DEVELOPMENT OF MANGO BASED WHEY DRINK USING THREE PROCESSING TECHNIQUE AND DETERMINATION OF IT'S BIOACTIVE COMPOUND AND NUTRITION PROFILING

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List of Abbreviation

FAO: Food and Agriculture Organization

Kcal: kilo calorie

Ca: calcium

%: percentage

Anova: Analysis of variance

AOAC: Association of Official Analytical Chemists

TSS; Total Soluble Solids

ºB: Degree Brix

CHO: Carbohydrate

Dl: deciliter

DPPH: 2,2-diphenyl-1-picrylhydrazyl

ºC: Degree Celsius

etc: Et cetera

g: gram

kg: kilogram

mg: milligram

TE: Trolox equivalent

QE: quercetin equivalents

SPSS: Statistical Package for Social Science

PPM: parts per Million

M: meter

DNA: Deoxycarbo Nucleic acid

ABSTRACT

The king of fruits, the mango (Mangifera indica L.), is well renowned for its delicious flavor and fragrant aroma as well as its high nutritional content. The polyphenols mangiferin, catechins, quercetin, kaempferol, gallic acid, and benzoic acid are the primary bioactive substances present in mangoes. These substances are linked to the protection of degenerative diseases, such as cancer, cardiovascular disorders, and diabetes. The two main components of whey proteins are lacto-albumin and lactoglobulin. Whey is thrown away in the food sector. This study aims to produce a beverage from mango pulp and whey using three distinct processing methods. The juice with the best sensory evaluation (60:35:5) is processed using three distinct methods: microwave, ultra-sonication, and mild pasteurization. Significant nutritional value was demonstrated by this treatment. Ultra-sonication is the best therapy out of the three. Microwave pasteurization is less acceptable than mild pasteurization. The findings of ultrasonic treatment are as follows: moisture(86.45±0.05%),crude fiber (2.30±0.05%),ash(3.50±0.05%),fat(0.65±0.05%),protein(3.50±0.05%),carbohydrate (3.26±0.09%),drymatter(13.45±0.05%),PH(4.42±0.06),TSS(11.08±0.06ºBx),calcium (0.69±0.07mg/dl),vitaminA(0.41±0.04RAE/gm),antioxidant(2.98±0.01mgTA/100gm) flavonoid(3.57±0.03mgQE/100gm). Mild pasteurization treatment value is also more acceptable.

Keywords: Mango, Whey, Mango Based Whey drink, Sensory Evaluation, Ultra-sonication, Microwave, Mild-Pasteurization, Antioxidant, Flavonoid.

CHAPTER 1

Introduction

1.1 General Feature

It is well known that eating fruit and fruit-related products has protective effects against a number of chronic illnesses, particularly cardiovascular conditions, hypertension, type 2 diabetes, various cancers, asthma, obesity, cognitive decline, and depression(Fardet et al., 2019). Fruits and vegetables are the foundation of a healthy and sustainable diet, or one that has minimal negative effects on the environment and promotes food and nutrition security as well as a healthy lifestyle for both current and future generations(Rejman et al., 2021). According to many expert groups, having a minimum of 400 g of fruit and vegetables per person each day—which in dietary practice translates to five servings with a larger proportion of vegetables—is the best way to maximize the advantages to human and planetary health(WHO and FAO Announce Global Initiative to Promote Consumption of Fruit and Vegetables, n.d.).

A fruit plant commonly grown in tropical and subtropical regions of the world is the mango (Mangifera indica L.), which belongs to the Anacardiaceae family. Mango fruit is a great addition to a human diet that is focused on wholesome, environmentally friendly foods, which is what customers are increasingly doing(Friel et al., 2014). Mangoes are a satisfying and nutrient-dense food option for a balanced diet, whether they are consumed in fresh form or in a range of processed goods. A range of bioactive substances, such as polyphenols, which serve as antioxidants and have been found to have anti-inflammatory, anti-carcinogenic, and anti-aging characteristics, are also abundant in mango fruit(Pace et al., 2014). The mango fruit has been used throughout its whole life cycle, from the extremely young and immature to the completely ripe. Full-ripe mango is used to make squash, nectar, drinks, mango leather, puree, mango fruit bars, frozen and canned mango slices, and jam. On the other hand, raw fruit is used to process into pickle, chutney, mango sauce, raw mango powder (amchoor), and green mango drink(Zafar & Sidhu, 2017).

After the curd is separated from the milk during the coagulation of milk using proteolytic enzymes or acids, the liquid portion of milk known as whey, sometimes known as cheese serum, is produced. Due to the disposal problems brought on by its high biological oxygen requirement and rich organic matter, it was regarded as a significant dairy waste for many years(Ahn et al., 2001). Today, though, whey proteins are valued for their bioactive components and are acknowledged as a viable food source. It has a substantial connection to the dairy sector due to its high nutritional makeup and utilization in a number of commercial food product applications. In general, fresh liquid whey used in the production of cheese is made up of 94.2% water and 50% of total solids, of which 0.8% is made up of whey proteins, 0.5% is made up of minerals, 0.1% is made up of fat, and 4.3% is lactose, which is the primary component(de Wit, 1998).

Fruit juice is a popular beverage option, and the market for it has expanded significantly in recent years. In fact, according to recent data, the market for fruit juice and juice drinks expanded by 37% between 1999 and 2020 to reach £2.32 billion, and the volume climbed by 26% during that time to reach almost 2.2 billion liters annually. The surge in consumer interest in health and nutrition as well as the availability of a variety of juices to suit all tastes and demands are likely contributing factors to its popularity growth(Caswell, 2009).

In Bangladesh, a recent study found that post-harvest management flaws cause an average of 24% of mangoes worth Tk3,600 crore to be squandered during various stages of each mango season (Motalab et al., 2014). Eighty to ninety percent of the milk that enters cheese-making facilities is converted to whey, and 100 million tonnes of this waste whey is created for making cheese each year(Buchanan et al., 2023).So, the purpose of this study is to find a more efficient way to use whey and mango.

1.2 Aims and Objectives:

General Objective:

The aim of this study was to formulate a juice by using mango and whey which processed through 3 different processing technique (ultra-sonication, microwave, mild pasteurization).

Specific Objectives:

a) To identify the best concentration among the 4 different concentrated juice.
b) To process the juice through 3 different processing technique.
c) To identify their physiochemical properties.
d) To identify their bioactive compound
e) To comparison among three processing technique.

CHAPTER 2

Review of Literature

If the study's conceptual framework is founded on the thoughts and ideas acquired from survey work of existing writing of both hypothetical and observational form, it will be simpler to organize the research in a thorough manner.

2.1 Mangoes

Mango (Mangifera indica L.) is widely farmed and distributed in many tropical and subtropical areas. Mangoes come in more than 500 different classifications, and some of them have evolved and been described in various parts of the world. There are 69 species in the Mangifera genus, most of which are found in tropical Asia(Gulcin et al.,2004). India, Pakistan, Mexico, Brazil, Haiti, the Philippines, and Bangladesh are the top mango-producing nations in the world. Bangladesh has a large mango population, which is primarily grown on homestead plantations. Mango cultivation is suited in Bangladesh's northern areas, where the soil and climate are ideal. A great range of excellent mango cultivars, including Fazlee, Langra, Gopalbhog, Himsagar, Khirsapat, Kohitoor, Laksmanbhog, Chausa, Amrapali, Mallika, Mohanbhog, and Misribhog, are produced in Bangladesh. These mango cultivars are in demand and are useful commercially in the food sector (Motalab et al., 2014.)

2.1.1 Amrapali (Rupali Amm)

Amrapli, also known as Rupali Amm to people and one of their favorite mango varieties, was used in our mango products.

A named mango cultivar called "Amrapali" was first made available in 1971. At the Indian Agriculture Research Institute in Delhi, Dr. Pijush Kanti Majumdar created it as a hybrid variant of the "Dasheri" and "Neelum" plants. Since then, this mango has been planted in orchards and farms all over India. In Chakdaha, Nadia district, West Bengal, the Amrapali Mango was originally planted. Dr. Pijush Kanti Majumdar provided the seed.The tree is a regular-bearing dwarf with clusters of little fruits. Its flesh is a rich orange-red color and contains 2.5–3.0 times more carotene than other commercial mango types. It is understood to have a shorter shelf life, nevertheless. The yield is 16 tonnes per hectare on average(Jabin et al., 2023).

Figure 1: Picture of Amraprali (Motalab et al.,2014)

Taxonomical Classification:

Kingdom: Plantae

Division: Mangoliophyta

Class: Magnoliopsida

Order: Sapindales

Family: Anacardiaceae

Genus: Mangifera

Species: Mangifera indica

Hybrid parentage: Dasheri × Neelum

Cultivator: Amrapali

2.1.2 Compositions of mangoes:

2.1.2.1 Nutritional Composition:

The type/variety of the mango, the location and climatic conditions of its production region, and the maturity of the fruit all play a role in the nutritional makeup of mango pulp(Saleem Dar et al., 2016). Table 1 lists the nutritional benefits of mango. Mango contains a nutrients variety of macro- and micronutrients. Carbohydrates, proteins, amino acids, lipids, organic acids, and dietary fiber are all present in mango pulp in terms of macronutrients(Lebaka et al., 2021). The pulp is also a good source of micronutrients, including trace minerals such as calcium, phosphorus, iron, and vitamins (vitamins C and A). Consumption of mango pulp provides high energy.

Along with the above basic nutrition ingredients, mango pulp contains water (Maldonado-Celis et al., 2019).

Table 1: Micro Nutrients of Mango

Mineral	Value (mg) per 100 gm
Calcium	7-16
Iron	0.09-0.41
Magnesium	8-19
Phosphorus	10-18
Potassium	120-211
Sodium	0-3
Zinc	0.06-0.15
Copper	0.04-0.32
Manganese	0.03-0.12
Selenium	0-0.6

(Maldonado-Celis et al., 2019)

Table 2: Macro Nutrients of Mango

Parameter	Content (mg) per 100 gm
Water	78.9-82.8
Ashes	0.34-0.52
Total Lipid	0.30-0.53
Total Protein	0.36-0.40
Total Carbohydrate	16.20-17.18
Total dietary fiber	0.85-1.06
Energy (Kcal)	62.1-190

(Maldonado-Celis et al., 2019)

2.2.2.2: Phytochemical properties:

The mango pulp is renowned for containing high levels of bioactive substances such carotenoids, phenolic acids, polysaccharides, sterols, and alkaloids(Maldonado-Celis et al., 2019). The indigenous people of the Caribbean utilize mango to heal ulcers, gastritis, diarrhea, and fever. As a result, mango is listed on the TRAMIL list, which is a study project on the medicinal plant resources in the region(Fardet et al., 2019). The crucial secondary metabolites known as phenolic acids play a crucial function in the maintenance of human health and serve as a means of protection against a number of diseases. The primary phenolic acids found in pulp are those derived from hydroxycinnamic and hydroxybenzoic acids. These acids can be found either in free form or conjugated with glucose, quinic acid, or both(Kumar et al., 2021).

Ascatechins, quercetin, anthocyanins, kaempferol, rhamnetin, and tannic acid are significant phytochemicals having anti-inflammatory and antioxidant properties(Coelho et al., 2019). They also belong to the flavonoid class of compounds. The fresh mango pulp contains a significant amount of quercetin and its glycosides (46.6 mg/kg), as well as smaller amounts of kaempferol, rhamnetin, myricetin, and fistian(Vilela et al., 2013).

2.2: Whey:

The natural macronutrients of glucose, protein, and fat, together with water and ash, are present in whey in its raw, liquid form. Lactose, a milk sugar, makes up the majority of the carbohydrate portion, whereas phospholipid is the primary fat. Numerous micronutrients can be found in liquid whey. Minerals including zinc, calcium, phosphorus, and potassium are among these nutrients(Ha & Zemel, 2003).

Table 3: Nutrients of Whey

Nutrient	Content
Fat, g	0.1
Carbohydrates, g	4.0
Protein, g	1.0
Nutritional value, kcal (kJ)	20.9 (87.5)
Vitamins, mg	
A	-
B_1	0.03
B_2	0.11
PP	0.14
C	0.50
Minerals, mg	
Sodium	40.0
Potassium	125.0
Calcium	60.0
Magnesium	6.0
Phosphorus	71.0
Iron	0.1

(Ha & Zemel, 2003)

Milk proteins, peptides, and digestive enzymes are also present, albeit in smaller quantities. The whey protein chain's five primary ingredients are:

1. **Beta-lactoglobulin**

With between 50 and 55 percent of the overall whey protein content, it is the most prevalent portion. It is a source of important amino acids, such as branched chain amino acids, or BCAAs, which stop the breakdown of muscle. Foods high in whey protein like milk and yogurt include beta-lactoglobulin, which aids in muscle growth following resistance training(Ali, 2019).

2. **Alpha-lactalbumin**

With a percentage of 20–25%, alpha-lactalbumin is the second most prevalent substance in whey protein. It has a high tryptophan content and may have advantages such as improved mood under stress, increased serotonin production, and sleep control. It is the primary protein in human breast milk(Mann et al., 2019).

3. **Glycomacropeptide**

Depending on the whey protein's quality, glycomacropeptide can make up as much as 15% of the total. It is a peptide created during the production of cheese. Among other bioactive characteristics, it aids in the prevention of dental cavities and induces a feeling of fullness that might aid in weight control(Rodzik et al., 2020).

4. **Immunoglobulins**

Infants and others benefit from immunoglobulins' ability to boost immunity. They make up 10% to 15% of whey protein(de Wit, 1998).

5. **Bovine Serum Albumin (BSA)**

It makes up between 5 and 10% of the whey protein. It has a high concentration of necessary amino acids, lowers cholesterol absorption, and other beneficia qualities(Slozhenkina et al., 2021).

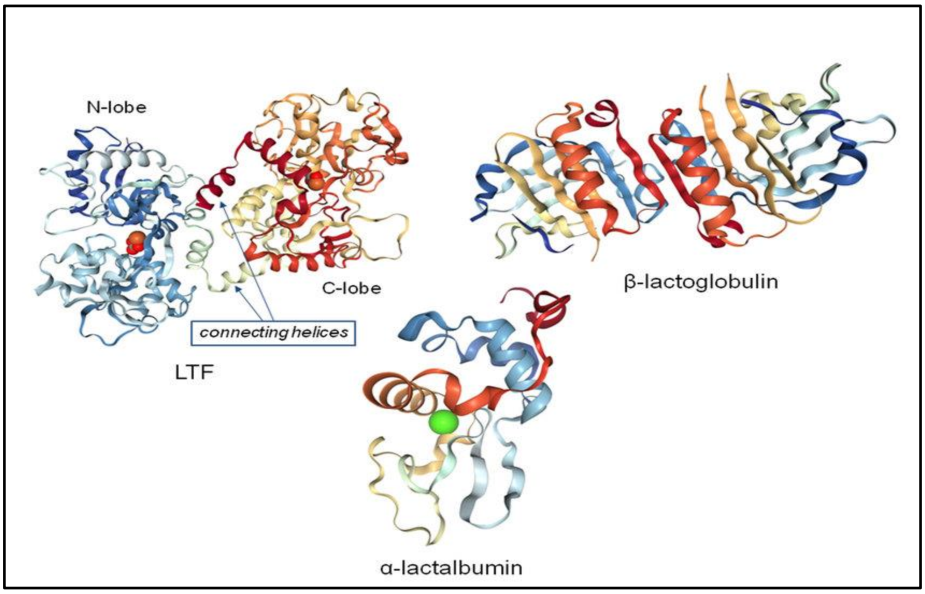

Figure 2: Primary Ingredients of Whey (Rodzik et al.,2020)

Lactoferrin, lactoperoxidase, and lysozyme are three additional whey protein constituents that range in concentration from 0.5% to 2(Minj & Anand, 2020). In addition to controlling bacterial and fungal development, lactoferrin also controls iron absorption. A naturally occurring antibacterial agent is lactoperoxidase. There is proof that lysozyme strengthens the immune system and has potent antimicrobial capabilities(Chavan & Kumar, 2016).

2.3: Sugar:

A crystalline carbohydrate having a sweet flavor and a caloric value of 4K per gram, sucrose is more frequently referred to as sugar.The two main sources of sugar are beet and cane, but it can also be found in a wide range of other foods, including honey, corn syrup, fruits, and vegetables(Draycott, 1972). The main function of sugar in food is to improve flavor, but it also greatly affects the dish's color, texture, and fermentation, as well as how perishable it is. Increased sugar consumption has been linked to rising obesity, cardiovascular disease, and type 2 diabetes rates in recent years(Howard & Wylie-Rosett, 2002).

2.4: Juice:

Juice is a well-liked beverage among customers who view it as a "healthy," "natural," and convenient option for those who are busy (UK Fruit Juice, Juice Drinks and

Smoothies Market Report.).Juice can be broadly categorized into two groups, despite the fact that the market for juice is always growing:

1. Fruit juice
2. Juice drinks.

Fruit juice: According to the British Soft Drinks Association, fruit juice is a beverage made from only 100% pure fruit juice and usually doesn't have any added sugar or other components(*The British Soft Drinks Association*, n.d.).

Juice Drinks: Anything less than 100 percent pure fruit juice is used in juice drinks. On the ingredients panel, which is typically on the back of the package, you can see how much fruit juice is in each of these drinks. Actually, a wide variety of products with varying amounts of fruit juice are available. These beverages could include those that are bought in a ready-to-drink style or those that are bought as "cordials," also called dilatable drinks. Prior to ingestion, they must be diluted. Typically, four parts water are added for every one component cordial. Products created with sugar and low-sugar alternatives made with sweeteners are both examples of dilatable goods. "High juice" juice drinks are a recent development in this field. Compared to most other juice drinks, these products contain more juice, with some of the ones that are already on the market having fruit juice concentrations of up to 70%(Caswell, 2009).

2.5: Ultra-sonication process:

An developing technology that is deemed green since it saves a lot of energy and increases productivity is ultrasound, which is non-toxic and environmentally benign. It has been used to research food composition (fruits, vegetables, and dairy products) and to detect contamination by foreign extraneous components in canned and dairy foods. Ultrasound has a wide range of applications in science and food technology. Although there has been a significant deal of study on ultrasound technologies in the field of food technology, much more work needs to be done in the future to build industrially automated. The greatest production of high-quality and safe food products should be achieved with the aid of ultrasonic systems, which will also assist to reduce labor, costs, and energy(Majid et al., 2015) (Kwiatkowska et al., 2011)

The cavitation process caused by ultrasound (US) processing, one of the nonthermal procedures, enhances the amount of polyphenols in the materials it treats. The enhancement of diffusion and the breaking down of cell walls through acoustical cavitation in the US increases the rates of mass transfer. Because radicals OH* produced during US therapy, it's possible that flavonoids concentrations are rising along with the molecules' tendency to be hydroxylated. In order to improve fruit safety while preserving their nutritional value and sensory qualities, US processing alone or in combination has been proposed as an initial step(Faisal Manzoor et al., 2021; Majid et al., 2015)

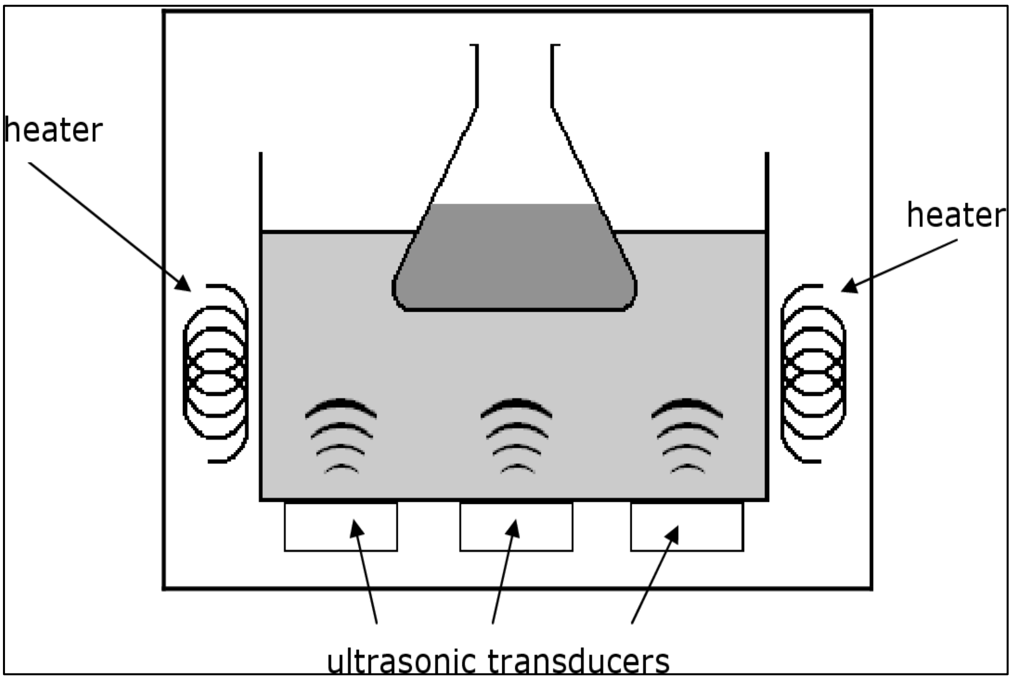

Figure 3: Ultra-sonication Process (Majid et al.,2015)

2.6 Microwave Processing:

Because of the quicker processing times, more even heating, and greater efficiency of microwave heating compared to conventional heating, it has attracted a lot of attention. Dielectric materials polarize when exposed to propagating microwaves, which causes microwave heating. As a result of the alternating electric field, the polar molecules found in dielectric materials realign and realign with the electric field at a microwave frequency(Ramaswamy, 2020). In contrast to conventional furnace heating, the high speed realignment of polar molecules causes friction between the molecules. As a result, heat is produced volumetrically inside the materials, resulting in a shorter processing time. Because polar molecules rotate like dipoles, molecular friction acts as a medium for the delivery of microwave radiation at the molecular level. Microwave heating is also caused by the migration of polarized ions as a result of ionic polarization. The two main mechanisms for microwave heating are dipole rotation and ionic polarization. At frequencies above 1 GHz, the dipole rotation predominates, whereas at frequencies below 1 GHz, the ionic polarization predominates. The frequency for industrial microwave processing is 2.45 GHz, and the dipolar rotation is the predominant rotation for microwave food processing(Bakr & M, 2020).

According to hypotheses such as selective heating, electroporation, cell membrane rupture, and magnetic field coupling, the fate of bacteria and inactivation of enzymes during microwave pasteurization can be understood. According to the principle of selective heating, when a specific group of microorganisms is heated to a temperature greater than that of the fluid they are in, they can be quickly eliminated. According to the electroporation theory, when there is an electrical potential across a cell, the membrane develops pores that allow cellular components to flow out. The high voltage is placed across the cell membrane, according to the principle of cell membrane rupture, which causes the cell membrane to break. According to the notion of magnetic field coupling, a cell rupture results from the interaction of vital molecules like proteins with electromagnetic energy(Mullin, 1995) (Darawshe et al., 2014).

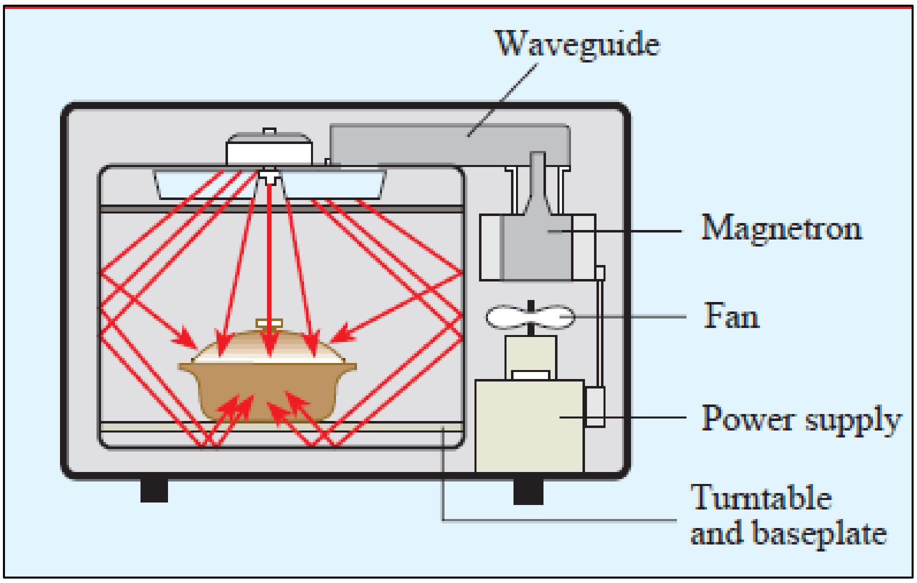

Figure 4: Microwave Processing (Darawshe et al.,2014)

2.7 Mild Pasteurization:

Due to their abundance in natural, healthy ingredients, fruit juices are the most popular beverages worldwide. Fruit juices drank in particular without thermal pasteurization have been linked to outbreaks of foodborne illness or spoiling issues over the previous ten years(Hasting, 1992). The process of thermal pasteurization must be efficient in order to create fruit juice that is safe, pathogen-free, of superior quality, matches consumer expectations, and reduces financial losses. To accomplish this, a variety of factors must be taken into account, including the physicochemical characteristics of fruit juices (such as pH), the inactivation mechanisms of target enzymes and microorganisms, the enzymatic and microbiologic origins of fruit juices, and finally, the engineering aspects of thermal pasteurization(Azizi-Lalabadi et al., 2023).For fruit juice, there are often two different pasteurization temperatures and times: one is heating to 61.1–65.6 degrees Celsius for 30 minutes, and the other is heating to 71.7 degrees Celsius for at least 15 seconds(H. S. Lee & Coates, 2003). The optimal temperature for each type of bacterium and its tolerance to heat and cold vary.Within a limited temperature range, bacterial reproduction is slowed down by lower temperatures and accelerated by higher temperatures (the ideal temperature range for microbial growth is often between 28 and 37 degrees Celsius). If the temperature is too high, however, the bacteria will perish.In reality, pasteurization is the process of killing bacteria with the right combination of temperature and holding time while using pathogens that aren't extremely heat-resistant(Abdul Karim Shah et al., 2016) (N, 2020).

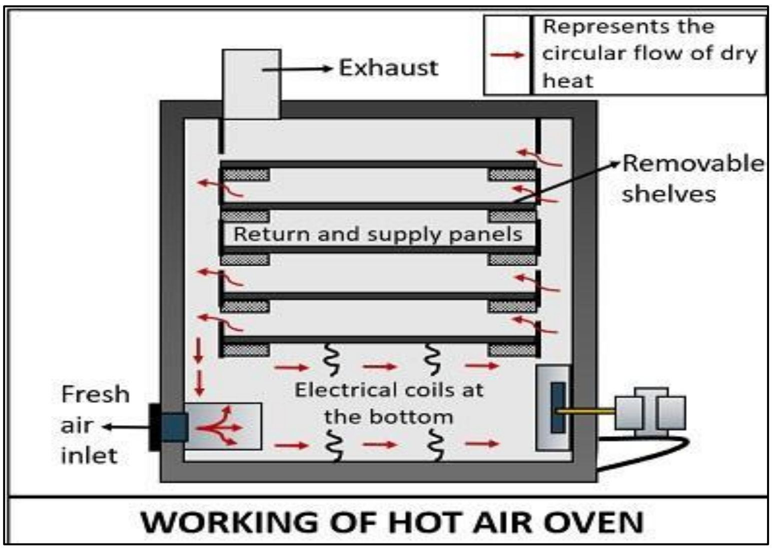

Figure 5: Hot Air oven (H.S.Lee & Coates,2023)

CHAPTER 3

Materials and Methods

3.1: Study Area:

The entire study was carried out at the lab of Applied Food Science and Nutrition, Food Processing and Engineering, and Applied Chemistry and Chemical Technology at Chattogram Veterinary and Animal Sciences University (CVASU), Chattogram.

3.2: Study Duration:

From June to August 2023, a three-month period, the study was carried out.

3.3: Sample Collection:

Ripe and fresh mangoes were chosen as the study's primary sample type. Mangoes were bought from Rajshahi. Milk was the second item used in this study, and it was brought from the supermarket.

Figure 6: Map of Bangladesh

3.4 Juice Preparation: The juice was made in accordance with the following steps after samples were collected(Pandey et al., 2019).

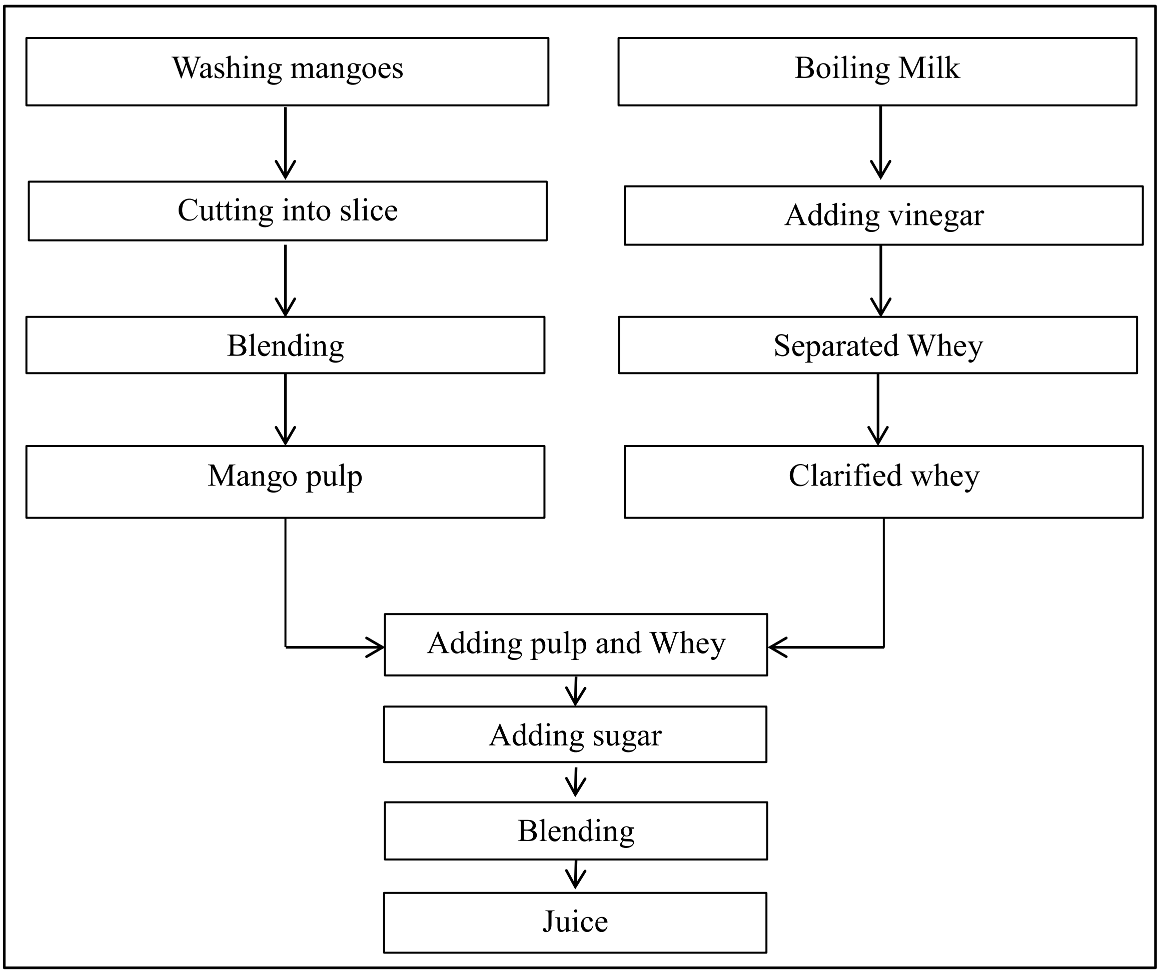

Figure 7: Preparation of Juice

3.5 Study Design:

For the creation of juice, several ratios of mango pulp and whey concentration were used(Pandey et al., 2019). The table is a list of the various concentrations (100ml).

Ingredients	Juice 1	Juice 2	Juice 3	Juice 4
Whey (ml)	50	60	70	80
Mango pulp (ml)	50	35	25	15
Sugar (gm)	No sugar	5	5	5

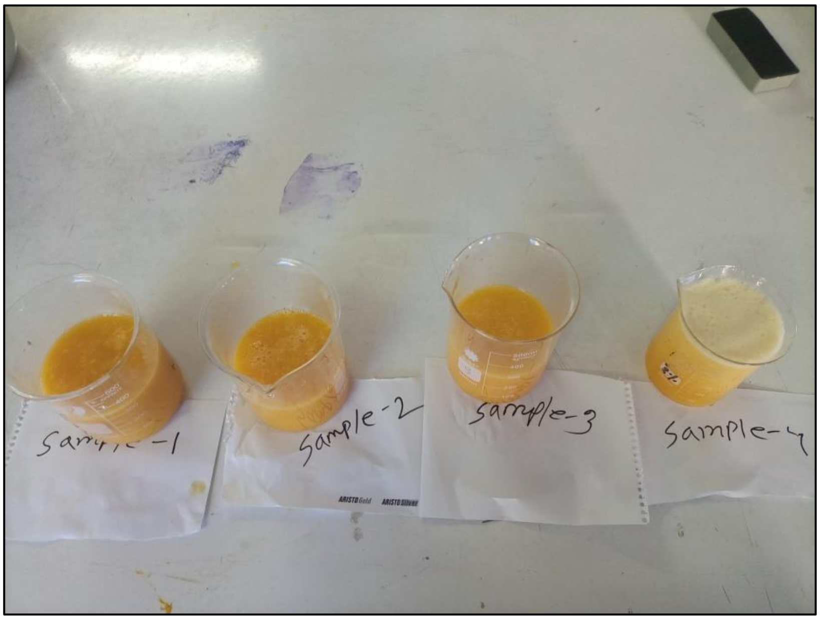

Figure 8: Juice with different Ratio

3.6 Sensory evaluation:

To ensure that the finished product was received favorably by consumers on all counts, sensory evaluation was carried out. Whether the developed product was suitable or not was decided by a taste testing panel. CVASU faculty, staff, and students participated in the panel test. A panel of 20 participants were given the juice, and they were asked to sample four different formulations that were coded with juices 1, 2, 3, and 4. The sensory attributes of juice look, color, flavor, texture, taste, and overall acceptability were sought for from the panelists, and they were requested to provide an appropriate assessment. The technique may not be able to tell you how customers feel about a product, but it can show you what qualities a top-notch product should have. A rating was assigned based on the comments made about the four samples. The four samples' qualitative sensory attributes (taste, color, flavor, consistency, and overall acceptability) will be evaluated using nine-point Hedonic measures (Kozlowska et al., 2003)(Reis et al., 2017).

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The scale was set up in such a way that : Like extremely=9, Like very much=8, Like moderately=7, Like slightly=6, Neither like nor dislike=5, dislike slightly=4, dislike moderately=3, Dislike very much=2, Dislike extremely=1)

3.7 Different Treatment:

The best concentrated juice (juice 2) that was more palatable to consumers was chosen through a sensory test. Juice 2 has now through three processing steps(Ahmed et al., 2022). But the control was simply the newly extracted juice, which had no treatment.

Table 4 Different Treatment on Juice

Name	Treatment
Control	No Treatment
Sample 1	Ultra-sonication
Sample 2	Microwave
Sample 3	Mild Pasteurization

3.7.1 Ultra-sonication

A 250 ml Erlenmeyer flask was filled with a sample of juice measuring 50 ml. Once the flask was in the thermostatic sonic bath (Power Sonic 520, Korea), the sonication temperature was changed to 255 °C. The processing parameters included a frequency of 40 kHz and a constant power of 500 W throughout a 15-minute period. Juice samples were immediately cooled after the treatment and kept at room temperature (25 °C) for additional examination(Ruiz-De Anda et al., 2019).

3.7.2 Microwave:

Juice was treated in a 2,450 MHz microwave oven (Panasonic NN-CD9978, Japan). Each 250 ml beaker containing 50 ml of fresh juice sample was heated for 20 seconds in the microwave. Gloves were used to remove the sample as soon as boiling was detected. In order to store it for later analysis, it was cooled until it reached a temperature of 25 °C (Khalil, 2019).

3.7.3 Mild pasteurization:

A beaker containing 50 ml of juice was placed in a hot air oven set to 85ºC for 15 minutes in Hot Air oven. Gloves were used to remove the sample as soon as boiling was detected. In order to store it for later analysis, it was cooled until it reached a temperature of 25 °C(Zulueta et al., 2013).

3.8 Physiochemical analysis of Juice

3.8.1: Proximate analysis:

Proximate analysis is a term used to describe the quantitative examination of macromolecules found in food. Combining methods like extraction and Kjeldahl, we can determine the quantities of protein, fat, moisture, ash, and carbohydrates(Okokon & Okokon, 2019).

3.8.1.1: Moisture content:

Water analysis is one of the most significant and commonly utilized metrics in the preparation and monitoring of meals. Because the amount of dry mass in a piece of food is inversely connected to the amount of water it contains, the water content is directly relevant economically for both the producer and the consumer. Moisture has a much greater impact on the quality and stability of food, though. The moisture content was determined using a procedure that adheres to the Association of Official Analytical Chemists' standards(AOAC, 2023).

Procedure:

- 250 ml sample of was added to an empty crucible after it had been weighed.
- The crucible's weight with the sample inside was measured.
- The crucible was then dried for 48–72 hours at 105°C in a hot air oven.
- The crucible was taken out of the oven and put in a desiccator to cool.
- The final weight of the crucible was established.

Calculation: The percent of moisture was calculated as follow Moisture % = {(Initial weight – Final weight)/ Sample weight} × 100

3.8.1.2: Dry Matters/Total solids:

Moisture content tells you how much water is actually in the feed item, whereas dry matter is what's left behind after the water has been taken out(Rafiq et al., 2016).

Calculation: AOAC procedures were used to calculate total solid(AOAC, 2023). And use the information gathered during the measurement of moisture, the proportion of the overall solid content got determined:

% Total solids = 100 – % moisture content.

3.8.1.3: Ash Content:

AOAC procedures were used to determine the ash content. The inorganic residue left over after organic stuff is destroyed is known as ash content(AOAC, 2023)**.**

Procedure:

- 5 grams of the sample juice powder was placed in a pre-dried, weighted crucible, and it was then converted to charcoal.
- In order to completely extract the charcoal, the charcoal was subsequently burned for 4 hours in a muffle furnace at a temperature of roughly 650°C.
- The crucible was taken out of the fire. In a desiccator, it was properly chilled before being weighed.

Calculation: The below phrase was used to determine the ash content.

Ash % = (Amount of ash supplied by sample/ sample weight) × 100

3.8.1.4: Crude Fiber:

Cellulose, hemicelluloses, and lignin make up the majority of the liquid component of carbohydrates known as "crude fiber." The crude fiber was calculated (2023) using the AOAC method.

Procedure:

- It was heated for 30 minutes in a determined amount (5 gram) of fat-free meal in a mildly acidic medium (1.25% H_2SO_4).
- Additionally, heating was conducted for 30 minutes at a fixed volume in a low alkaline medium (1.25% NaOH).
- It was determined by digestion and then ash was subtracted from the residue produced.

- The remains were then burned in a muffle furnace to between 550 and 600 °C (or white ash).

Calculation :

Calculation of the crude fiber percentage as follows:

% crude fiber = {(w- w1)/w2} × 100

Here, W= Weight of crucible, crude fiber and ash

W1=Weight of crucible and ash

W2= Weight of sample

3.8.1.5 : Crude Fat:

To assess the fat content of various foods, the foods are dissolved in polar solvents (such methanol or chloroform), and the supernatant is then filtered to separate the fat from the other ingredients. The filtrate is divided among several funnels, the mixture is allowed to dry so that the extracts can be measured, and then the predicted fat percentage is computed. The samples' crude fat content was determined using AOAC (2023) methods and a Soxhlet apparatus.

Procedure:

- Five grams of powdered juice were collected in a thimble.
- The material was hydrolyzed using HCl.
- Hydrolyzed lipid materials extraction with ether. Ether evaporates.
- The lipid residue was heated at 100 degrees continuously. % crude fat was used to express residue.

Calculation: The percentage of crude fat was expressed as follows expression.

Fat % = (weight of the extract / weight of the sample) × 100

3.8.1.6: Crude protein:

The Kjeldahl method can be used to quantify the nitrogen concentration of both organic and inorganic substances. Again, Kjeldahl nitrogen is evaluated in foods and beverages, flesh, feeds, grains, and pasture crops with the intention of estimating the crude protein. The nitrogen content of soil, wastewater, and other substances can also be ascertained using the Kjeldahl method. It is an accepted process that is described in a number of authoritative sources, such as (AOAC, 2023). The material was digested using a digestion solution of concentrated sulphuric acid (H2SO4), sodium sulphate (Na2SO4), and mercuric oxide (HgO).

Procedure:

- 1 gm of the sample, which was wrapped in ash-free filter paper 21 and placed in a clean, dry Kjehldahl flask, was collected.
- 10 ml of concentrated sulphuric acid (H2SO4) was added, along with a digestion solution containing sodium sulphate (Na2SO4), mercuric oxide (HgO), and concentrated sulphuric acid (H2SO4) in a 1:1 ratio.
- For six hours, there was digestion. A volumetric flask was then placed inside the beaker when it had cooled.
- In that flask, 2.5 ml of 15% Na2S2O3 combination and 10 ml of 50% NaOH were then added. There was a 10-minute distillation.
- A 2% boric acid indicator was used to collect the distillate.
- Titrated with 0.02N HCl was the solution. A blank digestion took place at the same moment.

Calculation: The calculations for % nitrogen or % protein must take into account which type of receiving solution was used and any dilution factors used during the distillation process. In the equations below, “N” represents normality. “ml blank” refers to the milliliters of base needed to back titrate a reagent blank if standard acid is the receiving solution, or refers to milliliters of standard acid needed to titrate a reagent blank if boric acid is the receiving solution. When boric acid is used as the receiving solution the equation is

Nitrogen % = {(ml of standard acid – ml of blank) × N of acid × 1.4007}/sample weight

3.8.1.8: Carbohydrate:

In order to calculate the differences between the Nitrogen Free Extractive (NFE) and the carbohydrate content (NFE). It was suggested that the solution was the difference between 100 and the total of the other proximal portions.

Calculation: Hence it was calculated using the formula below-

% CHO = 100% - % (Protein + Fat + Fiber + Ash + Moisture content)

3.8.2: P^H and TSS analysis:

The pH and water activity are the two fundamental elements that have the biggest impact on the shelf life and rate of juice deterioration. Flavor, consistency, and shelf life can all be affected by pH variations. Due to the presence of organic acids, which change amongst the various types of juices, fruit juices typically have low pH values that fall between 2.0 and 4.5. Monitoring pH is essential for preserving juice's consistency in quality(Boulton, 1980). Total soluble solids content (TSS), measured as a proportion of fresh matter mass, exhibits a strong positive association with sugar content and is regarded as a key fruit quality characteristic as a result(Astuti & Waris, 2018).

3.8.2.1 P^H Measurement:

The pH scale is used in the study of chemistry to determine whether an aqueous solution is acidic or basic. The negative logarithm of the activity of the (solvated) hydronium ion, or pH, is the concentration of hydronium ions. International agreements have been made to compile a set of reference solutions whose pH can act as a yardstick for the pH scale. Using a concentration cell with transference, primary pH standards are computed by comparing the stark contrast between a hydrogen electrode and a standard electrode, such as a silver chloride electrode(J. Lee et al., 2005).

3.8.2.2 Total Soluble solids:

The total soluble solids of the jelly sample were calculated using a refractometer. The recommended method (Sugiura et al., 1983) for measuring total soluble solids (TSS) was used, which called for a digital refractometer (Atago RX 1000). The results were displayed as a Brix percentage, which is a measure of dissolved solids.

3.9: Vitamin and mineral determination:

The body needs vitamins and minerals, which are micronutrients, to carry out a number of regular processes. But because our bodies can't make these micronutrients, we have to get them from the food we eat. Organic substances known as vitamins can be categorized as either fat-soluble or water-soluble(Lukaski, 2004).

3.9.1: Vitamin A:

The amount of vitamin A was calculated using a colorimeter. Using both retinol and beta carotene contributions, the overall Vitamin A content of a certain food is determined. Alcohol is added to light petroleum after retinol and carotenoids have been removed in order to precipitate proteins. After being notified of the intensity of the yellow color created by the carotenoid, the light petroleum is vaporized before the color reaction is carried out, and the remaining petroleum is mixed with chloroform. It is considered how much the carotenoid contributed to the reaction. The samples' retinol interacts with trifluoroacetic acid (TFA) in a chemical process. The sample and TFA reaction have a blue hue, which shows how much retinol is present in the sample. The blue color is fleeting, so if it does show up, it must be noticed within two seconds of adding the reagent(Bayfield, 1971). 10 ml of each sample preparation was mixed in a tube with 1 ml of distilled water and 2 ml of ethanol using a vortex mixer. The tube was centrifuged at 3000 rpm for 15 minutes before 1 cc of the supernatant was taken out. First identified was beta-carotene. The blank solution was made using S2 reagent (6 ml), and the standard preparation was done with standard reagent (6 ml) pipetted into the cuvette. The sample solution was made by pipetting 1 milliliter of sample extract, 2 milliliter of S1 reagent, and 3 milliliter of S2 reagent into a cuvette. All were well mixed with a vortex mixer and a mechanical shaker for ten minutes. The tubes were rotated at 3000 RPM for the whole ten-minute centrifugation. The intensity was then calculated at 420 nm in comparison to the blank using 2 ml of sample supernatant, standard, and blank. This was carried out immediately to prevent the solvent from evaporating and the light from damaging the carotenoids. Then, the retinol was found. 2 ml of the sample extract used to calculate the amount of carotenes was collected to create the sample solution, and the contents of the sample cuvette were then dried out in a water bath that had been heated to 50 °C. After the solvent had evaporated, 100 l of S4 reagent and 1 ml of S5 reagent were added to the sample cuvette. The blank solution was made by pipetting S4 and S5 reagents into cuvettes in quantities of 100 l and 1 ml, respectively. The standard solution was made using 100 l of standard reagents and 1 ml of S5 reagent. These were thoroughly combined using a vortex mixer. The absorbance was measured at 620 nm precisely 2 seconds after the administration of the reagent because S5 reagent is a strong acid with an unpleasant vapor(Rietz et al., 1975). The amounts of retinol, carotene, and all vitamins are measured as follows:

Carotene (mg/l) = (- 0.0167 × Absorbance) + 0.0091

Retinol (mg/l) = (0.0759 × Absorbance) + 0.1023

Where, 0.0759 and 0.0167 are slope; 0.1023 and 0.0091 are intercept Total vitamin A (RAE) = µg of retinol + (µg of beta-carotene / 6)

3.9.2 Calcium measurement:

The amount of calcium in the sample is calculated by observing the color complex that forms when calcium and o-cresolphtalein interact in an alkaline media. The amount of calcium present in the sample directly affects how intense the color is(Olalla et al., 2002).

Reagent Requirement

- Buffer solution
- Ethanolamine
- Chloroform
- Methanol
- Chromogen solution

Procedure:

- Use distilled water to zero the device.
- Standard, sample, and reagent are pipetted into a cuvette.
- Stir and incubate for five minutes at 37 °C.
- Utilizing a spectrophotometer set to 570 nm, compare the absorbance of the sample (A) and the standard to the blank.

- For 40 minutes, the color is steady.

Calculation:

Amount of calcium (mg/dL) = [Sample (A) – Blank (A)] / [Standard (A) - Blank (A)] × 10.

3.10 Determination of Bioactive compound:

Various foods may naturally contain bioactive substances. The majority of bioactive substances contain antibacterial, anti-inflammatory, anticarcinogenic, and antioxidant activities. As a result, a number of epidemiologic studies claim that certain of them also protect against cardiovascular illnesses(Cui et al., 2021).

3.10.1 Sample extraction:

A sample of juice was extracted using acidified methanol(Sripakdee et al., 2015).In anutshell,

20 mL of 1%(v/v) HCl methanol were combined with 5 mL of the juice

↓

Left it for a whole night

↓

For 10 minutes, the extract was centrifuged at 4000 rpm.

↓

The total phenolics, flavonoids, and antioxidant activity were measured in the supernata

Figure 9: Sample Extraction

3.10.2 Determination of Antioxidant capacity by DPPH scavenging method Extract

According to (Yang et al., 2008) methodology, the antioxidant solution's capacity to scavenge 2,2-diphenyl-1-picrylhydrazyl (DPPH) was assessed. Briefly,

3 mL of 0.1 mM DPPH solution and 1 mL of sample solution were combined.

↓

The combined solution was left at room temperature (29 o C) for 30 minutes in the dark

↓

· Its absorbance was measured at 517 nm.

Figure 10: Determination of Antioxidant

The percentage inhibition was calculated according to the equation:

Inhibition (%) = (Ac As / Ac) x 100.

Where, Ac is the absorbance of control (containing DPPH solution),

As is the absorbance of sample.

Antioxidant activity was expressed as mg BHT equivalent/ 100 mL of sample. All determinations were performed in triplicate.

3.10.3 Determination of total Flavonoid content:

In accordance with the aluminum chloride colorimetric method, the samples' total flavonoid content (TFC) was determined(Gattuso et al., 2007). To do this,

- Samples were made by collecting aliquots of 0.5 mL of diluted extract
- Combining them with additional chemicals(2.8 mL of pure water, 0.1 mL of 10% $AlCl_3$, and 0.1 mL of 1 mol/L potassium acetate).
- At room temperature, the mixture was held for 30 minutes.

- A UV-visible spectrophotometer (UV2600, Shimadzu Company, USA) was used to measure the absorbance at 415 nm using a control solution made up of the same amount of distilled water and 10% aluminum chloride.
- The number of milligrams of quercetin equivalents (mg QE/g) used to represent the quantity of flavonoids in each milligram of extract.

3.10.4 Determination of phenolic Compounds:

(Škerget et al., 2005) somewhat adjusted their estimation of the total polyphenol content. By thos method,

2.5 mL of 10%(v/v) Folin-Ciocalteu reagent, 2 mL of 7.5%(w/v) Na2 CO3, and 0.5 mL of diluted extract were added to 0.5 mL of mixture.

↓

The mixture was thoroughly mixed on a vortex vibrator for five minutes.

↓

Keep at one hour of incubation at room temperature (29o C) in the dark.

↓

The absorbance at 765 nm was then measured.

↓

Gallic acid was employed as a calibration curve.

↓

The results were represented as mg of gallic acid equivalents per 100 mL of sample.

Figure 11: Determination of phenolic content

CHAPTER 4

RESULT

4.1: Sensory Quality Evaluation:

Following statistical research, it was determined that Juice 2 was the most consumer-acceptable of the four samples. They also had some degree of acceptability for samples 1 and 3, while juice 4 received the lowest ratings.

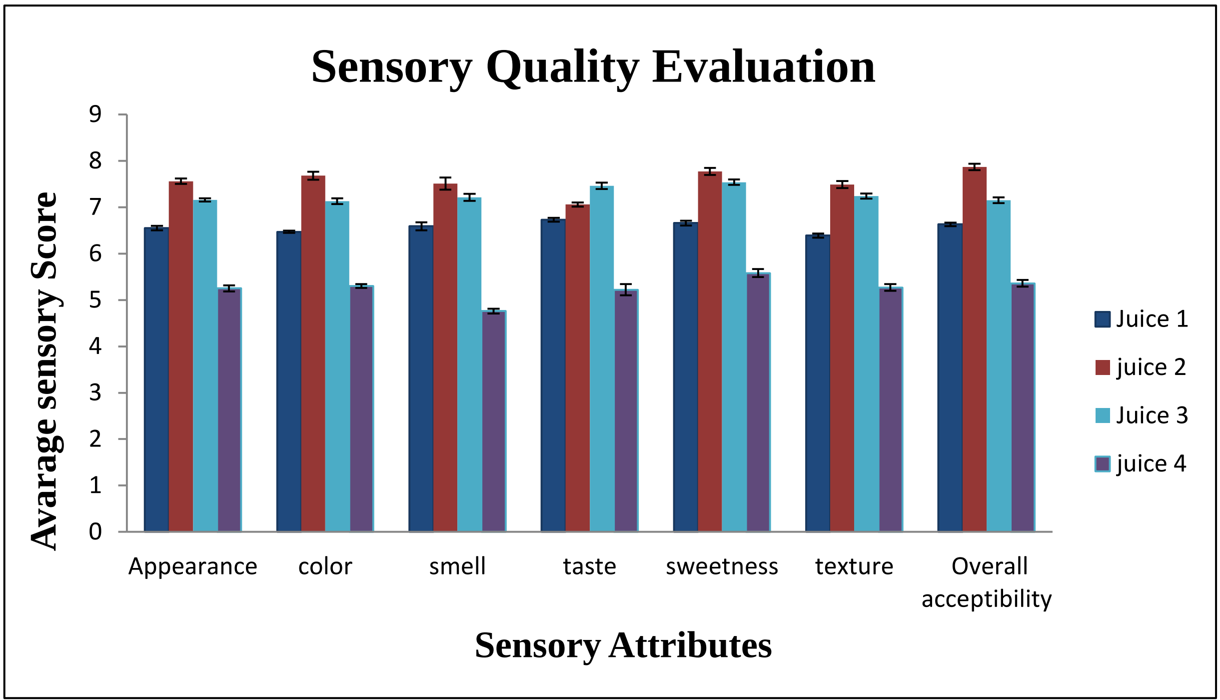

Figure 12 : Sensory Quality Evaluation

(All values are Mean ± Standard Deviation and number of replications, n=3. Juice 1 is 50% whey with 50% mango pulp (no sugar). Juice 2 is 60% whey with 35% mango pulp + (5% sugar). Juice 3 is 70% whey with 25% mango pulp + (5% sugar). Juice is 80% whey with 15% mango pulp + (5% sugar))

4.2 Physiochemical properties of Juice:

4.2.1 Nutritional Attributes:

Nutritional Characteristics of Juice was assessed by determining moisture, dry matter protein, fat, crude fiber, ash , carbohydrate, p^H, TSS.

One way ANOVA (analysis of variance) test was conducted to see the overall mean differences of values for different parameter of juice which run through 3 different treatment.

Table 5: Result of proximate Analysis

Sample	Control	Sample 1	Sample 2	Sample 3	p value
Moisture (%)	86.88±0.04^{d}	86.45±0.05^{b}	86.09±0.15^{a}	86.74±0.07^{c}	0.001
crude fiber(%)	2.68±0.01^{b}	2.30±0.05^{a}	2.36±0.15^{a}	2.75±0.10^{b}	0.001
Ash(%)	3.65±0.050^{b}	3.50±0.05^{a}	3.60±0.60^{b}	3.64±0.08^{ab}	0.053
Fat(%)	0.55±0.09^{ab}	0.65±0.05^{b}	0.41±0.10^{a}	0.39±0.08^{a}	0.019
crude protein(%)	3.01±0.04^{b}	3.05±0.05^{b}	2.73±0.11^{a}	2.73±0.06^{a}	0.001
CHO(%)	3.26±0.09^{a}	4.74±0.09^{a}	4.04±0.40^{b}	3.83±0.09^{a}	0.001
Dry matter(%)	13.14±0.06^{a}	13.45±0.05^{a}	13.80±0.10^{b}	13.28±0.10^{a}	0.001

(Here, Control is without any treatment, Sample 1 is Ultra-sonication treatment. Sample 2 is Microwave treatment ,Sample 3 is Mild pasteurization treatment . And, All values are Mean ± Standard Deviation and number of replications, n=3. The presence of different superscripts along a column indicates significant differences and the same superscripts shows not significant differences at ($p<0.005$)).

4.2.2 P^H and TSS

Table 6: Result of P^H and TSS

Sample	Control	Sample 1	Sample 2	Sample 3	P value
P^H	4.66±0.070^{b}	4.42±0.064^{a}	4.43±0.503^{b}	4.70±0.060^{a}	0.001
TSS(ºBx)	12.11±0.043^{b}	11.08±0.062^{a}	12.04±0.352^{b}	12.06±0.049^{b}	0.001

(Here, Control is without any treatment, Sample 1 is Ultra-sonication treatment. Sample 2 is Microwave treatment ,Sample 3 is Mild pasteurization treatment . And, All values are Mean ± Standard Deviation and number of replications, n=3. The presence of different superscripts along a column indicates significant differences and the same superscripts shows not significant differences at ($p<0.005$)).

4.3: Vitamin and Minerals Analysis:

Calcium and Vitamin A were assessed.

Table 7: Result of calcium and Vitamin A

Sample	Control	Sample 1	Sample 2	Sample 3	P value
Calcium(mg/dl)	0.62 ± 0.10^{b}	0.69 ± 0.070^{b}	0.67 ± 0.030^{b}	0.31 ± 0.610^{a}	0.001
Vitamin A(RAE/gm)	1.28 ± 0.05^{b}	0.41 ± 0.040^{a}	0.75 ± 0.050^{a}	1.26 ± 0.408^{b}	0.001

(Here, Control is without any treatment, Sample 1 is Ultra-sonication treatment. Sample 2 is Microwave treatment ,Sample 3 is Mild pasteurization treatment . And, All values are Mean ± Standard Deviation and number of replications, n=3. The presence of different superscripts along a column indicates significant differences and the same superscripts shows not significant differences at ($p<0.005$)).

4.4: Bioactive compound of juice:

As bioactive compound total flavonoid content, total phenolic content and antioxidant capacity were all determined. Tannic acid used as the standard for calculating antioxidant capacity in this case.

Table 8: Result of Bioactive Analysis

Sample	Control	Sample 1	Sample 2	Sample 3	p value
Antioxidant (mgTA/100g)	3.02 ± 0.05^{b}	3.09 ± 0.001^{c}	3.05 ± 0.030^{b}	2.98 ± 0.010^{a}	0.001
Flavonoid (mg QE/100gm)	4.17 ± 0.08^{b}	3.57 ± 0.031^{a}	4.10 ± 0.117^{c}	4.28 ± 0.105^{b}	0.001
Phenolic (mgGAE/100gm)	0.05 ± 0.04^{a}	0.03 ± 0.02^{a}	0.02 ± 0.03^{a}	0.04 ± 0.03^{a}	0.737

(Here, Control is without any treatment, Sample 1 is Ultra-sonication treatment. Sample 2 is Microwave treatment ,Sample 3 is Mild pasteurization treatment . And, All values are Mean ± Standard Deviation and number of replications, n=3. The presence of different superscripts along a column indicates significant differences and the same superscripts shows not significant differences at ($p<0.005$)).

CHAPTER 5

Discussion

5.1: Sensory Evaluation:

Sensory analysis of the purpose of juice was to attain the highest organoleptic approval of all juices. Juice 2 had the highest overall acceptance (7.87±0.070), according to the sensory analysis findings from graph 1. It might be due to the flavor, consistency, color, and appearance, among other factors. Juice 2 and juice 3 (7.150±0.064) are somewhat comparable. The Panel enjoyed it as well. Juice 4 estimates a hedonic score as low as 5.36±0.070. It could be as a result of the taste and color being affected by the rising whey content and falling mango pulp content. The panel rejected more subdued and somewhat pale hues. The ratio of 60:40 between mango pulp juice and whey was found to be more tolerable here, as per panday and their group finding (Pandey et al., 2019). As a result, juice 2 (60:35:5) outperformed other compositions in our investigation in terms of organoleptic performance.

5.2: Physicochemical properties of Juice

5.2.1: Nutritional Attributes

Table 1 illustrates how non-thermal processing techniques affected the physicochemical characteristics of the juices that served as controls and those that underwent processing.The moisture of the control and processed juice samples ranged from 86.09 to 86.88 percent, with significant differences ($p < 0.05$) between the two, although the microwave-processed juice's moisture had the lower value. According to (Ahmed et al., 2023) the moisture ranges from 75.50 to 87.20. But when a material is processed with a microwave, the electromagnetic field has an impact on the entire object, causing the water molecules to vibrate countless millions of times every second. The energy generated as a result of this vibration enables the material's moisture to quickly evaporate(celen,2019). Due to this, microwave processing has a low moisture content.

Additionally, the crude fiber of the treated samples (microwave, ultrasonication) varied from 2.30 to 2.75 percent, demonstrating statistically significant differences ($p<0.05$) between these values and the control. However, there were no discernible variations between the control and mild pasteurization procedures in terms of the crude fiber. According to (Mutua et al., 2017), the range vary form 2.54 to 3.64, our value is slightly lower than that.Once more, the value of ash varied between 3.50 and 3.65, but ultra-sonication significantly differed from control and microwave-processed juice (p 0.05). With respect to the control and other treated juices, mild pasteurization does not significantly differ (p 0.05). The range vary form 1.78 to 3.00 according to (Mutua et al., 2017) as our value is slightly higher than that.

Juice that had been ultrasonically processed had much more fat (0.65%) than juice that had not been processed (0.55%), whereas juice that had undergone light pasteurization had fat (0.39%) added to it. The range, in (Ahmed et al., 2023) estimation, is between 0.60 and 1.97 percent. That's in line with our ideals. Additionally, the crude protein of the treated samples (microwave, mild pasteurization) ranged from 2.73 to 3.05 percent, demonstrating statistically significant differences (p 0.05) between these values and the control. The unprocessed proteins from the control and ultrasonication methods didn't differ much from one another, though. The range given by (Ahmed et al., 2023) is substantially higher than our estimate, ranging from 5.67 to 7.50. The variation in whey content in juice may be the root of this.

Once more, the range of the carbohydrate value was 3.26 to 4.74, but the microwave had a significant difference ($p<0.05$) from the control and other processed juices. All processing techniques, however, significantly ($p<0.05$) increased the amount of carbohydrates in juices. The range is from 3.18 to 18.23, according to (Ahmed et al., 2023). That's in line with our ideals.Dry matter values ranged from 13.14 to 13.80, whereas microwave juices and control juices significantly differed ($p<0.05$).

5.2.2 P^H and TSS

Additionally, the P^H of the treated samples (after ultra-sonication and mild pasteurization) ranged from 4.42 to 4.70, demonstrating statistically significant differences ($p<0.05$) between these values and the control. The P^H of the control and microwaved items didn't differ noticeably, though. According to (Yasmin et al., 2015), the range is between 4.40 and 5.00. TSS values varied from 11.08 to 13.80, however ultra-sonication significantly differed from control and other processed juices ($p<0.05$). (Pandey et al., 2019) estimates a range from 17.10 to 19.00, which is significantly greater than our estimate. Use of less mango pulp may be the reason of this.

5.3 Vitamins and Minerals:

In contrast, moderate pasteurization significantly differed from control and other processed juices ($p<0.05$) in terms of calcium value, which ranged from 0.31 to 0.69 mg/g. The range given by Futus is substantially higher than our estimate, ranging from 17.10 to 19.00(Yasmin et al., 2015)

Additionally, the vitamin A of the treated samples (ultrasonication, microwave) ranged from 0.41 to 1.28 (RAE/gm), demonstrating statistically significant differences ($p<0.05$) between these values and the control. But there were no discernible variations in the levels of vitamin A after the control and light pasteurization procedures. The range is between 20 to 30 (RAE/gm) according to (Muoki et al., 2009).

5.4 Bioactive compounds:

Bioactive characteristics In Table 3, the impact of non-thermal processing techniques on the bioactive components of unprocessed and processed juices is displayed. There were no appreciable variations between control and processed juice, and TPC concentrations in juice ranged from 0.02 to 0.05 (mg GAE/100 ml), which is incredibly low. Our number is not close to (Abbasi et al., 2015) estimate of the amount of phenolics in mango pulp, which ranges from 20.20 to 40.40 mg GAE/100 ml. This discrepancy can be attributed to the fact that we used more whey than mango pulp. The antioxidant concentration of the samples that were subjected to mild pasturization and ultra-sonication varied from 2.98 to 3.09 mg TA/100 ml, suggesting a significant difference ($p<0.05$). The antioxidant content of the control and microwave-processed foods didn't differ significantly ($p<0.05$). (abid & jabbar, 2014) discovered that apple juice's DPPH antioxidant activity is 15% higher when power ultrasound is used. Our study demonstrates that the benefit of ultrasonication is greater than that of other processing techniques. But the flavonoids in the samples that had been microwaved and ultrasonically treated ranged from 3.57 to 4.28 mg QE/100 ml, demonstrating a significant difference ($p<0.05$). Flavonoids in the mild pasteurization and control procedures did not differ significantly ($p<0.05$). The range, according to (Abbasi et al., 2015), is 2.58 to 8.10 mg QE/100 ml. our value is match with that.

5.5: Overall comparison among 3 treatments:

A closer look shows that microwave has a lower value than moderate pasteurization and ultra-sonication. In contrast to control, they are slightly less valuable. Dry matter, fat, crude protein, and carbs all have high ultra-sonication values. A new functionality of proteins as support shield materials during the creation of microspheres results from ultrasound-enhanced mass transport effects, which are a singular avenue to change the 3D folded structure of protein(Ahmed et al., 2022). This can be caused of high value in ultra-sonication. Unsaturated fatty acids can be oxidized as a result of ultrasound, and as ultrasonic power increases, so does the degree of oxidation(Bao et al., 2021). This can be caused of decreasing fat than control. However, moisture, crude fiber, and ash values are high in mild pasteurization but lower than control.

Although this value is lower than control, the PH and TSS values are high for moderate pasteurization and low for ultrasonication. This heat treatment did inactivate some of the spores, and the more inactivation that was seen, the lower the pH of the heating media(Samapundo et al., 2014). A decreased pH during ultrasonication may be the reason of this. The breakdown of long-chain carbohydrate molecules into soluble sugar compounds during mild pasteurization can result in an increase in total soluble solids(Ojha et al., 2018).

Although there is no discernible difference, calcium is somewhat more abundant in ultra-sonication than in control. The crystalline triple helical structure of collagen is not denatured by ultra-sonication; rather, it is just loosened and opened, allowing the hydroxyapatite crystals to escape. This is in contrast to hydroxyapatite, which has a crystalline structure that can be disrupted by ultra-sonication, facilitating its dissolution(Guo et al., 2022). Calcium levels may have gone up as a result. Among the three treatments, mild pasteurization had the highest levels of vitamin A, however they were somewhat lower than the control. As heat treatments were applied more vigorously, vitamin A degradation increased(Sachdeva et al., 2021). A reduction in vitamin A could be the reason.

In the case of ultrasonication, the antioxidant value is just a little bit greater than the control. In apple juice, power ultrasound improves DPPH antioxidant activity by 15%. But a higher phenolic content and cell wall breakage brought on by cavitation during sonication might enhance the extraction and accessibility of these substances. Additionally, polyphenolic oxidase activity may rise as a result of sonication therapy, which might account for the rise in phytonutrients(abid & jabbar, 2014).

There are no appreciable changes between the juice that has been mildly pasteurized and the control sample in terms of flavonoids, or total flavonoids content (TFC). But there was a very tiny increase in TFC. The rise in TFC of thermally treated juice observed in this study may be due to the fact that thermal treatment increases the amount of flavonoids liberated from the cell matrix(Igual et al., 2011).

A very low value for phenolic compounds was discovered in our investigation. You might need to use more whey as a result than mango pulp. There are a few trace amounts of phenolic chemicals in whey. The whey protein's total phenolic content per 100 g of sample was 778 µmol GAE/100 g (Thongzai et al., 2022).

CHAPTER 6

Conclusion

The study was divided into three sections: a sensory assessment of various juice concentrations, three different methods for processing the juice, and a final assessment of the juice's nutritional and bioactive content. This study suggests that the addition of mango pulp can turn whey into juice. Whey can be used in the food sector in this way rather than being wasted. This is excellent for them. Not only that, but every year when mangoes are wasted in the summer, they can be used in this big way, which will be highly beneficial economically for the nation. According to this study, juice can be treated using three different methods. Neither the nutritional value nor the bioactive value will be impacted by these three treatments. This treatment may help them get well in some circumstances. For both kids and adults, this juice will be a ready-to-drink that is also filling. Infused with bioactive ingredients, it will be a fantastic source of nutrition. Also, this will be a fantastic product for the food sector because there aren't any fruit drinks made with whey currently available. The product's quality can be raised by incorporating additional fruits.

CHAPTER 7

Recommendations and Future perspective

In the newly growing subject of developing new technologies for fruit value addition, these experiments ended with encouraging findings. Its acceptance and market worth also improved as a result. Following are the study's suggestions:

- It's important to gather samples in a tidy manner.
- Fresh mango is necessary. To fend off microbiological attack, mango pulp should be kept in a freezer. If at all feasible, use freshly prepared ingredients.
- The extreme susceptibility of whey to microbial attack requires that it be used immediately.
- It is best to use ripe mango.
- It's important to keep good sanitation throughout the whey manufacturing process.
- Without any precipitation, juice should be well blended.
- In order to guard against microbial attack, it should be kept in the freezer after processing.

Observations for the future are:

- By employing this technique, we may effectively utilize whey rather than discard it.
- Mangoes that have been plucked too early might still be used in delicious ways.
- The ecology won't be harmed by fruit waste.
- This technique works with other seasonal fruits as well.
- The food business will experience economic gains as well as a reduction in waste.
- Juice will come in a new variety.
- People will have access to a healthy juice.

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Appendices

Appendix A: Questionnaire for Hedonic test:

Name of the Taster: …………….. Date: ………..

Please taste these sample and check how much you like or dislike each one on seven sensory attributes such as color, taste, flavor, texture and overall acceptability. Use the appropriate scale to show your attitude by checking at the point that best describe your sense and feeling about the sample. Please give a reason for this attribute. Remember you are the only one who can tell what you like. An honest expression of your personal feeling will help us. For taste/flavor/mouth feel/ appearance/ overall acceptability.

The scale is arranged such that: Like extremely=9, like very much=8, like moderately=7, like slightly =6, neither like nor dislike=5, dislike slightly=4, dislike moderately=3, dislike very much=2, dislike extremely=1.

Table 9: Result Sensory Evaluation

parameter	Juice 1	juice 2	Juice 3	juice 4
Appearance	6.55±0.05	7.56±0.06	7.16±0.035	5.25±0.066
Color	6.47±0.025	7.68±0.085	7.13±0.065	5.3±0.044
Smell	6.59±0.087	7.51±0.133	7.21±0.076	4.760.052
Taste	6.73±0.04	7.06±0.045	7.46±0.07	5.22±0.12
Sweetness	6.66±0.052	7.77±0.075	7.54±0.06	5.58±0.085
Texture	6.39±0.045	7.49±0.078	7.24±0.055	5.27±0.075
Overall Acceptability	6.63±0.035	7.87±0.07	7.15±0.064	5.36±0.07

Appendix B

Antioxidant Capacity:

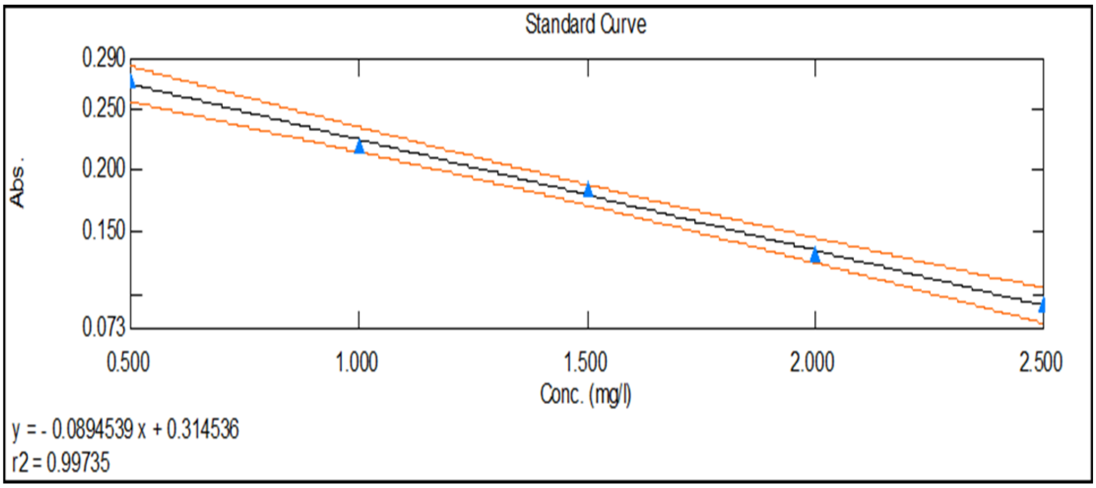
Standard Table of trolox:

Anti Oxidant Capacity of Juice

Standard Table of Trolox:

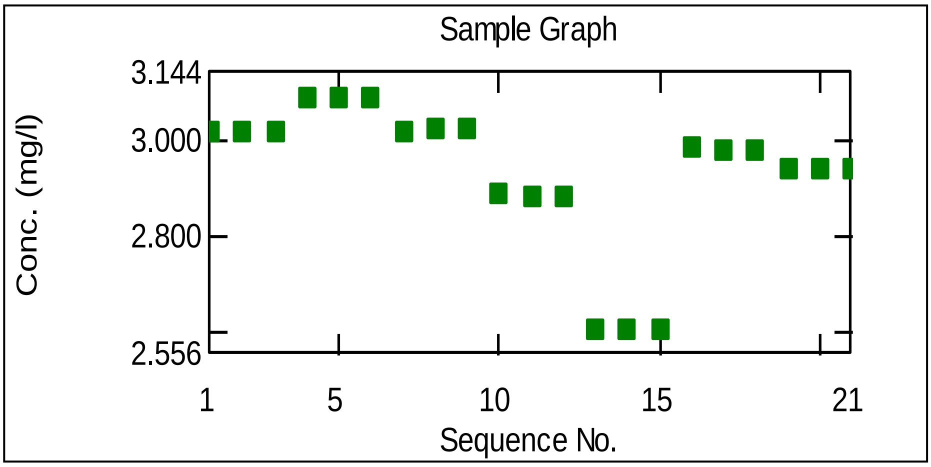
	Sample ID	Type	Conc	WL517.0
1	std1	Standard	0.500	0.272
2	std2	Standard	1.000	0.221
3	std4	Standard	1.500	0.185
4	std5	Standard	2.000	0.133
5	std6	Standard	2.500	0.092

Standard Curve:



Sample Table:

	Sample ID Comments	Type	Conc(mg/100g)	WL517.0
1	Control1	Unknown	3.020	0.044
2	Control2	Unknown	3.021	0.044
3	Control3	Unknown	3.021	0.044
4	S1.1	Unknown	3.095	0.038
5	S1.2	Unknown	3.092	0.038
6	S1.3	Unknown	3.095	0.038
7	S2.1	Unknown	3.023	0.044
8	S2.2	Unknown	3.027	0.044
10	S3.1	Unknown	2.892	0.056
11	S3.2	Unknown	2.888	0.056
12	S3.3	Unknown	2.888	0.056



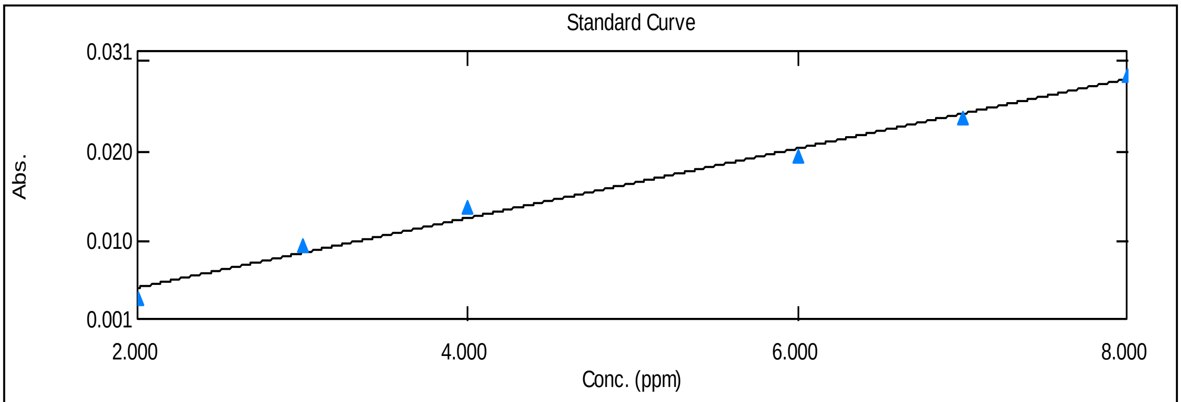
Appendix C

Flavonoid Content:

Standard Table of Qwercetin:

	Sample ID	Type	Conc	WL415.0	Wgt.Factor	Comments
1	Std_1	Standard	2.000	0.004	1.000	Dilution Factor 1
2	Std_2	Standard	3.000	0.010	1.000	Dilution Factor 1
3	Std_3	Standard	4.000	0.014	1.000	Dilution Factor 1
4	Std_4	Standard	6.000	0.020	1.000	Dilution Factor 1
5	Std_5	Standard	7.000	0.024	1.000	Dilution Factor 1
6	Std_6	Standard	8.000	0.029	1.000	Dilution Factor 1

Standard

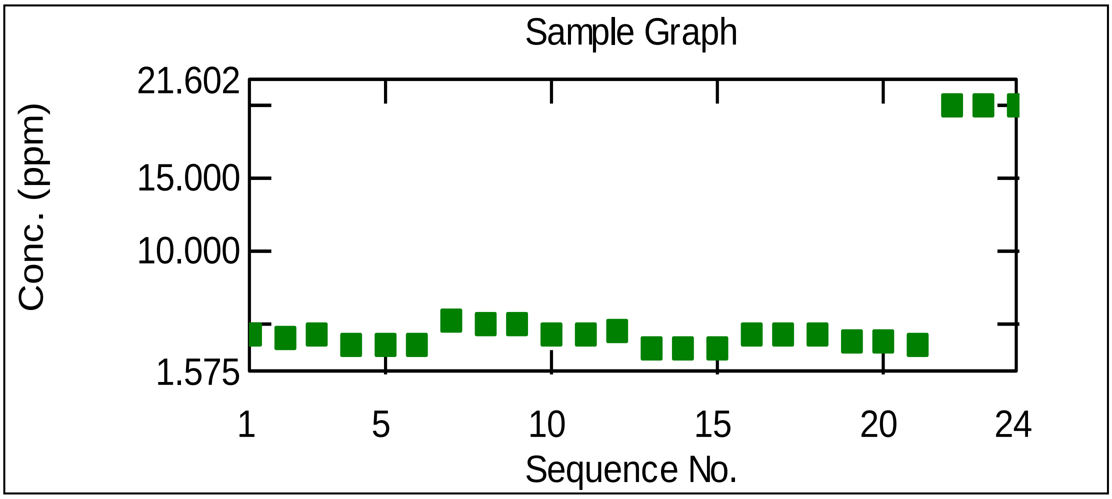


y = 0.00385110 x - 0.00271158
r2 = 0.98868

Sample Table:

Sample		IDType	Conc(mg/100g)	WL415.0	Comments
1	Control1	Unknown	4.222	0.014	Dilution Factor 1
2	Control2	Unknown	4.076	0.013	Dilution Factor 1
3	Control3	Unknown	4.234	0.014	Dilution Factor 1
4	S1.1	Unknown	3.601	0.011	Dilution Factor 1
5	S1.2	Unknown	3.542	0.011	Dilution Factor 1
6	S1.3	Unknown	3.588	0.011	Dilution Factor 1
7	S2.1	Unknown	5.046	0.017	Dilution Factor 1
8	S2.2	Unknown	4.814	0.016	Dilution Factor 1
9	S2.3	Unknown	4.971	0.016	Dilution Factor 1
10	S3.1	Unknown	4.310	0.014	Dilution Factor 1
11	S3.2	Unknown	4.160	0.013	Dilution Factor 1
12	S3.3	Unknown	4.367	0.014	Dilution Factor 1

Sample graph:



Appendix D:

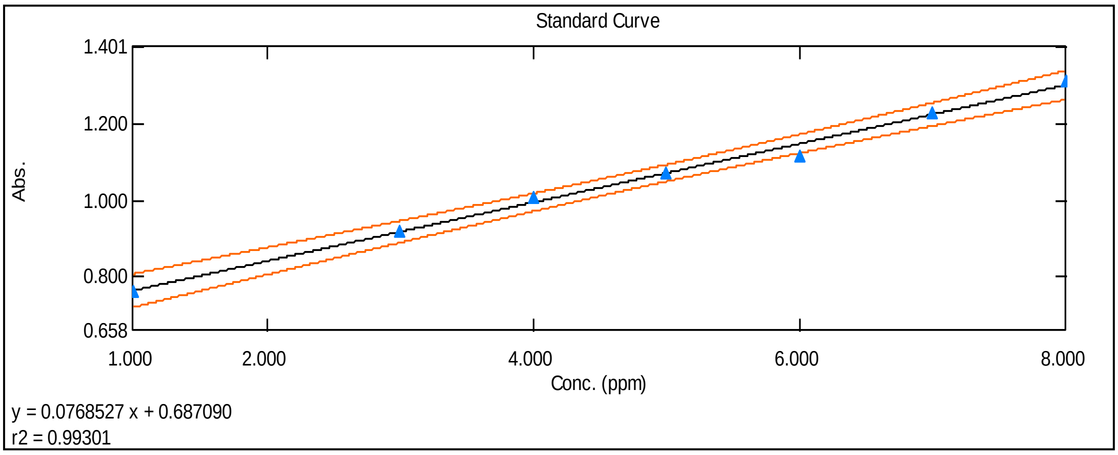
Phenolic Contant:

Standard Table of Gallic Acid:

Standard table of Gallic Acid:

	Sample ID	Type	Conc	WL760.0	Wgt.Factor
1	STD1	Standard	1.000	0.763	1.000
2	STD2	Standard	2.000	0.780	1.000
3	STD3	Standard	3.000	0.920	1.000
4	STD4	Standard	4.000	1.007	1.000
5	STD5	Standard	5.000	1.074	1.000
6	STD6	Standard	6.000	1.115	1.000
7	STD7	Standard	7.000	1.230	1.000
8	STD8	Standard	8.000	1.314	1.000

Standard



Sample Table:

	Sample ID	Type	Conc(mg/100g)	WL760.0	Comments
1	Control1	Unknown	-0.396	0.655	Dilution Factor 1
2	Control2	Unknown	-0.420	0.654	Dilution Factor 1
3	Control3	Unknown	-0.452	0.651	Dilution Factor 1
4	S1.1	Unknown	-1.981	0.532	Dilution Factor 1
5	S1.2	Unknown	-1.982	0.531	Dilution Factor 1
6	S1.3	Unknown	-1.976	0.532	Dilution Factor 1
7	S2.1	Unknown	-1.921	0.536	Dilution Factor 1
8	S2.2	Unknown	-1.931	0.535	Dilution Factor 1
9	S2.3	Unknown	-1.941	0.535	Dilution Factor 1
10	S3.1	Unknown	-2.152	0.518	Dilution Factor 1
11	S3.2	Unknown	-2.140	0.519	Dilution Factor 1
12	S3.3	Unknown	-2.145	0.519	Dilution Factor 1

Appendix E: Photo Gallery

Amraprali(Rupali)

Making Whey

Whey

Mango Pulp

Different Concentration Juice

Sensory Evaluation

Ultra-sonication

Microwave

Extraction

Centrifuge

Bioactive Determination

Brief-Biography

This is Rijawana Jahan, daughter of MD Lutfur Rahaman and Aysa Begum from Sitakunda Upazila in the Chattogram district of Bangladesh. Rijawana Jahan received her Secondary School Certificate Examination from Kapashgola City Corporation Girl's High School in Chattogram in 2012 and her Higher Secondary Certificate Examination from Chittagong Govt. Women College in 2014. She obtained her B.Sc. (Hons) in Food Science and Technology from the Faculty of Food Science and Technology at Chattogram Veterinary and Animal Sciences University, Chattogram, Bangladesh. Now, she is a candidate for the degree of Master of Science in Applied Human Nutrition and Dietetics under the Department of Applied Food Sciences and Nutrition at Chattogram Veterinary and Animal Sciences University (CVASU). She is very interested in working to improve people's health through proper guidance and suggestions, as well as rising public awareness about food safety and nutrition.