# Quality evaluation of jam produced from edible portions of watermelon (Citrullus lonatus)

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## ABSTRACT

This study evaluated the physicochemical, microbiological and sensory properties of jam produced from the edible portions of watermelon grown in Benue State, Nigeria, as a means of reducing post-harvest losses. Three jam formulations were prepared: Sample A (100% pulp, control), Sample B (100% rind) and Sample C (50% pulp and 50% rind). The jams were analysed for ash, moisture, titratable acidity (TTA), total soluble solids (TSS), pH, total viable count (TVC) and yeast and mould count (YMC) during three weeks of ambient storage, and sensory attributes. Sample C had the highest ash content (1.26%), Sample A the highest moisture (32.40%) and TTA (0.80%), and Sample B the highest TSS (73.44 °Brix); pH (4.20–4.24) did not differ significantly. Microbial growth appeared only in the third week, when TVC and YMC ranged from $2.06 \times 10^2$ to $4.45 \times 10^3$ and $2.8 \times 10^2$ to $3.4 \times 10^3$ CFU/g, respectively, with Sample B lowest. Sample A had the highest overall acceptability (8.27). Pulp-only jam had the best sensory quality, while rind-containing jams remained acceptable and had higher mineral content. Watermelon rind, usually discarded, can be used in jam production to reduce post-harvest waste.

***Keywords:*** *Blend, Jam, Pulp, Rind, Watermelon.*

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## Highlights of this paper

- Incorporation of watermelon rind increased the ash (mineral) content of the jam from 0.49% in the pulp-only jam to 1.26% in the 50:50 pulp–rind blend, while lowering its moisture content.
- The rind-only jam had the highest total soluble solids (73.44 °Brix), the lowest moisture content (29.20%) and the lowest microbial counts after three weeks of storage at ambient conditions.
- Although the pulp-only jam was the most preferred (overall acceptability 8.27), the rind-containing jams remained acceptable, showing that watermelon rind can be used in jam production to reduce post-harvest waste.

## 1. INTRODUCTION

Fresh fruits and vegetables are known to be highly perishable agricultural food commodities due to their high moisture content (Shipman, Yu, Zhou, Albornoz, & Beckles, 2021). Rural farmers that engage in fruit production are often pressured into giving away their farm produce at very cheap prices or risk their produce rot away owing to the short shelf life of the fruits after the harvest. This practice causes untold economic hardship to the rural farmers. To prevent this loss, processing of these fruits into more shelf stable products with added values is of great importance. One of the strategies for making fruits accessible during the off season as well as improving their economic values is by processing them into jam (Halder, Huirem, Karmakar, Hayat, & Bhattacharya, 2024; Shinwari & Rao, 2018).

Jam is traditionally made from the pulp of a single fruit or mixed fruits. Jam is a semi-solid or intermediate moisture food obtained by cooking fruits with sugar, with or without the addition of pectin and acid, to achieve the desired consistency and total soluble solids (Shinwari & Rao, 2018). Jam should contain more than 65 % total soluble solid (TSS) under the conventional high-soluble-solids formulation. Jam is a type of fruit preservation which can be canned or sealed for long term storage. Jam could be used as bread spread or filling in biscuit and ice cream. Production of jam requires ingredients (fruit pulp / whole, pectin, acid, sugar) of correct quantities in order to get the desired finished product. Raw material quality and process of manufacturing are the exponents of finished goods (Shinwari & Rao, 2018).

The production of fruit jam emphasizes the utilization of various, often underutilize or exotic fruits to enhance nutritional value, ensure year round availability, minimizes wastage and optimize gelling properties (Shinwari & Rao, 2018). Fruits such as yellow plum, lemon, apple, African star apple, cranberries, bananas, pineapple, and watermelon have been used for the production of jam. Watermelon is one of the favorite fruits among the health conscious individuals. It is packed with rich phyto - nutrients, which in the true sense is indispensable for optimal health (Baião, da Silva, & Paschoalin, 2025). Certain nutrients in watermelon have several health promoting and disease preventive properties.

Watermelon (Citrullus lanatus) is a widely cultivated fruit known for its refreshing taste, high water content and nutritional benefits (Baião et al., 2025). Watermelon originated from Africa, but has been exported to the various nations of the world. In Nigeria, particularly in Benue State, water melon farming has become increasingly popular due to the regions favorable climate conditions and fertile soil, which are ideal for growing high quality watermelon (Akaa, Gbeyongu, & Akaa, 2025). Benue State often referred to as the "Food Basket of the Nation" is renowned for its rich agricultural produce, including varieties of fruits and vegetables. Watermelon production is practiced in Makurdi Local Government Area of Benue State, where farmers engage in its cultivation as an agricultural enterprise (Akaa et al., 2025). Despite the production of watermelon in the area, the highly perishable nature of the fruit creates a need for appropriate post-harvest handling and value addition.

The process of jam making from watermelon involves utilizing the edible portions (pulp, rind, and seed) of the fruit, which contain nutrients and bioactive compounds such as lycopene, carotenoids, vitamin C, citrulline, fibre,

minerals and other phytochemicals (Baião et al., 2025; Nnenne, Ubaoji, Ogbodo, Enemor, & Oladejo, 2020; Sadiq et al., 2021; Zia, Khan, Shabbir, & Aadil, 2021). Studies have shown that the rind and seeds, which are commonly discarded during watermelon consumption and processing, contain nutritional and functional components of potential value in food product development (Nnenne et al., 2020; Rico, Gullón, Alonso, & Yáñez, 2020; Zia et al., 2021). These nutritional benefits make watermelon portions potential raw materials for the development of value-added products. Furthermore, the unique flavor and natural sweetness of watermelon can create a distinctive appealing product that could cater for diverse consumers' preferences.

High sugar content is adopted in jam making in order to suppress microbial growth, sweeten the product, help set the pectin, and make the product glisten (Shinwari & Rao, 2018). Pectin helps form a gel matrix with the fruit components and sugar under appropriate acidity and soluble-solids conditions. The quality and stability of jam are influenced by the type and concentration of fruit, sugar, pectin and acid, as well as processing conditions and storage temperature (Shinwari & Rao, 2018).

The act and art of jam making is an interesting process that helps reduce post – harvest losses that are often associated with fresh fruits. Previous studies have demonstrated the feasibility of using watermelon in jam production and have evaluated the resulting products based on physicochemical, microbiological and sensory characteristics (Olatidoye, Ababi, & Adeoti, 2025; Omotayo, 2017). However, previous Nigerian studies have mainly investigated watermelon in combination with other fruits or juices, while limited information exists on jam produced from the edible portions of locally available watermelon without relying solely on conventional watermelon pulp. The main objectives of this study was to evaluate the phytochemical properties, microbiological shelf – stability, and sensory attributes of jam produced from the edible portions of local watermelon fruit varieties grown in Benue State, Nigeria.

## 2. MATERIALS AND METHODS

### *2.1. Materials*

Fresh watermelon fruits and granulated sugar were obtained from a fruit market in Makurdi, Benue State, Nigeria. The materials were transported to the Department of Food Science and Technology, Joseph Sarwuan Tarka University, Makurdi (formerly Federal University of Agriculture, Makurdi), for sample preparation and subsequent analyses.

### *2.2. Preparation of Watermelon Jam*

The method described by Omotayo (2017) with slight modifications, was used for the preparation of watermelon jam. Freshly purchased watermelon fruits were thoroughly washed with potable tap water in the laboratory. The washed fruits were cut into suitable portions, after which the pulp and rind were separated. The pulp was blended using a laboratory blender to obtain a homogeneous pulp, while the rind was separately blended to obtain a homogeneous rind material. Figure 1 illustrates the flow chart for the preparation of jam from the edible portions of watermelon. It shows that fresh watermelon fruits are sorted and washed, after which the pulp and rind are processed separately through blending, addition of ingredients, cooking and cooling to obtain the jam.

For the preparation of watermelon pulp jam, the prepared pulp was mixed with granulated sugar at a ratio of 1:1 (watermelon pulp:sugar, w/w) and heated with continuous stirring until a total soluble solids (TSS) value of 68.5 °Brix was attained. The finished jam was immediately filled into sterilized 500 mL glass bottles, allowed to cool and sealed.

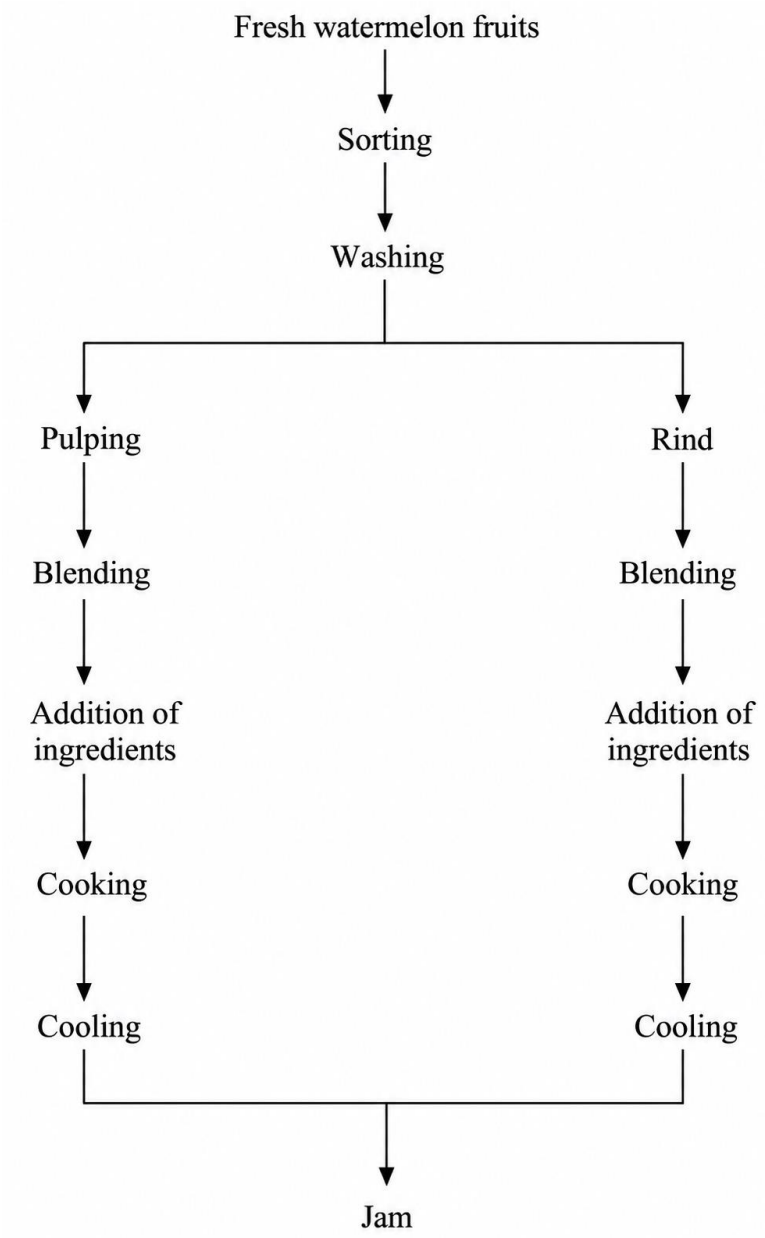



**Figure 1.** Preparation of Fresh Watermelon Jam.
**Source:** Omotayo (2017).

Watermelon rind jam was prepared using the same procedure, except that the watermelon pulp was replaced with the prepared rind. The rind was mixed with sugar at a ratio of 1:1 (watermelon rind:sugar, w/w) and heated with continuous stirring until a TSS value of 68.5 °Brix was attained. For the composite jam, watermelon pulp and rind were first blended at the specified formulation ratio and subsequently mixed with sugar at a ratio of 1:1 (watermelon material:sugar, w/w). The mixture was heated with continuous stirring until a TSS value of 68.5 °Brix was attained. The hot jam was immediately filled into sterilized 500 mL glass bottles, allowed to cool and sealed.

### *2.3. Blend Formulation*

The watermelon pulp and rind were blended at different ratios to obtain the following samples:

Sample A: 100:0 (watermelon pulp), serving as the control.

Sample B: 0:100 (watermelon pulp).

Sample C: 50:50 (watermelon pulp).

The formulated samples were processed using the same jam-making procedure, with the proportion of watermelon pulp and rind varied according to the formulation ratios.

### 2.4. Physicochemical Analysis

The pH, total soluble solids, total titratable acidity, moisture content and ash content of the jam samples were determined using standard analytical methods described by the Association of Official Analytical Chemists (Latimer, 2012).

### 2.5. Microbiological Analysis

#### 2.5.1. Total Viable Count

The total viable count of each jam sample was determined using the pour-plate method. One gram of each sample was aseptically homogenized in 9 mL of sterile peptone water to obtain a $10^{-1}$ dilution. Serial ten-fold dilutions were subsequently prepared to obtain $10^{-2}$, $10^{-3}$, $10^{-4}$ and $10^{-5}$ dilutions. One millilitre of the appropriate dilution was transferred into sterile Petri dishes, followed by the addition of sterile molten nutrient agar. The contents were gently mixed and allowed to solidify. The plates were incubated at 37 °C for 24–48 h. The determination was carried out in triplicate. Colonies developing on the plates were counted using a colony counter and the results were expressed as colony-forming units per gram (CFU/g).

#### 2.5.2. Total Fungal Count

The total fungal count of the jam samples was determined using the pour-plate method on potato dextrose agar (PDA) supplemented with 10% tartaric acid to inhibit bacterial growth. The inoculated plates were incubated at room temperature (28 ± 2 °C) for 3–4 days. Following incubation, the colonies were counted using a colony counter and the results were expressed as colony-forming units per gram (CFU/g).

### 2.6. Sensory Evaluation

Sensory evaluation was carried out at midday (12:00 noon) in a sensory evaluation room using a 9-point hedonic scale ranging from 9 (like extremely) to 1 (dislike extremely), as described by Amponsah, Golly, Sarpong, Derigubah, and Endeme (2017). The jam samples were served with bread as a carrier to the selected panellists. Twenty panellists comprising ten final-year students aged 20–25 years and ten members of staff aged 30–50 years from the Department of Food Science and Technology, Joseph Sarwuan Tarka University, Makurdi, participated in the evaluation. The samples were randomly assigned to the panellists and presented in random order to minimize positional bias. The sensory evaluation was conducted in an air-conditioned room with individual booths equipped with low-level illumination. Clean water was provided for rinsing the mouth between samples. The panellists evaluated the samples based on appearance, taste, aroma, texture, mouthfeel and overall acceptability. The sensory scores obtained were subjected to statistical analysis to determine the presence of significant differences among the samples.

### 2.7. Statistical Analysis

The data obtained were subjected to statistical analysis using Statistical Package for the Social Sciences (SPSS), version 20.0. One-way analysis of variance (ANOVA) was used to determine significant differences among the

sample means. Duncan's multiple range test was used for mean separation where significant differences existed. Differences between means were considered statistically significant at $p \leq 0.05$.

## 3. RESULTS AND DISCUSSION

### 3.1. Physicochemical Properties of Watermelon Jam

The physicochemical properties of jam produced from different proportions of watermelon pulp and rind are presented in Table 1. The ash content ranged from 0.49 to 1.26%. Sample A, produced from 100% watermelon pulp and serving as the control, had the lowest ash content (0.49%), whereas Sample C, containing 50% watermelon pulp and 50% watermelon rind, recorded the highest value (1.26%). Sample B, produced from 100% watermelon rind, also had a significantly ($p \leq 0.05$) higher ash content than Sample A. The higher ash content of the rind-containing samples may be associated with the greater contribution of mineral constituents from the rind. Nnenne et al. (2020) reported higher concentrations of potassium and calcium in watermelon rind than in the pulp, indicating that incorporation of rind can increase the mineral contribution of watermelon-based products. The ash content of 1.26% recorded in Sample C was higher than the overall ash range of 0.33–0.53% reported for apple-banana jam by Adewole et al. (2022). Differences between the present results and those reported by Adewole et al. (2022) may be related to differences in fruit species, formulation, mineral composition of the raw materials and processing conditions. The progressive increase in ash content with rind incorporation therefore suggests that watermelon rind contributed appreciably to the inorganic fraction of the jam.

**Table 1.** Physicochemical properties of jam produced from different edible portions of watermelon.

| Sample | Ash (%) | Moisture (%) | Titratable Acidity (%) | Total Soluble Solid (TSS) (°B) | pH |
|---|---|---|---|---|---|
| A | $0.49^{c} \pm 0.01$ | $32.40^{a} \pm 0.01$ | $0.80^{a} \pm 0.04$ | $61.31^{c} \pm 0.13$ | $4.20^{a} \pm 0.01$ |
| B | $1.07^{b} \pm 0.01$ | $29.20^{b} \pm 0.68$ | $0.64^{b} \pm 0.04$ | $73.44^{a} \pm 0.03$ | $4.23^{a} \pm 0.01$ |
| C | $1.26^{a} \pm 0.00$ | $30.17^{b} \pm 0.23$ | $0.50^{c} \pm 0.04$ | $70.61^{b} \pm 0.62$ | $4.24^{a} \pm 0.01$ |
| LSD | 0.02 | 1.32 | 0.10 | 1.17 | 0.03 |

**Note:** Values are means ± standard deviations of duplicate determinations. Means in the same column with different superscripts are significantly ($p \leq 0.05$) different.
Key:
A = 100 % watermelon pulp.
B = 100 % watermelon rind.
C = 50% watermelon pulp and 50 % watermelon rind.

The moisture content of the jam samples ranged from 29.20 to 32.40%. Sample A had the highest moisture content (32.40%), while Sample B had the lowest value (29.20%), followed by Sample C (30.17%). The moisture contents obtained in the present study were lower than the range of 40.32–55.20% reported for apple-banana jam by Adewole et al. (2022) and the range of 40.32–65.21% reported for pineapple, watermelon and apple jam blends by Salam, Lydia, and Elizabeth (2020). The differences may be associated with variations in fruit composition, fruit-to-sugar ratio, initial moisture content and the extent of moisture loss during heating. The significantly higher moisture content of Sample A compared with Samples B and C indicates that incorporation of watermelon rind was associated with lower moisture content in the final product. Moisture content is an important factor in the storage stability of jam because the availability of water influences microbial growth. Thus, the relatively lower moisture contents recorded in Samples B and C may contribute to improved storage stability when suitable packaging and hygienic storage conditions are maintained (Du, Davila, Ramirez, & Williams, 2022).

The total titratable acidity (TTA) of the jam samples differed significantly ($p \leq 0.05$), with Sample A, containing 100% watermelon pulp, recording the highest value. The higher TTA of the pulp-only jam indicates a greater contribution of titratable organic acids from the watermelon pulp. Incorporation of watermelon rind

reduced the TTA of the jam, as observed particularly in Sample C containing equal proportions of pulp and rind. This observation is consistent with the differences in acidity reported between watermelon flesh and rind. A comparative study of watermelon flesh, rind and rind-flesh blends reported significant differences in titratable acidity among the samples, demonstrating that the proportion of rind can influence the acid characteristics of watermelon-based products. The lower TTA observed with rind incorporation may therefore be associated with the lower acid contribution of the rind relative to the pulp and the consequent dilution of pulp-derived acids in the blended formulations. Titratable acidity is an important quality parameter in jam because acidity contributes to flavour and participates in the interaction between fruit acids, sugar and pectin during gel formation (Wan-Mohtar et al., 2021).

The total soluble solids (TSS) of the jam samples ranged from 61.31 to 73.44 °Brix, with significant ($p \leq 0.05$) differences among the samples. Sample B, produced from 100% watermelon rind, recorded the highest TSS. Total soluble solids represent soluble constituents of a product, including sugars, organic acids, soluble pectin, phenolic compounds and minerals. A study comparing watermelon flesh, rind and rind-flesh blends reported significantly higher °Brix in flesh than in rind, although the final TSS of a processed product is also influenced by formulation and concentration during heating. Therefore, the higher TSS observed in Sample B should not be attributed specifically to cellulose, as cellulose is not a major soluble-solids constituent. Instead, the observed difference may have resulted from the soluble constituents contributed by the raw material and differences in moisture removal during cooking. High TSS is an important characteristic of conventional jam because increased soluble solids contribute to sweetness and reduce the availability of water for microbial growth. The TSS values obtained in the present study indicate that the samples underwent substantial concentration during processing.

The pH values of the jam samples ranged from 4.20 to 4.24, with no significant ($p \geq 0.05$) differences among the samples. The narrow pH range indicates that replacement of watermelon pulp with rind did not substantially alter the hydrogen-ion concentration of the finished jam under the processing conditions used. The values were higher than the pH range of 3.00–3.11 reported for apple-banana jam by Adewole et al. (2022). This difference may be related to the inherent acidity of the fruits used and differences in formulation and processing. The absence of significant differences in pH, despite the observed differences in TTA, indicates that the variation in titratable acid concentration was not sufficient to produce a statistically detectable change in hydrogen-ion concentration among the jam samples. The relationship between pH, TTA and soluble solids is important in jam formulation because these parameters collectively influence product flavour, gel formation and preservation. Studies of jam formulation have also demonstrated that changes in sugar and acid formulation can influence pH, TTA and °Brix.

### *3.2. Microbiological Quality of Watermelon Jam During Storage*

The microbiological quality of the jam samples during storage is presented in Table 2. No visible microbial growth was observed during the first two weeks of storage for either total viable count (TVC) or yeast and mould count (YMC). Microbial growth became detectable during the third week of storage, indicating that the jam samples maintained detectable microbiological stability during the first two weeks but subsequently developed measurable microbial populations under the storage conditions employed.

**Table 2.** Microbial population of jam produced from different edible portions of watermelon during three weeks of storage at ambient temperature.

| Storage Periods (Weeks) | Samples | | |
|---|---|---|---|
| | **A** | **B** | **C** |
| | Total Viable Count cfu/g | | |
| 1 | X | X | X |
| 2 | X | X | X |
| 3 | $4.45^{c}$ x $10^{3}$ | $2.06^{a}$ x $10^{2}$ | $4.49^{b}$ x$10^{2}$ |
| | Mould and Yeast Count (cfu/g) | | |
| 1 | X | X | X |
| 2 | X | X | X |
| 3 | $3.4^{b}$ x $10^{3}$ | $2.8^{a}$ x $10^{2}$ | $3.7^{a}$ x $10^{2}$ |

**Note:** Values are means of triplicate determinations.
Means followed by the same superscript along rows are not significantly ($p \geq 0.05$) different.
x = No visible growth.
Key
A = 100 % watermelon pulp
B = 100 % watermelon rind
C = 50% watermelon pulp and 50 % watermelon rind
CFU /g = Colony forming unit / gram.

During the third week of storage, the TVC ranged from $2.06 \times 10^{2}$ to $4.45 \times 10^{3}$ CFU/g, while the YMC ranged from $2.8 \times 10^{2}$ to $3.4 \times 10^{3}$ CFU/g. Sample B, containing 100% watermelon rind, recorded the lowest microbial counts, whereas Samples A and C recorded higher populations. The differences among the samples may be associated with differences in their physicochemical characteristics, particularly moisture content and soluble solids, as well as differences in the composition of the pulp and rind. Sample B had the lowest moisture content (29.20%) and the highest TSS, conditions that can reduce the availability of water for microbial growth.

The lower microbial population observed in the rind-containing sample may also be related to the phytochemical composition of watermelon rind. Nnenne et al. (2020) reported the presence of phytochemical constituents in watermelon rind and demonstrated antioxidant activity in the fruit parts, with rind showing greater concentrations of some phytochemicals than pulp. However, the present study did not determine the antimicrobial activity of the rind or identify specific antimicrobial compounds. Therefore, the lower microbial count in Sample B cannot be attributed solely to antimicrobial activity and is more appropriately interpreted as the combined effect of the physicochemical and compositional characteristics of the formulation.

The appearance of microbial growth during the third week indicates a gradual reduction in microbiological stability during storage. Jam preservation depends on several intrinsic and extrinsic factors, including soluble-solids concentration, water availability, acidity, heat treatment, packaging and storage conditions. The absence of detectable growth during the first two weeks followed by measurable microbial counts during the third week suggests that the combined preservation effects of the processing conditions were sufficient to delay microbial development but did not completely prevent it throughout the storage period.

The microbiological results should therefore be interpreted as an indication of the microbial quality of the products under the storage conditions investigated rather than as proof of complete microbiological safety. The present analysis determined total viable bacteria and yeast and mould populations but did not include specific tests for pathogenic microorganisms. Consequently, the absence of detectable growth during the initial storage period and the relatively low counts recorded subsequently indicate the microbiological condition of the samples tested, but do not establish the absence of all potential foodborne pathogens.

### *3.3. Sensory Properties of Watermelon Jam*

The sensory attributes of the jam produced from different proportions of watermelon pulp and rind are presented in Table 3. The appearance scores ranged from 7.47 in Sample B, containing 100% watermelon rind, to

8.40 in Sample A, containing 100% watermelon pulp. The higher appearance score obtained for Sample A indicates greater visual acceptance of the pulp-only jam by the panellists. The difference may be associated with the characteristic colour contributed by watermelon pulp. Watermelon pulp contains carotenoid pigments, including lycopene, which contribute to the characteristic red colour of the fruit. Nnenne et al. (2020) also reported differences in the phytochemical composition of watermelon pulp and rind, demonstrating that the two portions differ in their chemical composition.

**Table 3.** Sensory attributes of jam produced from different edible portions of watermelon.

| Sample | Appearance | Taste | Aroma | Texture | Mouthfeel | Overall acceptability |
|---|---|---|---|---|---|---|
| A | $8.40^{a} \pm 0.63$ | $8.00^{a} \pm 0.85$ | $7.93^{a} \pm 0.70$ | $7.87^{a} \pm 1.13$ | $8.00^{a} \pm 0.85$ | $8.27^{a} \pm 0.46$ |
| B | $7.47^{b} \pm 1.36$ | $7.10^{b} \pm 1.30$ | $7.53^{b} \pm 0.92$ | $7.13^{a} \pm 1.41$ | $7.13^{b} \pm 1.51$ | $7.40^{b} \pm 1.24$ |
| C | $7.53^{b} \pm 0.83$ | $7.00^{b} \pm 1.06$ | $7.27^{c} \pm 1.03$ | $7.33^{a} \pm 0.90$ | $7.27^{a} \pm 1.16$ | $7.27^{b} \pm 0.96$ |
| LSD | 0.73 | 0.80 | 0.22 | 0.36 | 0.89 | 0.76 |

**Note:** Values are means (n = 20) ± standard deviations of triplicate determination. Means in the same column with different superscripts are significantly ($p \leq 0.05$) different.
Key
A = 100 % watermelon pulp
B = 100 % watermelon rind
C = 50% watermelon pulp and 50 % watermelon rind.

The taste scores differed significantly ($p \leq 0.05$) among the jam samples. The differences may be attributed to the varying proportions of pulp and rind in the formulations, which altered the relative contribution of soluble sugars, organic acids, fibre and other flavour-related constituents. Watermelon rind has been reported to have a substantially lower °Brix than watermelon flesh, indicating a lower concentration of soluble solids and a less sweet character. Therefore, increasing the proportion of rind in the formulations may have modified the sweetness and flavour characteristics perceived by the panellists.

The aroma scores ranged from 7.27 in Sample C to 7.90 in Sample A. The higher aroma score recorded for Sample A indicates greater acceptance of the aroma of the pulp-only jam. This difference may be related to the greater contribution of watermelon pulp-derived aroma characteristics in the formulation. Research comparing watermelon rind and flesh has demonstrated differences in their volatile profiles, with rind containing substantially fewer volatile compounds than flesh. Such differences provide a possible basis for variation in the perceived aroma of products containing different proportions of rind and pulp, although volatile compounds were not determined in the present study.

The texture scores differed significantly ($p \leq 0.05$), with Sample A recording the highest score (7.87) and Sample B the lowest score (7.13). The lower texture score of the rind-only formulation may be associated with the structural composition of the rind. Nnenne et al. (2020) reported higher crude fibre in watermelon rind than in the pulp. Incorporation of the more fibrous rind therefore has the potential to alter the consistency and mouthfeel of the resulting jam. The difference in texture scores observed among the samples is consequently consistent with the compositional differences between watermelon pulp and rind.

The mouthfeel scores followed a similar pattern, with Sample A receiving the highest score of 8.00. The lower scores recorded for Samples B and C may be related to the incorporation of rind and the resulting changes in the physical characteristics of the jam. The presence of rind-derived fibre and other structural components may influence the perceived smoothness and mouthfeel of the product. The sensory response therefore reflects the combined effects of the raw material composition and processing conditions.

For overall acceptability, Sample A recorded the highest score (8.27), followed by Sample B (7.40) and Sample C (7.27). The higher overall acceptability of Sample A corresponds with its relatively higher scores for appearance,

taste, aroma, texture and mouthfeel. This indicates that the pulp-only formulation produced sensory characteristics that were more favourably received by the panellists under the conditions of the study. Samples B and C nevertheless recorded scores above the midpoint of the 9-point hedonic scale, indicating that the rind-containing formulations retained a degree of consumer acceptability. Similar studies on fruit-based jams have demonstrated that changes in fruit composition can influence appearance, taste, aroma, texture and overall acceptability. For example, Adewole et al. (2022) reported significant differences in sensory characteristics among apple-banana jam formulations with different fruit proportions.

The sensory findings therefore indicate that complete replacement of watermelon pulp with rind altered the sensory characteristics of the jam, particularly appearance, texture, mouthfeel and overall acceptability. The 50:50 pulp-rind formulation also showed lower overall acceptability than the pulp-only control. Nevertheless, the acceptable sensory scores recorded by the rind-containing samples indicate that watermelon rind can be incorporated into jam production, although further formulation optimization would be required where the objective is to improve the sensory characteristics of rind-rich products.

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