"The Development and Assessment of Beetroot Ice Cream"

A Project Report By
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ID. 191-34-173

Submitted to the Department of Nutrition and Food Engineering

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

Supervised By
Mr. Juwel Rana
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Faculty of Health and Life Sciences (FHLS)
Daffodil International University

LETTER OF TRANSMITTAL

Date:
To
Dr. Nizam Uddin
Department of Nutrition & Food Engineering
Faculty of Health and Life Sciences
Daffodil International University
Subject: Submission of the thesis work report

Sir,

As part of the Nutrition and Food Engineering (NFE) program's curriculum, I, Md. Rabius Sani, holding ID No. 191-34-173, would like to express my joy and pleasure in being able to present my thesis paper. This report was created based on the knowledge and data I obtained throughout my product development. Detailed information about Product Development is provided in this paper. I did my best to study and work as much as I could at this time because it was the first time, I had the opportunity to produce a product on my own. I had the chance to learn how to design new products and how various laboratory tests are carried out thanks to my thesis research.

I thus want to share this thesis report with you in the hopes that your nice comments will help me in the future and inspire me to succeed.

Sincerely Yours,

…………………………….
Md. Rabius Sani
ID: 191-34-173
Department of Nutrition and Food Engineering
Faculty of Health and Life Sciences
Daffodil International University

LETTER OF AUTHORIZATION

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

Subject: Declaration regarding the validity of the thesis report.

Sir,

The title of this thesis paper is "Knowledge and Extension of the Practice of "The Development and Assessment of Beetroot Ice Cream." It was sent to the Daffodil International University in Ashulia, Dhaka, Bangladesh, Faculty of Health and Life Sciences, Department of Nutrition and Food Engineering.

The department and faculty members were the exclusive focus of this investigation.

Sincerely yours,

…………………….

Md. Rabius sani
Id.191-34-173
Department of Nutrition and Food Engineering
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Daffodil International University

LETTER OF RECOMMENDATION

I am happy to confirm that the thesis work report on "the development and assessment of beetroot ice cream." was completed by Md. Rabius Sani carrying the Department of Nutrition and Food Engineering's ID No. 191-34-173 has been authorized for presentation and defense/viva voce.

I'm happy to vouch for the accuracy of Md. Rabius Sani's work on the facts and conclusions in the report. For additional academic advice and viva or defense, I wholeheartedly concurred with the report offered by Md. Rabius Sani. He is a highly likable individual with a strong moral foundation. Working with him has been quite enjoyable.

I wish him all success in life

……………………………….

Mr. Juwel Rana

Assistant Professor
Department of Nutrition and Food Engineering.
Faculty of Health and Life Sciences (FHLS)
Daffodil International University.

CERTIFICATION OF APPROVAL

I am pleased to certify that the thesis work report on “The Development and Assessment of Beetroot Ice Cream.” was conducted by Md. Rabius Sani, bearing respectively ID No: 191-34-173 of the Department of Nutrition and Food Engineering has been approved for presentation and Defense/Viva voice.

I am glad to hereby certify that the data and findings presented in the report are the authentic work of Md. Rabius Sani bears a strong moral character and a very pleasant personality.

I wish him all success in life

……………………………

Dr. Nizam Uddin
Associate Professor and Head
Department of Nutrition and Food Engineering
Faculty of Health and Life Sciences (FHLS)
Daffodil International University.

ACKNOWLEDGEMENT

I want to thank Almighty Allah in particular for allowing me to be well from the beginning of my thesis time to its completion, allowing me to study and submit my thesis report on schedule.

I want to publicly thank my supervisor, Juwel Rana, Assistant Professor at the Department of Nutrition and Food Engineering. I would like to take this chance to thank Daffodil International University for its helpful advice, encouragement, and oversight.

I want to thank Dr. Nizam Uddin, associate professor and department head of Daffodil International University's Department of Nutrition and Food Engineering, for his helpful suggestions and encouragement. The whole Nutrition and Food Engineering Department at Daffodil International University has my sincere thanks for providing me with a chance that has benefited me not only in terms of academic understanding but also in terms of appropriate practical consequences.

The Department of Nutrition and Food Engineering at Daffodil International University's Md. Reaz Mahmud, Assistant Technical Officer, is another person I would like to express my gratitude for making my thesis days easier and for providing me with lots of study time. for helping and encouraging me during my laboratory tests.

Last but not least, I would like to thank the lab aids for their assistance from the Nutrition and Food Engineering department for all of their assistance with my moral and material requirements as well as for sharing their expertise with me to further mine.

ABSTRACT

Using red beetroot juice, milk, milk powder, sugar, and cream, the study attempted to create beetroot ice cream and assess its quality criteria. Three samples were made with varying amounts of cream and beetroot juice (200, 250, and 300 milliliters). When compared to conventional beetroot ice cream, the nutritional and sensory qualities of the 250 ml combo are much better. The mean sensory scores of highly acceptable beetroot ice *had* better color (84%), flavor (80%), texture (86%), taste (78%), and overall acceptability (82%) than other samples. According to the nutritional and sensory research, the beetroot ice cream with 250 ml of beet juice was found to be more palatable than the other two formulations (200 ml and 300 ml). The final product contains 250 ml of beetroot juice, which is approximately, the protein 3.9 gm, the fat 14.6%, the brix 15%, and the pH 6 among 100ml. The number of bacteria per plate is 45. overall sample sensory quality based on sensory features, 2 out of all assessors enjoyed it greatly, 24% liked it very lot, and 11% liked it somewhat. The beetroot ice cream helps to weight gain, improve digestion, and inflammation, improve vitamin, mineral, and micronutrient deficiency, etc. Almost 4 months after it was produced, the overall quality of this ice cream hasn`t changed. The research indicates that developing ice cream with such uncommon nutritious vegetables provides various nutrient and health benefits.

Keywords: Beetroot Ice Cream, Health Promoting Properties, Novel Food Development, Nutritional Composition, Sensory Evaluation.

Table of Content

CHAPTER – 1
INTRODUCTION

Development and Assessment of beetroot ice cream represents an innovative approach to the world of frozen desserts, where traditional flavors are reimagined and health-conscious choices are explored. Beetroot ice cream is a unique and exciting fusion of a popular indulgence and a nutritious, vibrant vegetable. This intriguing ice cream variant takes an unexpected turn from the typical vanilla, chocolate, or fruit flavors, offering a rich, earthy, and slightly sweet taste profile that may surprise and delight the palate.

The development of beetroot ice cream involves a creative culinary process that blends the natural sweetness and distinctive color of beetroots with the creamy and smooth texture of traditional ice cream. The idea is to make a dessert that, in addition to being aesthetically pleasing, may also have health advantages because beetroots are strong in nutrients and include antioxidants. This unconventional ice cream choice may cater to a growing demand for healthier, more diverse, and unique frozen treats, suitable for a wide range of consumers.

Beetroot is a type of root vegetable that is full of nutrients and health benefits. These contain minerals including calcium, magnesium, potassium, salt, phosphorus, copper, iron, zinc, manganese, and water-soluble pigments called betalains, such the reddish-violet betacyanin and the yellow-orange betaxanthins. They also include carotenoids, nitrates, flavonoids, and vitamins.

Beetroot is a significant source of phytochemicals that promote health, according to several studies (Clifford, Howatson, West, & Stevenson, 2015). According to Slavov et al. (2013), polyphenols, carotenoids, and vitamins that exist in beetroot possess anti-inflammatory, anticarcinogenic, hepato-protective, and antioxidant properties. Additionally, they aid in wound healing, lower blood pressure, diabetes, and cardiovascular disease prevention. As a result, adding beetroot to various food products has positive health effects and brings up new creative possibilities for the creation of functional foods.

For humans to survive, plant foods are essential. Although beets had been cultivated for medicinal purposes for thousands of years, they were first used as food and drink in the third century. Written accounts from Europe indicate that beetroot was cultivated before the tenth century (Yashwant, 2015).

1.2: Objectives of the Study.

Formulating a novel form of ice cream is the study's goal.

- Enrich with lots of Micro-nutrients, Vitamin and Minerals.
- Development of Nutrition-rich Ice Cream.
- Kind of ice cream helps to stabilize blood pressure.
- Helps to improve the digestive system.
- Vast area of consumption consumers (children, pregnant women and athletes, and any age of people).

CHAPTER-2

LITERATURE REVIEW

One extremely significant and exciting direction in the food business is the creation of new food items using functional components derived from plants. The range of goods, which includes ice cream, is always growing since more and more plant-based components are being added to the product's mix to enhance its nutritional value. Beetroot (Beta vulgaris) was used as the plant ingredient for ice cream manufacturing in this investigation. Numerous beneficial inorganic and organic compounds, including minerals, proteins, carbohydrates, organic acids, betalains, vitamins, folic acid, and betaine, may be found in the roots of common beets. We have compared and evaluated the effects of various heat treatment methods on the number of dry materials and the organoleptic qualities of beetroot puree. (Evstigneeva, T-2020).

Furthermore, there is increased worry about the possible health impacts of food, since it is growing in popularity to have dual benefits of meeting nutritional demands and avoiding illness. This general tendency serves as the cornerstone of the functional foods industry, as new food items that provide fresh eating experiences are constantly being created. (Edmonds, Wadhwa, & Wibisono, 2013).

Foods deficient in bioactive substances require further improvement when these items are designed with the primary goal of obtaining certain functional qualities. This means that adding bioactive natural ingredients to ice cream, a product with a high consumption level would be beneficial, especially if doing so could also make ice cream look better. (Edmonds et al., 2013).

Frozen dairy treats, including ice cream, are often complicated colloidal systems made of milk, sweeteners, stabilizers, emulsifiers, coloring, and flavoring additives. Although artificial compounds are widely used, the majority of these agents may be acquired from natural sources, which makes the final goods highly desirable to customers. (Erkaya, Dağdemir, & Sengül, 2012).

It is important to use natural coloring agents when it involves food coloring, especially if the related compounds can exhibit any type of bioactivity. Color plays a significant role in the enjoyment of food products and can serve as an indicator of their quality. Recalling that the majority of manufactured substances are frequently thought to cause several unfavorable side effects, including allergic or intolerant reactions, makes this even more crucial (Wissgott &Bortlik,1996).

Root vegetables like beetroot are high in Minerals, Vitamins, Carotenoids, Nitrates, Flavonoids, Potassium, Sodium, Phosphorous, Calcium, Magnesium, Copper, Iron, Zinc, and Manganese, as well as water-soluble pigments identified as betalains, which include beta-cyanins (reddish-violet color) and betaxanthins (yellow-orange color). These pigments have a variety of nutritional and health benefits. According to several studies, beetroot is a significant source of phytochemicals that promote health (Clifford, Howatson, West, & Stevenson, 2015). According to Slavov et al. (2013), beetroot's carotenoids, polyphenols, and vitamins have anti-inflammatory, anticarcinogenic, hepato-protective, and antioxidant properties. They also help heal wounds, decrease blood pressure, prevent diabetes, and lessen the risk of cardiovascular disease. Thus, using beetroot as a component in various food items has positive health impacts on people and opens up new food product development opportunities.

CHAPTER -3
MATERIALS & METHODS

3.1.1: Process of Raw Materials Collection

One of the main requirements of the process of developing a product is gathering high-quality raw materials. To make this ice cream, I used beetroot juice. There are no such juices on the Bangladeshi market. I must therefore buy raw beetroot from the Mirpur local market in Dhaka, Bangladesh. After that, it was turned into liquid juice using a higher centrifugal juicer and pasteurized using a double broiler technique. In addition, the department store was where other ingredients like sugar, powdered milk, liquid milk, condensed milk, and whipping cream were bought. Solvents and chemicals of the analytical reagent grade were used in the study.

3.1.2: Location of Study

The study was carried out at Daffodil International University's Department of Nutrition and Food Engineering Laboratories in Dhaka, Bangladesh.

3.1.3: Raw Materials

The raw material list is shown below.

- Beetroot.
- Whipping Cream.
- Sugar.
- Powdered Milk.
- Liquid Milk.
- Condensed Milk.

3.1.4: Preparation of Pasteurized Beetroot Juice

To develop the beetroot ice cream, I used pasteurized Beetroot juice. At the beginning of my development process, I had to prepare the beetroot juice.

3.1.4.1: Apparatus/ Equipment Used

- Electric Measuring Balance,
- Bowl,
- Sharp Knife,
- Peeler,
- Chopping Board,
- High Duty Electric Juicer,
- Cloth Strainer,
- Pan,
- SS Food Grade Bowl,
- Gas Stove,
- PE Wrapping Paper,
- SSFG Measuring Cup,
- Hand Mixture,
- Fridge,
- Ice

3.1.4.2: Treatment Used

- Double Broiler Method

3.1.4.3: The Procedure of Making Pasteurized Beetroot juice.

- At first, we need to clean the dust of beetroot with water.
- Then we need to Measure the beetroot.
- Then Peel the skin with a peeler.
- Dice the beetroot in medium cube size.
- Then put the beetroot into a high-duty electric juicer.
- Then strain the juice with a cloth strainer and pour it into a measuring cup.
- Then prepare a Double broiler to pasteurize the juice.
- Juice should be heated at 60℃ for 5 min and continuous stair.
- Add 1/3 of sugar based on juice quantity.
- After heating the juice bowl should be replaced with an ice bath and continuous stair.
- After decreasing the juice temperature strain with a cloth Strainer and place into an airtight container/ using wrapping paper on a bowl and store in the refrigerator. Beetroot Ice cream Bases are ready to use in different ratios of mixing with cream.

3.2: Formulation of Beetroot Ice Cream.

3.2.1: Apparatus/ Equipment Used for Formulation of Beetroot Ice Cream

Equipment used in the production of beetroot ice cream.

- Food Grade SS Bowl.
- Electric Hand Mixture.
- Measuring Cup.
- Scissor.
- Cane Opener.
- Spatula.
- Cloth Strainer.
- Container

3.2.2: Raw Materials Used for Making Beetroot Ice Cream

List of Raw Materials that have been used in making Beetroot Ice Cream

- Whipping Cream.
- Condensed Milk.
- Powdered Milk.
- Powdered Sugar.
- Liquid Milk.
- Beetroot juice.

3.2.3: Preparation:

Figure 1: Beetroot Ice Cream (with Different Ratio of beetroot juice)

3.2.4: Flow Chart of Beetroot Ice Cream Making Process.

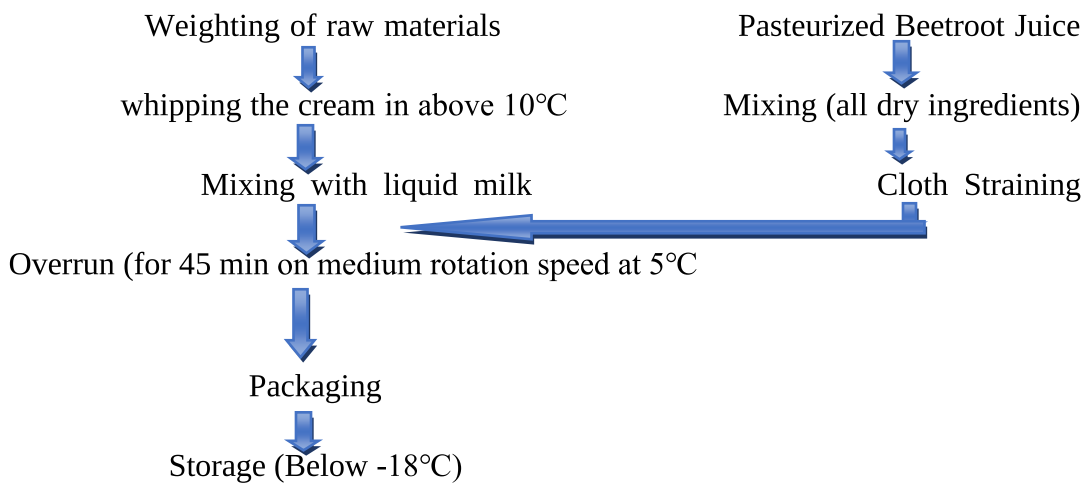

Figure 2: Process diagram of Beetroot Ice Cream

3.2.5: Different Formulations of Beetroot Ice Cream. (Portion Size 10, 1L)

Table-1.

Ingredients	Sample 1	Sample 2	Sample3
Beetroot juice	200 ml	250 ml	300 ml
Whipping Cream	250 ml	250 ml	250 ml
Condense Milk	100 gm	100 gm	100 gm
Powder Milk	80 gm	80 gm	80 gm
Liquid milk	270ml	230 ml	220 ml
Powder Sugar	100 gm	100 gm	100 gm

3.2.6: Samples:

Figure 3

Sample-1

Sample-2

Sample-3

3.2.7: Sample Overview of Beetroot Ice Cream

Table-2

Samples	Parameter	Result
Sample-1	Color	Lite purple
	Texture	Iced crumbly
	Flavor	Mild
	Taste	Pleasant
Sample-2	Color	Purple
	Texture	Smooth
	Flavor	Pleasant
	Taste	Good
Sample-3	Color	Deep Purple
	Texture	Smooth
	Flavor	Over flavor
	Taste	After tasting as acidic

3.3: Nutritional Analysis of Beetroot Ice Cream

3.3.1: Determination of Brix of Beetroot Ice Cream

Brix is a unit of measurement used to quantify the sugar content in a solution, and it is commonly used in the food and beverage industry to measure the sweetness of liquids. To determine the Brix of beetroot ice cream, you'll need a refractometer, which is a device designed for measuring the concentration of a solution.

3.3.1.1: Apparatus:

- Electric Measuring Balance.
- Refractometer
- Clean and Dry Spoon or Pipette.
- Beaker.
- Distilled water.
- Tissue

3.3.1.2: Materials/ Samples:

Beetroot Ice Cream

3.3.1.3: Procedure:

- Make sure the beetroot ice cream sample is measured at 20g & and well-mixed to ensure a homogeneous mixture.
- Before using the refractometer, calibrate it using distilled water or a calibration solution according to the manufacturer's instructions.
- Using a clean and dry spoon or pipette, place a small amount (a few drops) of the beetroot ice cream onto the glass surface of the refractometer.
- Gently close the refractometer's cover plate to evenly spread the sample over the glass surface.
- Hold the refractometer up to a light source, ensuring that light passes through the sample.
- Examine the Brix value via the eyepiece at the point on the scale where the line connecting the bright and dark regions meets.
- Clean the refractometer between readings by wiping the glass surface with a soft, clean cloth or tissue. Use distilled water if necessary.
- For more accurate results, repeat the process a few times and take the average Brix value.

3.3.1.4: Calculation:

To calculate the Brix of a solution, you can use the following formula:

Brix = (Mass of Sucrose/Total Mass of Solution) $\times 100$

3.3.2: Determination of pH of Beetroot Ice Cream

Using a pH meter or pH indicator strips, one may measure the ice cream's alkalinity or acidity to find its pH balance.

3.3.2.1: Materials/Apparatus

- pH Meter
- Beetroot Ice Cream Sample
- Sample Cups or Containers
- Spoon
- Calibration Solutions

3.3.2.2: Procedure:

- If your pH meter requires calibration, follow the manufacturer's instructions using the provided calibration solutions. Calibration is essential for accurate pH measurements.
- Take a small sample of the beetroot ice cream and place it in a clean, dry container.
- Turn on the pH meter and dip the pH meter electrode into the ice cream sample without touching the bottom or sides of the container.
- Allow some time for the pH reading to stabilize. The pH meter may display a fluctuating value initially, but it should eventually settle.
- Once the pH reading has stabilized, record the pH value displayed on the meter.
- Rinse the pH meter electrode with distilled water to clean it between samples. Make sure it's dry before testing the next sample.
- If you want to ensure accuracy, you can repeat the process with another sample and average the results.

3.3.2.3: Calculation:

pH is equal to -log[H+].

The number of ions of hydrogen (H+) in the solution determines the pH of a product, such as this beetroot ice cream.

3.3.3: Determination of Fat of Beetroot Ice Cream by Using Gerber Method.

The test is a volumetric approach that uses centrifugal force to remove fat from ice cream. To enhance the separation of fat from other substances, amyl alcohol is added after sulphuric acid dissolves the protein that forms the membrane surrounding fat globules.

3.3.3.1: Preparation of Sulfuric Acid

3.3.3.1.1: Materials Needed:

- Concentrated sulfuric acid (98% purity)
- Distilled water
- Pipette 10 ml
- Clean glass bottle & cap
- Pipette filler
- Safety equipment (gloves, goggles, lab coat, etc.)

3.3.3.1.2: Procedure:

- Wear appropriate PPE, including gloves and goggles, to protect yourself from contact with sulfuric acid.
- To prevent fume inhalation, work in an area with good ventilation or behind a fume hood.
- Measure the required amount of concentrated sulfuric acid. The concentration needed may vary depending on the specific Gerber method. And I took 10 ml of Sulfuric Acid.
- Slowly add the measured sulfuric acid to an appropriate container. Use caution to avoid splashes or spills.
- Dilute the sulfuric acid by adding distilled water slowly. The dilution ratio will depend on the specific requirements of your Gerber method, but it is typically around 10:1 (water to sulfuric acid).
- Stir the solution thoroughly to ensure uniform mixing. Use a glass rod or another suitable stirring implement. And I prepare 100 ml Sulfuric Gerber Solution.
- Store the prepared sulfuric acid solution in a labeled, chemical-resistant container. Make sure the container is tightly sealed to prevent fumes from escaping.
- Always follow the specific guidelines and protocols provided in the Gerber method you are using. The exact concentration and preparation steps may vary.

3.3.3.2: Sample Preparation

3.3.3.2.1: Materials

- Ice Cream Sample.
- Beaker
- Measuring Balance
- Spatula
- Thermometer

3.3.3.2.2: Procedure

- At first, we take a beaker and tear the measuring balance.
- Take 50 gm of Sample and Add 50 gm of distilled water.
- Mix with a spatula and make sure it will mix properly.
- Make sure sample temperatures are estimated at room temperature.

3.3.3.3: Equipment and Materials of Fat Determination

- Sulfuric acid.
- Amyl-Alcohol.
- Butyrometers- based on fat content, 6%, 8%, and 10% scales.
- Shaker stands and stoppers for butyrometers constructed of rubber or plastic of an appropriate quality.
- 10 ml sulfuric acid pipette (rubber suction mechanism).
- A 10.75 ml sample pipette.
- An amyl alcohol pipette of 1 ml.
- Electric Centrifuge.
- 65 + 20C water bath.

3.3.3.4: Procedure

- Using the 10ml acid pipette, pour 10ml of sulfuric acid into the butyrometer.
- Pour ice cream into a 10.75 ml pipette to transfer the sample to the butyrometer.
- Fill the pipette with 1 ml of amyl-alcohol and shut it.
- Shake the butyrometer in the shaker stand and invert it many times until no white particles are visible.
- Soak the butyrometer in the water bath for five minutes.
- After removing it and wiping it dry with a cloth, place it in the centrifuge with two butyrometers positioned opposite one other. Centrifuge at maximum speed for 4 minutes.
- Lower the stoppers and butyrometers into the water bath, where they should remain for three to ten minutes.

- To transfer the fat column's bottom end onto the main graduation mark, slightly unscrew the stopper.

3.3.3.5: Visual Confirmation of Fat Detection

- Straw yellow is the proper hue for the fat.
- The fat column's ends have to be well-defined and distinct.
- There shouldn't be any particles or debris in the fat column.
- The water immediately beneath the fat column ought to be crystal clear.
- The fat must lie inside the range of graduation.

3.3.3.6: Calculation:

As we remember the sample preparation, we took 50 gm sample and 50 gm water so we took the result of fat determination into ½ and the calculation of beetroot ice cream fat will be double.

3.3.4: Determination of Protein of Beetroot Ice Cream by Using Kjeldahl Method.

To assess the protein content of organic materials, the Kjeldahl method is a commonly used approach for estimating the nitrogen concentration. The general procedures for using the Kjeldahl technique to find the protein content in beetroot ice cream are as follows:

3.3.4.1: Materials and Equipment:

- Beetroot ice cream sample
- Measuring Balance
- Concentrated sulfuric acid (H_2SO_4)
- Digestion catalyst (e.g., K_2SO_4 and $CuSO_4$)
- Distillation apparatus
- Burette
- Standardized hydrochloric acid (HCl)
- Indicator (e.g., phenolphthalein)
- Steam distillation apparatus
- Receiver flask
- Titration flask
- Water condenser
- Digestion tubes
- Heat source (e.g., heating mantle)

3.3.4.2: Procedure:

3.3.4.2.1: Sample Preparation:

- Accurately weigh a suitable sample of beetroot ice cream, typically 1-2 grams.
- Transfer the weighted sample into a tube for digestion.

3.3.4.2.2: Digestion:

- Fill the digestion tube with an enzyme for digestion (such as K_2SO_4 or $CuSO_4$).
- Ensuring that the material is well submerged, pour strong sulfuric acid (H_2SO_4) into the digesting tube.
- Apply regulated heat to the digesting tube. During this process, nitrogen and other organic molecules are broken down into their constituent elements.

3.3.4.2.3: Distillation:

- Transfer the digesting mixture to a distillation device when it has cooled.
- To the distillation flask, add water along with a few drops of an appropriate indicator (such as phenolphthalein).
- After plugging in the distillation equipment, begin the process, and let it run for 30 minutes before collecting the distillate in a receiver flask.

3.3.4.2.4: Titration:

- Titrate the obtained distillate using hydrochloric acid that has been standardized (HCl). The quantity of ammonia produced during the distillation is ascertained by the titration.
- When the titration's endpoint is reached, the hue will shift from pink to light yellow.

3.3.4.3: Calculation:

- Using the amount and concentration of the HCl used in the titration, calculate the nitrogen content.
- To get the protein content, multiply the nitrogen content by the conversion factor, which is typically 6.25.

The following is the general formula to determine protein content:

Protein Content (%) = (Nitrogen content / Conversion factor) ×100

3.3.5: Determination of CFU of Beetroot Ice Cream by PCA Method.

Analyzing the microbiological load—most commonly, bacteria—in the sample is necessary to calculate the Colony Forming Units (CFU) in beetroot ice cream.

3.3.5.1: Apparatus

- Sterile containers and utensils.
- Sterile pipettes.
- Micro Pipettes.
- Petri dishes.
- Prepared Sample (Beetroot Ice Cream)
- PC Agar medium.
- NaCl for Saline Solution.
- Incubator.
- Autoclave.
- Magnetic stair.
- Aluminum Foil.
- Measuring Balance.
- Sterile spreader or glass rod.
- Sterile gloves.

3.3.5.2: Procedure:

- Take a 200 ml sterilized beaker and fill it with 10 g of beetroot ice cream as a sample.
- Mix well after adding 90 ml of distilled water.
- Cover the beaker lid with aluminum foil and let it sit at room temperature.
- Use 100 ml of distilled water to prepare 2.3 g of PC agar.
- Next, using a magnetic staircase, heated to 100°C.
- Mix 100 milliliters of distilled water with 0.5 gram of NaCl.
- Autoclave PC agar, NaCl, and all equipment at 121°C and 15 PSI.
- Following the autoclave, the serial dilution procedure was carried out and all equipment was put in a laminar airflow to prevent air contamination.
- After being placed on a test tube rack, seven test tubes were serially marked.
- Each test tube then received 9 ml of NaCl.
- Next, a micropipette was used to transfer a milliliter of the diluted mixture into the second tube after 1 milliliter of the sample had been added to the first tube and evenly mixed. Up to the seventh dilution, the procedure was further repeated.
- Into a laminar airflow chamber goes the agar mixture. Per the dilution sequence, 1 milliliter of the material was placed into each of the seven petri dishes.
- The agar medium was transferred into the petri dish and allowed to harden at room temperature, having reached the optimal temperature of 36°C.
- The laboratory films were wrapped around the petri dish once it had solidified and labeled with the batch number.

- The Petri dish was now incubated at 35 to 37°C for a duration of 24 to 48 hours.

3.3.5.3: Calculation.

CFU/g = Number of colonies × Dilution Factor ÷ Weight of sample (g)

3.3.6: Sensory Evaluation by 9-Point Hedonic Scale Test

The influence of beetroot juice ratio on the sensory attributes of ice cream (taste, color, texture, and general acceptance), for which I produced three ice cream samples. adopting a hedonic rating system with nine points 9-people like things very much, 8-like things very much, 7-people like things moderately, 6-people like things somewhat, 5-people neither like nor dislike things, 4-people dislike things slightly, 3-people detest things moderately, 2-people despise things very much, and 1-person dislikes things excessively. To determine customer acceptance, sensory analysis was used.

The outcome, of sample 2, was unexpectedly good. I used fifty assessors for the hedonic exam. Teste and other fundamental sensory attributes are among the examples, along with color, texture, and flavor. Consumer research effectively gathers acceptance data through the use of the hedonic scale.

3.3.6.1: Sensory Evaluation of Beetroot Ice Cream

This sensory examination is conducted using the Hedonic Rating Exam. Flavor, taste, texture, and color are only a handful of the most significant sensory characteristics. Consumer research has found that the hedonic scale is a reliable method for gathering information about preferences. To record liking ratings, preference mapping studies frequently employ a nine-point hedonic scale, which is depicted in the picture as a typical example.

9	8	7	6	5	4	3	2	1
Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like Nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely

Table 3: 9-point Hedonic Scale

Sensory Evaluation by Hedonic Scale.

Name: ……………………… Date: …………………….

Product: ……………………

After tasting these samples, rate your preference for each one.

To indicate your attitude about the sample, select the relevant scale and check the one that most accurately expresses your feelings.

9	8	7	6	5	4	3	2	1
Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like Nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely

N.B: Based on this scale please mention the number based on your feelings

Ex. Sample-1: 7, Sample-2: 9, Sample-3: 2

Parameter	Sample 1	Sample 2	Sample 3
Color			

Parameter	Sample 1	Sample 2	Sample 3
Taste			

Parameter	Sample 1	Sample 2	Sample 3
Texture			

Parameter	Sample 1	Sample 2	Sample 3
Flavor			

Parameter	Sample 1	Sample 2	Sample 3
Overall Acceptancy			

Comment:

……………………………..

Figure-4 **Signature**

CHAPTER-4
RESULT & DISCUSSION.

The three samples of beetroot ice cream underwent microbiological, sensory, and nutritional testing to determine their approximate composition. This information was then examined in the Nutrition and Food Engineering lab.

4.1: Chemical composition of Beetroot Ice Cream 100 ml

Sample	Brix (%)	pH	Fat (%)	Protein (g)
Sample 1	14.5	6.3	14	3.7
Sample 2	15	6	14.6	3.9
Sample 3	12.5	5.9	13	3.8

Description: The 3 beetroot samples tested in the NFE lab and the values of sample 2 are (brix%: 15, pH: 6, Fat%: 14.6, and Protein: 3.9g per 100 ml) more acceptable than the other 2 samples.

4.2: Microbial Analysis of Beetroot Ice Cream.

The CFU (Colony Form Unit) is measured in the monthly interval. The Values of given below and Shown in CFU/ml.

Month	Sample 1	Sample 2	Sample 3
1^{st}	3.5×10^5CFU/ml	3.2×10^5CFU/ml	3.7×10^5CFU/ml
2^{nd}	4.3×10^5CFU/ml	4.5×10^5CFU/ml	5.3×10^5CFU/ml
3^{rd}	5.2×10^5CFU/ml	5×10^5CFU/ml	6.8×10^5CFU/ml

4.2.1: Sample Overview after the 1- month interval.

Month -1:



Sample -1 **Sample -2** **Sample -3**

Month- 2:



Sample-1 **Sample -2** **Sample -3**

Month -3:



Sample- 1 **Sample -2** **Sample-3**

Figure-5

4.3: Sensory Evaluation Data of Beetroot Ice Cream

Parameter	Sample 1	Sample 2	Sample 3
Color	10%	84%	6%
Taste	13%	80%	7%
Texture	10%	86%	4%
Flavor	16%	78%	6%
Overall Acceptancy	12%	82%	6%

4.3.1: Three Beetroot Ice Cream Samples Overall Acceptability.

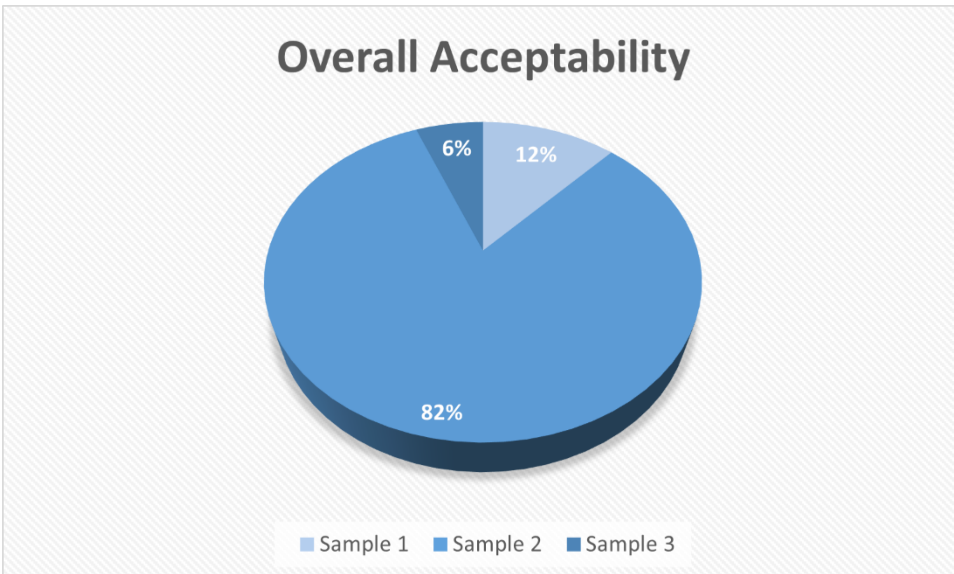

Figure- 6

Regarding consumer preference, the second sample outcome on the 9-point hedonic test received the highest rating. Overall acceptance for the first sample was 12%, for the second, 82%, and for the third, 6%. The taste, flavor, color, and stability scores on the overall sensory quality are indicated by a 9-point hedonic test.

4.3.2: 9-Point Hedonic Scale According to Color.

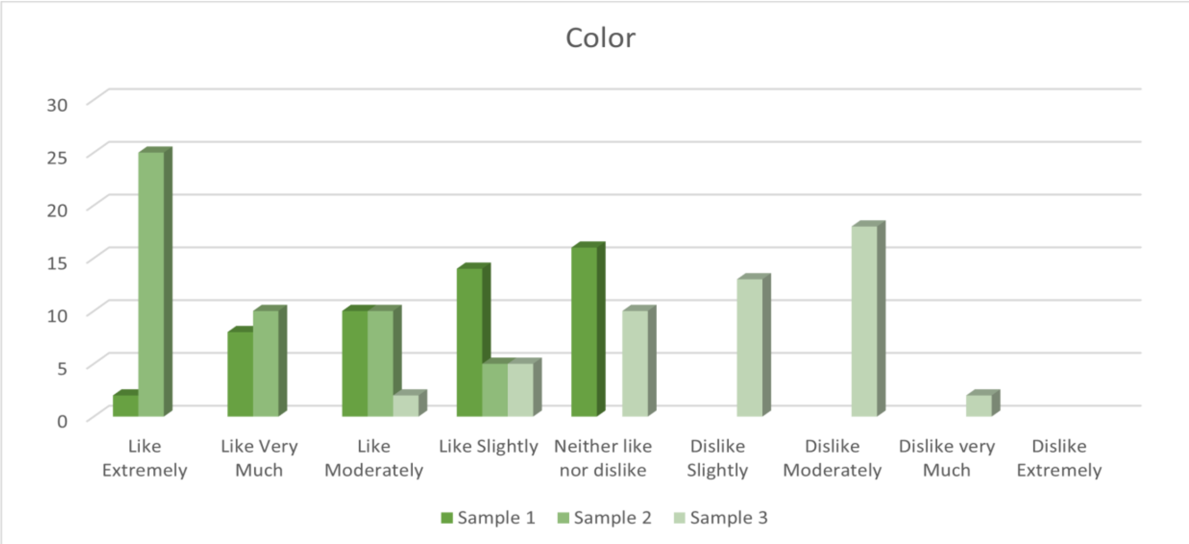

Figure-7

Using a hedonic scale of nine, the color qualities of samples 1, 2, and 3 are shown. Sample 2 receives the highest score for being loved.

4.3.3: 9-Point Hedonic Scale According to Taste.

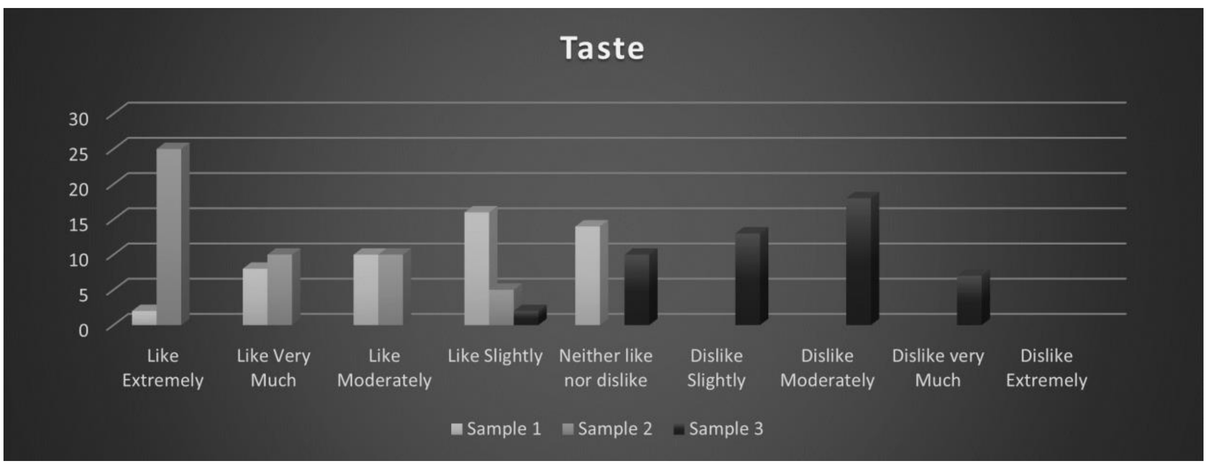

Figure-8.

Sample 2 has the highest score for being strongly loved out of the three samples. Samples 1, 2, and 3's taste qualities are presented on a 9-point hedonic scale.

4.3.4: 9-Point Hedonic Scale According to Texture.

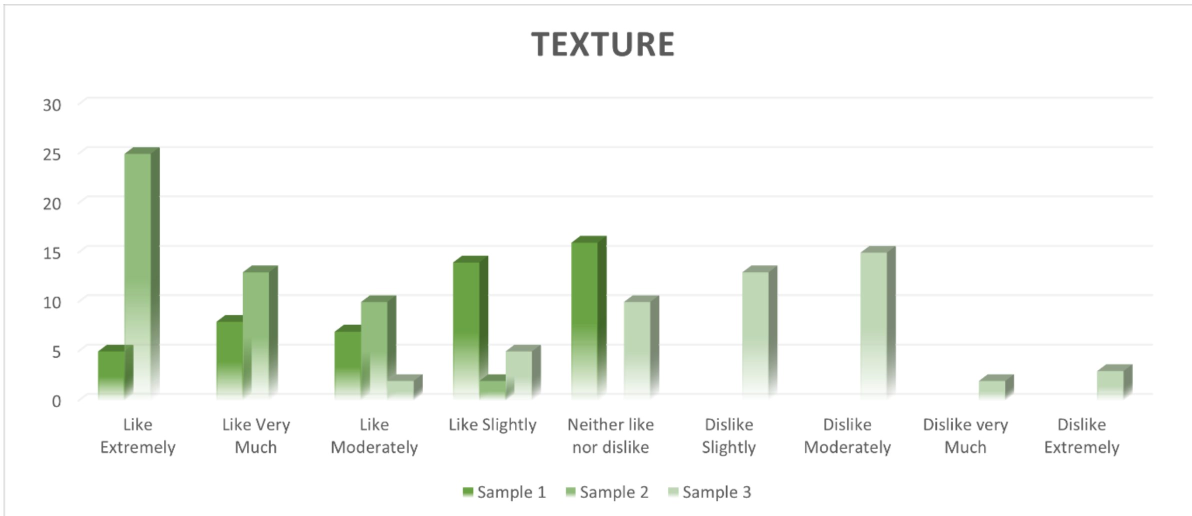

Figure-9

Using a hedonic scale of nine, which measures how much the textural features of samples 1, 2, and 3 are loved, sample 2 receives the highest score.

4.3.5: 9-Point Hedonic Scale According to Flavor.

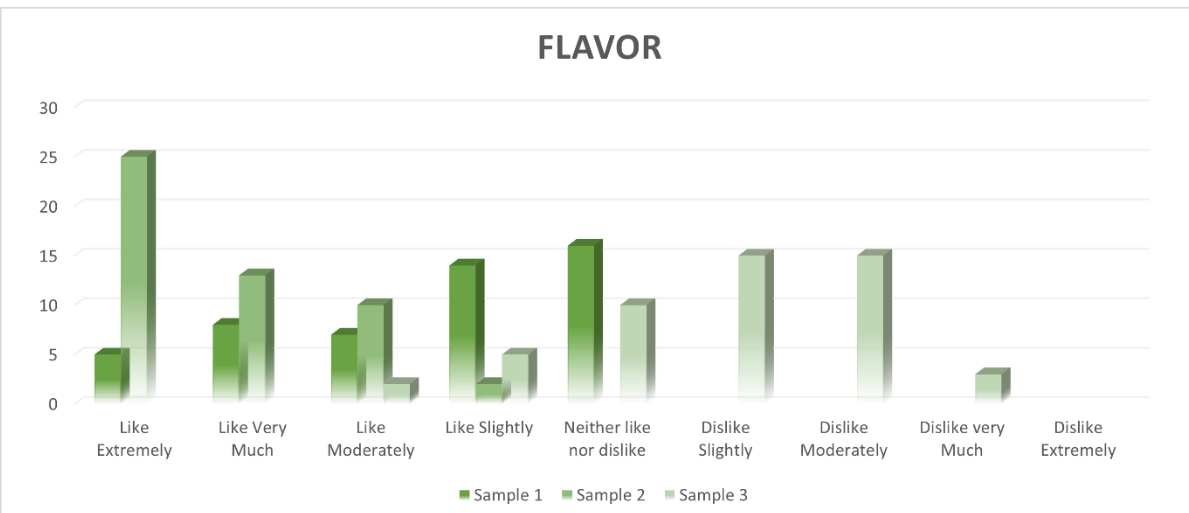

Figure-10.

Sample 2 has the greatest value for being greatly loved, whereas samples 1 through 3's taste qualities are presented on a 9-point hedonic scale.

4.3.6: 9- Point Hedonic Scale According to Overall Acceptancy.

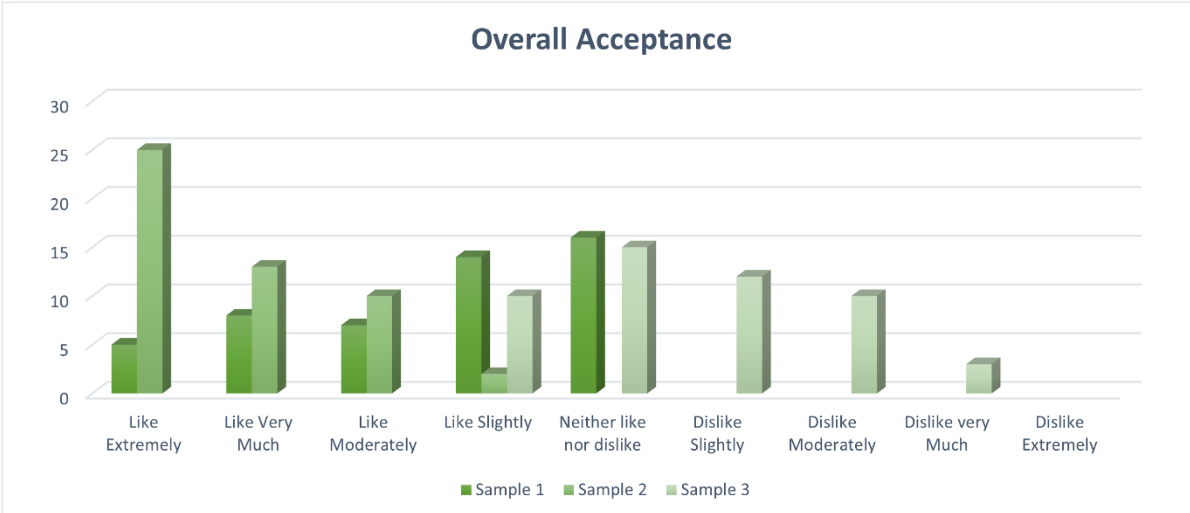

Figure-11

Sample 2 receives the highest rating for being greatly loved, while samples 1, 2, and 3's overall acceptability are shown on a 9-point hedonic scale.

4.3.7: Overall Sensory Quality of Sample 2 (Final Product).

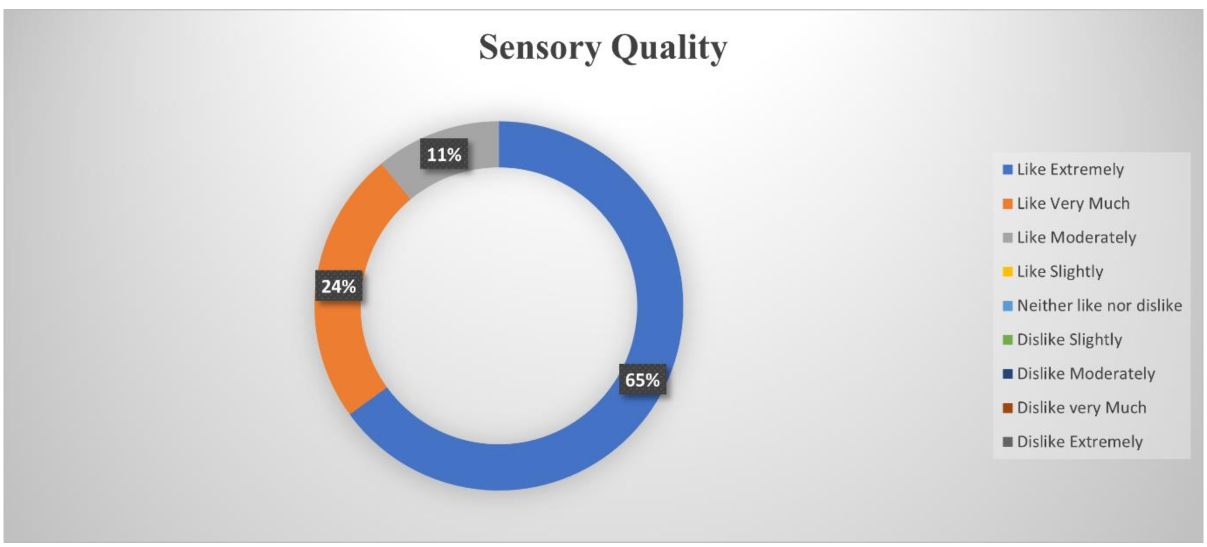

Figure-12.

Based on sensory qualities, 65% of assessors expressed extreme approval for the beetroot ice cream (sample 2), 24% expressed very much approval, and 11% expressed moderate approval.

CHAPTER-5
5.1: CONCLUSION

Due to its high edible value, rich in dairy nutrients, and high-calorie food ice cream has become one of the most popular foods in every aged people—the right technique to integrate such unpopular veggies (beetroot) with lots of health benefits. Usually ice cream contains fat, sugar, protein, and lots of dairy nutrients. Because of its unique flavor and taste and more like lots of vitamins, minerals, and dietary fibers like Folate (Vitamin B9), Manganese, Potassium, Vitamin C, Iron, Nitrate, Betaine, and also Phytonutrients (such as betalains), which will have a positive impact on your health. The final product incorporates 250 ml of pasteurized beetroot juice and has the highest rating of color, taste, texture, flavor, and overall acceptance than the other samples. Before conducting market research for commercialization, more studies could be done to identify all pertinent product attributes.

5.2: Reference:

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