DEVELOPMENT AND QUALITY ASSESSMENT OF PAPAYA AND CARROT MIXED JAM: NUTRITIONAL PROFILE AND SENSORY EVALUATION

A PROJECT REPORT
BY
EYAHYA
ID: 201-34-1105

Submitted to the Department of Nutrition and Food Engineering in the partial fulfillment of B.Sc. in Nutrition and Food Engineering.

Supervised By

Ms. Arifa Sultana

Lecturer (Senior Scale)

Department of Nutrition and Food Engineering

Co-Supervised By

Dr. Nizam Uddin

Associate Professor and Head

Department of Nutrition and Food Engineering

FACULTY OF HEALTH AND LIFE SCIENCE (FHLS)
DAFFODIL INTERNATIONAL UNIVERSITY
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APPROVAL

This project title **"Development and Quality Assessment of Papaya and Carrot Mixed Jam: Nutritional Profile and Sensory Evaluation"** submitted by Eyahya to the Department of Nutrition and Food Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirement for the degree of B.Sc. in Nutrition and Food Engineering and approved as to its style and content.

EXAMINING COMMITTEE

Chairman of the Board: Dr. Nizam Uddin

External Member : Md. Mostak Uddin Thakur

Internal Member-1 : Md. Harun. Ar Rashid

Internal Member-2 : Zannatul Ferdousi

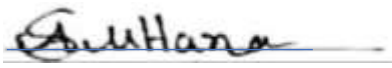
9.12.2024

Dr. Nizam Uddin
Associate Professor & Head
Department of Nutrition and Food Engineering
Faculty of Health and Life Science
Daffodil International University

DECLARATION

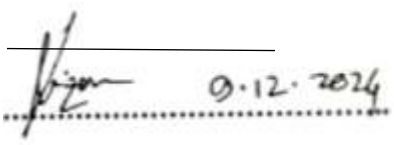
We hereby declare that, this project has been done by us under the supervision of **Ms. Arifa Sultana, (**Senior Scale)**, Department of NFE,** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

Supervised by:



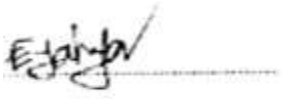
Ms. Arifa Sultana
Lecturer (Senior Scale)
Department of Nutrition and Food Engineering
Daffodil International University

Co-Supervised by:



Dr. Nizam Uddin
Associate Professor & Head
Department of Nutrition and Food Engineering
Faculty of Health and Life Science
Daffodil International University

Submitted by:



Eyahya
ID: 201-34-1105
Department of NFE
Daffodil International University

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ABSTRACT

The development of nutrient-rich and innovative food products has gained significant attention in recent years. This study focuses on the development and quality assessment of mixed jam using raw papaya and carrots, aiming to enhance nutritional value while maintaining sensory appeal. Raw papaya, known for its digestive enzymes and vitamin content, was combined with carrots, a rich source of beta-carotene to create a functional and health-promoting jam. Mixed Jam formulations with varying ratios (50:50) and (50:30:20) of raw papaya, carrots and guava were prepared and analyzed for physicochemical properties, including ph., total soluble solids, fat, protein and texture. Sensory evaluations were conducted with a panel to assess taste, color, aroma, spread ability, and overall acceptability. Sample 1 of the mixed jam has a moisture content of 28.38%, while sample 2 shows a slight increase to 30.57%. The Brix value for sample 1 is 67%, with sample 2 slightly higher at 68.5%. The pH level of sample 1 is 3.61, and sample 2 is a bit more acidic at 4.16. Microbial counts show 2.5×10^3.CFU/ml for sample 1 and 3×10^3.CFU/ml for sample 2. Lastly, the protein content in sample 1 is 0.88%, and sample 2 shows a slight decrease to 0.83%. These variations reflect minor differences in composition and microbial load between the two samples.

Keywords: Mixed jam, Papaya, Carrot, Nutrition

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CHAPTER 1
INTRODUCTION

1.1 Introduction of Mixed Jam

Mixed jam is a semi-solid culinary creation crafted by simmering fruit or vegetable pulp with sugar, pectin, acid, and additional components until it achieves a substantial, cohesive consistency. Ideally, it should comprise 65% or more total soluble solids (TSS) and contain a minimum of 45% pulp. (Awulachew et al, 2021)

Papaya (*Carica papaya L.*) is widely grown in tropical and subtropical regions around the world. In Bangladesh, it is one of the most important fruits in terms of cultivation area and yield per hectare. Approximately 125,000 metric tons of papaya are produced annually on about 1,240 hectares of land, with an average yield of 7 tons per hectare (BBS, 2011). However, papaya production in Bangladesh remains significantly below global standards (Chowdhury et al., 2008). Furthermore, post-harvest losses are estimated to be around 39.9%, resulting in financial losses of approximately 15.64 million USD. (A. K. Das et al, 2023)

Papaya is a significant fruit that is grown widely across the country. Despite Bangladesh's climatic conditions affecting papaya production, it is still widely cultivated in areas like Jashore, Rajshahi, Kustia, Tangail, Khulna, and the hill tracts. Unripe papayas are suitable for making salted pickles, while partially ripe fruits are ideal for producing items like jelly, jam, candy, nectar, puree, and concentrate. Papaya can also be used to create products such as slabs, powders, toffee, tutti-frutti, dried rolls, and dried slices. (M. I. KAYSAR1 et al, 2019)

Carrots (*Daucus carota L.*), a principal root vegetable in the Apiaceous family, are grown extensively around the world and are valued for their versatility and nutritional benefits. However, their highly perishable nature poses significant challenges, including high transportation costs and difficulties in ensuring their safe delivery from farms to markets. These issues often result in substantial wastage, especially in rural areas where agro-processing facilities are scarce. To combat these problems, innovative preservation methods are essential. Among these, jam production stands out as an effective solution, transforming fruit or vegetable pulp into a stable, long-lasting product by combining it with sugar, pectin, and citric acid. (A. K. Das et al, 2023)

A high-quality mixed jam has a smooth, uniform texture without any noticeable pieces. It boasts a bright color, a pleasant fruit flavor, and a semi-set consistency that is easy to spread, with no excess liquid present. Mixed jam made with papaya and carrots is a delightful and unique combination that offers a sweet and slightly tangy flavor profile.

Despite existing research into the production of mixed papaya and carrot jam, several significant gaps remain. Current studies have provided insights into the chemical composition and nutritional benefits of this jam, yet comprehensive data on the exact nutrient levels and how processing affects these nutrients are still lacking. There is also a need for robust clinical evidence to validate the health benefits claimed by the jam. Furthermore, the impact of various processing methods on the nutritional quality of the jam has not been fully explored. Additionally, research on consumer preferences and sensory attributes is limited, which affects product optimization. Long-term studies examining the dietary impact of mixed papaya and carrot jam on health are also needed. Addressing these gaps will improve the understanding and development of this nutritionally rich product.

1.2 Objective of the Study

The study aims to:

- To optimize the formulation of raw papaya-carrot mixed jam by varying the ratios of the ingredients.
- To assess the nutritional and physicochemical properties of the jam.
- To Analyze consumer preferences and sensory attributes.

CHAPTER 2
LITERATURE REVIEW

2.1 Literature Review

Mixed Jam is a product typically created from sound, ripe, and fresh vegetables, which may also include dehydrated, frozen, or previously packaged varieties, as well as vegetable juices, pulp, or juice concentrates. The jam-making process involves boiling these vegetable pieces or purees with nutritive sweeteners like sugar, dextrose, invert sugar, or liquid glucose until reaching a spreadable consistency. Jam production serves as an effective preservation method, combining vegetable pulp or juice with sugar, pectin, and citric acid, and boiling the mixture to achieve a thick, spreadable texture. Successful vegetable jam production relies on the availability of essential ingredients such as fresh vegetables, pectin, citric acid, sugar, and jars at reasonable prices. (Awulachew et al, 2021)

Papaya and carrot mixed jam, a unique blend of flavors and nutrients, offers a healthy and delicious alternative to traditional jams. This literature review explores the optimization of the production process for this specific type of jam, focusing on factors that can enhance its nutritional value, taste, and shelf life. (M.S Rana et al, 2020)

papaya, a highly valued tropical and subtropical crop, thrives in over 50 countries, producing approximately 6.8 million tons annually. This plant is abundant in a wide array of phytochemicals, including polysaccharides, vitamins, minerals, enzymes, proteins, glycosides, saponins, flavonoids, and phytosterols. These bioactive compounds endow papaya with a multitude of pharmacological benefits, underscoring its significance in regular dietary consumption. Beyond its nutritional value, papaya supports digestion and effectively breaks down gluten, a vital property for individuals with dyspepsia or celiac disease. Additionally, it exhibits antioxidant, antimicrobial, carminative, anticancer, hepatoprotective, immunomodulatory, and other therapeutic properties. (Farhan Saeed et al, 2012.)

Carrots are widely enjoyed either fresh or as ingredients in various processed foods like juices, drinks, jams, baby food, and fiber products. They are also a rich source of carotene. The remarkable health benefits of carotenes—such as their conversion into vitamin A within the body, their unique antioxidant properties, their role in boosting the immune system, and their potential in reducing cancer risk—have inspired this work. It aims to provide consumers with appealing products that combine the nutritional and health benefits of both dates and carrots. (Vikanksha et al, 2022)

One of the most appealing aspects of papaya and carrot mixed jam is its low-calorie content compared to many other jams. The sweetness comes from natural sugars in the fruits, reducing the need for added sweeteners. Moreover, the enzymes present in papaya can aid in digestion, making it a beneficial choice for those with sensitive stomachs. Mixed Jam made in the NFE lab and it nutritional and sensorial qualities were analyzed Mixed Jam contained 28.86% moisture. Brix content 67%. pH level of 3.61 and fat 0.32 %. It’s a simple, convenient, and cost-effective recipe. with a longer shelf life under refrigerated conditions.

The demand for processed foods has risen significantly over the past few decades. Jam has become a popular breakfast addition not only in foreign countries but also in Bangladesh. As people's lifestyles become faster-paced, there is a growing need for convenient products, and meals must now be quick and easy to prepare. Jam is a type of processed food typically made from fruits, and the processing of these fruits offers several benefits. These factors encompass increased awareness of the health benefits of mixed jam, a rise in consumer disposable income, and a growing trend in the use of e-commerce platforms. (Mozakkin et al, 2021)

The existing literature on mixed papaya and carrot jam provides valuable insights into its diverse characteristics. Research has extensively examined its chemical composition, highlighting the presence of vital nutrients, bioactive compounds, and potential health advantages. These studies form a foundational understanding of the nutritional value of the mixed jam, illustrating how it may contribute to a balanced diet. The analysis of its components reveals important information regarding the synergistic effects of combining papaya and carrot, such as enhanced antioxidant activity and improved absorption of vitamins. The presence of fiber in both ingredients also suggests benefits for digestive health, further supporting the notion that this mixed jam can be a nutritious addition to one’s diet. Furthermore, the research delves into the sensory properties of mixed papaya and carrot jam, including flavor, texture, and aroma, which are crucial for consumer acceptance and marketability. Understanding these sensory attributes can help in the formulation of products that appeal to a wider audience, thereby increasing their potential in the food industry. (Ibrahim et al, 2021)

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CHAPTER 3
MATERIALS AND MATHODS

3.1 Materials

To ensure the authenticity and superior quality of the final product, the production of mixed jam (papaya and carrot) necessitates the careful selection of ingredients. Papaya and carrot are the primary components, valued for their outstanding nutritional attributes. Maintaining the freshness and natural sweetness of the jam requires the use of hygienic, food-safe storage containers. For those seeking a smoother texture, a fine-mesh strainer can be employed to effectively remove any unwanted particles or surface debris. Additionally, natural flavor enhancers or small amounts of food-grade colorants may be added to elevate both the flavor and visual appeal, if preferred.

Uses of Ingredients:

- Raw Papaya
- Carrot
- Guava
- Sugar
- Pectin
- Citric Acid

Table 1: Ingredients & Amounts

Ingredients	Sample 1	Sample 2
Papaya + Carrot Pulp	250+250 gm	250+150 gm
Guava	0gm	100gm
Sugar	450 gm	450 gm
Pectin	0.5 %	No
Citric Acid	1 g	1 g

The production process for the two samples of mixed jam, using table 1's ingredients and amounts. Samples one and two contain 300 gm of papaya, 200 gm of Carrot, 450 g of sugar, 1g of Citric Acid, and 0.6% of pectin. Sample two has 250 gm of papaya, 200 of carrot and 50 of guava, 440g of sugar, 1g of Citric acid.

3.2 Method:

Flowchart of Mixed Jam:

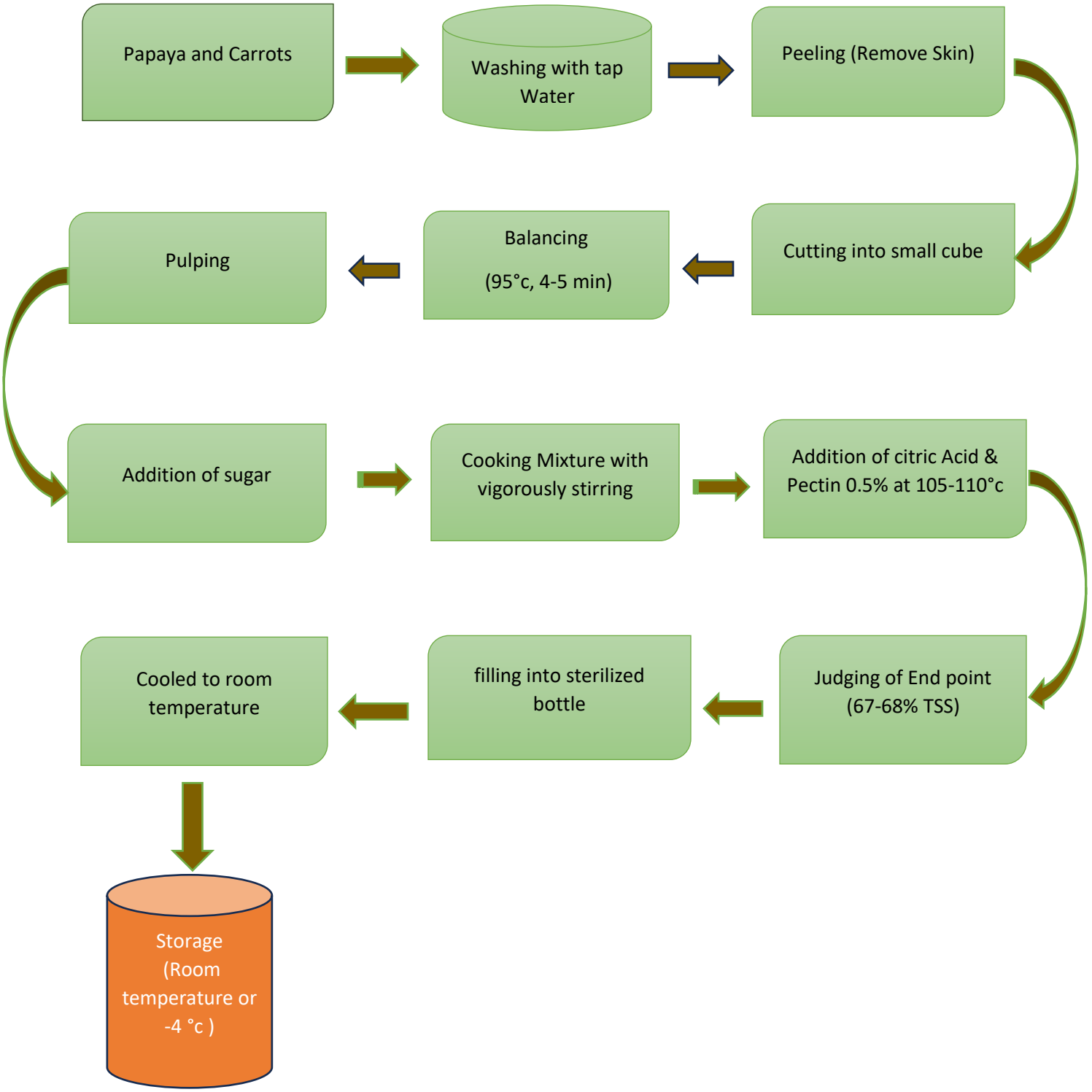

Figure -1: Papaya and carrot mixed jam

The finished product of papaya and carrot mixed jam is a vibrant and nutrient-rich spread, merging the tropical sweetness of papaya with the subtle earthiness of carrots. Its bright orange color reflects the natural hues of both ingredients, making it visually appealing. The jam has a smooth, spreadable texture that works well on toast, crackers, and pastries, while its balanced flavor brings out fruity notes from papaya and a mild undertone from carrots. The papaya and carrot jam are versatile, suitable as a spread, dessert topping, or even a baking ingredient. It provides consumers with a flavorful, health-conscious option that combines both taste and nutrition, with reduced-sugar variations further enhancing its dietary appeal.

3.2.1 Determination of Moisture Content

Moisture content is a critical parameter in food products, including mixed jam, as it influences the shelf life, texture, and microbial stability of the product.

Procedure:

- Place the sample into the moisture analyzer, activate the device, and allow it to run for approximately five minutes.
- Subsequently, the moisture analyzer displays the results on the screen (as per the operating instructions of the digital moisture analyzer).
- I observed the moisture value after adhering to the indicated procedure.

Figure-2: Moisture Analyzer (nscbd.com)

Calculating Moisture Content:

The moisture content is determined by calculating the weight loss during drying, using the formula:

Moisture Content (%) =(W2−W3) /(W2−W1) ×100\

Where:

- W1 = Weight of empty container
- W2 = Weight of container + fresh sample
- W3 = Weight of container + dried sample

3.2.2 Determination of ºBrix

The determination of °Brix (degrees Brix) is a measure of the sugar content in an aqueous solution. It is commonly used in industries like food and beverage production, particularly for jam, juices, wine, and syrups, to assess sugar concentration.

Procedure:

- Clean the refractometer's prism with distilled water and dry it with a tissue.
- Clean the prism again after calibration.
- Place 2–3 drops of sample on the prism.
- Close the cover plate to spread the evenly across the prism surface.
- Look through the eyepiece (for analog refractometers) or check the digital display.

Figure-3: Refractometer (nscbd.com)

3.2.3 Determination of pH

The pH determination measures how acidic or basic a solution is, on a scale from 0 (very acidic) to 14 (very basic), with 7 being neutral. It's commonly used in chemistry, biology, food, water treatment, and many other fields to control quality and safety.

Procedure:

To measure the pH of mixed jam, begin by turning on the pH meter. Prepare a sample of the Jam and transfer it into a beaker. Ensure the pH electrode and temperature sensor are both clean and dry. Calibrate the pH meter using standard buffer solutions (buffers 1 and 2). Once the meter is calibrated, immerse the electrode into the sample in the beaker. Allow the reading to stabilize, and then record the pH once the displayed value has settled.

3.2.4. Determination of Protein

The determination of protein content in mixed jam aims to accurately quantify the total protein present in the product, serving several essential purposes. Firstly, it provides valuable nutritional information, helping consumers and manufacturers understand the protein contribution of the snack for better dietary planning.

Procedure:

Sample Preparation: Weigh a specific amount of the food sample 10gm using an analytical balance. Record the weight.

Digestion:

- Take sample .4 gm, H2SO4 10 ml and digestion mixture 2gm
- Put it on the digestion flask
- Use two digestion flasks for this procedure so that average value can be taken
- At first heat slowly, then increase the heat and heat about 3-4 hours
- The end point will be no white smoke of H2SO4 and the solution will be crystal clear
- Cool it for some time

Distillation:

- Pour the solution in a volumetric flask and make it 100ml level using distilled water
- Take 10 ml from that volumetric flask to the distillation flask,
- Take 150 ml distilled water and 10ml of 40% NaOH to the distillation flask.
- Take 50 ml of distilled water and 10ml 0.1N HCl and 2 drop of methyl red (1%) in the trapping conical flask
- Use three distillation flasks for this procedure where one of them will be blank i.e. no sample. Only take 150ml distilled water with 10 ml 40% NaOH.
- Use three trapping solution in 3 trapping conical flasks remaining the same thing.
- Set up the condenser and start it
- Start the distillation unit and run for 30 min.

Titration:

- Fill the burette with 0.1N NaOH
- Do the titration 3 times with 3 trapping solution
- The end point will be color changes from pink to light yellow

Calculation: protein % $\frac{(B-S) \times 1.4 \times 10 \times 5.95 \times 0.1}{sample\ weight}$

3.2.5 Determination of Fat

The objective of determining fat content in mixed jams is to assess the nutritional quality and composition of the product, particularly in relation to health claims, ingredient transparency, and product labeling.

Procedure:

- Slightly grind ~30 g sample with mortar and pestle (excessive grinding will lead to greater loss of fat in mortar).
- Wearing plastic gloves, remove pre-dried cellulose extraction thimbles from the desiccator. Label the thimbles on the outside with your initials and a number (use a lead pencil), then weigh accurately on an analytical balance.
- Place ~2–3 g of sample in the thimble. Reweigh. Place a small plug of dried glass wool in each thimble. Reweigh.
- Place the three samples in a Soxhlet extractor. Put ~350 ml petroleum ether in the flask, add several glass boiling beads, and extract for 6 h or longer.
- Place a 250-ml beaker labeled with your name below your samples on the Soxhlet extraction unit.
- Samples in thimbles will be placed in the beaker after extraction and before drying.
- Remove thimbles from the Soxhlet extractor using tongs, air dry overnight in a hood, then dry in a vacuum oven at 70ºC, for 24 h. Cool dried samples in a desiccator then reweigh.

Calculation of % fat:

%FAT = ((wt. after drying) - (wt. after extraction)) x 100/ (thimble and sample wt.) - (thimble wt.))

3.2.6 Determination of ash content

Dry ashing procedures use a high temperature muffle furnace capable of maintaining temperatures of between 500 and 600ºC. Water and other volatile materials are vaporized and organic substances are burned in the presence of the oxygen in air to CO_2, H_2O and N_2. Most minerals are converted to oxides, sulfates, phosphates, chlorides or silicates.

Procedure:

- Weigh accurately crucible.
- Place 3–5 g of sample in the crucible accurately.
- Place in a forced draft oven at 130°C for 1 h.
- Remove from oven, cool, and store in desiccator until samples are weighed.
- Place the crucible with dry sample in a muffle furnace at 585°C for 6 h.
- Remove from furnace, cool, and store in desiccator until samples are weighed.
- Calculate percentage ash (dry basis)

Calculation % ash,

$$\% \text{ ash} = \frac{\text{Weight of ash}}{\text{Weight of dry sample}} \quad X\ 100$$

3.2.7 Total Carbohydrate

A subtract method was used to compute the total amount of carbohydrates.

Fat + Protein + Ash + Moisture - 100 = Percentage of Total Carbohydrate

3.2.8 Determination of Microbial Contamination

Microbial contamination refers to the unintended introduction of microorganisms such as bacteria, fungi, yeast, or Mold into a product, sample, or environment. Determining microbial contamination is crucial in industries such as food, pharmaceuticals, cosmetics, and water quality monitoring. Regular testing ensures consumer safety, validates manufacturing processes, and extends the shelf life of juice products.

Procedure-

- Procedure for Microbial Contamination Test First, gather all necessary instruments, such as test tubes, beakers, measuring cylinders, pipettes, micropipettes, and petri dishes. Sterilize them in an autoclave at 121°C for 30 minutes.
- After sterilization, carefully remove the instruments from the autoclave and place them in a laminar airflow cabinet to prevent contamination.
- Prepare a 9 mL solution of sodium chloride in each test tube and add 1 mL of the sample to the first test tube to begin the serial dilution process.
- Using a micropipette, transfer 1 mL of the diluted sample from the first test tube to the second. Continue this process sequentially for each test tube, transferring 1 mL to the next, while labelling the test tubes as 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}, and 10^{-7}.
- Add 9 mL of agar media to each petri dish using a pipette, then use a micropipette to transfer 1 mL of the sample from each test tube to its corresponding petri dish. Spread the media evenly in each dish and allow it to solidify.
- Once the media has solidified, place all petri dishes in an incubator set to 37°C for 24 hours.
- After the incubation period, remove the petri dishes from the incubator, count the microbial colonies, and record the results.

Following was the Formula:

Colony-Forming Unit (CFU/ mL) = (Colony Count x Dilution Factor) / Sample Volume

3.2.9 Sensory Evaluation

The objective of sensory evaluation is to assess and analyze the sensory characteristics of a product, such as its appearance, taste, smell, texture, and sound—using human senses. This process aims to measure consumer preferences, determine product quality, and evaluate differences or improvements in products. Sensory evaluation is widely used in food, beverage, cosmetic, and other industries to ensure products meet customer expectations and standards. It helps in optimizing formulations, conducting quality control, and guiding product development based on sensory data.

Sensory Evaluation of Mixed Jam

To assess the sensory attributes (appearance, colour, texture, taste, aroma, and overall acceptability) of a mixed fruit jam made from papaya and carrots using human panellists, in order to determine its quality, consumer preference, and acceptability.

Procedure:

A hedonic scale is a verbal expression tool used to indicate varying levels of preference or aversion, ranging from strong dislike to strong like.

- Smiley faces can be used alongside a 9-point scale to visually represent the degree of liking or disliking.
- Participants can also provide comments on the product's appearance, taste, aroma, and texture.
- Once the data is collected, the results should be analysed to assess overall consumer preferences and product attributes.

Table 2: Sensory Evaluation questionnaire of mixed jam

Sample Code:

Attribute	**9** Like Extremely	**8** Like Very Much	**7** Like	**6** Like Slightly	**5** Like or Dislike	**4** Dislike Slightly	**3** Dislike Moderately	**2** Dislike	**1** Extremely Dislike
Colour									
flavour									
Taste									
Texture									
Overall Acceptability									

CHAPTER 4
RESULTS AND DISCUSSTION

4.1 The proximate composition of mixed fruit jam

Table 3 illustrates the nutritional composition of mixed fruit jam.

Mixed fruit jam, made from a vibrant blend of fruits (papaya and carrots), is a flavorful spread packed with essential nutrients, making it a valuable addition to a balanced diet. Naturally rich in vitamins and fiber, it offers a sweet yet wholesome option for snacking. Despite its delightful sweetness, mixed fruit jam is moderate in calories when consumed in reasonable portions, making it an enjoyable and satisfying treat.

Sample 1 of the mixed jam has a moisture content of 28.38%, while sample 2 shows a slight increase to 30.57%. The Brix value for sample 1 is 67%, with sample 2 slightly higher at 68.5%. The pH level of sample 1 is 3.61, and sample 2 is a bit more acidic at 4.16. Microbial counts show 2.5×10^3.CFU/ml for sample 1 and 3×10^3.CFU/ml for sample 2. Lastly, the protein content in sample 1 is 0.88%, and sample 2 shows a slight decrease to 0.83%. These variations reflect minor differences in composition and microbial load between the two samples.

Table 3: Nutrient content of Mixed fruit jam

Sample No	Moisture (%)	TSS (%)	Ash (%)	Protein (%)	Fat (%)	PH	Carbo-hydrate (%)
Sample -1	28.38	67	0.36	0.88	0.32	3.61	67.85
Sample -2	30.57	68.5	0.34	0.83	0.35	4.16	67.55

4.2 Microbiology test quality of Mixed Jam

Table 4: Microbiology test quality of mixed jam

Test Name	Number of colonies	
TPC	Sample -1	2.5×10^3.CFU/ml
	Sample -2	3×10^3.CFU/ml

The optimal percentage of mixed jam in a product is determined by several factors, including flavor, nutritional content, and consumer preferences. A widely accepted standard for authentic and natural taste is around 100% pure mixed jam. Deviations from this standard, whether large or small, can influence the overall quality of the jam. Our mixed jam maintains a high concentration of pure ingredients, ensuring a rich and authentic flavor profile. Adhering to industry standards, our product reflects a commitment to capturing the essence of mixed jam in its purest form. This approach is driven by our dedication to authenticity, meeting consumer expectations, and maintaining high-quality standards.

4.3 Sensory Quality

Sensory Quality encompasses the assessment of a product's characteristics through human senses taste, aroma, texture, visual appeal, and overall sensory satisfaction. For mixed jam, sensory quality is a pivotal factor in driving consumer preference and loyalty.

Sample -1 **Sample -2**

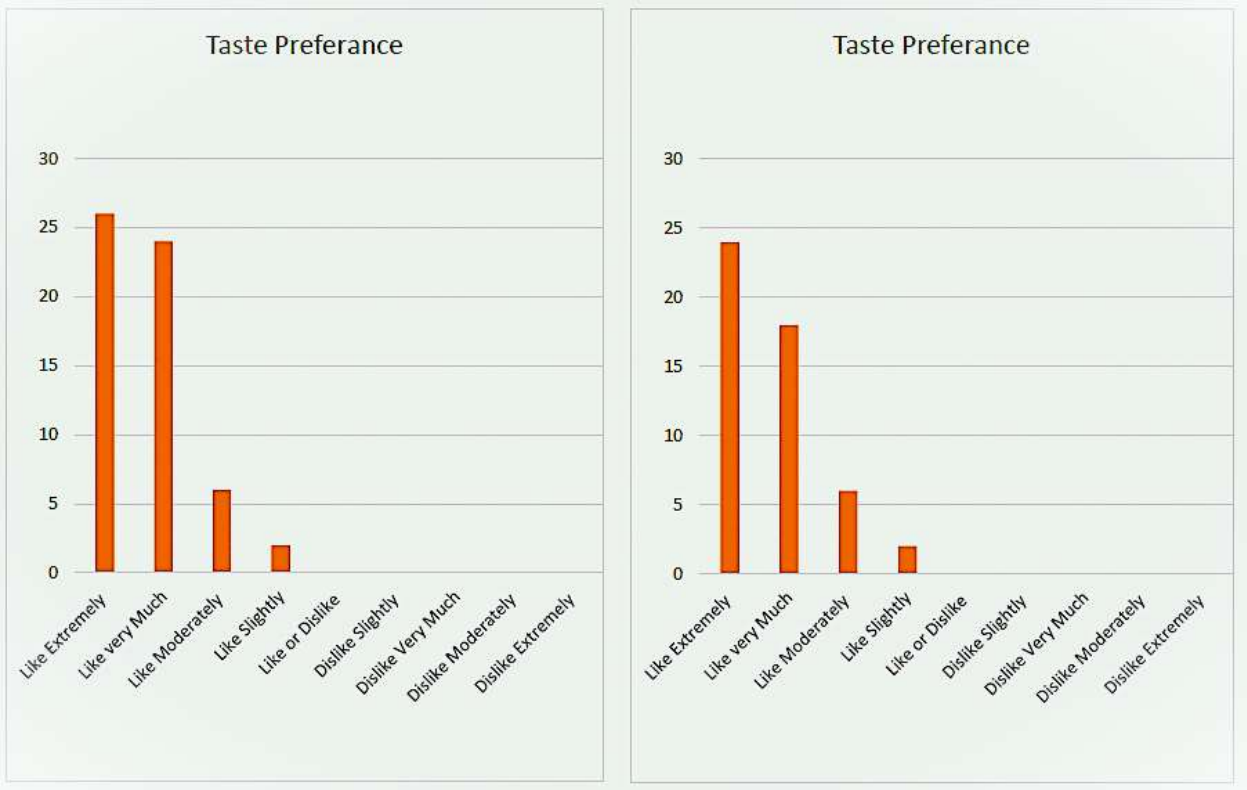

Figure 5&6: Taste Preference

Figures 5 and 6 present the taste attributes of two mixed jam samples, depicted using bar charts based on a 9-point hedonic scale. The charts reveal that sample 1 achieved the highest rating, categorized as "extremely liked." This sample was exceptionally well-received, with 26 out of 30 participants expressing strong approval. The favorable response underscores the superior sensory appeal of sample 1, showcasing its ability to resonate with consumer preference.

Sample -1 **Sample -2**

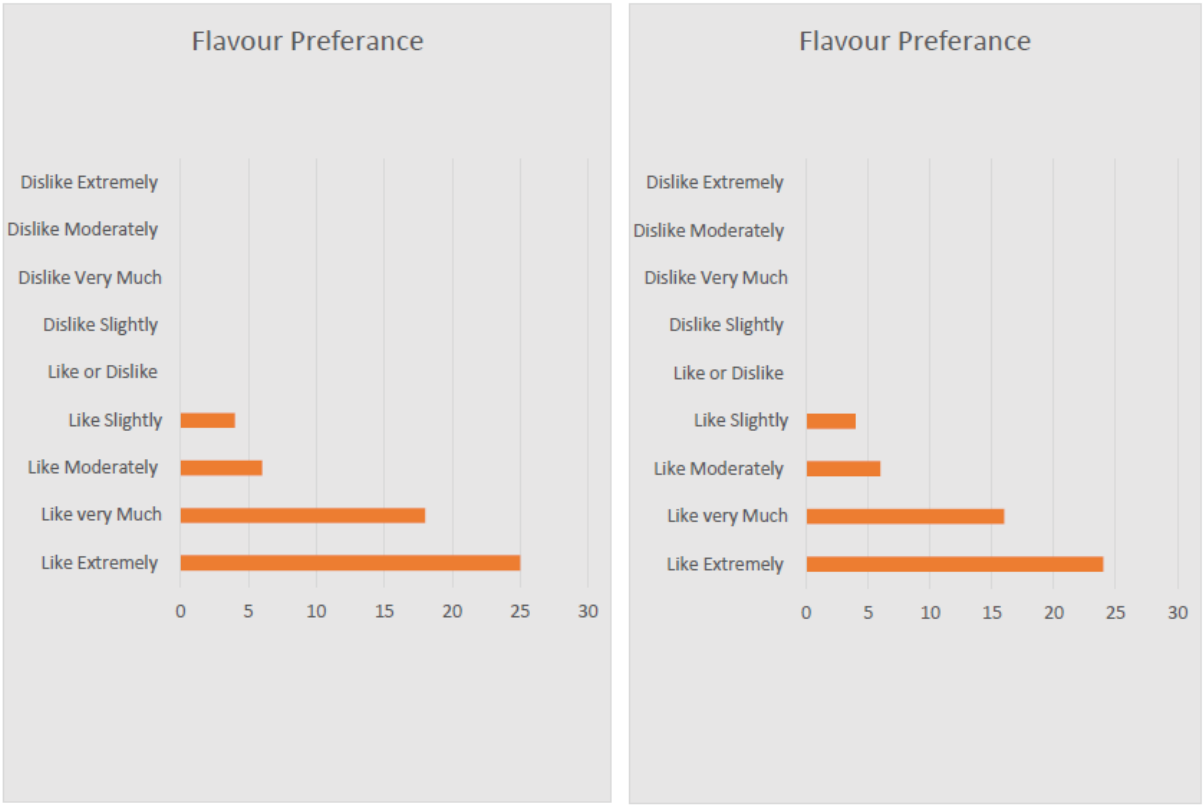

Figure 7&8: Flavor Preference

Figures 7 and 8 depict the flavor attributes of two mixed jam samples, presented in bar charts using a 9-point hedonic scale. The data reveals that sample 1 received the highest rating, categorized as "liked very much." This sample was highly favored, with 25 out of 30 participants expressing strong approval. The exceptional reception of sample 1 reflects its superior flavor profile and its strong alignment with consumer taste preferences.

Sample -1 **Sample-2**

Figure 9&10: Texture Preference

Figures 9 and 10 illustrate the texture attributes of two mixed jam samples, represented in bar charts based on a 9-point hedonic scale. The charts indicate that sample 1 achieved the highest rating, categorized as "liked very much." This favorable assessment highlights the appealing texture of sample 1, showcasing its positive reception among consumers.

Sample -1 **Sample-2**

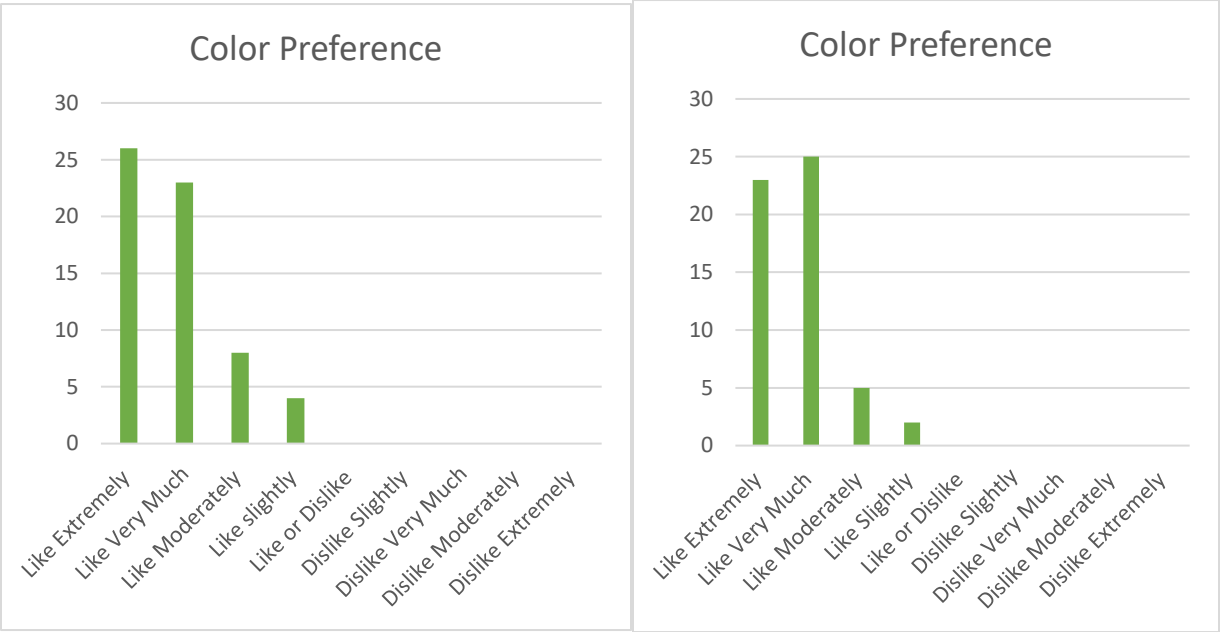

Figure 11&12: Color Preference

Figures 11 and 12 display the color attributes of two mixed jam samples in bar charts, based on a 9-point hedonic scale. The charts indicate that Sample 1 received the highest score, rated as "like extremely.

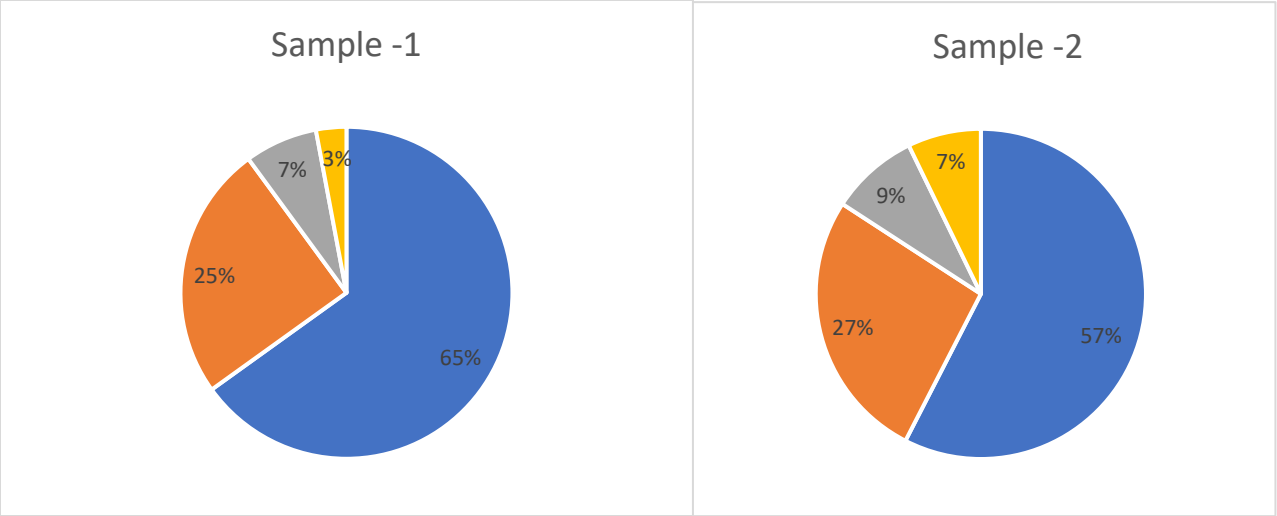

Figure 13&14: Overall Acceptance of Mixed Jam

According to the data provided, Sample 1 achieved a higher score of (8.67) for color, (7.63) for flavor, (7.56) for texture, (7.27) for taste, (8.18) for aroma, and (7.67) for overall acceptability. In comparison, Sample 2 recorded averages (7.1) for color, (6.84) for flavor, (6.67) for texture, (6.91) for taste, (7.27) for aroma, and (8.57) for overall acceptability. Sample C, on the other hand, received lower scores, with an average of (6.47) for color, (5.93) for flavor, (6.87) for texture, (6.29) for taste, (6.07) for aroma, and (7.27) for overall acceptability. The overall sensory evaluations of Mixed Jam are presented in Figures 13 and 14. In Sample 1, 65% of participants rated it as extremely favorable, while 25% gave it a very positive rating. For Sample 2, 57% of participants rated it as extremely favorable, and 27% rated it as very positive. Additionally, no participants expressed any dislike for the mixed jam. These findings indicate that Sample 1 achieved the highest ratings for both taste and overall acceptability, whereas Sample 2 received the lowest taste rating. When comparing these results to previous research, similar trends in sensory evaluation have been reported in studies on fruit jams and spreads. For instance, a study by mixed fruit jams found that product acceptability often correlates with higher sugar content, moisture and flavor balance, factors which can significantly enhance sensory preference.

CHAPTER 5
CONCLUSION

To conclude, the development and quality assessment of mixed papaya-carrot jam in the NFE lab has shown promising results. Additionally, the mixed jam was found to be a great source of Vitamin, contributing to its nutritional value. From a sensory perspective, as illustrated in Figure 13 (Sample 1), it exhibited high overall acceptability. An impressive 65% of participants rated it as extremely favorable, while 25% expressed a strong preference. Notably, no participants showed any dislike for the jam. These findings validate the successful enhancement of the production process, resulting in mixed jam with desirable sensory qualities and nutritional benefits. Sample 1 of the mixed jam has a moisture content of 28.38%, while sample 2 shows a slight increase to 30.57%. The Brix value for sample 1 is 67%, with sample 2 slightly higher at 68.5%. The pH level of sample 1 is 3.61, and sample 2 is a bit more acidic at 4.16. Microbial counts show 2.5×10^3.CFU/ml for sample 1 and 3×10^3.CFU/ml for sample 2. Lastly, the protein content in sample 1 is 0.88%, and sample 2 shows a slight decrease to 0.83%. These variations reflect minor differences in composition and microbial load between the two samples. These results highlight the impact of mixed jam production on its physicochemical properties and sensory analysis, as well as the importance of monitoring changes over time for quality control and product development.

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APPENDIX

APPENDIX 1
Synopsis of the thesis
1. Name: Eyahya
2. Id: 201-34-1105
3. Project Title: Development and Quality Assessment of Papaya-Carrot mixed Jam: Enhancing Nutritional Value and Sensory Evaluation

4. Introduction:
A mixed jam made from papaya and carrots combines complementary flavors and textures, resulting in a distinctive spread that is both tasty and nutrient-rich. This jam benefits from the natural sweetness and fiber of papaya and the mild, earthy sweetness of carrots, which also provide beta-carotene, enhancing the jam's nutritional profile and visual appeal. In sensory testing, papaya-carrot jam, especially with a balanced 50:50 ratio, is well-received for its texture, taste, and smooth consistency, appealing to a wide consumer base. The combination contributes beneficial nutrients, such as vitamins A and C, and offers dietary fiber, antioxidants, and color stability, which together improve the jam's shelf life and attractiveness. (A. K. Das, 2023)

A mixed jam made with papaya and carrots is rich in nutrients, drawing on the beneficial qualities of both fruits. Papaya provides significant vitamin C, as well as vitamins A and B9 (folate), along with potassium, all of which are important for supporting immune function, healthy skin, and good vision. Carrots supply beta-carotene, dietary fiber, and other antioxidants, which contribute to heart health and help combat oxidative stress. This blend also boosts fiber content, which aids digestion, while natural sugars offer an energy source. The jam's acidity and moisture levels contribute to flavor consistency and prolong shelf life during storage. (Basary, 2022)

5. Objective:
- To enhance the flavor, color, and overall appeal of the jam.
- To Analyze consumer preferences and sensory attributes.
- To Explore the long-term dietary impact of the jam on health.
- To optimized production methods, aim to boost the key nutritional components in the jam

Ingredients:

- Raw Papaya
- Carrot
- Sugar
- Pectin
- Citric Acid

Instrument:

- Blender machine
- Slicer
- Biker
- Knife
- Spoon

Jam Production Process

1. **Inspection**: Fresh and firm papaya and carrots are received and sorted based on their color and sensory appeal. Any spoiled or damaged fruits are removed, typically by hand picking or using color sorters.

2. **Washing**: Vegetable are washed using a solution of 200 ppm chlorine in water to ensure effective cleaning. The water's pH and temperature must be controlled to avoid damaging the Vegetable. In industrial settings, dump washers and spray washers are commonly used.

3. **Peeling**: Depending on the fruit, peeling may be done by hand (or mechanically using automated peelers in industrial operations. Vegetable with hard inner stones, such as require pitting before processing.

4. **Pulping**: The pulp is extracted by removing seeds and cores. Pulping machines with adjustable gaps between the sieve and rotor are used to handle different types and qualities.

5. **Addition of Sugar**: The required amount of sugar and pectin is added to the pulp or juice. Water may be added if necessary. The sugar binds to water molecules, which frees up the pectin, helping to form a gel. The amount of pectin and sugar affects the consistency of the jam—more pectin results in a firmer jam, while more sugar may make it stickier.

6. **Boiling**: Boiling is the most critical stage in jam making. The mixture is heated until the sugar dissolves, and the mixture reaches a specific temperature.

7. **Addition of Citric Acid**: Citric acid is added during the boiling process. The mixture is heated to 105°C or until it reaches 68-70% Total Soluble Solids (TSS) to ensure proper setting. A "sheet test" is performed to check consistency—if the jam drops as sheets or flakes, it's ready.

8. **Filling into Jars**: The hot jam is poured into sterilized jars and cooled in a water bath. To enhance preservation, the jars can be sealed with paraffin wax or other waxes, and metal caps are vacuum-sealed.

9. **Storage**: The jars are stored in a cool, dry place, away from direct sunlight. Proper storage can extend the shelf life of the jam for about one year.

Place of the Study:
Food processing Lab, Department of Nutrition and Food Engineering, Daffodil international University

Period of the Study:
I started my project work on 24 March, 2024.

Supervisions:
Supervisor: Ms. Arifa Sultana, Sr. Lecturer, Dept. of NFE
Co-Supervisor: Dr. Nizam Uddin, Associate Professor & Head**,** Dept. of NFE

Expected Outcome:

- Superior Quality
- Prolonged Shelf Life
- Successful Testing:
- Customer Satisfaction
- Increased Demand

Period of the Study:

Task	Activities by Months or Days (Starts and End)					
	1	2	3	4	5	6
Literature review						
Product Development						
Sensory Evaluation						
Product Testing						
Project writing and submission						

Conclusion:

A mixed jam made with papaya and carrots provides various health benefits. Rich in vitamins and minerals, including vitamin C, A, and folate, the jam supports immune function, skin health, and vision. The antioxidants in papaya and carrots offer anti-inflammatory effects and may reduce oxidative stress.

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Signature of the Supervisor	Signature of the Co-Supervisor

DEVELOPMENT AND QUALITY ASSESSMENT OF PAPAYA-CARROT MIXED JAM: NUTRITIONAL PROFILE AND SENSORY EVALUATION

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