**Physicochemical Properties and Consumer Preferences of Java Apple (*Syzygium samarangense*) Fruit Jelly**

# **Abstract**

**Background-** Java apple (*Syzygium samarangense)* is a tropical fruit characterized by its crisp texture and refreshing flavor. It is packed with essential micronutrients, such as calcium and potassium, making it a valuable part of a nutritious diet.

**Aim**- This study aimed to formulate and evaluate the physicochemical properties, nutrient composition, and sensory qualities of Java apple-based fruit jellies.

**Study Design**- Six jelly samples were developed applying different juice-to-sugar ratios, with steady pectin levels and protect through gamma radiation to avoid chemical preservatives. The samples were evaluate for pH, moisture content, °Brix (total soluble solids), protein, fat, and ash contents allowing standard protocols.

**Place and Duration of Study-** The study conducted from January 2025 to April 2025 in Dhaka.

**Result and Discussion**- The result showed that a slight increase in acidity (pH 3.93 to 3.80) and a persistently decrease in moisture content (33.5% to 32.0%) over the formulas, while °Brix was persistently at 66, ensuring sufficient sweetness and texture. Nutrient properties inevitably same within all samples, with low fat (0.4%), moderate protein (1.3%), and ash content (2.4%), suggesting lower nutrient content because of new formulas. Most of the data from a panel of 100 sensory evaluation panel members showed that samples with average moisture (almost 32.5%) and steady pH (3.82–3.83) were the most liked, particularly Samples 3 and 4, which offered the best flavor, taste, and appearance. The study focuses on how underutilized exotic fruits like *S. samarangense* can be used to make nutritious confections that meet the growing demand from consumers for processed meals that are natural, useful, and visually appealing.

**Conclusion-** This study highlights the significance for developing sustainable, preservative-free, and nutritious jellies for the betterment of future generations of healthy individuals.

**Keywords:** Java Apple, Jelly, Sensory Evaluations, Nutrient Value, Functional Food, Proximate Analysis, Physicochemical Properties.

# **Introduction**

Confectionery products are widely consumed across all aged people, with jellies and gummies particularly favored by children and adolescents due to their sweet taste, chewy texture, and colorful appearance Teixeira-Lemos, Almeida et al. (2021), (Heristika, Ningrum et al. 2023). These products possess a gel-like consistency and are composed of fruits (at a minimum concentration of 45g per 100g) and sugars (approximately 55g per 100g), typically in the forum of sucrose syrup and/or glucose(Park, Olawuyi et al. 2021, Renaldi, Junsara et al. 2022, Charoenphun, Noonim et al. 2025). They also contain thickeners, acids, essence, and food colorants or dye (Park, Olawuyi et al. 2021). The various fruit-based jellies made with tropical fruits like java apple, orange, guava, and berries are gradually popular because of their natural sweetness and nutritional value (Cervera-Chiner, Barrera et al. 2021, Noman 2022, Afifah, Ayustaningwarno et al. 2023, Charoenphun, Noonim et al. 2025).

*Syzygium samarangense,* a flowering plant from the Myrtaceae family, is widespread to Southeast Asia's tropical regions, which include the larger Sunda Islands, the Malay Peninsula, and the Andaman and Nicobar Islands(Banadka, Wudali et al. 2022, Tarigan, Pramastya et al. 2022, Idris, Khandaker et al. 2023). The plant (commonly known as wax apple, Java apple, Semarang rose-apple, and wax jambu) has been introduced and internationally harvested across tropical countries (Idris, Khandaker et al. 2023). The Java apple is a low-calorie containing fruit, with 100 g of fresh pulp containing around 25-35 kcal which is very low in energy production. It contains 8-10 g of carbs (mainly dietary fiber, simple carbohydrate including glucose, fructose, and sucrose), 0.2-0.5 g of vegan-protein, and less than 0.2 g of lipid. The fruit comprises important micronutrients such vitamin C (15-20 mg/100 g), calcium (20-30 mg/100 g), potassium (100-120 mg/100 g), and trace amounts of iron and phosphorus(Banadka, Wudali et al. 2022, Idris, Khandaker et al. 2023). These nutritious properties are mostly attributed to its rich phytochemical content, including antioxidant and poly phenolic compounds (Banadka, Wudali et al. 2022, Tarigan, Pramastya et al. 2022, Idris, Khandaker et al. 2023).

With rising consumer awareness concerning health, nutrition and environmental sustainability, there is increasing demand for functional foods made of natural and tropical fruits(Banadka, Wudali et al. 2022, Tarigan, Pramastya et al. 2022). There are various plant are widely used to make traditional medicine, with various parts including leaves, flowers, fruits, roots, and barks which being used for therapeutic purpose for centuries(Idris, Khandaker et al. 2023). These plant-derived substance are insight to prevent and control chronic disease like diabetes, cancer, arthritis, atherosclerosis, cardiovascular disease, and neurological disorders, as well as simulate skin repair and overall well-being(Tarigan, Pramastya et al. 2022, Idris, Khandaker et al. 2023). The younger generation is particularly concerned about health and nutritious foods(Teixeira-Lemos, Almeida et al. 2021). Consumers' concerns about health, nutrition, food safety, and the environment have led to the development of appealing food products. Nowadays, Tropical fruits, which are now underutilized, can meet the demand for nutritious, flavorful, and visually appealing natural meals with medicinal benefits(JAHANGIR 2023). The Java apple presents a promising opportunity to develop novel, appealing, and health-oriented confectionery products such as fruit jellies. By combining sensory appeal with nutritional and functional benefits, Java apple jelly may fulfill the preferences of modern consumers, particularly health-conscious younger populations. Therefore, this study aims to analyze the physicochemical characteristics, consumer preferences including sensory evaluation of Java apple fruit jelly. The findings are intended to provide light on the potential of *S. samarangense* as an innovative component in the functional confectionery market. By introducing the growing interested in natural and beneficial foods, this work provides a scientific basis for the commercialization of Java apple jelly, which and benefit both consumers and producers.

1. **Method and Materials**
	1. **Preparation and formulation of Java Apple jelly samples**

In the study, we were collected fully ripened java apples from Mirpur-1, Dhaka. These fruits were fresh, clean, and fee from physical damage, pests, and foreign matter. After selection, the fruits were washed thoroughly with purified water and air dried to remove surface impurities. The cleaned fruits were sliced into approximately 5 cm pieces and blended to produce fresh juice for sample preparation. In jelly preparation, fresh water, java apple fruit juice**,** refined sugar**,** pectin (E440) was used.

**2.1.1 General procedure**

For each sample, fresh fruits were collected, peeled, grated and chopped into small pieces. The processed fruit was then blended to a smooth consistency using a blender. All ingredients were measured according to the specific formulation for each sample. The fruit puree and sugar were combined and boiled for 5-7 minutes. Pectin was added when the Brix value reached 64-66 to achieve the desired gelatinous texture. Gamma radiation was used for preservation, no chemical preservatives were added.

**Table: 1- Ingredient list and Ratio of different sample**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sample No.** | **Juice** | **Sugar** | **Pectin** | **Juice: Sugar** | **PH(Potential of Hydrogen)** |
| Sample One | 130 | 70 | 2 | 65:35 | 3.80 |
| Sample Two | 125 | 75 | 2 | 60:48 | 3.81 |
| Sample Three | 110 | 90 | 2 | 55:45 | 3.82 |
| Sample Four | 100 | 100 | 2 | 50:50 | 3.83 |
| Sample Five | 90 | 110 | 2 | 45:55 | 3.85 |
| Sample Six | 70 | 130 | 2 | 35:65 | 3.93 |

**2.1.2 Process diagram of making Java Apple Jelly:**

**Figure-1: Process diagram of making Java Apple Jelly**

# **2.2 Analysis Physicochemical Properties**

#### 2.2.1 Ash Content Determination

#### Ash Content was determined following AOAC (2005) standard method. Approximately 5-10g of each sample was placed in a clean, dry porcelain and incinerated in a muffle furnace at 600℃ for six hours. After cooling in a desiccator, the residual ash was weighed, and the ash content was calculated as a percentage of original sample mass.

#### 2.2.2 Brix Estimation (Total Soluble Solids)

A hand refractometer was used to measure the Total Soluble Solids (TSS) of the jelly samples. A few drops of each sample were placed on the prism surface of the instrument, and the Brix value was noted by looking at the refractive index. To ensure accuracy, the refractometer was calibrated with distilled water before each use.

**2.2.3 PH (Potential of Hydrogen) Determination**

A calibrated digital pH meter was used to measure the pH of each jelly sample. To increase accuracy, measurements were made three times. Following the application of gamma radiation, all pH values were noted.

**2.2.4 Moisture Content Determination**

The moisture content was evaluated by oven-drying 5 g of jelly sample at 105°C for one hour. After drying, samples were chilled in a desiccator and weighed again. The moisture content was determined using the following formula:

|  |  |  |
| --- | --- | --- |
|  Moisture content (%) = | MW | × 100  |
| MD |

Where:

* **MW** = Mass of water lost
* **MD** = Dry mass of the sample

**2.2.5 Protein content Determination**

Protein content was measured using the Kjeldahl method, which involved the following steps:

1. **Digestion:**  4g of sample was digested with 10 ml of concentrated sulfuric acid (H2SO4) and 2 g of catalyst mixture.
2. **Distillation:**  The digest was distilled to release ammonia.
3. **Titration:**  The distilled ammonia was titrated with ).1 N NaOH to determine nitrogen

concentration, which was then converted to protein using a conventional conversion factor.

**2.2.6 Fat Content Determination**

The fat content was analyzed using the Soxhlet extraction method. A 5 g sample was placed in a thimble and extracted with petroleum ether for six hours. After the solvent was evaporated, the remaining fat was weighed and expressed as a percentage of the original sample.

**2.3 Sensory Quality Analysis**

The study implemented a nine-point hedonic scale for sensory evaluation. The jelly samples were evaluated by a group of skilled volunteers based on their flavor, texture, and taste. From (1= neither like nor dislike, 2=like slightly, 3= like moderately, 4= like very much, 5= like extremely scores) varied. The samples' overall acceptability was assessed by calculating the average score for each attribute. A consumer panel of 100 participants evaluated test balance, texture, and overall acceptability. They gave consent to willingly participate in sensory test.

# **Result and Discussion**

**3.1 Physiochemical Properties**

The physicochemical analysis of six Java apple samples revealed consistent sugar concentrations and a continuous decrease in both pH and moisture content across the series (table-2). All samples were constructed to achieve a target °Brix of 66 to ensure adequate sweetness and get strength.

|  |  |  |  |
| --- | --- | --- | --- |
| **Sample** | **PH(Potential of Hydrogen)** | **Moisture (%)** | **°Brix** |
| Sample-1 | 3.93 | 33.5 ± 0.2 | 66 |
| Sample-2 | 3.85 | 33.0 ± 0.3 | 66 |
| Sample-3 | 3.83 | 33.0 ± 0.2 | 66 |
| Sample-4 | 3.82 | 32.5 ± 0.2 | 66 |
| Sample-5 | 3.81 | 32.0 ± 0.3 | 66 |
| Sample-6 | 3.80 | 32.0 ± 0.2 | 66 |

**Table-2:** Physicochemical Properties of Java apple fruit jelly sample

The pH values declined gradually from 3.93 in sample-1 to 3.80 in sample six, indicating a slight increase in acidity with successive formulations (∆pH = 0.13). the variation in pH levels reflects differences in acidity among the samples, with Sample -1 being the least acidic and sample-6 the most acidic. Moisture content is crucial for ensuring consistent hydration across all samples, which is essential for maintaining product quality and extending shelf life(Park, Olawuyi et al. 2021, Renaldi, Junsara et al. 2022, Charoenphun, Noonim et al. 2025). Moisture content decreased from 33.5% in sample-1 to 32.0% in sample-6. This 1.5% reduction corresponds with enhanced gel firmness, as lower water activity typically improves textural stability in jellies. In contrast, (Charoenphun, Noonim et al. 2025) gave the moisture content of drinking jelly from 95.04% to 96.52. In this investigation, the drinking jelly's TSS (°Brix) was detected at 66, which was much higher than prior research values. One study revealed TSS levels ranging from 12.5 to 15.1(Charoenphun, Noonim et al. 2025), while another evaluated carrot jellies with various gelling agents and sugar alternatives and discovered TSS values ranging from 3.10 to 3.87 °Brix. Furthermore, a study on hydrocolloid-based functional meals fortified with *Caulerpa lentillifera* found TSS values ranging from 44.8 to 46.8. (Cervera-Chiner, Barrera et al. 2021, Renaldi, Junsara et al. 2022, Said and Sarbon 2022, Heristika, Ningrum et al. 2023, Nasir, Yuswan et al. 2023, Charoenphun, Noonim et al. 2025, Das, Hasan et al. 2025) discovered that increasing gelling agent concentration can affect TSS by changing water retention and distribution. The higher °Brix in this study is likely due to the use of more concentrated sweeteners or fruit content, which contributes to increased sweetness, texture, and product stability.

This controlled sweetness allowed pH and moisture to be the primary variables under evaluation. Samples with intermediate acidity (Sample-3 and Sample-4) received the highest scores for balanced flavor and pleasant mouthfeel. Sample-1 (highest pH) was judged overly sweet and slightly soft, while Sample-6 (lowest pH) was considered too tart and overly firm. These results suggest that a pH of approximately 3.82-3.83 combined with a moisture content near 32.5% yields the most favorable sensory profile. From (Charoenphun, Noonim et al. 2025), reported that their sample’s pH range from 3.4 to 4.0 which is similar to our study. A study on citrus jelly in Poland found similar pH values below 4.6 (Kowalska, Konopska et al. 2023). On the contrary, (Nasir, Yuswan et al. 2023), different products e.g-Caulerpa lentillifera gave the pH range more than 5.93. The berry-orange gummy investigation found small differences in juice-particle mouthfeel and scent strength compared to commercial sweets. Java apple jelly, free of pulp grains, received high grades for smoothness and balanced acidity due to its optimum pH (3.82-3.83) and moisture content similar to 32.5% (Cervera-Chiner, Barrera et al. 2021). Similarly a study conducted in India on dragon fruit reported a pH value below 4.41, and °Brix range between 64 and 66(Narayan and Prasad 2023). This findings align with results observed in the production of various fruit jellies, suggesting consistency in physiochemical characteristics during processing.

According to (Park, Olawuyi et al. 2021, Renaldi, Junsara et al. 2022, Said and Sarbon 2022, Charoenphun, Noonim et al. 2025), maintaining a pH below 5 is effective in preserving jellies, as it prevents the growth of typical spoilage microorganisms. An increase in pH can promote microbial growth, thereby reducing the shelf life of drinking jelly. In addition to physiochemical properties, the proximate composition of fat, protein, and ash in each Java apple jelly sample was assessed (Figure-2).

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**Figure 2- Nutrient Properties of Java Apple Jelly**

All six-sample contained very low-fat levels, ranging narrowly from approximately 0.4% in sample-1 to about 0.43% in sample-6. This slight increase (∆≈ 0.03%) is negligible in practical terms and confirms that jelly matrix remains essentially fat-free. Similarly, fat content in the Polish jellies was consistently below 0.5g(Teixeira-Lemos, Almeida et al. 2021). These difference may be attribute to variations in the formulation, particularly the type and proportion of ingredients used, such as- fruit content and added proteins. Protein content was uniform across formulations, averaging around 1.3%. Sample-1 measured roughly 1.25%, while sample-6 sample 1.35%, indicating a marginal upward trend (∆≈0.10%) that does not substantially affect nutritional profile. In the study, the protein content of drinking jelly samples ranged from .95% to 1.00%, which is notably lower than the values reported in the Polish study, where protein levels varied between 3.25g and 5.30 g(Teixeira-Lemos, Almeida et al. 2021). Ash (mineral residue) consistently registered highest among the three nutrients, at approximately 2.4% in sample-1 rising to about 2.5% in sample-6 (∆≈0.10%), indicating a consistent mineral composition of the samples and addition of pectin. (Afifah, Ayustaningwarno et al. 2023) found higher mineral residue variability in wood apple-soyabean powder jellies (3.59$\pm $ 0.34% to 2.72$\pm $ 0.002%) due to use of legume flour. Java apple contains bioactive components such as terpenes, tannins, and alkaloids, all of which have pharmacological activities. Its fruits also include important elements like as calcium, iron, magnesium, potassium, and zinc, as well as vitamins C, thiamin, riboflavin, and niacin. In the current investigation, ash values ranging from 2.24% to 2.29%. These findings highlight the jelly product's nutritional potential, implying that it could serve as a functional food with both health advantages and appealing sensory properties.

This slight increase may reflect incremental variations in added pectin or mineral content of fruit. Overall, nutrient profiles were stable across all six jelly formulations, with only minor, systematic increases in fat, protein, and ash as sample number increased. These small shifts suggest that adjustments made during processing (e.g.- heating time, pectin concentration) had minimal impact on the basic nutritional makeup of the jellies.

**3.2 Sensory Attributes**

A consumer panel (n=100) evaluated each Java apple jelly sample on three attributes – taste, flavor, and appearance using a 5-point hedonic scale (1= neither like nor dislike, 2=like slightly, 3= like moderately, 4= like very much, 5= like extremely).













**Figure-3: Overall sensory quality of Java apple jelly**

There were no panelists selected “like slightly” or “neither like nor dislike” so only the top three categories are shown (figure-3). Samples 3, 4 and 6 collected the strongest “like extremely” response (93-96%), indicating high sweetness-acidity balance. Sample 1 and 5 showed a more even spread between “like extremely” (58% to 53%) and “like very much” (13% to 43%), while sample-2 had a substantial “like moderately” segment (29%), suggesting less optimal taste balance. In flavor, sample 3 and 6 led in “like extremely” (85%), followed closely by sample 2, 4, and 5 (42-45% “like very much”.

Sample 1 had the largest “like moderately” group (12%), indicating that its flavor was acceptable but not outstanding. On the other hand, appearance, sample 2 and 5 achieved the highest “like every much” rating (45%), while sample 3 and 6 had the greatest “like extremely” response (60%). Sample-1’s appearance drew the largest “like moderately” proportion (20%), and sample 4 had a notable “like moderately” share (31%). Overall, sample 3 and sample 6 consistently received the highest proportions of top-category rating across all three attributes, highlighting them as the most preferred formulations. Sample-4 excelled in taste but was less flavor in appearance. Sample 1, 2, and 5 exhibited more moderate acceptance, particularly in appearance and flavor. Compared to a Indonesian paper (Afifah, Ayustaningwarno et al. 2023), wood-apple-soybean jellies, which received both "like" and "dislike" comments for taste and texture, our Java apple formulations were predominantly "liked" for taste, flavor, and look. While their panels frequently rated these attributes as "dislike" (especially for lower-scoring samples), ours only rated them as "like moderately," "like very much," or "like extremely." This implies that adjusting the pH and moisture in Java apple jelly results in a consistently well-accepted product, with all samples having purely positive hedonic outcomes. Another study from Chattogram Bangladesh found that natural sweeteners can improve acceptability in ice-apple jelly, however formulation errors resulted in "dislike" ratings in some tests(JAHANGIR 2023). In contrast, our Java apple pectin-sugar matrix provided constant sweetness and mouthfeel, as shown by high "like very much" and "like extremely" responses (≥85%).

1. **Conclusion**

This study developed the nutritional value of Java apple (Syzygium samarangense) as an essential component in the production of healthy and appetizing fruit jellies. By adjusting the juice-to-sugar ratio, it was possible to achieve appropriate physicochemical properties such as balanced pH, desirable moisture content, and steady °Brix levels without reducing nutritional quality. The jellies showed low fat content and adequate amounts of protein and minerals, which facilitated their acceptance as nutritious confectionary food products. Sensory test revealed positive consumer approval, particularly regarding combinations with balanced acidity and texture. Furthermore, the use of gamma irradiation improved microbiological safety and increased the product's shelf life without the need for artificial preservatives. Overall, Java apple jelly is a possible alternative for conventional sweets, providing consumer cravings for natural, healthy, and nutritionally beneficial foods. Future research may look on production flexibility and long-term storage stability in order to support industrial applications.

**Conflict of Interest Statement**

The Authors declares no conflict of interest.

**Consent**

All authors declare that ‘written informed consent was obtained from the vendor for publication of this case report and accompanying images.

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**Competing Interests**

Authors have declared that no competing interests exist.

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1.

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