Value addition and Standardization of Mango Jam (*Mangifera indica*)

ABSTRACT

The study was carried out to develop a value-added mango jam in which mango and tamarind are taken and treated with varying quantities of sugar, honey, and jaggery. This exploration was facilitated through a Completely Randomized Design (CRD) experiment, which evaluated seven treatments. Physicochemical analyses and organoleptic assessments were conducted over a 60-day storage period at ambient temperature. Results indicated that Treatment 4 (Mango + Tamarind + Jaggery 60% + Honey 40%) exhibited superior physicochemical properties, including total soluble solids, pH, total acidity, moisture content and ascorbic acid content. Organoleptic evaluations favored Treatment 4(Mango + Tamarind + Jaggery 60% + Honey 40%) for color and appearance, flavor and taste, texture, aroma, and overall acceptability, followed by Treatment 2 (Mango + Tamarind + Sugar 75% + Honey 25%). Notably, all treated samples surpassed the control in organoleptic tests. Furthermore, the assessments revealed improved sensory attributes at cold temperatures compared with ambient conditions. Treatment 6 (Mango + Tamarind + Jaggery 90% + Honey 10%) demonstrated the highest Benefit-Cost Ratio (1.45). These findings suggest the potential for optimizing mango jam formulations to enhance both physiochemical properties and consumer acceptance.

Keywords: Mango, Tamarind, Organoleptic test, Jam, Benefit cost ratio.

1. INTRODUCTION

Mango (*Mangifera indica L.*) is the most important fruit crop in tropical and subtropical regions of the world. Mango fruit is regarded as one of the best fruit in the world market because of its excellent flavor, delicious taste, beautiful colour, attractive fragrance and health giving properties **(Salunke & Desai, 1984).** Among all fruits, mango is considered to be one of the best fruits in the world. Therefore, it's most famous, nutritionally rich fruit with unique flavor, aroma, taste and nutraceutical properties making it popular among new functional foods. It is often labeled as "super fruits" and is also known as the king of all the tropical fruits **(Cyril *et al.*, *2017*).** Mango fruit is a rich source of fiber, vitamin A and C, essential amino acids and over-abundance of phytochemicals **(Mirza *et al.*, 2020).** Several studies have suggested that polyphenolic antioxidant compounds in mango contribute towards protection against breast and colon cancers. It has abundant vitamin-A and flavonoids like β-carotene, α-carotene and β-cryptoxanthin **(Chidley *et al.*, 2013).** All these phytochemical have been known to have antioxidant properties and are essential for vision. Mango fruit is generally a good source of carbohydrates, protein, fat, fiber, vitamins, minerals, and carotenoids **(Jahurul *et al.*, 2015; Lauricella *et al.*, 2017).**

Due of their seasonality, the majority of fruits are only available during specific times of the year. Furthermore, because fruits spoil quickly, there are often higher post-harvest losses. Preserving the fruits in processed form without significantly reducing their nutritional content is the only approach to ensure their year-round availability **(Srivastava and Kumar, 2002).**

For the majority of fruits, including citrus, mango, banana, and grape, processing criteria have been established. On the other hand, tamarind has not received much attention. Africa is the native fruit of the tamarind. Tamarindus indica L. is its botanical name, and it is a member of the Leguminosae family. Because it provides shade and shelter, tamarinds are highly valued **(M.D. Chaturvedi, 1956).**

It's one of the most significant tropical fruit trees, and it grows all over India. It produces 150–500 kg of fruits annually, with a weight range of 15–30 gram (Duke, 1981). Only a few types of tamarind are cultivated in India; some are sour and some are sweet. The most significant portion of the tree is its fruit, which is also the most acidic of all fruits and contains 8–18% tartaric acid, an unusual plant acid (Duke, 1981). India is the world's largest producer and user of tamarind. An estimated 3,00,000 MT of fruits are produced in India each year, and the country exports tamarind goods valued at Rs. 50.0 crores.

The pulp has high concentrations of iron (17 mg/100 g), calcium (17 mg/100 g), and phosphorus (110 mg/100 g). The primary ingredient in sour culinary dishes like as chutneys, sauces, sambar, rasam, and other drinks is tamarind pulp. The crucial raw ingredient used to make tamarind pulp concentrate and soft drinks is fruit pulp. In many affluent nations, the local candy sector makes substantial use of the fruit pulp (Lewis, 1964).

In recent years, there has been a growing interest in value addition processes aimed at enhancing the shelf life, palatability, and marketability of mango products, including jams. Value addition in mango jam involves the incorporation of novel ingredients, optimization of processing techniques, and exploration of innovative packaging solutions to cater to evolving consumer preferences and demands **(Reddy et al.,2018).**

2. MATERIALS AND METHODS

The current study, “Value addition and standardization of Mango Jam” was carried out in 2023 in the post-harvest laboratory of Department of Horticulture, at the Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.), India. In this study, the design used for the analysis of variables was completely Randomized Design (CRD) with 7 treatments which comprises of four replication in terms of storage days. The table below contains details on the treatments:

List 1: List of the treatment notions and their treatment combination.

Treatment Notion	Treatment combination
T_0	Control
T_1	Mango + Tamarind + Sugar (60%) + Honey (40%)
T_2	Mango + Tamarind + Sugar (75%) + Honey (25%)
T_3	Mango + Tamarind + Sugar (90%) + Honey (10%)
T_4	Mango + Tamarind + Jaggery (60%) + Honey (40%)
T_5	Mango + Tamarind + Jaggery (75%) + Honey (25%)
T_6	Mango + Tamarind + Jaggery (90%) + Honey (10%)

METHODOLOGY

Material collection

Mango fruits sourced from local markets in Prayagraj district, Allahabad, underwent meticulous selection based on essential criteria like color, firmness, aroma, texture, weight, shape, blemishes, and the exclusion of foreign matter, ensuring the quality required for the study. Similarly, tamarind was also procured from the local markets in Prayagraj to be used in the jam preparation. The ripe mangoes and tamarind were then classified according to their maturity levels to facilitate the jam-making process. To uphold quality standards, any rotten or severely damaged fruits were excluded from consideration.

Mango Pulp and Tamarind Extract Preparation

The mangoes were thoroughly washed to remove any dirt or impurities. The fruits were then peeled, and the seeds were removed. The mango pulp was extracted by separating the flesh from the seed. For the specific preparation of mango jam with a 90% mango and 10% tamarind composition, the tamarind was extracted by soaking the tamarind fruit in water and then filtering the mixture to obtain the pulp. The mango pulp was then mixed with the tamarind pulp in a ratio of 9:1, ensuring the desired flavour profile. The mixture was then blended to create a smooth consistency, which was crucial for the final jam product.

Mango Jam Preparation

The extracted mango-tamarind pulp mixture was heated in a pot to boil, effectively killing any harmful bacteria present. Sugar or jaggery, honey, and citric acid were then added to the boiling pulp to enhance the flavor and sweetness, with the quantities adjusted based on taste preferences. Pectin was incorporated to improve the texture and consistency of the final product, ensuring proper setting. Sodium benzoate, a chemical preservative, was added to the mango-tamarind mixture to slow down the growth of germs and increase its shelf life. Every ingredient was added or subtracted as needed as the mixture was continuously watched to get the perfect thickness and flavor balance. The prepared mixture was then transferred into

sterilized bottles to maintain hygiene and prevent contamination. The filled bottles were allowed to cool down gradually to room temperature before sealing. Finally, labels were affixed to the bottles, indicating the treatment and replication numbers, and the jam was stored in a cool, dry place away from direct sunlight.

Experimental design

The study employed a Completely Randomized Design (CRD) with 4 replications to investigate the effects of storage period on the quality of mango jam. The treatment factors included four different storage periods: 1 days, 30 days, 60 days, and 90 days. Mango jam samples were stored at ambient temperature to simulate typical household storage conditions. Each treatment combination was replicated four times to ensure statistical robustness and to reduce experimental error. The data collected from the experiment will be analyzed using appropriate statistical methods to determine the effects of storage period on the quality attributes of mango jam.

3. RESULTS AND DISCUSSION

The physico-chemical properties, including T.S.S, pH, Acidity, Moisture content, Ascorbic acid with organoleptic properties such as color, taste, flavor, texture, and overall acceptability, were assessed to determine the nutritional value and sensory acceptability of the product.

Physicochemical Properties of Mango Jam

The current study's experimental findings on the value addition and standardization of mango jam (Mangifera indica) have been examined and analyzed in the context of earlier studies conducted both domestically and internationally. The experiment's outcomes are summed up as follows:

T.S.S

Table 1 presents data about total soluble solids, which show a significant difference across all treatments as well as a subsequence rise in total soluble solids. The maximum score for TSS were recorded in treatment T4 [Mango + Tamarind + Jaggery (60%) + Honey (40%)] which is (67.73°Bx , 67.89°Bx, 67.93°Bx, 68.17°Bx) followed by T2 [Mango + Tamarind + Sugar (75%) + Honey (25%)] which attained (67.68°Bx, 67.73°Bx, 67.79°Bx, and 68.12°Bx). Significantly, the lowest total soluble solid was measured in T0 (control) at 1 day, 30, 60, and 90 days of storage, with values of 66.38°Bx,66.54°Bx,66.74°Bx,and 66.82°x, respectively. A slight increase in Total Soluble Solids (TSS) during storage may be attributed to the conversion of polysaccharides into sugars through the hydrolysis process. This observation aligns with the findings of Vikram and Prasad (2014), who noted compositional changes in value-added kinnow-Aonla Ready-to-Serve (RTS) beverages, showing an increase in TSS levels over a six-month storage period. Similarly, **Jain et al. (2007)** reported a similar trend in Aonla RTS beverages, indicating an increase in TSS levels during storage.

Acidity

Table 1 can be used to see that all treatments had a substantial effect during the storage period. Treatment T4 [Mango + Tamarind + Jaggery (60%) + Honey (40%)] earned the

highest possible acidity score which is (2.32, 2.41, 2.34, 2.32) followed by T2 [Mango + Tamarind + Sugar (75%) + Honey (25%)] which attained (2.13, 2.15, 2.17, 2.09). However significantly the minimum acidity was recorded in T3 [Mango + Tamarind + Sugar (90%) + Honey (10%)] with (1.14, 1.92, 1.17, 1.25) after being stored for 1, 30, 60 and 90 days. Similar results were reported by **Jaiswal et al. (2008)**, who found that degradation of pectin substances into soluble solids might have contributed towards increasing the level of acidity in aonla jam during storage.

pH

There was a significant difference across all treatments and a subsequence increase in pH, according to the pH data shown in Table 1. The pH maximum score was noted in treatment T4 [Mango + Tamarind + Jaggery (60%) + Honey (40%)] which is (3.47, 3.16, 2.91, 2.86) followed by T2 [Mango + Tamarind + Sugar (75%) + Honey (25%)] which attained (3.17, 3.09, 2.92, 2.84). Significantly, the lowest pH was, however, measured in T0 (control) at 1 day, 30, 60, and 90 days of storage, with values of 3.04, 2.90, 2.85, and 2.78, respectively. Variations in pH during storage may be due to change in chemical properties which are affected by storage conditions. This finding agreed with the finding of **Rayguru et al., (2008) and Vikram and Prasad (2014),** also reported similar trend in apple jam.

Moisture content

Table 2 displays the moisture content data, which show a substantial difference across all treatments as well as a subsequence rise in moisture content. The highest possible moisture content score of (29.67, 29.66, 29.86, 29.92) was obtained in treatment T3 [Mango + Tamarind + Sugar (90%) + Honey (10%)], which was followed by T1 Mango + Tamarind + Sugar (60%) + Honey (40%)] with (27.88, 27.83, 26.91, 26.92). At 1, 30, 60, and 90 days of storage, respectively, T0 (control) had the lowest moisture content reported, with values of (25.71, 25.81, 25.84, and 25.91). It is the dehydration phenomena that causes the rise in moisture content. **Ferdous and Alim (2018)** also came to similar conclusions.

Ascorbic acid

Data on ascorbic acid are shown in Table 2, which again indicates a subsequence decline in ascorbic acid and a significant difference across all treatments. In treatment T4 [Mango + Tamarind + Jaggery (60%) + Honey (40%)], the highest ascorbic acid score was noted which is (17.26, 16.88, 15.93, 14.75) followed by T2 [Mango + Tamarind + Sugar (75%) + Honey (25%)] which attained (17.16, 16.33, 15.27, 14.35). However significantly minimum ascorbic acid was recorded in T6 [Mango + Tamarind + Jaggery (90%) + Honey (10%)] with (15.30, 13.77, 12.13, 11.89) at 1 days as well as 30, 60 and 90 days of storage respectively. This pattern of decreasing of ascorbic acid (mg/100g) during storage might be due to an increase in temperature level which was affect the ascorbic acid due to its thermolabile nature which was destroyed with temperature during storage period. Moreover, it may probably due to the process of oxidation of ascorbic acid into dehydroascorbic acid by enzyme ascorbinase. This kind of similar observations were also recorded by **Shakir *et al.* (2008)** in apple and pear mixed fruit jam and **Sawant *et al.* (2009)** in kokam + pineapple blended jam. Similarly, the decreasing

trend of the ascorbic acid over storage period was given by **Patel *et al.* (2015)** in Pineapple blended with banana jam.

Table 1: Treatment effects in terms of TSS, acidity, and pH, a measure of physico-chemical analysis.

Treatment notion	Treatment combination	T.S.S. Storage period (Days)				Acidity (%) Storage period (Days)				pH (%) Storage period (Days)			
		1 day	30 days	60 days	90 days	1 day	30 days	60 days	90 days	1 day	30 days	60 days	90 days
T_0	Control	66.38	66.54	66.74	66.82	1.89	1.96	2.00	1.91	3.04	2.90	2.85	2.78
T_1	Mango + Tamarind + Sugar (60%) + Honey (40%)	67.41	66.33	67.38	67.61	1.95	2.01	2.03	1.93	3.10	2.93	2.89	2.80
T_2	Mango + Tamarind + Sugar (75%) + Honey (25%)	67.68	67.73	67.79	68.12	2.13	2.15	2.17	2.09	3.17	3.09	2.92	2.84
T_3	Mango + Tamarind + Sugar (90%) + Honey (10%)	66.83	67.72	67.73	67.78	1.14	1.92	1.17	1.25	3.08	2.92	2.82	2.76
T_4	Mango + Tamarind + Jaggery (60%) + Honey (40%)	67.73	67.89	67.93	68.17	2.32	2.41	2.34	2.32	3.47	3.16	2.91	2.86
T_5	Mango + Tamarind + Jaggery (75%) + Honey (25%)	67.02	67.12	67.38	67.66	1.65	1.69	1.68	1.71	3.15	2.91	2.83	2.79
T_6	Mango + Tamarind + Jaggery (90%) + Honey (10%)	66.45	66.54	67.04	67.08	1.90	1.93	1.96	2.02	3.14	3.07	3.00	2.90
Mean		67.07	67.12	67.46	67.60	1.85	2.01	1.91	1.89	3.16	3.00	2.89	2.82
C.V.		0.11	0.28	0.31	0.26	3.87	1.98	2.60	2.25	1.91	1.86	2.71	1.32
F' test		S	S	S	S	S	S	S	S	S	S	S	S
S.E. (d)		0.05	0.13	0.15	0.12	0.05	0.03	0.04	0.03	0.04	0.04	0.06	0.03
C.D. at 5 %		0.11	0.27	0.31	0.25	0.11	0.06	0.07	0.06	0.09	0.08	0.11	0.05

Table 2: The effects of various treatments on ascorbic acid and moisture content in terms of physico-chemical analysis.

Treatment notion	Treatment combination	Moisture content (%) Storage period (Days)				Ascorbic acid (mg/ 100g) Storage period (Days)			
		1 day	30 days	60 days	90 days	1 day	30 days	60 days	90 days
T_0	Control	25.71	25.81	25.84	25.91	14.76	13.95	12.94	12.64
T_1	Mango + Tamarind + Sugar (60%) + Honey (40%)	27.88	27.83	26.91	26.92	16.42	15.65	14.75	13.72
T_2	Mango + Tamarind + Sugar (75%) + Honey (25%)	27.86	26.91	26.92	26.94	17.16	16.33	15.27	14.35
T_3	Mango + Tamarind + Sugar (90%) + Honey (10%)	29.67	29.66	29.86	29.92	15.95	15.01	14.66	14.11
T_4	Mango + Tamarind + Jaggery (60%) + Honey (40%)	26.76	26.79	26.82	27.02	17.26	16.88	15.93	14.75
T_5	Mango + Tamarind + Jaggery (75%) + Honey (25%)	25.78	25.80	25.91	26.11	16.91	15.11	14.11	13.10
T_6	Mango + Tamarind + Jaggery (90%) + Honey (10%)	27.54	27.62	26.27	27.13	15.30	13.77	12.13	11.89
Mean		27.31	27.20	26.93	27.13	16.25	15.24	14.25	13.51
C.V.		0.17	0.15	0.14	0.23	0.28	0.38	0.46	0.53
F' test		S	S	S	S	S	S	S	S
S.E. (d)		0.03	0.03	0.04	0.05	0.03	0.04	0.05	0.05
C.D. at 5 %		0.07	0.06	0.08	0.09	0.07	0.09	0.10	0.11

Table 3. The effects of various treatments on colour and appearance, taste and flavour in terms of organoleptic evaluation.

Treatment notion	Treatment combination	Colour and appearance				Flavour and taste			
		Storage period (Days)				Storage period (Days)			
		1 day	30 days	60 days	90 days	1 day	30 days	60 days	90 days
T_0	Control	7.34	7.15	6.84	5.77	6.68	6.44	5.67	5.26
T_1	Mango + Tamarind + Sugar (60%) + Honey (40%)	7.51	7.29	7.15	6.36	7.33	7.26	7.20	6.45
T_2	Mango + Tamarind + Sugar (75%) + Honey (25%)	8.00	7.84	7.67	7.14	8.52	8.26	7.45	7.24
T_3	Mango + Tamarind + Sugar (90%) + Honey (10%)	7.84	7.84	7.33	6.86	7.84	7.60	7.26	7.19
T_4	Mango + Tamarind + Jaggery (60%) + Honey (40%)	8.17	8.01	7.84	6.94	8.66	8.45	7.52	7.36
T_5	Mango + Tamarind + Jaggery (75%) + Honey (25%)	7.68	7.34	7.18	6.02	7.40	7.16	6.67	6.01
T_6	Mango + Tamarind + Jaggery (90%) + Honey (10%)	7.66	7.16	7.01	5.84	7.16	6.83	6.40	6.16
Mean		7.74	7.52	7.29	6.42	7.65	7.43	6.88	6.52
C.V.		2.01	1.42	0.99	0.82	0.67	0.85	0.96	1.21
F' test		S	S	S	S	S	S	S	S
S.E. (d)		0.11	0.08	0.05	0.04	0.04	0.04	0.05	0.06

Table 4. The effects of various treatments on texture score and overall acceptability in terms of organoleptic evaluation.

Treatment notion	Treatment combination	Texture score				Overall acceptability			
		Storage period (Days)				Storage period (Days)			
		1 day	30 days	60 days	90 days	1 day	30 days	60 days	90 days
T_0	Control	7.34	6.71	6.46	6.10	7.12	6.77	6.32	5.71
T_1	Mango + Tamarind + Sugar (60%) + Honey (40%)	7.50	7.10	6.75	6.27	7.45	7.22	7.03	6.36
T_2	Mango + Tamarind + Sugar (75%) + Honey (25%)	7.92	7.68	7.44	7.12	8.15	7.93	7.52	7.17
T_3	Mango + Tamarind + Sugar (90%) + Honey (10%)	7.58	7.30	7.09	6.74	7.75	7.58	7.23	6.93
T_4	Mango + Tamarind + Jaggery (60%) + Honey (40%)	7.70	7.43	7.21	6.68	8.18	7.96	7.52	6.98
T_5	Mango + Tamarind + Jaggery (75%) + Honey (25%)	7.20	7.08	6.36	5.78	7.43	7.19	6.74	5.94
T_6	Mango + Tamarind + Jaggery (90%) + Honey (10%)	7.01	6.58	6.11	5.69	7.28	6.86	6.51	6.29
Mean		7.46	7.12	6.77	6.34	7.62	7.36	6.98	6.48
C.V.		0.73	1.18	0.80	1.01	3.36	3.42	4.26	4.34
F' test		S	S	S	S	S	S	S	S
S.E. (d)		0.04	0.06	0.04	0.05	0.18	0.18	0.21	0.20

Organoleptic Properties of Mango Jam

A slightly declining trend score card for color and appearance among the treatments was evident from the statistically examined data displayed in Table 3. The highest color and appearance score card (8.17, 8.01, 7.84, 6.94) was obtained in treatment T4 [Mango + Tamarind + Jaggery (60%) + Honey (40%)]. This was followed by T2 [Mango + Tamarind + Sugar (75%) + Honey (25%)], which achieved (8.00, 7.84, 7.67, 7.14). Nonetheless, T0 (control) showed the least amount of color and appearance (7.34, 7.15, 6.84, 5.77) at 1 day, 30, 60, and 90 days of storage, respectively. The statistical analysis of the data in Table 3 shows a significant declining trend in the scorecard. T4 [Mango + Tamarind + Jaggery (60%) + Honey (40%)] achieved the highest flavor and taste score of 8.66, 8.45, 7.52, 7.36) followed by T2 [Mango + Tamarind + Sugar (75%) + Honey (25%)], which achieved 8.52, 8.26, 7.45, 7.24. Significantly, the lowest flavor and taste were noted in T0 (control) at 1 day, 30, 60, and 90 days of storage, respectively, with values of 6.68, 6.44, 5.67, and 5.26. In storage, the jam's color and flavor progressively faded over time, but its consistency held steady. Among the treatments, T0 showed early sign of microbial growth, indicating a link to deterioration. The study suggests that storing mango jam at room temperature for upto 90 days may result in better acceptability.

Table 4 displays the statistically examined data, which indicated a pattern of slightly declining texture score score cards among the treatments. Treatment T2 [Mango + Tamarind + Sugar (75%) + Honey (25%)] achieved the highest texture score (7.92, 7.68, 7.44, 7.12) while T4 [Mango + Tamarind + Jaggery (60%) + Honey (40%)] achieved the second-highest score (7.70, 7.43, 7.21, 6.68). The statistically analyzed data presented in Table reveals a notable decreasing trend score card, with the maximum score for overall acceptability recorded in T4 [Mango + Tamarind + Jaggery (60%) + Honey (40%)] at (8.18, 7.96, 7.52, 6.98) followed by T2 [Mango + Tamarind + Sugar (75%) + Honey (25%)] at (8.15, 7.93, 7.52, 7.17). However, a significantly lower minimum texture score was recorded in T6 [Mango + Tamarind + Jaggery (90%) + Honey (10%)] with (7.01, 6.58, 6.11, 5.69) at 1 day as well as 30, 60, and 90 days of storage, respectively. Significantly, the lowest flavor and taste were noted in T0 (control) at 1 day, 30, 60, and 90 days of storage, respectively, with values of 7.12, 6.77, 6.32, and 5.71. Overall acceptability scores were decreased in all the treatments during storage due to decline in colour, consistency and flavour scores. Similar results were reported by **Sogi and Singh (2001), Jadhav.et al. (2006)** in aonla beverages**.**

4. CONCLUSION

The physico-chemical analysis of the mango jam treatments revealed that the T4 formulation, consisting of mango, tamarind, 60% jaggery, and 40% honey, performed the best in terms of total soluble solids (TSS), pH, acidity, moisture content, and ascorbic acid content. The organoleptic assessment also showed that the T4 treatment, with the same composition as above, scored the highest in color and appearance, flavor and taste, texture, and overall acceptability. The study also found that the mango jam scored better in color and appearance, aroma, taste, texture, and overall acceptability when stored at cold temperature than at room temperature.

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