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Research Paper

Production and Evaluation of Physicochemical and Organoleptic Characteristics of Papaya–Orange Blended Jam

Rahm Dil[1*], Raheela Razzaq[2], Zahoor Ahmed[1], Pawan Kumar[1], Muhammad Dawood[1], Fareed Ahmed[1], Imtiaz Ghafoor[3], and Aamir Azeem[1]

[1]*Institute of Food Sciences and Technology, Sindh Agriculture University, Tandojam, Pakistan*

[2]*National Institute of Food Science and Technology, University of Agriculture, Faisalabad, Pakistan*

[3]*Food Department Balochistan, Quetta, Pakistan*

**Corresponding Author's email:* rahmdil.baloch55@gmail.com

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Abstract

Jams are nutritious and delicious spreads generally developed from fruit, sugar, and pectin, ensuring the accessibility of fruits during the off-season. The present study aimed to develop papaya-orange blended jam and to evaluate its physicochemical and organoleptic characteristics. Four variations of papaya-orange jams were prepared, which included T_1 (100% papaya), T_2 (75:25 papaya-orange), T_3 (50:50 papaya-orange), and T_4 (25:75 papaya-orange). Among different treatments, the T_2 treatment was found to be the best based on physicochemical and organoleptic evaluation which resulted in a pH value of 4.78, TSS 68.13°Brix, moisture 35.47%, ash 1.09%, vitamin C 1.99 mg/g, titratable acidity 1.95%, dry matter 64.49%, color 8.00, texture 7.66, taste 8.33, aroma 8.00 and overall acceptability 8.66. This was followed by T_4 with a pH value of 4.24, TSS 67.90°Brix, moisture 30.51%, ash 0.98%, vitamin C 1.86 mg/g, titratable acidity 1.65%, dry matter 69.39%, color 7.33, texture 7.00, taste 8.00, aroma 7.66, and overall acceptability 8.00. Treatment T_3 showed a pH value of 4.09, TSS 67.77°Brix, moisture 27.39%, ash 0.92%, vitamin C 1.74 mg/g, titratable acidity 1.52%, dry matter 72.48%, color 6.66, texture 6.66, taste 7.00, aroma 7.00, and overall acceptability 7.00. While the lowest scores were recorded in T_1, i.e., pH value 3.86, TSS 67.66°Brix, moisture 24.90%, ash 0.82%, vitamin C 1.31 mg/g, titratable acidity 0.98%, dry matter 75.01%, color 6.33, texture 6.00, taste 6.00, aroma 6.00, and overall acceptability 6.00. Thus, based on observed results, the T_2 treatment was found to have the optimum physicochemical and organoleptic properties, and a blend of papaya-orange fruits could be successfully utilized in fruit jam development to enhance the physicochemical and organoleptic properties of the jam.

Introduction

Fruits are also regarded as being significant in a healthy diet because they are rich in nutritional value (Friday et al., 2021). During their seasons of growing, fruits are normally abundant but are limited during off season. When the fruits are improperly handled during the different periods of the year, there could be huge losses after harvest and result in financial losses to the growers and the retailers (Akter et al., 2022). Fruits are highly healthy and give an individual the necessary daily dose. They can be made into various products, which include fruit juice, jellies, marmalade and jam to minimize the losses that occur after harvesting (Adegbanke, 2025). Fruit jam is associated with convenience, sensory, and nutritional benefits throughout the off-season and are one of the most eaten preserved fruit products across the world (Basary et al., 2022). Jam is an add-modern and traditional product that is taken on the daily basis. It is among the optimal methods of preservation in order to extend the shelf life of fruits. It is produced through boiling of the fruit pulp and sugar. It can also improve its functions via some other ingredients like coloring agents, flavoring agents and preservatives. New innovative products that contain good nutrition profiles should be developed due to the closure of the growing demand of flavor products. Today, mixed jams are used as a favorite item in the daily menu as the new flavour products are more demanded. Nonetheless, mixed fruit jams do not receive a close examination in comparison to single fruit jams (Maimaitiyiming et al., 2024).

A commercially produced tropical and subtropical fruit crop in the world is Papaya (*Carica papaya* L.) and ranks among the top most fruit products high in nutrients (Chinnasamy et al., 2025). There are important nutrients that are present in papaya i.e. dietary fiber, Vitamins (i.e. A, C, B, and E), minerals (i.e. potassium, magnesium), Bioactive compounds (i.e. antioxidants, flavonoids, phytosterols, phenolic compounds) as well as enzymes (i.e. Chymopapain and Papain). It is also rich in glycosids and carotenoids, pantothenic acid and folate. It has great medical properties, such as anti-fungal, antimicrobial, anti-fertility, anti-amoebic, anthelmintic, antimalarial, immunomodulatory, and hepatoprotective effects, which makes it a significant component of the natural medicine field (Ugbogu et al., 2023). Nevertheless, it has a high moisture content and is not practical to use due to its perishability.

Making papaya fruit into fruit jam extends its shelf life and improves the economic value (Tessalonika et al., 2022). The papaya is a very versatile fruit with numerous applications applied in the world in various ways. Although the green papaya is typically eaten in savory meals that are made using green papaya that have not been fully ripened, the ripe and mature fruits are generally turned into food items like candies, pickles, sauces, and jam. It also finds applications in numerous culinary and drug preparations because it can be used in different ways (Suryawanshi et al., 2022). A large area of application is in the manufacture of fruit jam which is a popular and well eaten nutritious breakfast beverage. These practices, which entail the transformation of perishable fruits into jams and jellies, are not only beneficial in finding their way into the intestines but also curb postharvest losses (Kaur et al., 2024).

Most commonly referred to as mandarins, tangerines, and sweet oranges (Malta), oranges constitute the largest consumed citrus fruit in the world and is responsible almost 13% of all fruit production in the world (FAO, 2024). Oranges are widely known by their taste and flavor, its outstanding versatility, and its fantastic health qualities (Cervoni, 2021). Oranges are rich in bioactive compounds, including folic acid, minerals, and polyphenols that play an important role in the nutritional and health of the body (Riaz et al., 2022). The oranges play a major role in composite jams since they give it a fresh, colourful flavour that increases the intrigue and flavour pleasures. The current research paper aims at formulating and establishing the physicochemical and organoleptic properties of fruit jam produced using a combination of papaya and orange.

Materials and Methods

Sample collection

The jam was made by buying fresh papaya and orange fruits, sugar, pectin, citric acid and others in one of the local markets, Hyderabad City and transferring them to the Institute of Food Science and Technology laboratory at Sindh Agriculture University, Tandojam.

Information about different treatments used in the present study

It used a formulation recipe of papaya-orange jam in conducting several trial experiments. Different proportions of papaya and orange fruits were employed to come up with a blended jam of the papaya and orange fruits. The control used in treatment T1 involved the use of 200g (100) papaya fruit pulp alone and other ingredients. Papaya pulp 150g of orange pulp 50g equivalent ratio was used in T2. T3 was formulated using 100g of papaya fruit pulp and 100g of orange fruit pulp in a 50:50 ratios. T4 treatment was made using 150g of orange fruit pulp and 50g of papaya fruit pulp in a ratio of 75: 25.

Table 1. Treatment plan/ingredients used in papaya-orange jam preparation

T1 (Treatment 1)	Papaya	100%	200 g
	Orange	-	-
	Water		50ml
	Sugar	75%	150 g
	Citric acid	0.25%	0.5 g
	Pectin	1%	2 g
T2 (Treatment 2)	Papaya	75%	150 g
	Orange	25%	50 g
	Water		50ml
	Sugar	75%	150 g
	Citric acid	0.25%	0.5 g
	Pectin	1%	2 g
T3 (Treatment 3)	Papaya	50%	100 g
	Orange	50%	100 g
	Water		50ml
	Sugar	75%	150 g
	Citric acid	0.25%	0.5 g
	Pectin	1%	2 g
T4 (Treatment 4)	Orange	75%	150 g
	Papaya	25%	50 g
	Water		50ml
	Sugar	75%	150 g
	Citric acid	0.25%	0.5 g
	Pectin	1%	2 g

Preparation of sample

Figure 1 was used to prepare papaya-orange blended jam. The green and yellow papaya and orange fruits were first wiped and soaked in tap water to get away dust, dirt, or debris. After the washing, the fruits were peeled and sliced (with stainless steel knives) and then their seeds were taken out. The pulp of the papaya and oranges fruits was weighed and placed in a stainless-steel pan and cooked under different ratios based on the treatments. This was to ensure the pectin did not clot, by swirling the fruit pulp throughout the heating process. The heating mixture was added to which the sugar was to dissolve, and then the mixture was boiled until the concentration of the total soluble solids (TSS) in the jam was 66–68°Brix. The successful jams had then been placed in sterile glass. The filling was done in a short time in order to prevent contamination. The glass bottles were filled, left to cool at ambient temperature, and refrigerated at 42^{o} C to be examined on the basis of organoleptic and physicochemistic parameters.

Selection of fresh and ripe fruits (Papaya and Oranges)
↓
Washing with clean tap water
↓
Peeling, pulping, and cutting into small pieces
↓
Weighing the fruit pulp according to Treatments (T_1–T_4)
↓
Mixing with other ingredients
↓
Cooking the mixture with continuous stirring
↓
Jam setting test (Drop test on cold plate)
↓
Filling the hot fruit jam into sterilized glass bottles
↓
Cooling at room temperature
↓
Storage in the refrigerator at 4 ± 2 ºC

Figure 1. Flow diagram for the processing of papaya and orange to make jam

Physicochemical analysis

The pH of the samples was calculated after AOAC (2016) with the assistance of the digital pH meter. The method of Mazumdar and Majumder (2021) was used to estimate Total Soluble Solids (TSS). The level of moisture in the jam was measured as per the AOAC (2016) method. The content of the ash was identified based on the procedure described in AOAC (2016). The amount of vitamin C in jam was determined by the titration process, as reported by James (1995) and Mazumdar and Majumder (2021). The technique of AOAC (2016) has been used to assess titratable acidity. The content of dry matter (percent) of the samples by the AOAC (2016) method was calculated using the following equation:

$$\textbf{Dry matter content (\%)} = \textbf{100} - \textbf{moisture content \%}$$

Organoleptic analysis

Fruits jam samples were ready and offered to the Judges (academic staff and senior students of IFST) with coded samples and assessed on the basis of the nine-point hedonic scale (9 = like extremely to 1 = dislike greatly) given by Lawless and Heymann (1998) that were familiar and experienced in terms of organoleptic evaluation.

Statistical analysis

Statistical analysis Log of variance (ANOVA analysis) was applied to test the data obtained in the current research project. The method of calculating the significant differences in means described by Gomez and Gomez (1984) and relying on the least significant difference (LSD) at a 0.05% probability level was then used to determine the important differences in means.

Results

Physico-chemical composition of papaya-orange jam

The present study aimed to develop papaya-orange blend jam and to assess its various physico-chemical and organoleptic characteristics. The results showed that the maximum pH value was recorded in T_2 (4.78), followed by T_4 (4.24) and T_3 (4.09), while the minimum pH value was observed in T_1 (3.86) (Table 2). Similarly, T_2 had the highest total soluble solids (68.13 °Brix), followed by T_4 (67.90 °Brix) and T_1 (67.77 °Brix), while the lowest TSS (°Brix) was noted in T_3 (67.66 °Brix). Moisture content was also the highest in T_2 (35.47%), followed by T_4 (30.51%), and T_3 (27.39%), while the lowest moisture content was recorded in T_1 (24.90%). Ash content was also highest in T_2 (1.09%), followed by T_4 (0.98%) and T_3 (0.92%), while the minimum ash content was recorded in T_1 (0.82%). Vitamin C content was also highest in T_2 (1.99 mg/g), followed by T_4 (1.86 mg/g), and T_3 (1.74 mg/g), while the lowest Vitamin C content was observed in T_1 (1.31 mg/g). Titratable acidity content was recorded to be maximum in T_2 (1.95%), followed by T_4 (1.65%), and T_3 (1.52%), while the treatment T_1 showed the minimum titratable acidity content of 0.98%. Similarly, a higher dry matter content was recorded in T_1 (75.01%), followed by T_3 (72.48%) and T_4 (69.39%), while the minimum dry matter content was noted in T_2 (64.49%).

Organoleptic evaluation of papaya-orange jam

The organoleptic evaluation of papaya-orange jam revealed that the maximum scores for color (8.00), texture (7.66), taste (8.33), aroma (8.00), and overall acceptability (8.66) were recorded in the T_2 treatment, which consisted of 75:25 of papaya and orange. It was followed by the T_4 and T_3 treatment with scores of 7.33 and 6.66 for color, 7.00 and 6.66 for texture, 8.00 and 7.00 for taste, 7.66 and 7.00 for aroma, and 8.00 and 7.00 for overall acceptability, respectively. While the treatment T_1 showed the minimum scores for color (6.33), texture (6.00), taste (6.00), aroma (6.00), and overall acceptability (6.00).

Table 2. Physicochemical Properties of Papaya-Orange Jam

Treatments	pH value	TSS (°Brix)	Moisture (%)	Ash (%)
T_1	3.86 d	67.77 b	24.90 d	0.82 c
T_2	4.78 a	68.13 a	35.47 a	1.09 a
T_3	4.09 c	67.66 b	27.39 c	0.92 bc
T_4	4.24 b	67.90 ab	30.51 b	0.98 ab
SE ±	0.0668	0.1109	0.9561	0.0565
LSD 0.05	0.1541	0.2558	2.2047	0.1302

T_1 = Control (100% papaya), **T_2** = Papaya: Orange (75:25), **T_3** = Papaya: Orange (50:50), **T_4** = Papaya: Orange (25:75), **SE** = Standard Error, **LSD** = Least Significant Difference, (Mean values with different letters are significantly different at $p < 0.05$).

Table 3. Vitamin C, Titratable Acidity, and Dry Matter Content of Papaya-Orange Jam

Treatments	Vitamin C (mg g^{-1})	Titratable acidity (%)	Dry matter (%)
T_1	1.31 d	0.98 c	75.01 a
T_2	1.99 a	1.95 a	64.49 d
T_3	1.74 c	1.52 b	72.48 b
T_4	1.86 b	1.65 ab	69.39 c
SE ±	0.0236	0.1379	0.9561
LSD 0.05	0.0544	0.3180	2.2047

T_1 = Control (100% papaya), **T_2** = Papaya: Orange (75:25), **T_3** = Papaya: Orange (50:50), **T_4** = Papaya: Orange (25:75), **SE** = Standard Error, **LSD** = Least Significant Difference, (Mean values with different letters are significantly different at $p < 0.05$).

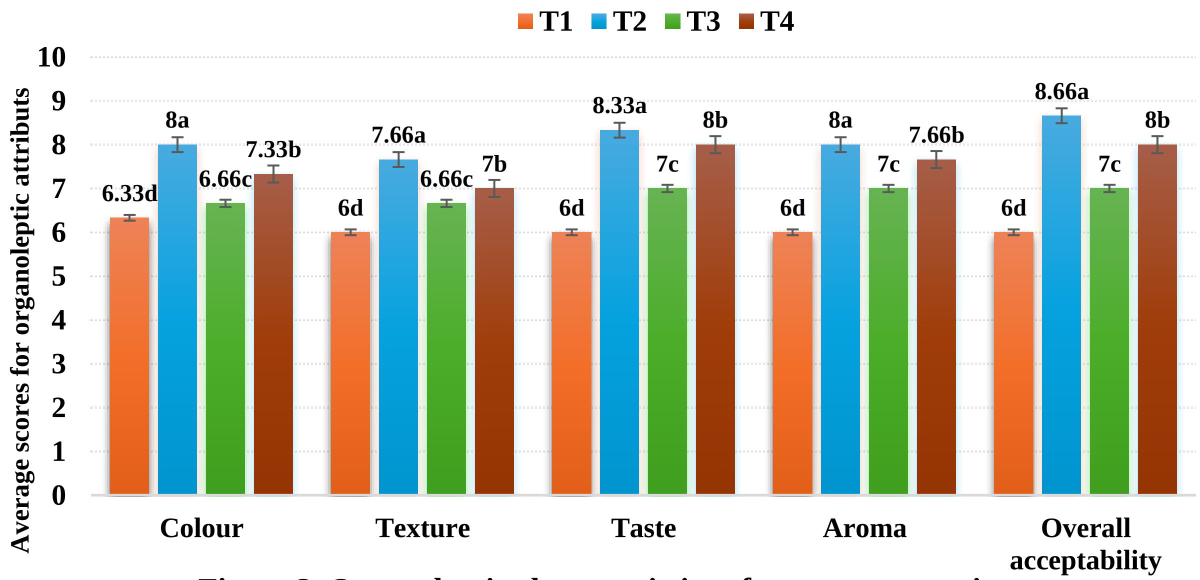

Figure 2. Organoleptic characteristics of papaya-orange jam

Discussion

The first jams were simply created to conserve the fruits in case they were required otherwise in the off-season. It is a medium moisture product that is produced after boiling of fruit pulp mix with sugar (sucrose), pectin, acid and other additives such as flavoring, coloring and preservatives to the extent that the mixture is thick and hard enough to sustain the fruit tissues (Baker et al., 2015; Kaur et al., 2009). Whether in current research, papaya and orange pulps modified into jam had a major effect of enhancing physicochemical characteristics such as TSS, TA, ash content, and vitamin C level while severely decreasing the moisture (%) and pH value. Manufacturing of papaya-orange mixed jam exemplified significant diversity in the physicochemical and organoleptic formulations among the various mixes of various treatments with T^2 recording a higher outcome in most of the parameters.

The measured pH values in all the treatments were between 3.86 and 4.78 with T_2 recording the highest pH (i.e. 4.78). This shows that there is a medium acidity which is likely because of the increased percentage of papaya pulp that is less acidic compared to the orange. Anwar et al. (2023) in a like study documented how papaya jams with the addition of date pit powder, immediately after their development, had pH values in the range of 3.51 3.70 and that their pH decreased during storage as a result of higher acid content owing to the degradation of sugar. Similar ranges of pH values were also reported by Makanjuola and Alokun (2019) in the fruit jam products that were prepared using tropical fruits, in which the combination of vegetables made the jam more balanced regarding acidity and increased the microbial stability. T_2 (maximum TSS 68.13 °Brix) was once again registered as the highest and this could be because papaya contains natural sugars and was well concentrated at the time of processing. Similar results were achieved by Pinandoyo et al. (2019), who have provided a TSS concentration of 68.00 °Brix content of protein-enriched papaya jam.

Increased moisture content (35.47) was observed in T_2 treatment which was an indication of the water-retention ability of papaya pulp. An increase in moisture retention may help in improving the texture although it, in this case, needs to be controlled so that it does not lead to microbial spoilage. The mineral content (measured as the ash content) also doubled considerably in T_2) where the value stood at 1.09. This is in line with Anwar et al. (2023), who added Gupta stand and Gupta wet did not observe any difference in papaya jams fortified with dates powder, in vitro levels of ash, within 0.35 -1.11. In a comparable test, Das et al. (2023) documented that an ash content of papaya-carrot blended jam was between 0.22 to 0.41 percent. T_2 also showed a higher Vitamin C content of 1.99mg/g which could be attributed to the fact that ascorbic acid could have been preserved in both fruits. Possibly, the synergistic effect of the papaya and orange fruit pulp saved the vitamin C in the heat process. Vitamin C content of fruit jams is less as compared to fresh fruits since it is lost during the cooking process that is undertaken in order to produce jam. Nevertheless, on average, fruit jam includes 5-25 mg of vitamin C per 100g (Shakir et al., 2024). Experiments found a consistent result with Awolu et al. (2018), who also found vitamin C in the range of 3.68-10.31mg 100g-1 in the blends of a pineapple-banana-watermelon pulp jam.

Titratable acidity showed the highest in T_2 (1.95%), thus showing that the presence of orange had an important effect on acid profile. This plays an indispensable role in the taste and the preservation of the jam. The long duration of preservation of the jams by the acid is to prevent microbial growth. The titratable acidity of fruit jam is significant as it influences the jam flavor, texture and shelf life of jam. The titratability of the acidity of the fruit jam depends not only on the number of natural acids in the fruits but also on how much citric acid or other acidic compounds are added to the jam (Shakir et al., 2024).

The relative content of dry matter was between 64.49 in T_2 and 75.01 in T1. Kantor et al. (2018) state that the dry matter percentage in commercial jam varies between 40 and 70. Nonetheless, homemade jams can be spread, between 20 percent and 70%. This may vary due to various reasons which include the type of fruit, how much sugar is added and the cooking method.

The organoleptic review of the generated jam corroborated the excellent acceptability of T_2 as the best scores were made on color and texture, taste and aroma as well as general acceptability. Good balance between sweetness (papaya) and tanginess (orange) explains the attractive sensory properties that make the product more flavorful. Sensory analysis is an important technique of evaluating the attributes of food items because it utilizes the human senses such as sight, smell, taste, touch as well as hearing. It is an important device that is used to determine the quality of food items and to determine desired qualities and confidence in homogeneous sensory characteristics (Adegbanke, 2025). Shakir et al. (2024) also obtained similar results in banana jam prepared using varying amounts of added pectin and various varieties of banana.

Generally, the treatment that offered the best result in terms of providing nutritional content and a jam that is palatable was T_2, which was a combination of 75% papaya and 25% orange. Besides improving the nutritive content, the effective incorporation of papaya and orange not only increased the consumer acceptability, but also, the formula has a high potential to be used in commercial jam production.

Conclusion

Judging by the results of the conducted research, it could be assumed that the mixing of papaya and orange fruits in different proportions had a great impact on the physicochemical and organoleptic features of the fruit jams created. Of all the treatments, T_2 blend with papaya-orange ratio of 75: 25 displayed the most desirable outcomes in terms of physicochemical and sensory characteristics, then T_4 and T_3 treatment followed with the lowest scores in the treatment. The observed findings show that a fruit blend of papaya and orange can be successfully employed in the production of fruit jam to enhance the product quality and its acceptability by the consumers.

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Conflict of Interest

The authors declare no conflict of interest.

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