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Physicochemical, Microbiological, Nutritional and Sensory Quality of Pineapple-Watermelon Jam

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ABSTRACT

This study focuses on the production and evaluation of jam made from pineapple (Ananas comosus) and watermelon (Citrullus lanatus) blends. The jams were analyzed for their proximate composition, physicochemical properties, microbiological quality, and sensory attributes. The proximate analysis revealed moisture content ranging from 49.64% to 54.91%, protein content from 11.35% to 15.72%, fiber content from 2.00% to 2.10%, fat content from 1.10% to 1.20%, and carbohydrate content from 27.04% to 35.62%. The increase in watermelon proportion resulted into higher moisture content, while pineapple-dominant samples exhibited increased protein and carbohydrate levels. The physicochemical analysis demonstrated vitamin C levels ranging from 22.08 to 30.12 mg/100g, pH values between 3.65 and 3.75, and total soluble solids (TSS) from 36.50% to 42.50%. Increasing watermelon content decreased the TSS and pH, while higher sugar concentrations were observed in pineapple-dominant samples. Microbial analysis revealed acceptable total viable bacterial and fungal counts, and all samples were free from coliform bacteria, indicating good sanitary conditions.
Sensory evaluation indicated significant differences in taste, texture, aroma, color, and overall acceptability among the samples. The control sample (100% pineapple) generally had the highest scores for most sensory attributes, although composite samples, especially Sample B (80% pineapple, 20% watermelon), showed favorable results in overall acceptability. This study highlights the potential of reducing post-harvest loss and blending pineapple and watermelon for producing high-quality jam with enhanced sensory properties.

Keywords: Nutrient, Watermelon, Pineapple, Fruit, Jam, Microbial, Physicochemical, Microbiological, Sensory Quality

Aims Research Journal Reference Format:
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1. INTRODUCTION

Fruits are essential sources of vital nutrients such as carbohydrates, vitamins, bioactive components, and minerals in the human diet. Despite their nutritional value, more than 30% of fruits are lost during and after harvest, leading to significant economic losses annually. One effective strategy to reduce postharvest losses is fruit processing, which not only extends shelf life but also provides growers with fair returns, thereby improving their financial standing (Dereje & Abera, 2020). By converting fruits into shelf-stable products like juice, fruit bars, jelly, and jam, processed fruit products become available to consumers year-round. Fruits are particularly prone to postharvest losses due to their high moisture content, which makes them perishable, especially in developing countries with limited postharvest infrastructure (Amjad et al., 2023).

Pineapple (Ananas comosus), a tropical fruit rich in natural sugars (sucrose, glucose, and fructose), minerals, and vitamins, is ideal for jam preparation due to its flavor and nutritional value. It is the third most produced tropical fruit globally, following bananas and citrus fruits (Ali et al., 2020). Watermelon (Citrullus lanatus) is another fruit with high water content, sweet taste, and antioxidant properties. Watermelon is typically consumed fresh or as juice, its rind, often discarded, can also be used in processed products like jam (Nadeem et al., 2022). Pineapple, a member of the Bromeliaceae family, is among the five most important tropical fruits worldwide, with several varieties available for both fresh consumption and processing (Gomez et al., 2022).

It is rich in antioxidants, phenolic compounds, and vitamins such as vitamin C and β-carotene, but its high moisture content makes it highly perishable (Mohsin et al., 2020). Similarly, watermelon is rich in lycopene, a powerful antioxidant with anti-cancer properties, and offers a unique nutritional profile that includes vitamins, minerals, and sugars (Ndanitsa et al., 2021; Narayanan et al., 2024). However, watermelon has high water activity and susceptibility to spoilage make it a challenging fruit to store (Zia et al., 2022).

In Nigeria, both watermelon and pineapple are primarily consumed fresh, which results in high postharvest losses during peak seasons due to poor handling and storage. Therefore, there is a need for affordable and easily adoptable food processing techniques to convert surplus fruit into shelf-stable products like jam. Such approaches would help reduce food waste and provide an economically viable alternative for preserving fruit during times of abundance. Jam is a nutrient-dense product that includes fibers, proteins, vitamins, and antioxidants (Rafique et al., 2023).

The process of jam production involves several stages: extracting, clarifying, boiling, and stabilizing the fruit pulp. The quality of the jam depends heavily on the concentration of ingredients, particularly sugar and pectin, as well as processing conditions (Chalchisa et al., 2022). In many countries such as Brazil, Chile, China, and India, fruit jam production is a significant industry, utilizing fruits like grapes, apricots, and pineapples (Owusu-Apenten & Vieira, 2023; Emelike & Akusu, 2019).

These two fruits can be effectively utilized in the production of jam, which offers a way to preserve their nutritional benefits while creating a product with a longer shelf life. The development of pineapple and watermelon jam not only addresses the issue of postharvest fruit losses but also offers consumers a novel, nutritious, and sensory-appealing product. This study aims to develop and evaluate the nutritional composition, sensory characteristics, and microbiological attributes of a jam produced from blends of pineapple and watermelon. By exploring this combination, the research seeks to create a sustainable and economically feasible product that could potentially reduce fruit waste and provide health benefits to consumers.

2. MATERIALS AND METHODS

2.1 Materials

The primary ingredients used in this study were pineapple (Ananas comosus), watermelon (Citrullus lanatus), and sugar, all of which were sourced from Under G market in Ogbomoso, Oyo State, Nigeria. The equipment utilized for jam production included a weighing scale, gas burner, cooking pot, thermometer, and blender. Additional tools and materials such as packaging jars, bowls, knives, a juice extractor, distilled water, muslin cloth, and stirrers were obtained from the Food Technology Laboratory at Ladoke Akintola University of Technology (LAUTECH), Ogbomoso.

2.2 Methods for Jam Production from Watermelon and Pineapple

The jam was produced following the method outlined by Salam et al. (2020), with slight adjustments. All equipment, including the packaging jars, knives, muslin cloth, preserving pans, and stirrers, was sterilized by heating for 15 minutes at 90°C. Fully ripe watermelons and pineapples were selected based on their color and the absence of defects, as overripe fruits may promote microbial growth. The fruits were thoroughly washed with distilled water, peeled, and rewashed to ensure they were clean. The mesocarp (flesh) was separated from the seeds, chopped into small pieces, and processed using a juice extractor. The juice was then filtered through a muslin cloth.

The blended watermelon and pineapple juices were transferred into separate pots and brought to a boil for 10 minutes at 88°C. Then, 100 g of sugar was added to each pot, and the mixture was stirred continuously until the sugar was fully dissolved. After this, 10 g of pectin was added, and after 5 minutes, 10 g of citric acid was incorporated. The mixture was continuously stirred until it thickened into a jelly-like consistency. After 35 minutes of cooking, the jam was immediately poured into sterilized packaging bottles, sealed, allowed to cool, and labeled for storage at 5 ^{o}C as shown in Figure 1 and Table 1 shows the formulation of watermelon and pineapple jam blends.

2.3 Proximate analysis

The four samples that was obtained from the processing of multiple fruit jam were subjected to proximate analysis (moisture, ash, protein, fat, crude fibre) while carbohydrate was determined by difference

2.3.1 Moisture content

The dish was placed in thermostatically controlled air oven at 103°C for about 30 min it was cooled in the desiccators and weighed. Five (5 g) of the sample was weighed into the dish. The dish containing the sample was placed in the oven for one hour, returned into the oven and the process repeated until a constant weight was obtained. (AOAC, 2012). All experiment was done in duplicate using:

$$\%\text{Moisture} = \frac{\left(\begin{array}{c}\text{Weight of can +}\\ \text{fresh sample}\end{array}\right) \text{- (Weight of can + dry sample)}}{\text{Weight of sample}} \times 10 \qquad \text{(i)}$$

2.3.2 Fat content

Sample of 3 g was weighed into the thimble, plugged with cotton wool and inserted into the Sox Tec HTz 25 – 50ml of the solvent (Hexane). It was poured into the extracting cups (with boiling chips). The extraction was carried out for 15 m in boiling position and for 30 – 45 min rising position. The solvent was evaporated and the cups dried at 100°C for 30 min, cooled in a desiccator and weighed (AOAC, 2012).

$$\%\ \text{Fat content} = \frac{\text{Weight of extracted matter}}{\text{Weight of sample}} \times 100 \qquad \text{(ii)}$$

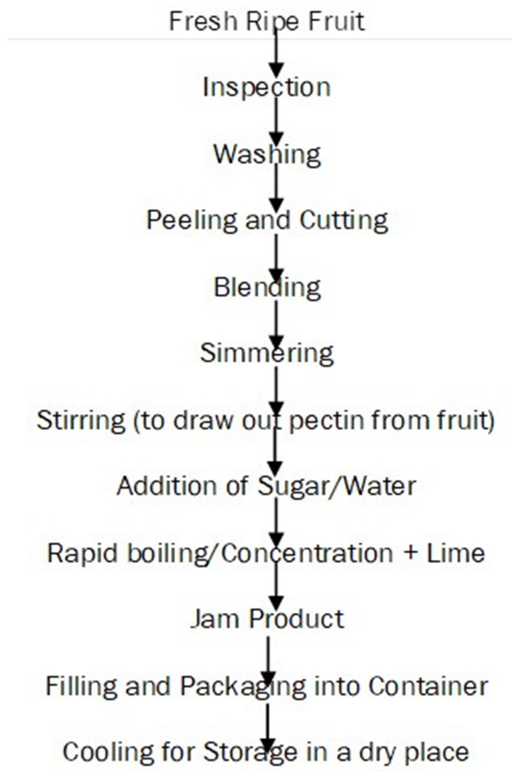

Fig 1: Flowchart for jam production

Table 1: Formulation of Watermelon- pineapple Jam

Ingredient	Sample A	Sample B	Sample C	Sample D
Pineapple (g)	100	80	70	60
Watermelon (g)	-	20	30	40
Sugar (g)	100	100	100	100
Lemon (ml)	10	10	10	10
Pectin (g)	10	10	10	10

2.3.3 Ash content

Crucibles were washed, dried in the oven, cooled and weighed. About two grams (2 g) of the dried sample was weighed into an empty porcelain crucible, ash in the muffle furnace at 500°C for 5 h in a pre-weighed crucible. The ash samples in the crucible were cooled in a desiccator and the ash content was determined.

$$\%\ \mathrm{Ash} = \frac{(\text{Weight of crucible+as }) - (\text{Weight of empty crucible})}{\text{Weight of sample}} \times 100 \qquad \text{(iii)}$$

2.3.4 Protein content

The protein content was determined by (AOAC, 2012) using micro Kjeldahl method. About 0.5g of dried sample was weighed into a digestion flask and 10 ml concentrated sulphuric acid (H_2SO_4) was added. Kjedhal tablet was also added and digestion flasks put into the digester at 400°C for 40 mins, until a clear solution is obtained. About 70 ml of the distilled water was added to prevent it from solidifying after digestion. The flask was placed in the distillation unit and 10 ml of 40% sodium hydroxide (NaOH) solution was dispersed to dilute the solution into it. The digest was distilled into 2.5ml of 40% boric acid for 5m. The distillate was titrated against 0.47 hydrochloric acid (HCl) until the permanent end point is obtained. Also, a blank was run first by titrating 5ml of 0.1NH_2SO_4 with 0.02N NaOH. The percentage was converted to crude protein by multiplying with a factor of 6.25.

2.3.5 Crude fibre content

Two grams (2g) of the sample was defatted during fat analysis. The defatted sample was boiled in 200 ml of 1.25% H_2SO_4 solution under reflux for 30 m. The sample was washed with several portions of hot (boiling) water using a filter paper to trap the particles (residue). The residue was carefully transferred back to the flask and 200ml of 1.25% NaOH solution was added to it. Again, the sample was boiled for 30 m and washed as before with hot water. Then it was transferred to a weighed porcelain crucible and dried in the oven at 105°C for 3 h. After cooling in a desiccator, it was weighed and then put in a muffle furnace and burnt at 550°C for 4 h until it became ash. Again, it was cooled in a desiccator and reweighed (AOAC, 2012).

$$\%\text{Crude fibre} = \frac{\text{weight of dried sample-weight of ash}}{\text{Weight of sample}} \times 100 \qquad \text{(iv)}$$

2.3.6 Carbohydrate content

The carbohydrate content was calculated by difference. The addition of fibre, moisture, protein, fat, ash and subtracting the value from 100 g represent the carbohydrate content of each of the samples. (AOAC, 2012).

$$100\% - (\%\text{ moisture} + \%\text{ Fat} + \%\text{ Ash} + \%\text{ Protein} + \%\text{ fibre}) \qquad \text{(v)}$$

2.4 Physiochemical analysis

2.4.1 pH

The pH of the sample extract of sample was measured by using a digital pH meter (Eu Tech, India). Before measuring the pH of samples, the pH meter was calibrated with standards buffer solutions of pH 4 and pH 7. The mean value of the triplicate reading was recorded to determine pH (AOAC, 2012).

2.4.2 Total Soluble Solids (TSS)

TSS of the samples were measured using a digital refractometer (Atago, Japan). For the measurement of TSS, the prism of the refractometer was cleaned and calibrated with distilled water. The results were expressed as °Brix. (AOAC, 2012).

2.4.3 Vitamin C determination

The Vitamin C of the different jam formulation was determined by using redox titration method (ShamsulAzrin, 2009). 2 g of jam sample was suspended in 20 mL of distilled water and the solution was stirred to homogenize the mixture. The mixture was then filtered through a muslin cloth to obtain the filtrate prior adding with 1 mL of the starch indicator. The solution was titrated with 0.005

mol/L iodine solution until the blue endpoint achieved. The vitamin C of the jam sample was expressed as mg of ascorbic acid/ 100 g of sample.

2.5 Microbiological analysis

2.5.1 Determination of Total Bacterial Count

Using a sterile syringe, 1 ml of each sample was transferred into 9 ml of sterile distilled water in a test-tube using a 10^{-4} serial dilution, 1 ml of the dilution was transferred into 9 ml of distilled water. The 10^{-4} dilution was plated by transferring 1 ml of the dilution into separate petri-dishes and sterile molten nutrient agar using pour plate method was added and mixed by swirling the plates before allowing it to solidify. The plates were inverted and incubated at 37 ºC for 24 h, and were examined for growth. Colonies were counted and recorded as total bacterial count.

$$\text{Total bacterial (cfu/ml)} = \frac{\text{Number of colonies } \times \text{dilution factor}}{\text{Volume of diluent plated}} \qquad \text{(vi)}$$

2.5.2 Determination of Total Coliform Count

Enumeration of total coliform bacteria was carried out using MacConkey agar by transferring 0.1ml of 10^{-4} dilution into MacConkey agar plate and spread using sterile glass spreaders. The petri dish was incubated at 37 ºC for 24 h. Thereafter, typical pinkish colonies were counted. The counts were presented as colony forming units per ml (CFU/ml).

2.5.3 Determination of fungi count

This involves the same procedures as bacterial count; however, Potato Dextrose Agar was used. After allowing the agar in the petri-dish to solidify, the plates were incubated at room temperature at 27 ºC for 48 h. After the incubation period, the plates were counted and recorded.

$$\text{Fungi count (cfu/ml)} = \frac{\text{Number of colonies } \times \text{dilution factor}}{\text{Volume of diluent plated}} \qquad \text{(vii)}$$

2.6 Sensory Evaluation

A comparative sensory evaluation of each of the sample was done by presenting the sample to a panel which consist of individuals who are familiar with the product. The panelists used the nine-point hedonic scale of preference to express the degree of like or dislike of the products. The quality factors that were assessed were; appearance, texture, aroma, taste and overall acceptability.

2.7 Statistical Analysis

All the analyses were carried out in triplicates. One-way analysis of variance (ANOVA) was carried out and mean separation was done with Duncan's Multiple Range Test (DMRT) with significant ($p<0.05$) difference on all the samples.

3. RESULT AND DISCUSSION

3.1 Proximate Composition of jam produced from pineapple and watermelon blends

The result of the proximate analysis of the composite jam is presented in Table 2. The moisture content ranged from 49.64 to 54.91%. The moisture content increased as the watermelon in the jam increases. Sample A as the lowest value of moisture content while Sample D had highest moisture content which may be as a result of combination of the fruits (pineapple, and watermelon in high proportion). The protein content of the pineapple jam ranged from 11.35% to 15.72%. Sample C, made up of (70% pineapple, and 30% watermelon) recorded high protein content of 15.72 %.

The protein content increased with increase in the substitution level of the fruits in sample (B and D). This result indicated that the blend samples had high protein content which was similar to the protein content of prickly pear pulp (7.02 - 8.51%) (Atef et al, 2013). There was a significant ($p \leq 0.05$) difference between the control sample A (100% pineapple) and the composite jam samples C (70% pineapple, and 30% watermelon with 0.07% and sample (B and C) with 0.02%. The fiber content of pineapple jam ranged from 2.00 to 2.10%. Sample A (pineapple 100%) has the lowest fiber content. Samples indicated a slight decrease as the concentration of sugar and the processing temperature increased. Besides, when compared with fresh pineapple fruit pulp, the crude fiber was low in the produced pineapple jam. This decrease can be attributed to the addition of sugar in the preparation of jam. Similarly, the loss of fiber was likely due to thermal degradation resulting in disruption of the polysaccharide network of the cell wall (Chalchisa et al., 2022) degradation because of the thermal treatment. There was no significant ($p \geq 0.05$) difference present in the ash contents between the samples. Ash content gives an indication of minerals composition of food sample is very important in many biochemical reactions which aid physiological functioning of major metabolic processes in the body (Ashaye et al, 2009).

The fat content of the control sample was high (1.20%). The result obtained from the study showed that the fat content was significant ($p < .05$) differently from each other. When comparing fresh fruit pulp with the corresponding developed fruit jam, it is observed that the operation condition led to a decrease in fat content. The fat content of pineapple jam slightly reduced as the concentration of sugar increased. This might be attributed to the ratio of composition of the fruit pulps to sugar. Higher temperatures contribute to a higher percentage reduction in fat content in a jam (Shinwari & Rao, 2018; Chalchisa et al., 2022). The carbohydrate content of the sample (A) is 35.62%. However, the carbohydrate content of the composite jams ranged from 30.60%-27.04% for sample B, C and D. The highest carbohydrate content observed in sample A might be attributed to the high carbohydrate content in pineapple (Huang et al, 2021). A significance ($p \leq 0.05$) difference was observed in the control and the composite samples; A (100% pineapple) Sample B (80% pineapple, and 20% watermelon) Sample C (70% pineapple, and 30% watermelon) Sample D (60% pineapple, and 40% watermelon).

Table 2: Proximate Composition of jam produced from pineapple and watermelon blends

Samples	Moisture	Protein	Fibre	Ash	Fat	Carbohydrate
A	49.645 ± 0.064^{a}	11.365 ± 0.021^{a}	2.000 ± 0.000^{a}	0.000 ± 0.000	1.200 ± 0.000^{b}	35.620 ± 0.354^{d}
B	51.335 ± 0.021^{c}	14.865 ± 0.021^{b}	2.100 ± 0.000^{b}	0.000 ± 0.000	1.100 ± 0.000^{a}	30.600 ± 0.042^{c}
C	51.210 ± 0.014^{b}	15.725 ± 0.035^{c}	2.100 ± 0.000^{b}	0.000 ± 0.000	1.100 ± 0.000^{a}	29.865 ± 0.049^{b}
D	54.905 ± 0.007^{d}	14.855 ± 0.035^{b}	2.100 ± 0.000^{b}	0.000 ± 0.000	1.100 ± 0.000^{a}	27.040 ± 0.042^{a}

Values represent means of triplicate reading, follow by different lowercase letter
Means within the same row with different alphabets are significantly different

- Sample A (100% pineapple)
- Sample B (80% pineapple, and 20% watermelon)
- Sample C (70% pineapple, and 30% watermelon)
- Sample D (60% pineapple, and 40% watermelon)

3.2 Physicochemical composition of jam made from pineapple and watermelon blends

The vitamin C content recorded was in the range of 22.08 to 30.12 mg/100 g on average (Table 3). The present result is in line with the reported values of Mieszczakowska-Frac et al. (2021) on jams. An increase in temperature increased the loss of vitamin C. Similar results were reported by Jawaheer et al. (2003) who observed 62.5% loss of ascorbic acid in guava jam after processing. Ascorbic acid is sensitive to heat, light and high temperature during processing.
Long-term heating in the presence of oxygen during processing can reduce the vitamin C content (Dereje and Abera, 2020).

The pH content of samples ranged from 3.65- 3.75 with Samples A (100% Pineapple) having the highest value and Sample C (70% pineapple and 30%watermelon) having the lowest value. There was significant difference ($p<0.05$) between the sample in terms of pH. The pH of jam is an important factor to obtain optimum gel condition. High acidity prevents the growth of food poisoning bacteria and also helps maintain the color and flavor of most fruits.

The pH in the present study was within the range 3.47 to 3.99 reported by (Babarinde et al., 2019) on matured overripe plantain jam. Long-term storage stability of fruit preparation is achieved through a combination of thermal processing, control of water activity and pH condition. Hence, it is important to control the pH values during jam processing to obtain a good quality product. The pH value of a food is directly related to the free hydrogen ions in that food and the recommended level of pH is in the range of 3.0 to 3.5 for jam (Chalchisa et al., 2022). Acids present in foods not only improve the palatability of many fruit products but also influence their nutritive value by playing a significant role in the maintenance of acid-base balance in the body.

The sugar content measured in (ºBrix) ranged from 42.50%-36.50% with samples A (100% Pineapple), having the highest sugar content of 42.50%, while samples D (60% pineapple, and 40% watermelon) have the least sugar content of 36.50%. This is expected as sugar content is a function of its quantity, which could also, serves as preservative in jam. In support of the present study, Valliath et al. (2023) stated that one of the most important constituents of fruit is sugar which functions as a sweetener and as a natural food preservative. Reducing the amount of sugar in the production of Jam preserves will upset the balance of fruit, sugar and pectin needed to ensure the jam or jelly sets. The five samples with different formulations were significantly different at ($p<0.05$) which played a role in gel formation to retard the microbial growth. Bernardino-Nicanor et al. (2015) reported that 60ºbrix is recommended for proper gel formation. Sugars are the most important constituents of fruits as well as preserves and are essential factors for the flavor of such foods.

Table 3: Physicochemical composition of jam produced from pineapple and watermelon blends

Samples	Vitamin C(mg)	pH	TSS (mg/L)
A	$22.080±0.084^{a}$	$3.750±0.071^{c}$	$42.500±0.000^{d}$
B	$22.630±0.042^{b}$	$3.650±0.071^{ab}$	$38.500±0.000^{b}$
C	$26.685±0.064^{c}$	$3.600±0.000^{a}$	$40.000±0.000^{c}$
D	$30.120±0.127^{d}$	$3.700±0.000^{ab}$	$36.500±0.000^{a}$

Values represent means of triplicate reading, follow by different lowercase letter
Means within the same row with different alphabets are significantly different ($p≤0.05$)
TSS: Total soluble solid.
Sample A (100% pineapple) ; Sample B (80% pineapple, and 20% watermelon)
Sample C (70% pineapple, and 30% watermelon) ; Sample D (60% pineapple, and 40% watermelon)

3.3 Microbiological Analysis of jam produced from pineapple and watermelon blends

Table 4 shows the microbial analysis (cfu/ml) of jam produced from watermelon and pineapple. The total viable bacterial count (plate count) is a measure of the hygienic quality of the water and not necessarily a measure of its suitability for consumption. Total bacteria count ranging from 1.00×10^4cfu/ml – 6.00×10^4cfu/ml with Sample D having the highest count and Sample C with the lowest count. The total plate counts do not exceed the standard ($\times 10^4$cfu/g) (Conference Organizing Committee, 2024). The reduction in the microbial levels may be due to the intense heat application involved in jam production as well as the high pH and the sugar content of the product.

The total fungi count ranging from 5.05×10^4cfu/ml to 9.10×10^4cfu/ml with Sample C having the highest count and sample D having lowest count. It was noticed that colony forming units were reduced with the increasing of samples acidity level. (Bazaraa et al., 2023) and (Brandao et al., 2018) also found an opposite relation with samples acidity to the mold colony forming units.

Total coliforms include bacteria that are found in the soil, in water that has been influenced by surface water, and in human or animal waste (Aram et al., 2021). There is absence of coliform in the samples. Also, the total absence of coliform group in all the samples confirms the good sanitary condition of the Jam preparation process. Also, these indicated that one of the most common applications of coliform bacteria as indicator organisms is in their association with hygienic conditions and overall quality, especially concerning heat processed foods, as they are killed by most heat processing conditions; therefore, their presence in a food generally indicates an inadequate heat process or post-processing contamination (Tong et al., 2025).

Table 4: Microbiological Analysis of jam produced from pineapple and watermelon blends

Samples	Bacterial	Fungi	Coliform
A	$1.05 \times 10^4 \pm 0.124^b$	$8.70 \times 10^4 \pm 0.171^c$	0.000
B	$2.00 \times 10^4 \pm 0.110^c$	$8.30 \times 10^4 \pm 0.000^b$	0.000
C	$1.00 \times 10^4 \pm 0.009^a$	$9.10 \times 10^4 \pm 0.721^d$	0.000
D	$6.00 \times 10^4 \pm 0.111^d$	$5.05 \times 10^4 \pm 0.003^a$	0.000

Values represent means of triplicate reading, follow by different lowercase letter
Means within the same row with different alphabets are significantly different ($p \leq 0.05$).
Sample A (100% pineapple)
Sample B (80% pineapple, and 20% watermelon)
Sample C (70% pineapple, and 30% watermelon)
Sample D (60% pineapple, and 40% watermelon)

3.4 Sensory Analysis of jam produced from pineapple and watermelon blends

The sensory evaluation results of pineapple and watermelon jam samples are shown in Table 5. One of the determinants of a consumer's product decision is sensory evaluation. With respect to the sensory evaluation of the jam produced from watermelon and pineapple blends, the appearance, texture, color, flavor and overall acceptability are shown in Table 4. Sensory evaluation is carried out by the senses of taste, smell, touch, and hearing when food is eaten. The complex sensation that results from the interaction of the senses is used to measure food quality in programs for quality control and new product development (Ruiz-Capillas et al., 2021).

The sample A, had the highest mean score of approximately 7.8 in taste against the Sample C with 6.95 least mean score. However, there were significant (p<0.05) different between the control sample and the composite sample A. Conversely, the study is in line with (Yeoh et al., 2025) whose work revealed that the taste of jam processed from blends of pineapple, tomato and pawpaw showed superiority over the control (commercial strawberry jam). They recorded (7.85 point) of taste compared slightly low to jam from apple (8.3 point) and coconut-based jam (9.0 point) further recorded a high mean score for taste of the composite jam produced.

It was observed that the texture of the composite sample D, had the highest mean score of approximately 7.35 as compared to the sample A 6.90. There were significant (p<0.05) different between the control and the composite samples. The present findings are in agreement with observed values of (Suutarinen et al., 2000), who observed a gradual decline in the texture properties of strawberry jam. The present value for texture is found to be slightly lower than the findings of (Emelike et al., 2019), who observed a decrease in the value of texture of grape and apple marmalade during storage. Similarly, (Shah et al, 2015), analyzed decrease in texture score from 8.00 to 6.21 in apple jam. Texture comprises those properties of product which is judged visually or by touch.

The aroma of any product normally influences its acceptability. The composite sample (A) had the high mean score of approximately 7.30 whilst the sample D recorded 6.45. The observation indicates a significant difference between the aroma of the sample A and that of sample D. Food appearance determines the first impression of consumers about food products influencing their buying decision. The appearance ranges from 7.1- 6.8%. Sample A had the high mean score of approximately 7.10 as compared to sample D 6.80. The observation indicates a significant difference between the appearance of the sample A and that of sample D.

The color of the composite sample D (60% pineapple and 40% watermelon) was significantly (p<0.05) different from the control samples A (100% pineapple) with the highest mean score of approximately 7.45 that is “liked very much”. The sample B had the lowest mean score of 6.95. The likeness of the color of composite jam may be as a result of the combination of low quantity of watermelon and pineapple into the jam.

Table 5: Sensory Analysis of jam produced from pineapple and watermelon blends

Samples	Taste	Texture	Aroma	Appearance	Colour	Overall Acceptability
A	7.800 ± 0.321^{d}	6.900 ± 0.165^{a}	7.300 ± 0.031^{c}	7.100 ± 0.119^{c}	7.200 ± 0.281^{b}	7.600 ± 0.188^{c}
B	7.150 ± 0.496^{b}	7.250 ± 0.069^{b}	6.850 ± 0.309^{b}	7.000 ± 0.338^{b}	6.950 ± 0.146^{a}	7.600 ± 0.188^{c}
C	6.950 ± 0.504^{a}	7.200 ± 0.151^{b}	6.950 ± 0.234^{b}	7.050 ± 0.099^{bc}	7.250 ± 0.118^{c}	7.450 ± 0.945^{b}
D	7.400 ± 0.046^{c}	7.350 ± 0.348^{c}	6.450 ± 0.605^{a}	6.800 ± 0.472^{a}	7.450 ± 0.431^{c}	7.250 ± 0.372^{a}

Values represent means of triplicate reading, follow by different lowercase letter
Means within the same row with different alphabets are significantly different (p≤0.05)
Sample A (100% pineapple)
Sample B (80% pineapple, and 20% watermelon)
Sample C (70% pineapple, and 30% watermelon)
Sample D (60% pineapple, and 40% watermelon).

The quality of the jam (Aroma, color, texture, appearance and taste) had indeed influenced the overall acceptability of the jam as indicated in the table above. There was no significant ($p \leq 0.05$) difference between the control and the composite samples (B) in the overall acceptability.

The composite sample B, had the highest mean score of 7.60 with the control sample recording the mean score of 7.60. The study therefore disagrees with the findings of (Emelike et al., 2019) who recorded a decreased in the overall acceptance of grape and apple marmalade from 8.8 to 7.96 during the storage interval. Similarly, (Ullah et al., 2018) also examined similar results of decreasing trends (9.00 to 7.00) in overall acceptability in fruit jam. Overall acceptability of 7.36 to 4.14 was reported by Ullah et al. (2018) for carrot and apple blended jam. Moreover, Dhushane & Mahendran (2022) established decline in the overall acceptability of lemon and watermelon jam.

4. CONCLUSION

The pineapple and watermelon jam samples made had a relatively higher nutritional quality which makes it a healthy and acceptable fruit jam that can be consumed by both young and adults. The study revealed that acceptable jams could be produced from pineapple and watermelon in the ratio 80:20 without adverse effects on the nutritional value. This will help in reducing wastage of these fruits but also boost its productions, utilization as well as the income of farmers and reduce the pressure on the use of other fruits for jam production. This research work shows that acceptable jam can be produced from most of the fruit when in season rather than allowing them to waste. They can also compete with other established fruit products of uniform quality and relatively low price in both local and international markets. This work is inline with the sustainable developmental goal of no poverty and hunger.

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Conflict of Interest
The authors declare no conflict of interest.

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