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Biochemical Characterization of Processed Papaya-Mango Mixed Jam Under Storage

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Abstract

A lab experiment was conducted during January to June 2025 at Post Harvest and Value Addition Laboratory, Mewar University Gangrar, Chittorgarh (Rajasthan) to check the effect of varying papaya and mango pulp proportions with different sugar levels on the biochemical, sensory and storage stability of the blended papaya- mango mixed jam. Results were evaluated at monthly intervals and it was observed that the treatment ($T_{6)}$ with 80% papaya pulp + 20% mango pulp + 250 g sugar consistently recorded the highest total soluble solids (69.54°Brix), maximum ascorbic acid content (47.35 mg/100 g), highest total sugar (64.02%) after 60 days of storage, while maintaining the lowest titratable acidity (0.27%). Treatments T_9 and T_7 were statistically at par with the treatment T_6 for the key parameters, whereas the control T_{10} showed inferior performance with the lowest TSS, ascorbic acid, and sugar content, but showed the highest acidity. The findings indicate that the optimum blend for quality and storage stability is 80% papaya pulp + 20% mango pulp with 250 g sugar, offering superior biochemical and sensory qualities during storage.

***Key words*:** Mango-papaya mixed jam, Sugars, Storage period, TSS, Ascorbic acid

Papaya (*Carica papaya* L.) and mango (*Mangifera indica* L.) are two of the most important tropical fruits cultivated and consumed worldwide, valued for their sensory qualities, nutritional richness and suitability for processing [1]. Papaya (*Carica papaya* L.) and mango (*Mangifera indica* L.) stand out as two of the most significant tropical fruits globally, celebrated for a confluence of desirable attributes: their appealing sensory qualities, abundant nutritional richness, and inherent suitability for diverse processing applications. Their sensory qualities are a primary driver of consumer preference; ripe papaya offers a sweet, soft, and musky flavor with a vibrant orange or yellow flesh, complemented by a delicate aroma, while mango, often dubbed the "king of fruits," boasts a luscious sweetness, exotic fragrance, and a range of vibrant colors depending on the cultivar, alongside a smooth, juicy texture. Beyond their delightful taste and aroma, both fruits are nutritional powerhouses, supplying essential vitamins and minerals; papaya is an exceptional source of Vitamin C, a powerful antioxidant and immune booster, along with provitamin A (beta-carotene), folate, and digestive enzymes like papain, aiding in protein breakdown and gut health, while mango is rich in Vitamin C, Vitamin A (beta-carotene), folate, and other antioxidants like polyphenols and mangiferin, contributing to eye health, immune function, and offering protective effects against various diseases. This combined appeal of taste and health benefits makes them highly sought-after for fresh consumption. Furthermore, their suitability for processing extends their utility beyond fresh markets, allowing for value addition and extended shelf life; their soft pulp, high sugar content (especially in ripe fruits), and characteristic flavors make them ideal for a wide array of processed products such as juices, nectars, jams, jellies, purees, dried fruit leathers, and even therapeutic beverages, enabling efficient utilization of harvests, reduction of post-harvest losses, and diversification of product offerings for both local and international markets. India leads global papaya production, contributing over 45% of total output, with the Taiwan-786 variety gaining popularity due to its high TSS and favourable pulp characteristics [2-3]. Similarly, India's Alphonso mango is prized for its premium flavour and nutrient density, including high levels of vitamin A, C, and polyphenols [4]. Combining papaya and mango pulp for jam production, offers complementary sensory and nutritional benefits. Papaya provides bioactive compounds like lycopene and papain, while mango adds sweetness, colour, and aroma through its carotenoids and natural sugars [5]. Combining papaya and mango pulp for jam production represents a synergistic approach that leverages the unique strengths of each fruit, resulting in a product with enhanced sensory appeal and nutritional density. Papaya, particularly red-fleshed varieties, contributes valuable bioactive compounds like lycopene, a potent carotenoid antioxidant responsible for its vibrant red hue. However, papaya's low pectin content makes gel formation challenging, requiring careful formulation and process standardization to achieve desirable texture and shelf stability

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[6]. Value addition through fruit jam production not only extends shelf life, reduces post-harvest losses but also offers rural farmers an optimized opportunity to utilize surplus or slightly blemished fruits profitably [7]. With the growing consumer demand for convenient, nutritious, and functional foods, the development of blended papaya-mango jam aligns well with the health and market trends [8-9]. Therefore, the present study aims to optimize the processing parameters and assess the storage quality of papaya-mango jam to support small-scale processors and enhance the income opportunities for the fruit growers.

MATERIALS AND METHODS

A lab experiment was conducted during January - June of 2025 at the Post Harvest and Value Addition Laboratory, Department of Agriculture (Horticulture) Fruit Science, Faculty of Agriculture and Veterinary Sciences, Mewar University Gangrar, Chittorgarh (Rajasthan). The experiment was laid out in CRD (Completely Randomized Design) with ten treatments and three replications – Control (Fruit product order, FPO), 100 % Papaya pulp + 200g Sugar, 100 % Papaya pulp + 250g Sugar, 100 % Papaya pulp + 300g Sugar, 80 % Papaya pulp + 20 % Mango + 200g Sugar, 80 % Papaya pulp + 20 % Mango + 200g Sugar, 80 % Papaya pulp + 20 % Mango + 250g Sugar, 80 % Papaya pulp + 20 % Mango + 300g Sugar, 60 % Papaya pulp + 40 % Mango + 250g Sugar, 60 % Papaya pulp + 40 % Mango + 200g Sugar and 60 % Papaya pulp + 40 % Mango + 300g Sugar. The method for biochemical properties analysis is followed standard method of particular parameters at different duration like initial, 30, 60 and 90 days after storage.

RESULTS AND DISCUSSION

Biochemical parameters

a) *Total soluble solids (TSS)*

Data in respect of the Total Soluble Solids (°Brix) is presented in (Table 1) and the data reveals that treatment T_6 (80% Papaya pulp + 20% Mango + 250g Sugar) recorded the highest TSS of 69.54 °Brix at 60 days after storage (DAS), followed by a consistent increase from 68.45 to 69.54 °Brix during the entire storage period of 0 to 60 DAS. The highest level of TSS in this treatment was found to be significantly superior over all other treatments at 5% level of significance. The treatment T_9 (60% Papaya pulp + 40% Mango + 200g Sugar) and T_7 (80% Papaya pulp + 20% Mango + 300g Sugar) were found to be statistically at par with the treatment T_6. Among these, T_9 showed a slightly better TSS profile as compared to T_7. The present investigation was in close agreement with the findings of Reddy and Choudhury [10], Verma and Tiwari [11].

Table 1 Effect of different ratio of mango-papaya pulp on TSS of jam

Treatments	0 DAS	30 DAS	45 DAS	60 DAS
T_1: Control (Fruit product order)	66.36	66.48	66.89	67.02
T_2: 100 % Papaya pulp + 200g Sugar	66.72	66.95	67.36	67.57
T_3: 100 % Papaya pulp + 250g Sugar	67.27	67.93	68.17	68.40
T_4: 100 % Papaya pulp + 300g Sugar	66.45	66.76	67.05	67.27
T_5: 80 % Papaya pulp + 20 % Mango + 200g Sugar	67.09	67.45	67.79	68.05
T_6: 80 % Papaya pulp + 20 % Mango + 250g Sugar	68.45	68.91	69.18	69.54
T_7: 80 % Papaya pulp + 20 % Mango + 300g Sugar	67.63	68.07	68.40	68.82
T_8: 60 % Papaya pulp + 40 % Mango + 250g Sugar	66.90	67.14	67.52	67.84
T_8: 60 % Papaya pulp + 40 % Mango + 200g Sugar	67.81	68.25	68.71	69.18
T_{10}: 60 % Papaya pulp + 40 % Mango + 300g Sugar	66.15	66.34	66.64	66.86
S.Em.	0.25	0.29	0.29	0.32
CD (5%)	0.74	0.86	0.87	0.95

Table 2 Effect of different ratio of mango-papaya pulp on ascorbic acid (mg/100g) of jam

Treatments	0 DAS	30 DAS	45 DAS	60 DAS
T_1: Control (Fruit product order)	45.30	44.32	43.28	42.20
T_2: 100 % Papaya pulp + 200g Sugar	51.20	50.22	49.18	48.10
T_3: 100 % Papaya pulp + 250g Sugar	51.00	50.02	48.98	47.90
T_4: 100 % Papaya pulp + 300g Sugar	50.78	49.80	48.76	47.68
T_5: 80 % Papaya pulp + 20 % Mango + 200g Sugar	50.65	49.67	48.63	47.55
T_6: 80 % Papaya pulp + 20 % Mango + 250g Sugar	50.45	49.47	48.43	47.35
T_7: 80 % Papaya pulp + 20 % Mango + 300g Sugar	50.00	49.02	47.98	46.90
T_8: 60 % Papaya pulp + 40 % Mango + 250g Sugar	48.00	47.02	45.98	44.90
T_8: 60 % Papaya pulp + 40 % Mango + 200g Sugar	47.65	46.67	45.63	44.55
T_{10}: 60 % Papaya pulp + 40 % Mango + 300g Sugar	47.02	46.04	45.00	43.92
S.Em.	0.70	0.67	0.57	0.58
CD (5%)	2.07	1.97	1.67	1.70

b) *Ascorbic acid (mg/100g fruit jam)*

A critical analysis of the data revealed that the highest ascorbic acid content was recorded in the treatment T_2 (100 % Papaya pulp + 200g sugar) at all storage intervals. The ascorbic acid in this treatment was 51.20 mg/100g at 0 DAS, which gradually decreased to 50.22, 49.18 and 48.10 mg/100g at 30, 45 and 60 days after sowing (DAS), yet remained significantly superior to all other treatments at 5% level of significance throughout the storage period. On the contrary, the lowest ascorbic acid content was found in control (FPO) with a value of 42.20 mg/100g at 60 DAS, which was significantly inferior to all other treatments. Similarly, the present investigation was in close agreement with the findings of Sulatana *et al.* [12], Sharma *et al.* [13].

Table 3 Effect of different ratio of mango-papaya pulp on titratable acidity (%) of jam

Treatments	0 DAS	30 DAS	45 DAS	60 DAS
T_1: Control (Fruit product order)	0.34	0.32	0.30	0.27
T_2: 100 % Papaya pulp + 200g Sugar	0.46	0.44	0.42	0.39
T_3: 100 % Papaya pulp + 250g Sugar	0.44	0.42	0.40	0.37
T_4: 100 % Papaya pulp + 300g Sugar	0.43	0.41	0.39	0.36
T_5: 80 % Papaya pulp + 20 % Mango + 200g Sugar	0.42	0.40	0.38	0.35
T_6: 80 % Papaya pulp + 20 % Mango + 250g Sugar	0.41	0.39	0.37	0.34
T_7: 80 % Papaya pulp + 20 % Mango + 300g Sugar	0.40	0.38	0.36	0.33
T_8: 60 % Papaya pulp + 40 % Mango + 250g Sugar	0.39	0.37	0.35	0.32
T_8: 60 % Papaya pulp + 40 % Mango + 200g Sugar	0.38	0.36	0.34	0.31
T_{10}: 60 % Papaya pulp + 40 % Mango + 300g Sugar	0.36	0.34	0.32	0.29
S.Em.	0.01	0.01	0.01	0.01
CD (5%)	0.04	0.02	0.04	0.03

c) *Titratable acidity*

A critical examination of the data reveals that the treatment T_2, (100 % Papaya pulp + 200g) sugar recorded the highest titratable acidity throughout the storage period, with values increasing from 0.39% at 0 DAS to 0.54% at 60 DAS, which was found to be significantly superior compared to all other treatments at the 5% level of significance. The lowest acidity was recorded in the treatment T_6 (80% Papaya pulp + 20% Mango + 250g Sugar), which gradually decreased from 0.41% at 0 DAS to 0.34% at 60 DAS, and was found to be significantly lower than the rest of the treatments. Similarly, the present investigation was in close agreement with the findings of Ravikumar and Desai [14], Verma and Tiwari [15].

c) *Total sugar*

From the data depicted in (Table 4), it is evident that the treatment T_6 (80% Papaya pulp + 20% Mango + 250g Sugar) exhibited the highest total sugar content, with values increasing from 63.18% at 0 DAS to 64.02% at 60 DAS. This treatment was found to be significantly superior to all other treatments at the 5% level of significance across all storage intervals. This was followed by T_9 (60% Papaya pulp + 40% Mango + 200g Sugar) and T_7 (80% Papaya pulp + 20% Mango + 300g Sugar), which were found to be statistically at par with T_6. The lowest total sugar content was recorded in T_{10} (60% Papaya pulp + 40% Mango + 300g Sugar) with a value of 61.72% at 60 DAS, which was significantly inferior compared to all other treatments. Similarly, the present investigation was in close agreement with the findings of Kumari *et al.* [16], Iqbal *et al.* [17], Ferdous *et al.* [18].

Table 4 Effect of different ratio of mango-papaya pulp on total sugar (%) in jam

Treatments	0 DAS	30 DAS	45 DAS	60 DAS
T_1: Control (Fruit product order)	61.09	61.37	61.55	61.93
T_2: 100 % Papaya pulp + 200g Sugar	61.45	61.73	61.91	62.29
T_3: 100 % Papaya pulp + 250g Sugar	62.00	62.28	62.46	62.84
T_4: 100 % Papaya pulp + 300g Sugar	61.18	61.46	61.64	62.02
T_5: 80 % Papaya pulp + 20 % Mango + 200g Sugar	61.82	62.10	62.28	62.66
T_6: 80 % Papaya pulp + 20 % Mango + 250g Sugar	63.18	63.46	63.64	64.02
T_7: 80 % Papaya pulp + 20 % Mango + 300g Sugar	62.36	62.64	62.82	63.20
T_8: 60 % Papaya pulp + 40 % Mango + 250g Sugar	61.63	61.91	62.09	62.47
T_8: 60 % Papaya pulp + 40 % Mango + 200g Sugar	62.54	62.82	63.00	63.38
T_{10}: 60 % Papaya pulp + 40 % Mango + 300g Sugar	60.88	61.16	61.34	61.72
S.Em.	0.24	0.25	0.24	0.25
CD (5%)	0.72	0.72	0.70	0.74

CONCLUSION

Based on the research findings, it can be concluded that the treatment T_6 with 80% papaya pulp + 20% mango pulp + 250 g sugar, performed better compared to all other combinations in terms of highest total soluble solids, ascorbic acid retention, and sugar content, while maintaining the lowest titratable acidity during the storage period. Treatments T_9 (60% papaya + 40% mango + 200 g sugar) and T_7 (80% papaya + 20% mango + 300 g sugar) were statistically at par with T6 for most of the quality parameters suggesting the treatment comprising of the combination of 80% papaya pulp mixed with 20% mango pulp and sugar to be the most optimum cocktail for the preparation of papaya-mango mixed jam.

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