

Research Article

Physicochemical Properties of Fruit Purees and Sensory Attributes of the Puree Blends Produced from Mango, Orange and Watermelon

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Abstract

This research investigated the proximate composition and functional properties and sensory attributes of mango, orange, and watermelon purees to assess their potential for reducing post-harvest losses and enhancing food formulations. These tropical fruits are highly perishable, leading to significant post-harvest losses in regions like Nigeria. By processing them into purees, shelf life can be extended, and nutritional value preserved, offering a viable solution to food wastage. The study analyzed key parameters such as bulk density, viscosity, water holding, and oil holding capacities to determine their applicability in the food industry. The results revealed that watermelon puree had the highest moisture content (93.85%) and water holding capacity (93.03%), while mango puree showed the highest bulk density (1.11 g/cm³), viscosity (3.84 cP), and oil holding capacity (27.01%). Orange puree had the highest fat content (0.96%) and a moderate water holding capacity (84.49%). The carbohydrate content was highest in mango puree (16.81%) followed by orange (12.91%) and watermelon (8.36%). Sensory evaluations were conducted to assess consumer acceptance, revealing that the puree blend of 20% mango, 30% orange, and 50% watermelon (Sample B) received the highest overall acceptability score of 7.72 out of 9. The research also examined the effects of incorporating maltodextrin as an additive to improve the texture and stability of the purees. The findings provided insights into the development of sustainable and nutritious fruit-based products, contributing to food security and economic sustainability in agricultural regions prone to fruit spoilage.

Keywords

Maltodextrin, *Mangifera Indica*, *Citrus Sinensis*, *Citrullus Lanatus*

1. Introduction

Fruit processing plays a vital role in reducing post-harvest losses and adding value to agricultural produce, particularly in tropical and subtropical regions where fruit production is

abundant but preservation techniques are limited. Post-harvest losses, estimated at 40-50% for tropical fruits, continue to pose a significant challenge to food security and economic

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sustainability in developing countries [1]. Nigeria, with its substantial production of mango, orange, and watermelon, faces considerable losses due to inadequate storage and preservation methods, making fruit processing an essential strategy for mitigating these losses [2].

Mango (*Mangifera indica*), orange (*Citrus sinensis*), and watermelon (*Citrullus lanatus*) are highly perishable fruits, rich in essential nutrients such as vitamins, minerals, and antioxidants. Processing these fruits into purees not only extends their shelf life but also preserves their nutritional quality, providing opportunities for the development of diverse food products. Recent studies have emphasized the potential of fruit purees in the food industry, where they serve as natural ingredients for beverages, baby foods, sauces, and desserts [3].

Furthermore, the functional properties of fruit purees, such as water holding capacity, oil holding capacity, and viscosity, are crucial for determining their applications in various food formulations. These properties can be optimized through the use of additives like maltodextrin, which improves stability, texture, and overall product quality [4]. Understanding these characteristics is essential for the effective incorporation of purees into food systems while maintaining desirable sensory and nutritional attributes.

This study aims to investigate the proximate composition and functional properties of mango, orange, and watermelon purees, focusing on their potential for reducing post-harvest losses and contributing to food product development. By analyzing key factors such as bulk density, viscosity, and holding capacities, this research provides valuable insights into how these fruit purees can be utilized effectively in the food industry, offering a sustainable solution to fruit wastage while enhancing the nutritional profile of processed foods.

2. Materials and Methods

2.1. Materials

The mango, orange varieties (20 kg each) and ten (10) fruits each were procured from the Gboko local market in Gboko Benue State Nigeria, while five (5) fruits of the 'Sugar Baby' variety of watermelon were sourced from the Makurdi Railway market also in Benue State, Nigeria.

All fruit varieties were transported in polyethylene bags to the Joseph Tarka Federal University of Agriculture, Makurdi, Nigeria for proper identification. They were then refrigerated in preparation for further processing and analysis.

2.2. Methods

2.2.1. Preparation

The fruits were washed and their average weights taken and recorded. They were peeled and the weights of the peels measured and also recorded. The remaining processes to

produce the puree prior to drying were according to the following flow charts.

Each puree type, depending on its stickiness and viscosity were mixed with 15%, 20%, 25% and 30% (w/w) commercial maltodextrin for water melon, orange and mango puree (the ratio of puree solids to carrier being 1:1.38; 1:1.95; 1:2.60; 1:3.35) respectively with Dextrose Equivalent (DE) 20 – 30. The purees were formulated into smoothies. With selected addition of maltodextrin, the most acceptable smoothie was subjected to the spray and freeze drying techniques.

2.2.2. Fruit Puree Production Process

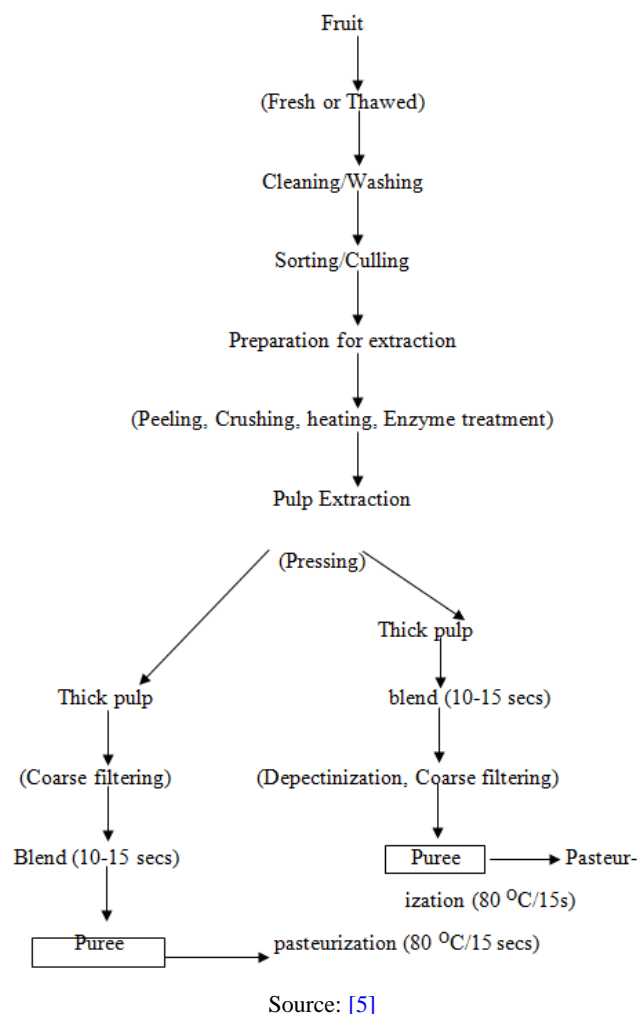
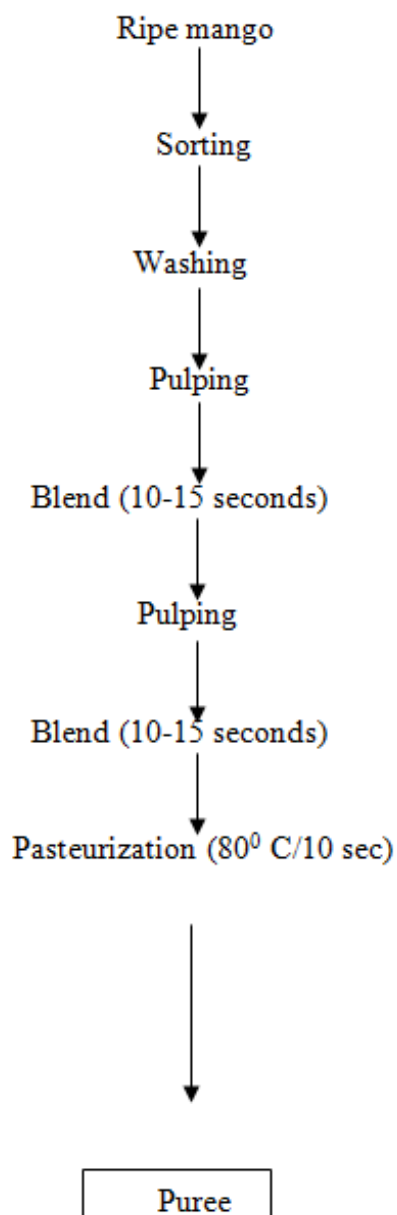


Figure 1. General Flow for Fruit Puree Production.

2.2.3. Production of Mango Fruits Puree

The production of the mango fruits puree was by the method of Aderoju and Adewale [6] as provided in Figure 2. The mango fruits were sorted, washed and blanched by immersion in a boiling hot water bath maintained at 98 °C for 5 min. The blanched mango fruits were then cooled in running tap water, peeled using stainless steel knives and the fleshy mesocarp sliced to obtain pieces which were blended in the Kenwood mixer in the presence of 0.2 M citric

acid buffer (pH 5.2) into a smooth slurry. The slurry was then stored in the freezer compartment of a household refrigerator prior to use for composite purees formulation.



Source: [6]

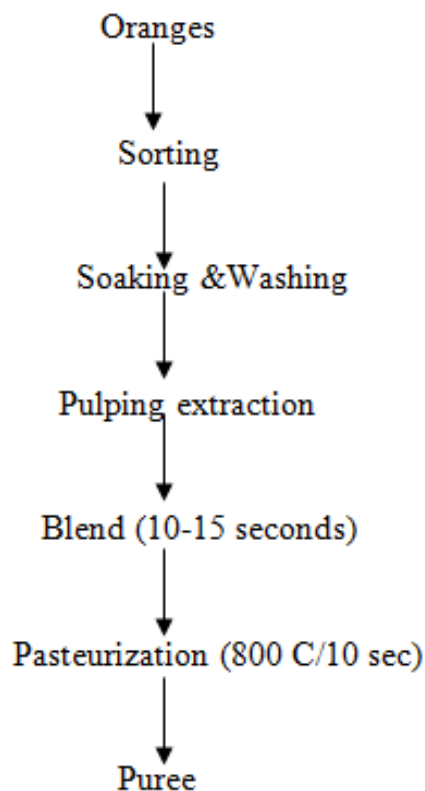
Figure 2. Mango Puree Production Flow Chart.

The purée of blanched mango pieces was obtained by crushing blanched mango in the presence of 0.2 M citric acid buffer (pH 5.2) blanched at 90 °C for 4 min in closed plastic containers. The analyses of the nutrients were carried on the purées 30 min after crushing.

2.2.4. Production of Orange Fruits Puree

Orange fruits puree was produced as described by Sharma and Anand, [7]. Essentially, as shown in Figure 3, the fruits were

sorted, washed, peeled and sliced using stainless steel knives. After removal of the seeds, the slices were blended into a smooth paste using the house hold electric blender. The orange puree was then pasteurized at 70 °C for 15 s in 250 ml glass beakers with aluminum foil covers. The pasteurized orange puree was rapidly cooled in an ice bath and promptly stored in a refrigerator prior to use for mixed purees formulation.

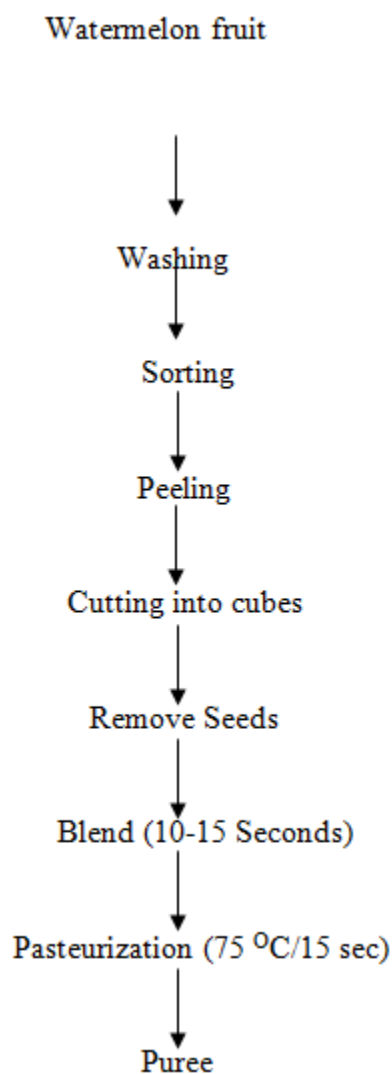


Source: [7]

Figure 3. Orange Puree Production Flow Chart.

2.2.5. Watermelon Fruits Puree Production

The flow chart for the production of watermelon puree is shown in Figure 4 using the method described by Akinwande and Ojo [8]. After washing and sorting, the fruits were peeled manually using stainless steel knives followed by slicing, removal of the seeds followed by blending of pulps in a household electric blender (Kenwood Electricals, UK) at speed number 3 for 15 s into smooth pastes which were pasteurized at 70 °C for 15 s in 250 ml glass beakers with aluminum foil coverings. After cooling, the watermelon purees were kept in a refrigerator prior to use for composite purees formulation.



Source: [8]

Figure 4. Watermelon Puree Production Flow Chart.

2.3. Composite Fruit Purees Formulation

The composite fruit purees compositions are shown in [Table 1](#). In order to minimize bias, the formulations were each coded using 3-digits random numbers. Each puree type was treated with commercial maltodextrin as a carrier agent respectively to obtain a dextrose equivalent (DE) of 30 for each group. The composite purees together with the maltodextrins were each blended into smoothies and subjected to prelimi-

nary sensory evaluation which indicated that the composite puree sample comprising 50% watermelon, 30% orange and 20% mango composite puree (code: 618) was the most acceptable smoothie and hence was used for the spray and freeze drying experiments respectively.

Table 1. Composite purees formulation.

Sample code	Puree composition (%)		
	Watermelon	Orange	Mango
573	30	50	20
618	50	30	20
335	20	50	30
804	50	20	30
732	20	30	50
408	30	20	50

2.4. Sensory Evaluation

The Sensory evaluation of the fresh composite purees was carried out using trained sensory panel consisting of staff and students of the University of Mkar. The panel consisted of 50 members including male and female members of the University of Mkar, Mkar. All evaluation sessions were held in the Food Chemistry Laboratory of the Food Science and Technology. The sensory evaluation of the fresh samples were carried out four hours after formulation while sensory evaluation of the dried products were after one week of production. The samples were stored at 5 °C and taken out three hours before serving. Appearance, Aroma, Taste, Texture, Consistency and overall acceptability were evaluated following a nine-point hedonic scale (9 = like extremely, 8 = like very much, 7 = like moderately, 6 = like slightly, 5 = neither like nor dislike, 4 = dislike slightly, 3 = dislike moderately, 2 = dislike very much, 1 = dislike extremely).

The panelists were thoroughly briefed on how to use the sensory evaluation forms and terminologies of sensory at-

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tributes. All samples were presented before the panelists at room temperature under normal lighting conditions in 50 ml cups coded with random, 3-digit numbers to ensure blind testing and avoid bias during the sensory evaluation process.

Drinking water was provided for oral rinsing. The average values of the sensory scores (Appearance, Aroma, Taste, Texture, Consistency and overall acceptability) were used in the analysis as described by Ihekoronye and Ngoddy [9].

Sample Coding: The samples were labelled with random 3-digit codes to ensure blind testing and avoid bias during the sensory evaluation process.

Serving Temperature: The reconstituted fruit samples were served at room temperature (~20 °C), as temperature fluctuations can influence the perception of taste and aroma [10].

Presentation of Samples: The samples were presented in 200 ml disposable identical cups that did not influence taste perception (neutral color and odor-free). Consistent portions of 50 mL per sample was used [10].

2.5. Proximate Composition

Moisture content, crude protein, crude fibre, fat content, ash content and total carbohydrate were determined according to the methods described by AOAC [11].

2.5.1. Moisture Content

Two grams of sample (in triplicate) were weighed into an empty, dry and clean crucible of a known weight. The crucible containing the sample was placed in an oven at 105 °C for 24 hrs. After that, the crucible was removed and placed in a desiccator containing dry silica gel and weighed three times at 10 minutes intervals and the weights were calculated as averages. This was repeated twice and the moisture content calculated as a percentage according to the following equation:

$$\% \text{ Moisture} = \frac{W_1 - W_2}{W} \times 100$$

Where:

W_1 = Weight of crucible and sample before drying

W_2 = Weight of crucible and sample after drying

W = Original Weight of Sample

2.5.2. Crude Protein

0.2 g of sample was placed in 10 mL Kjeldahl digestion flask; then 0.4 g of kjeldahl catalyst tablets and 3.5 mL of concentrated sulfuric acid were added. The flask was heated in an electrical heater for 2 hours. The samples were cooled and diluted with distilled water and placed in the distillation apparatus. Twenty mls of 50% sodium hydroxide (NaOH) was added and the distillation took place for 10 minutes. The evolved ammonia received in 10 mL of 2% boric acid con-

tained in a 100 ml conical flask and trapped was titrated against 0.02 N hydrochloric acid (14 cl) using a universal indicator (bromocresol green and methyl red in alcohol). The protein content was calculated as a percentage according to the following equation.

$$\text{Protein Content \%} = \frac{\text{titre} \times 100 \times \text{Normality} \times 0.014 \times 100}{\text{Weight of Sample} \times 6.25}$$

Weight of Sample

2.5.3. Crude Fibre

Five grams of the sample was digested into trichloroacetic acid by refluxing for 40 minutes and then filtered. The residue was washed with boiling distilled water and then with acetone. The washed residue was dry-heated at 150 °C in oven and the dried residue was scraped into porcelain crucible, weighed and placed in a muffle furnace for ashing for 2 hours, after which it was removed, cooled in desiccators and weighed. Crude fibre was calculated as a percentage according to the following equation:

$$\text{Crude fibre \%} = \frac{W_1 - W_2}{W_0} \times 100$$

Where:

W_1 = Weight of crucible + ash

W_2 = Weight of + residue

W_0 = Initial weight of sample

2.5.4. Ash Content

Two grams of the sample was weighed into a clean ashing dish with a known weight. The ashing dish containing the sample was ignited in a muffle furnace at 550 °C for 3 hours. The ashing dish was removed, cooled in a desiccator and weighed again. The ash content of the sample was calculated as a percentage according to the following equation.

$$\text{Ash content \%} = \frac{W_1 - W_2}{W_0} \times 100$$

Where:

W_1 = weight of empty ashing dish (before ignition)

W_2 = weight of the ashing dish containing the ash (after ignition)

W_0 = Original weight of the sample.

Total carbohydrates (TC) TC was determined by difference.

$100 - (\% \text{ protein} + \% \text{ fat} + \% \text{ crude fibre} + \% \text{ moisture} + \% \text{ ash})$

pH Determination [12].

pH was measured using glass electrode (Digital) pH meter (HANNA model: 8521) at ambient temperature. The pH electrode will be dipped in the sample up to sufficient depth such that the electrode should not touch the bottom of the beaker containing the sample. The reading was recorded.

2.5.5. Fat Content

Extraction thimble was weighed empty, filled with sample up to half and weighed again. The mouth of the extraction thimble was plugged with cotton wool to prevent sample from spilling. The thimble containing the sample was then placed with petroleum spirit up to half. The extractor containing thimble and sample was then fitted into the quick fit flask and connected to the condenser. The flask was heated on the heating mantle and the extraction carried out for 16 hours after which the petroleum spirit evaporated. The weight of flask and oil were determined after heating in boiling water to remove all traces of water and dried over calcium chloride in the desiccators and cooled.

Fat content was determined as a percentage according to the following equation:

$$\text{Fat content (weight of oil in the sample) \%} = \frac{(D-C)/(B-A) \times 100}{100}$$

Where:

A = Weight (g) of thimble

B = Weight (g) of thimble x sample

(B - A) = Weight (g) of sample

C = Weight (g) of empty quick fit flask

D = Weight (g) of quick fit flask + oil

D-C = Weight (g) of oil

2.5.6. Determination of Specific Gravity

Specific gravity of the product samples was determined using a density bottle.

The samples were poured into a 50 ml density bottle and weighed. Each weight is known as the mass. The mass was divided by the volume of the density bottle to get the density.

The specific gravity will be calculated according to the equation:

$$\frac{\text{Density of Sample}}{\text{Density of water}} \times \frac{X \text{ (g/ml)}}{0.998 \text{ (g/ml)}}$$

Where;

$$X = (W_2 - W_1) / V_{\text{ml}}$$

W₂ = Weight of sample + density bottle

W₁ = Weight of density bottle

V = Volume of the density bottle (50 ml)

The use of a hygrometer is a factor and easier method.

2.5.7. Viscosity (cP)

The viscosity of the samples was determined by a viscometer (DV-E Brookfield LV viscometer, USA) with spindle No.62 at 25 °C and velocity of 12 rpm

2.5.8. Determination of Water Holding Capacity

This was determined using the method of Onwuka [13]. One gram of the sample was dispensed into a weighed centrifuge tube with 10 ml of distilled water and mixed thoroughly. The mixture was allowed to stand for 1 hour before centrifuged at 3,500 rpm for 30 minutes. The excess water (unabsorbed) was decanted and the tube inverted over an absorbent paper to drain dry. The weight of water absorbed was determined by difference. The water absorption capacity was calculated as:

$$\text{WAC (\%)} = \frac{\text{Volume of Water used} - \text{Volume of free water}}{\text{Weight of sample used}} \times 100$$

2.5.9. Statistical Analyses

All the experiments were conducted in triplicate samples and the data was mean of the three replications. All data obtained were statistically analysed using the Analysis of Variance (ANOVA) using SPSS Version 20 and the Duncan Multiple range test to separate means with significance level $p < 0.05$ [9].

3. Results and Discussion

Table 1. Proximate composition of fresh mango puree, orange puree, and watermelon puree.

Puree	Moisture (%)	Ash (%)	Crude fiber (%)	Fat (%)	Protein (%)	Carbohydrate (%)	Energy (kcal)
Mango	76.88 ^c ±0.03	1.33 ^a ±0.25	1.83 ^a ±0.25	0.51 ^b ±0.030	1.57 ^a ±0.02	16.81 ^a ±0.03	77.66 ^a ±0.02
Watermelon	93.85 ^a ±0.03	0.31 ^c ±0.03	0.24 ^b ±0.03	0.40 ^b ±0.030	0.83 ^b ±0.25	8.36 ^c ±0.03	36.65 ^c ±0.03
Orange	79.69 ^b ±0.02	0.86 ^b ±0.03	0.45 ^b ±0.03	0.96 ^a ±0.030	0.76 ^b ±0.25	12.91 ^b ±0.03	62.87 ^b ±0.02

Values are mean ± standard deviation (SD) of triplicate determinations. Samples with different superscripts within the same column were significantly ($p < 0.05$) different.

Table 1 presents the proximate composition of fresh mango puree, orange puree, and watermelon puree.

Significant Differences between Samples

The data reveals significant differences among the purees

in terms of moisture, ash, crude fiber, fat, protein, carbohydrate content, and energy. Specifically:

Moisture Content

Watermelon puree has the highest moisture content (93.85%), followed by orange puree (79.69%) and mango puree (76.88%). This difference is significant ($p < 0.05$).

Watermelon has a naturally high water content, which contributes to its high moisture level (93.85%) [14]. In contrast, mangoes and oranges, though also high in water, have lower moisture content due to their denser, less water-rich pulp.

Ash Content

Watermelon puree has the lowest ash content (0.31%), while mango puree has the highest (1.33%). Orange puree falls in between (0.86%). The variation here is also statistically significant.

Ash content reflects the mineral content of the fruit. Watermelon, with its high water content and lower mineral density, shows a lower ash content compared to mangoes, which have more mineral-rich flesh [15].

Crude Fiber

Mango puree contains the more crude fiber (1.83%), compared to orange puree (0.45%) and watermelon puree (0.24%). This difference is significant.

Mangoes are known for their higher fiber content, particularly soluble fibers, which contribute to their higher crude fiber percentage [16]. Watermelon, with its high water content and lower fiber density, shows minimal crude fiber.

Fat Content

Orange puree has the highest fat content (0.96%), with mango puree (0.51%) and watermelon puree (0.40%) showing

lower levels. This variation is significant.

The fat content in these fruit purees is relatively low overall. However, oranges exhibit a higher fat content compared to mangoes and watermelons. This could be attributed to the differences in the lipid profiles of the fruits, with oranges potentially having a slightly higher content of essential fatty acids [17].

Protein Content

Mango puree has the highest protein content (1.57%), followed by orange puree (0.76%) and watermelon puree (0.83%). This difference is significant.

Mangoes have a higher protein content compared to watermelon and orange. This is consistent with the observation that tropical fruits like mangoes often contain more protein [18]. Watermelon, on the other hand, is lower in protein due to its more aqueous composition.

Carbohydrate Content

Mango puree has the highest carbohydrate content (16.81%), while watermelon puree has the lowest (8.36%). Orange puree is intermediate (12.91%). This is a significant difference.

Energy

Mango puree provides the most energy (77.66 kcal), with orange puree (62.87 kcal) and watermelon puree (36.65 kcal) showing significantly lower values.

The energy content of a fruit puree is a direct result of its carbohydrate, fat, and protein content. Mangoes provide the most energy due to their higher carbohydrate content and moderate levels of protein and fat. Watermelon, with its high moisture and lower macronutrient densities, offers the least energy.

Table 2. Functional properties of mango puree, orange puree and watermelon.

Puree	Specific gravity	Viscosity (cP)	Water holding capacity (%)	Oil holding capacity (%)
Mango	1.13 ^a ±0.02	3.84 ^a ±0.04	83.74 ^c ±0.03	27.01 ^a ±0.02
Watermelon	0.92 ^c ±0.01	1.53 ^c ±0.03	93.03 ^a ±0.03	18.03 ^c ±0.03
Orange	1.05 ^b ±0.02	2.04 ^b ±0.02	84.49 ^b ±0.39	23.01 ^b ±0.02

Values are mean ± standard deviation (SD) of triplicate determinations. Samples with different superscripts within the same column were significantly ($p < 0.05$) different.

Key:

cP = Centipoise

Significant Differences:

Specific Gravity

Mango also exhibits the highest specific gravity (1.13), followed by Orange (1.05) and watermelon (0.92). This trend aligns with the bulk density results, suggesting that mango puree is denser in terms of mass per unit volume compared to the other two.

Specific gravity is directly related to the composition and

structure of the puree. Mango puree's higher specific gravity may be due to its higher content of solids and fibers, which contribute to its denser consistency. Studies have shown that the physical properties of fruit purees, such as density, are influenced by the concentration of solids and their interaction with water [19].

Viscosity

The viscosity of Mango puree (3.84 cP) is notably higher

than both Orange (2.04 cP) and watermelon (1.53 cP). This means that mango puree is more resistant to flow than the other purees, indicating a thicker or more viscous texture.

The higher viscosity of mango puree could be attributed to its higher pectin content and fiber composition, which increase the puree's resistance to flow. Pectin and fibers are known to form a gel-like structure that can enhance viscosity [20]. The viscosity differences among purees are also influenced by their water-soluble and insoluble solids content.

Water Holding Capacity

Watermelon puree has the highest water holding capacity (93.03%), significantly greater than Orange (84.49%) and Mango (83.74%). This suggests that melon puree can retain more water compared to the other purees.

The higher water holding capacity of melon puree might be

related to its cellular structure and high water content. Melons typically have a higher water content compared to mangoes and oranges, which can lead to a higher capacity to retain water [21].

Oil Holding Capacity

Mango has the highest oil holding capacity (27.01%), compared to Orange (23.01%) and Melon (18.03%). This indicates that mango puree can absorb and retain more oil, which could affect its textural properties.

The oil holding capacity is influenced by the presence of fat and the structure of the puree. Mango puree's higher oil holding capacity could be due to its higher fat content compared to orange and melon purees, which allows it to absorb and retain more oil [22].

Table 3. Sensory attributes of the fresh mango-orange-water melon composite puree samples.

Sample Codes	Appearance	Aroma	Taste	Texture	Consistency	Overall acceptability
573	7.000±1.080 ^{ab}	6.7200±1.243 ^a	6.2800±1.021 ^c	6.3200±1.435 ^a	6.5200±1.530 ^b	7.0800±1.115 ^a
618	7.7200±1.060 ^b	7.2000±1.251 ^{ab}	7.2000±1.040 ^{ab}	7.1200±1.301 ^a	7.3200±1.069 ^a	7.7200±1.208 ^a
335	6.8400±0.943 ^b	7.0000±1.154 ^{ab}	7.0800±1.222 ^{ab}	6.4000±2.020 ^a	7.0800±1.382 ^{ab}	7.2000±1.208 ^a
804	6.8800±1.201 ^b	7.5200±0.770 ^b	7.4800±1.084 ^a	6.7600±1.984 ^a	6.8800±1.268 ^{ab}	7.5200±1.357 ^a
732	7.2400±1.640 ^{ab}	6.9600±1.206 ^{ab}	6.9200±1.288 ^{abc}	7.0400±1.428 ^a	7.1200±0.781 ^{ab}	7.6400±1.036 ^a
408	7.4400±1.193 ^{ab}	6.8400±1.374 ^{ab}	6.6400±1.350 ^{ab}	7.1200±0.971 ^a	6.9200±1.037 ^{ab}	7.1200±1.266 ^a

Values are mean ± standard deviation (SD) of triplicate determinations. Samples with different superscripts within the same column were significantly ($p < 0.05$) different.

Key:

573 = 20% mango, 50% orange, 30% watermelon

*618 = 20% mango, 30% orange, 50% watermelon

335 = 30% mango, 50% orange, 20% watermelon

804 = 30% mango, 20% orange, 50% watermelon

732 = 50% mango, 30% orange, 20% watermelon

408 = 50% mango, 20% orange, 30% watermelon

*Most Acceptable (Overall Acceptability)

Discussion

This analysis reflected the sensory preferences for various fruit purees, indicating that different samples excelled in specific attributes, impacting their overall acceptability.

Significant Differences between Samples

Appearance: Sample 618 scored highest in appearance (7.72 ± 1.06), significantly different ($p < 0.05$) from some other samples. Sample 408 also had a high appearance rating, likely due to the higher watermelon content (50%), which can enhance color vibrancy. Aloba and Akpapunam [23] found that in tropical fruit blends, higher watermelon content enhanced consumer ratings in terms of appearance and taste due to its sweetness and attractive red color. Watermelon known for its high water content and a naturally appealing red color,

contributed to color vibrancy, which affected appearance [24]. The findings aligned in terms of appearance and overall acceptability being improved with increased watermelon content, while other studies suggest that mango levels should be moderated to avoid overwhelming subtler flavors like orange.

Aroma: Sample 804, containing 30% mango, 20% orange, and 50% watermelon, received the highest aroma score (7.52 ± 0.77), which is significantly different from other samples. This may be attributed to watermelon's aroma contribution, known for its freshness appeal. Adding tangy notes, orange impacted acidity and a unique aroma, though it must be balanced to avoid overpowering.

Taste: Sample 804 also scored highest in taste (7.48 ± 1.08), suggesting that a balance of higher watermelon and lower

orange could optimize flavor perception. Sample 618, with a moderate amount of orange (30%), achieved higher ratings, in agreement with Bolarinwa *et al.* [25], who found that 20-30% citrus in composite purees optimizes flavor without excessive sourness.

Texture and Consistency: There were no significant differences across samples in texture, but slight variations in consistency, with Sample 618 scoring highest, suggesting that higher watermelon levels improve the smoothness of the puree. Mango is rich in fiber and has a thick, pulpy texture that can enhance the puree's body, especially at higher percentages [26]. This likely accounted for the more moderate scores in texture for samples with higher mango content (Sample 732). The water content of watermelon also aided in smoother consistency, which may explain the higher scores in samples with higher watermelon percentages (50% in Sample 618). However, Oke and Fawole [27] noted that mango contributes significantly to consistency but can mask some of the subtle flavors of orange and watermelon.

Overall Acceptability: Sample 618 received the highest overall acceptability (7.72 ± 1.21), suggesting that the composition of 20% mango, 30% orange, and 50% watermelon is the most balanced for sensory appeal.

Recent studies on fruit composite blends have shown trends consistent with these results. The pattern of these results can be attributed to the unique attributes of each fruit in the composite puree:

4. Conclusion

The processing of mango, orange, and watermelon into purees presents a practical and sustainable solution to mitigate post-harvest losses, enhance the economic value of these fruits, and promote food security. By investigating the proximate composition and functional properties of the purees, this study has highlighted the potential of these fruit purees as valuable ingredients in various food products. Mango, with its rich nutrient profile, orange with its high vitamin C content, and watermelon with its hydrating properties, offer significant benefits when converted into puree form, extending their shelf life and usability.

The incorporation of functional additives like maltodextrin can improve the texture, stability, and usability of the purees in processed food formulations. The analysis of the viscosity, water holding capacity, and oil holding capacity of the purees provides crucial information for optimizing their integration into food systems, ensuring that they maintain desirable sensory and physical attributes.

This study underscores the importance of fruit puree production as a viable approach to reducing fruit wastage, especially in regions like Nigeria where fruit production is abundant but post-harvest losses are high. By transforming highly perishable fruits into shelf-stable, value-added products, the food industry can benefit from extended market reach and improved profitability, while consumers gain access to nutri-

tious, convenient, and versatile fruit-based products.

Overall, the findings of this research contribute to ongoing efforts to promote sustainable fruit utilization, enhance nutritional diversity in food products, and support the agricultural sector's growth through innovative fruit processing techniques.

Conflicts of Interest

The authors declare no conflicts of interest.

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