease	7.28	17.14	23.18	9.52	6.04	10.46
T2	0	50.00	0.46	108.70	43.57	43.53	26.50
	30	50.39	0.44	114.52	42.28	43.74	26.73
	60	51.76	0.40	129.4	41.24	44.83	27.95
	90	53.98	0.35	154.23	40.00	45.83	28.98
	% increase/decrease	7.37	23.91	29.52	8.18	5.02	8.56
T3	0	50.06	0.50	100.12	39.95	43.01	25.93
	30	50.38	0.49	102.82	39.5	43.22	26.14
	60	51.63	0.47	109.85	38.65	44.18	27.19
	90	53.09	0.44	120.66	37.25	45.63	28.67
	% increase/decrease	5.71	12.00	17.02	6.75	5.74	9.56
T4	0	50.05	0.55	91.00	37.89	42.69	25.52
	30	50.27	0.54	93.09	37.65	42.89	25.78
	60	51.18	0.53	96.57	36.78	43.49	26.46
	90	52.20	0.51	102.35	35.44	44.93	27.90
	% increase/decrease	4.12	7.27	11.09	6.45	4.99	8.53
T5	0	50.00	0.61	81.97	36.63	42.63	25.34
	30	50.21	0.6	83.68	36.43	42.8	25.57
	60	51.18	0.58	88.24	35.21	43.48	26.37
	90	52.18	0.55	94.87	35.02	44.92	27.82
	% increase/decrease	4.18	9.84	13.60	4.40	5.10	8.91
T6	0	50.03	0.68	73.57	33.66	42.59	25.22
	30	50.24	0.66	76.12	33.29	42.73	25.47
	60	50.79	0.63	80.62	32.36	43.07	25.84
	90	51.52	0.63	81.78	32.32	44.00	26.84
	% increase/decrease	2.89	7.35	10.03	3.98	3.20	6.04
T7	0	50.05	0.69	72.54	33.07	42.40	25.00
	30	50.24	0.68	73.88	32.99	42.65	25.38
	60	50.76	0.65	78.09	32.33	43.02	25.78
	90	51.48	0.64	80.44	32.00	43.40	26.22
	% increase/decrease	2.78	7.25	9.82	3.24	2.30	4.65
	Storage period (days)	TSS (°Brix)	Acidity (%)	Acid: Brix ratio	Ascorbic acid (mg/100g)	Total sugar (%)	Reducing sugar (%)
CD @ 5%	0	N/A	0.02	11.34	2.05	0.23	0.3
	30	0.07	0.03	11.59	1.81	0.16	0.32
	60	0.28	0.02	13	1.56	0.19	0.51
	90	0.46	0.04	17.35	1.6	0.15	0.58

Table 2: Effect of a different combination of papaya- tomato blend chutney on different sensory parameters at different storage periods.

Treatments	Storage (days)	Colour	Flavour	Texture and consistency	Appearance	Overall acceptability
T1	0	N30B	Sweet with spicy, mild sour	Semi-liquid and Smoothy	Glossy	6.95
	30	N30B	Sweet with spicy	Light thicker and smoothy	Glossy	6.62
	60	N30C	Off flavour	Light thicker and tacky	Lightly dull	6
	90	N30D	Off flavour	Medium thicker and tacky	Dullness	5.89
T2	0	N30B	Sweet with mild sour, spicy	Semi-liquid and Smoothy	Opaque	7.59
	30	N30C	Sweet with mild sour	Semi-liquid and smoothy	Opaque	6.72
	60	N30C	Bland	Light thicker and tacky	Lightly dull	6.55
	90	N30D	Off flavour	Medium thicker and tacky	Dullness	6.22
T3	0	29A	Sweet with mild sour,	Semi-liquid and smoothy	Opaque	7.65
	30	29B	Sweet with mild sour	Semi-liquid and smoothy	Opaque	7.28
	60	29C	Bland	Light thicker and stodgy	Opaque	7.17
	90	29D	Bland	Medium thickerand stodgy	Lightly dull	7.13
T4	0	26A	Sweet with mild sour	Semi-liquid and Smoothy	Opaque	7.89
	30	26B	Sweet with very mild sour	Semi-liquid and smoothy	Opaque	7.56
	60	26C	Bland	Light thicker and gritty	Opaque	7.33
	90	26C	Bland	Medium thicker and gritty	Lightly dull	7.22
T5	0	28A	Sweet with medium sour	Semi-liquid and smoothy	Opaque	8.36
	30	28A	Sweet with medium sour	Semi-liquid and smoothy	Opaque	8.1
	60	28B	Sweet with very mild sour	Light thicker and smoothy	Opaque	7.52
	90	29A	Sweet with very mild sour	Medium thicker and smoothy	Opaque	7.43
T6	0	28B	Sweet with medium sour	Semi-liquid and smoothy	Opaque	8.67
	30	28B	Sweet with medium sour	Semi-liquid and smoothy	Opaque	8.58
	60	28C	Mild sweet with light sour	Light thicker and smoothy	Opaque	7.72
	90	28D	Mild Sweet and mild sour	Light thicker and smoothy	Opaque	7.62
T7	0	40A	Mild sweet with medium sour	Semi-liquid and smoothy	Opaque	8.93
	30	40A	Sweet with medium sour	Semi-liquid and smoothy	Opaque	8.44
	60	40B	Sweet with mild sour	Light thicker and smoothy	Opaque	7.91
	90	40B	Mild Sweet	Light thicker and smoothy	Opaque	7.86

(Policarpo *et al.,* 2007; Menezes *et al.* 2011) The same was observed in Bael-mango chutney (Sharma *et al.* 2019).

Sensory evaluation

The sensory parameters showed a considerable drop in chutney, as recorded in Table 2. The varying colour of the prepared papaya-tomato blend chutney was recorded by matching the colour with the Royal Horticultural society's Colour Chart (Wilson 1938). the colour varied differently for each storage interval. Comparatively, less colour change was observed in T5 (50:50) and maximum variation occurred in T1 (100:00) from 40 A-40B (vivid reddish-orange). In the case of flavour, texture and consistency, T6 (55: 45) and T7 (50: 50) were most acceptable. At the same time, T1(100:00) and T2 (95:05) were the least acceptable due to more significant changes. The appearance of the chutney ranged from glossiness and opaqueness to dullness. T5 (65: 35), T6 (55: 45) and T7 (50: 50) showed the same appearance of opaqueness, but T1(100:00) and T2 (95:05) showed dullness on the 90th day of the storage period.

The overall acceptability rating was considered based on all the parameters. The pattern of overall acceptability rating declined considerably from 8.93 to 5.89 as the storage time progressed but varied with different treatments. The changes like appearance, flavour texture and consistency are due to chemical changes or enzymatic and non-enzymatic variations in its composition. For example, a low temperature slows reactions such as oxidation, caramelization and enzymatic activity, leading to a loss of colour, look, texture and taste. A similar result was also seen in Guava-Papaya blend chutney (Kumar *et al.* 2020) and wild pomegranate chutney (Thakur *et al.* 2018).

Regarding biochemical parameters, the maximum variation was noticeable in T1 (100:00) and the minimum variation was noticeable in T7 (50: 50). These biochemical variations ultimately affected the sensory changes in the chutney. Hence due to lesser changes acceptance rate was higher in T7 (50: 50).

CONCLUSION

From the observation of 90 days period, it was found that chutney made from an equal proportion *i.e*, 50% Papaya: and 50% tomato (T7), emerged as the best treatment across all the other treatments. Also, statistically, it has a significant impact on quality aspects as compared to control. The study has shown the best way to preserve papaya is by making delicious chutney

with minimum damage even after 90 days. To arrive at more conclusive findings, it may be necessary to do more research to identify other relevant metrics, such as total phenolic compound concentration, viscosity and ash content.

Conflict of interest: None.

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