Development of Aloe vera (L.) jam using different sweeteners and determination of its quality parameter, bioactive compounds, and effect on blood glucose level.

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Roll no: 0219/04

Registration No: 765

Session: July-December, 2019

A thesis submitted in the partial fulfillment of the requirements for the degree of Master of Science in Food Chemistry and Quality Assurance

Department of Applied Food Science and Nutrition
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This is to certify that we have examined the above Master's thesis and have found that is complete and satisfactory in all respects and that all revisions required by the thesis examination committee have been made

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PLAGIARISM VERIFICATION

Title of Thesis: Development of Aloe vera (L.) jam using different sweeteners and determination of its quality parameter, bioactive compounds, and effect on blood glucose level.

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DEDICATED TO MY BELOVED FAMILY & TEACHERS

Acknowledgements

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Abbreviation

%	: Percentage
&	: And
ANOVA	: Analysis of variance
AOAC	: Association of Official Analytical Chemists
NFE	: Nitrogen Free Extractive
ºC	: Degree Celsius
CHO	: Carbohydrte
DPPH	: 2, 2-diphenyl-1-picrylhydrazyl
et al	: Et alii/ et aliae/ et alia
etc	: Et cetera
G	: Gram
GI	: Glycemic index
Kg	: Kilogram
mg	: Milligram
TFC	: Total flavonoid capacity
TPC	: Total polyphenol capacity
TE	: Trolox equivalent

Abstract

Aloe vera (L.) is a top ranked medicinal plant in Bangladesh. Since ancient times, people all over the world have taken advantage of the many health benefits offered by aloe vera. In recent years have seen an increase in the manufacturing of Aloe vera-based beverage and dietary supplement products, marking a new phase in the plant's evolution from a medicinal to a food-related ingredient. Aloe vera leaf with its high nutritional properties along with lowering blood glucose level has been found in many experiments. Thus the study was conduct to determine the nutrients, bioactive compounds, antioxidant activities and effect on lowering Glycemic index (GI) of jam made from aloe vera, and comparing the difference among these properties when using different types of sweeteners. Three different aloe verajam such as Sample A, Sample B and Sample C were prepared using three different sweeteners sugar, honey and jaggery respectively. In case of nutrients, Total flavonoid capacity (TFC) and Carbohydrate (CHO) is found higher in sample A and sample C (0.18-0.13%) respectively. Total polyphenol capacity (TPC) is found higher in sample B and sample C (0.96-0.88%); and Total fat is found higher in sample B (1.80%).The present study also reveals that the lowest moisture and ash percentage was in sample C and sample A. All three aloe vera jam samples (Samples A, B, and C) were well-received by panelist, despite noticeable differences in color, smell, test, texture, overall acceptability, and general acceptance. There were no statistically significant differences found between the two groups with regards to taste, texture, sweetness, or visual appeal ($P>0.05$). The color and overall acceptance of sample C received a low score of 3.2 and 2.5% respectively ($p<0.05$). Aloe vera jam made with different type of sweeteners was found effective on lowering GI of jam and the effectiveness vary on the type of sweetener in used in jam production. Sample B showed lowest GI (67.74%).

Key words: Aloe vera, Jam, antioxidant, different sweeteners, glycemic index, , nutritional properties, sensory evaluation.

Chapter 1: Introduction

In the last decade, there has been a dramatic shift in consumer demand, with more people seeking for food options that are higher in nutrients and bioactive compounds. Jams and jelly made from preserved fruits are a healthy option because they retain many of the fruits' nutrients and antioxidant (Kaunsar and Pavuluri, 2018). Jams are often produced with a considerable number of sugar, especially sucrose, however excessive sugar consumption has been connected to obesity, diabetes, cardiovascular disease, and hypertension. Customers are more concerned about their health as a result, they prefer low-calorie items and seek for nutritious products that should not only meet their appetite but also serve as a preventative against illness (Serra-Majem et al. 2018). Therefore, customers are emphasizing balanced diets with functional and health benefits. Research priorities have switched from animal products to plant-based foods due to the use of underutilized fruits, vegetables, and seeds (Sonawane and Arya 2018). Due to its high concentration of pharmacological characteristics, aloe vera (L.) has been employed as a therapeutic agent for eons. Researchers are interested in its bioactive components because to their functional qualities and health advantages. In light of this, it is crucial that jam be made with less sugar.

The plant Aloe vera (Aloe barbadensis), also known as Gheegwar/Ghritkumari, is a member of the family Lilaceae. The Arabic word "alloeh," meaning "bitter," is the source of the English word "aloe." It's a miraculous plant bestowed by Mother Nature, celebrated for the herbal medicine it provides (Rjasekaran et al. 2005). Aloe vera thrives in the arid conditions typical of deserts and other arid places. Although Barbadensis Miller aloe vera is the most widely used, there are actually more than 300 distinct species (Bhuvana et al. 2014). South Texas, Florida, South and Central America, Mexico, India, Africa, South California, Australia, the Caribbean, and Iran are among the most common locations for aloe vera cultivation. New records were set in Bangladesh for plant height, leaf number, leaf area, and fresh leaf weight by Aloe vera plants grown in non-calcareous soil, and for fresh gel weight, dry leaf weight, fresh leaf weight, and yield increase above acid sulphate soil by Aloe vera plants grown in calcareous soil. Aloe vera's medicinal and functional properties have led to a rise in its application in the creation of novel culinary items (Campestrini et al. 2013).

Chemical compounds that are beneficial to health can be found in abundance in the plant. About 99.5% of aloe vera's mucilage or gel is water, but the raw pulp is only about 98.5% water. Mono- and polysaccharides, sugar, lignin, phenolic compounds, organic acids, water- and fat-soluble vitamins, minerals, and enzymes make up the remaining 0.5 to 1% solid material. As a result of the pulp's intricate chemical composition, products made from aloe gel have a diverse array of pharmacological and therapeutic applications. In the realm of commerce, aloe vera reigns supreme as the most important commodity. In the food sector, aloe vera is put to use in a variety of ways, including the production of functional foods, the use of the plant itself as an ingredient, and the production of drinks and beverages utilizing the gel extracted from the plant. Although it has been demonstrated to have beneficial effects on human health, very little is known about the manufacture of aloe vera jam, how its quality is evaluated, or the effects it has on human health. This research was carried out to ascertain the Glycemic Index (GL) in the human body following the eating of jam and to design a high-quality jam incorporating bioactive compounds from Aloe vera.

1.1 Aims and Objectives

The purpose of the research was to develop a high-quality jam with bioactive compounds and a low Glycemic Index (GL) in a healthy human body.

1. To compare the nutritional composition of Jam using different sweeteners.
2. To compare the organoleptic and sensory properties of Jam using different sweeteners.
3. To calculate the Glycemic Index of Jam feeding different sweeteners.

Chapter 2: Review of Literature

2.1 History of Aloe Vera

Both the Arabic term "Alloeh" and the Hebrew word "Halal"—from which the English word "aloe" is derived—mean "bitter, shining material" (Gage, 1996). The ancient Egyptians considered aloe vera to be the "plant of immortality" because to the beneficial effects it had on human health. Common theories place its beginnings in Arabia, Somalia, Sudan, or Oman. Today, you may find aloe vera growing in almost any warm-weather or tropical location (Schmelzer, 2008).

The lily family includes perennials like aloe vera, which is a herbaceous plant (Liliaceae). The plant is able to survive extended dry spells because of the massive amounts of water stored in its leaves. The large water-retaining capacity of the leaves allows this plant to thrive in extremely hot and dry climes, where other plants die. Aloe vera leaves have two separate parts, the inner, colorless gel parenchyma and the outside, green leaf rind, which may be seen by cutting into an aloe vera leaf. The aloe vera plant, which is both rare and special, is a chemical treasure trove. Chemical analysis of the plant was probably pioneered by Professor Tom D. Rowe (Rowe and Parks, 1941). Up to 200 active compounds and 75 nutrients, including amino acids, anthraquinones, saponins, sugar, vitamins, enzymes, minerals, lignin, and salicylic acid, have been identified in aloe vera (Dureja, 1996). Some people today just can't have these things because of allergies or dietary restrictions.

2.2 Taxonomy of Aloe vera

Class: Magnoliopsida

Superorder: Lilianae – monocots

Order: Asparagales

Family: Xanthorrhoeaceae

Genus: *Aloe L. – aloes*

2.3 Utilization and Economic importance of Aloe vera

2.3.1 Aloe vera leave:

Aloe vera is generally beneficial for both humans and animals. Aloe vera gel, aloe vera latex, and aloe vera whole leaf extract are three different plant preparations that are utilized. The leaves of aloe vera have a triangular shape, a soft spike with edges, and are composed of a fleshy, mucilaginous substance (Rjasekaran et al. 2005). In aloe vera, the main gel layer is constituted of 95% water, while the outer layers are made up of lipids, amino acids, sterols, vitamins, and glucomannans. In the inner layer of aloe vera leaves, where the active components are concentrated in the gel and rind, one can find significant medicinal and pharmacological importance (Rjasekaran et al. 2005). In the intermediate layer, you'll find latex, which is a viscous yellow sap that is primarily composed of anthraquinones and glycosides. The rind is made up of about 15 to 20 cells and is composed of proteins and carbohydrates that it derives from. Vascular bundles are responsible for transporting water and starch (phloem) inside of the bark (Surjushe et al. 2008). Their biological components are capable of functioning on their own or in collaboration with one another (Boudreau and Beland; 2006). One of the most intriguing potential market players in the food and beverage industry is aloe vera. It has been exploited in the production of tea, in addition to other nutrient-rich beverages, and in the production of functional foods such as yogurt (Eshun and He; 2004). Polysaccharides in aloe vera, in particular vanadium, manganese, and copper, may have a significant role in the anti-diabetic benefits of the plant. Aloe vera is known to contain all three of these elements (Reynolds and Dweak; 1999). This plant has been linked to lowering blood lipid or cholesterol levels in hyperlipidemic patients (Geremias et al., 2006) and blood glucose levels in diabetics (Surjushe et al., 2008).

2.4 Nutritional properties

Table 2.1: Composition of aloevera pulp

Parameter	Value (%)
Energy	392.35 calories
Moisture	6.8
Protein	0.95

Carbohydrates	61.4
Sugar	01.90
Fiber	12.33
Ash	03.66
Lipid	14.86

Source: Zeenat et al. (2018) (http://dx.doi.org/10.19045/bspab.2018.700131).

Table 2.2: Composition of minerals in aloe vera

Macro elements		Micro and trace elements	
Elements	Concentrations (ppm)	Elements	Concentrations (ppm)
P	869.9	Zn	40.8
K	4464.8	Cr	4.6
Ca	2352	Mn	63.89
Na	21.5	Fe	49.1
Mg	8031	Ni	2.9

Source: Pawar & Kamble (2015).

2.5 Health benefits of Aloe vera:

2.5.1 Anti diabetic effects

Loss of -cells in the endocrine pancreas and/or decreased insulin sensitivity in target cells characterize the chronic disease diabetes mellitus (DM) (Balaji et al. 2019). Several scientific studies have shown that aloe vera can improve metabolic function, leading to lower blood sugar levels and maintained liver and kidney health Devaraj et al. (2013). He also state that Aloe vera affects diabetes by lowering BMI and raising insulin levels. Furthermore, Aloe vera gel's antioxidant properties may be helpful for diabetics (Jain et al. 2010). As a result of the insulin-stimulating polysaccharides it contains, this plant can be used to lower blood sugar. Finding that aloe vera gel has hypoglycemic effects in rats with streptozotocin-induced diabetes (Abdurrazak et al. 2015). Similar results were seen in another study, which found that diabetic rats given aloe vera extract (300 mg/kg) once daily experienced lower blood glucose levels (Manukumar et al. 2017). Finally, it has been demonstrated that aloe vera prevents glucose from being absorbed in the jejunum of rats and protects the pancreatic -cells of these animals (Mikołajczak , 2018).

2.5.2 Blood sugar level reduction

In clinical tests conducted on both humans and animals, aloe vera gel increased insulin sensitivity, which led to a reduction in blood sugar levels (Shin et al, 2011). In five randomized controlled trials (RCTs), involving a total of 415 participants, aloe vela led to a significant reduction in fasting blood glucose (FBG) concentrations (p = 0.02; weighed mean difference [WMD]: -30.05 mg/dL; 95% confidence interval [CI]: -54.87 to -5.23 mg/dL; findings from the study by Zhang et al (2016).

2.5.3 Antioxidant effect

Oxidative stress is the underlying cause of diabetes and its consequences, and it is caused by a mismatch between the systems that generate and neutralize free radicals. In vitro studies of secondary metabolites from aloe vera have shown that they possess antioxidant potential (Rajasekaran et al. 2005). Due to the presence of antioxidants including -tocopherol, carotenoids, and ascorbic acid, aloe vera has dose-dependent medicinal characteristics that make it effective against a wide variety of diseases (Eshun and He 2004). The results of a study published in 2008 by Ozsoy et al. suggest that Aole vera can reduce the oxidative damage caused by diabetes in the skin and the heart. By increasing glutathione levels and superoxide dismutase activity, aloe vera reduces the amount of lipid peroxidation that occurs at doses of 150 and 300 mg/kg, respectively (Mohapatra et al. 2013).

2.6 Medicinal benefit

For a healthy existence, we must consume nutritious foods. Components of the aloe vera plant have been documented as having numerous medical applications in various parts of the world. Several published studies corroborate the traditional health benefits of aloe vera.

1. Anti-diabetic treatment with aloe vera phytosterolslophenol, 24-methyllophenol, 24-ethyl-lophenol, cycloartanol, and 24-methylenecycloartanol resulted in a positive response from diabetic mice. These mice had type-2 diabetes (Tanaka et al.; 2006)
2. Aloe vera gel is used in decreasing sugar in diabetes (Okyar et al.; 2001).

3. Aloe vera gel contains glycoproteins that have anticancer and antiulcer characteristics, and they also have the ability to stimulate the creation of healthy skin cells in humans (Yagi et al; 2003).

4. Whether applied topically (to treat wounds, mild burns, and skin irritations) or taken orally (to treat constipation, coughs, ulcers, diabetes, headaches, and arthritis), aloe vera gel is known for its ability to boost the body's defenses (Eshun and He; 2004)

5. The bioactive chemicals may also be helpful for treating disorders such as constipation, radiation injury, wound healing, burns, dysentery, and diarrhea. These are only few of the conditions that fall into this category. They have a wide variety of applications in medicine, including those of substances that are astringent, hemostatic, anti-diabetic, anti-ulcer, antibacterial, anti-inflammatory, antioxidant, and anti-cancer (Rave and Staden; 1997).

6. There have been studies showing that aloe vera gel can prevent skin cancer caused by radiation (Haddad et al; 2013).

2.7 Aloe vera jam

Sugar and fruit puree are combined in a cooking process to produce jam, which is a semi-solid mixture. Jam is a food with a medium moisture content that is created by heating fruit pulp with sugar (sucrose), pectin, acid, and other ingredients (preservative, coloring, and flavoring components) until the mixture is sufficiently thick and the fruit tissues are firmly adhered. Jam must have at least 45% fruit and 68.5% total soluble solids (TSS), whereas the Codex Alimentarius Commission stipulates that the final product must contain at least 65% TSS (Baker et al. 2005) Utilizing the high-solids-high-acid concept, jams, jellies, and preserves are one of the most important fruit products created by businesses.

Chapter 3: Material and Methods

3.1 Study Area

Departments of Applied Human Nutrition and Dietetics, Animal Science and Nutrition, and Food Processing and Engineering at Chattogram Veterinary and Animal Sciences University (CVASU) were responsible for carrying out the experiment. Beginning on January 1, 2022, and ending on June 15, 2022, experiments lasted for a total of six months.

3.2 Collection of Aloe vera and other ingredient

The local market and store in the Chattogram neighborhood provided the locations for the collection of the fresh Aloe vera leaf samples. The aloe vera leaves that were used were hand-picked to ensure that they were extremely fresh. In order to formulate Jam, additional materials were purchased from the neighborhood store. These included sugar, honey, and palm jaggery. Additional components for the experiments, such as pectine and citric acid, were retrieved from the stocks that the laboratory maintained.

Figure 3.1: Study area.

3.3 Experimental design

After gathering all of the components, Aloe vera juice and sweeteners were used to create Aloe vera jam. Three distinct aloe vera jams were made with three distinct sweeteners. The proportions and constituents of jams A, B, and C are shown in Table 3.1. After processing, the proximate composition of Aloe vera jam (moisture, ash, crude fat, protein, crude fiber, and carbohydrates) was calculated. In addition, the

nutritional content, bioactive compounds (total antioxidant capacity, total polyphenol capacity, and total flavonoids), Glycemic Index, bacterial load, and consumer acceptability of each food category were evaluated.

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                          │ formulation        │    └─────────────────────┘
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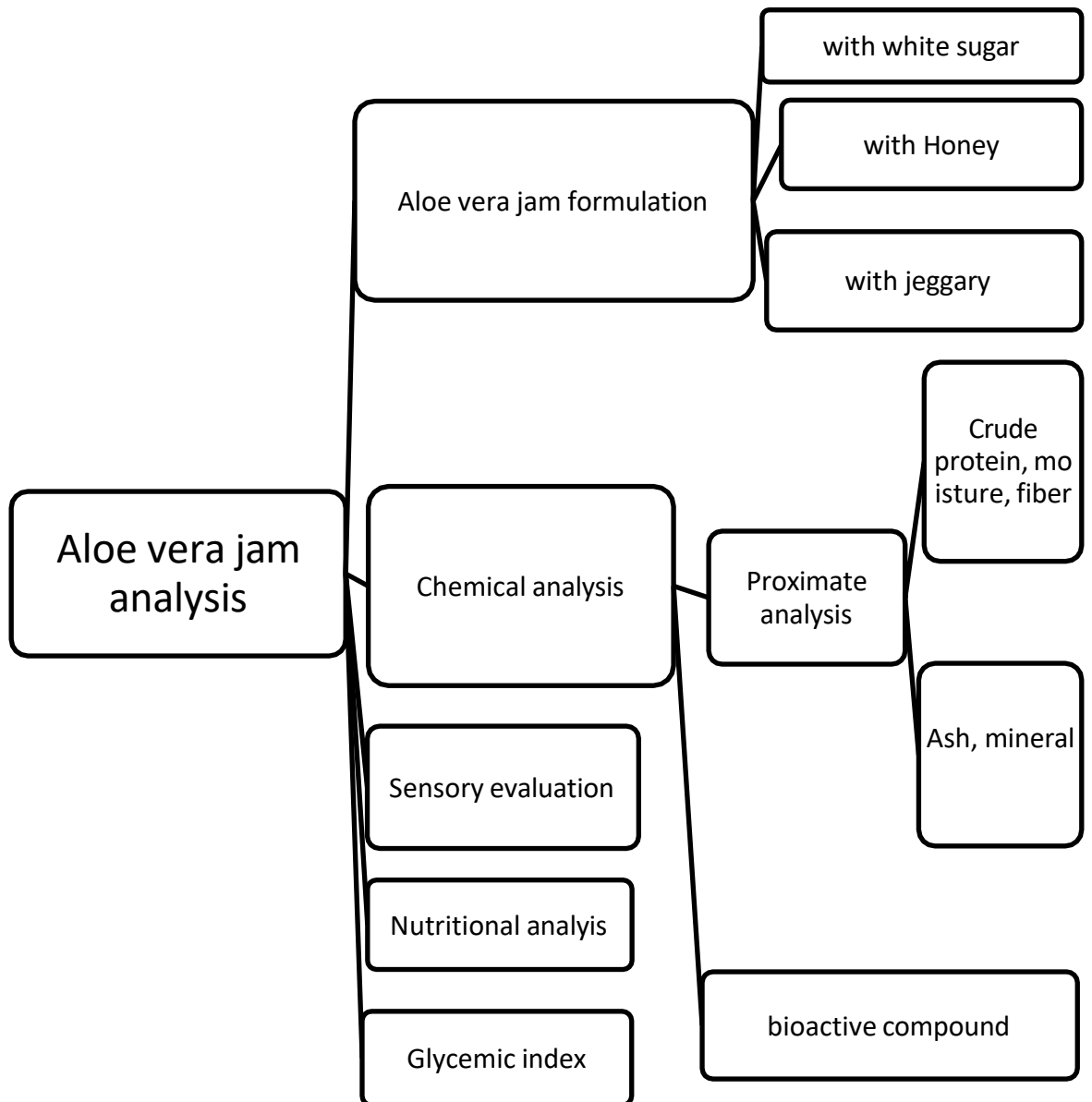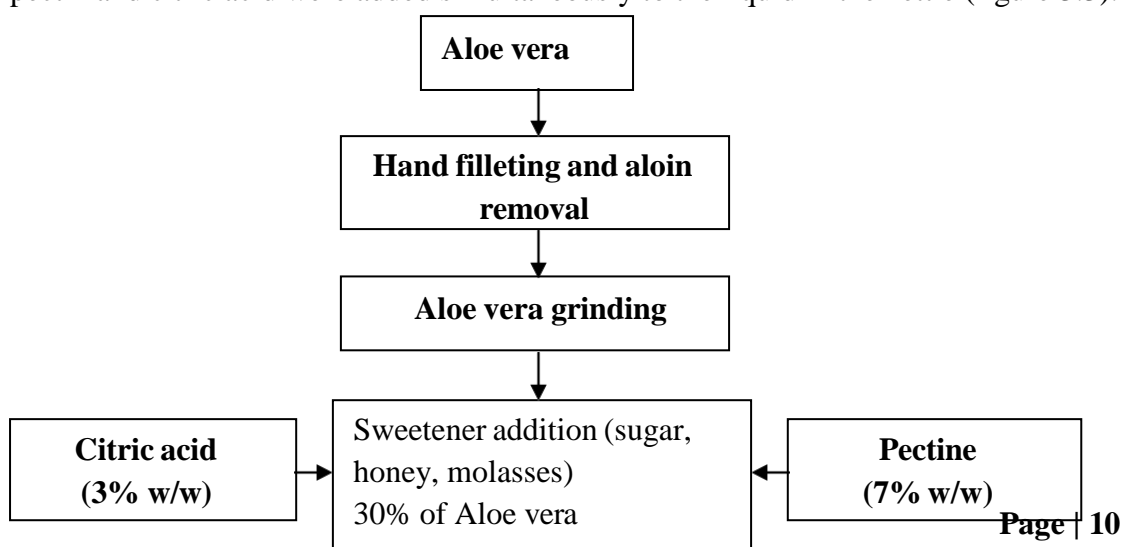
Figure 3.2: Study design

Table 3.1: Ingredients composition of experimental Jams

Ingredient	A (Aloe vera jam with Sugar)	B (Aloe vera jam with Honey)	C (Aloe vera jam with Jaggarey)
Aloe vera pulp	40 gm	40gm	40 gm
Sweeteners	30gm	21.13 ml	30gm
Pectine	7 gm	7 gm	7 gm
Citric acid	3.5 gm	3.5 gm	3.5 gm

3.4 Preparation of Aloe vera jam

The freshly acquired leaves of aloe vera were washed with water to remove any dirt and debris. After removing the peel, the whole pulp was diced into small pieces and then blended for 5 minutes in a mixture. After 15 minutes of settling, the foam on the surface of the juice was eliminated. Additionally, juice and sugar were added at this time, and the mixer was heated until the TSS reached 50 Brix. The mixture was then blended with aloe vera juice, 7% pectin, and 3.5% citric acid. The TSS reached a Brix level of 69 while cooking. The jam was then placed in a covered glass jar and stored at room temperature (28-32 ℃). According to the formula and method of Awan and Rehman, various ratios of artificial sweeteners were determined for jam manufacturing (1999). The preserves were cooked in open stainless steel saucepans. Aloe vera pulp was taken for each treatment and boiled in an open pot. After being dissolved individually with sweeteners (sugar, honey, and jeggary), commercial grade pectin and citric acid were added simultaneously to the liquid in the kettle (figure 3.3).

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                    │    Aloe vera    │
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              ┌──────────────────────────────┐
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              │           removal            │
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              │      Aloe vera grinding       │
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│  Citric acid  │  │ Sweetener addition (sugar,│  │   Pectine     │
│   (3% w/w)    │─▶│ honey, molasses)          │◀─│   (7% w/w)    │
│               │  │ 30% of Aloe vera          │  │               │
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          │                95º C)                │
          │           (for 15-0 min)            │
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          │       **Cooling and setting of jam** │
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          │       **Packaging and storage**      │
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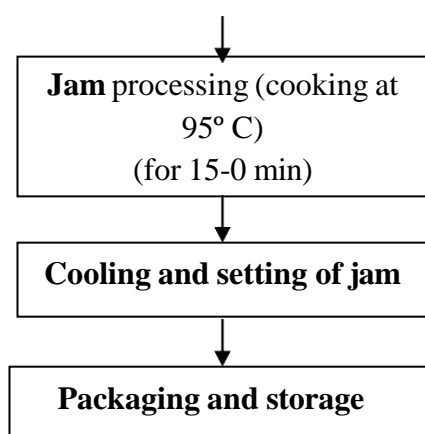
Figure 3.3: Processing steps of jam

3.5 Physicochemical analysis of jam

The AOAC 2016 method was used to analyze the moisture, protein, fat, fiber, and ash content of Aloe vera pulp-based jam samples. Additionally, total flavonoid and total polyphenol content, as well as antioxidant capacity, were measured in these samples.

3.5.1 Moisture content

Principle:

Testing and production of food rely heavily on moisture measurement, making it one of the most important and widely used parameters. In order to get an accurate reading of the water level, a technique developed based on the standard established by the Association of Official Analytical Chemists (AOAC, 2016) was used.

Procedure

A clean crucible was weighed
↓
Then 10g sample was taken in an empty crucible
↓
the crucible is reweighed
↓
The crucible was kept in a hot air oven at 105^0C and moisture is reduced for 48-72 hr
↓
The crucible then collected from the oven
↓
The crucible is placed in a desiccators to cool
↓
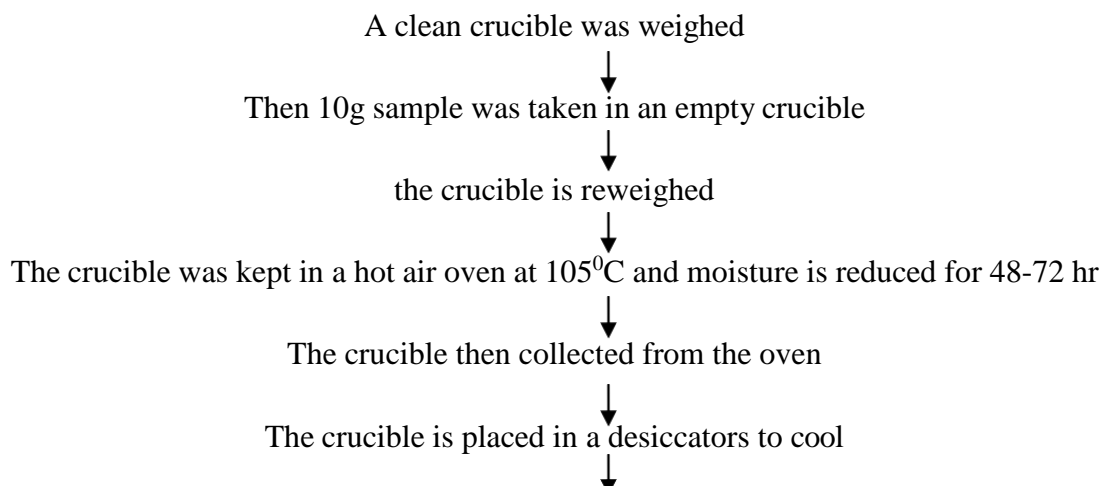
the crucible is weighed

$$\downarrow$$

Several repetition was done till to find constant result

Calculation:

The percent of moisture was calculated as follow

$$\text{Moisture \%} = \frac{\text{Initial weight } - \text{Final weight}}{\text{Sample weight}} \times 100$$

3.5.2 Assessment of Crude Fat

Using a soxhlet apparatus, the crude fat content of the samples was determined in accordance with AOAC (2016) guidelines using the following formulla:

$$\text{Fat \%} = \frac{\text{Weight of the extract}}{\text{Weight of the sample}} \times 100$$

3.5.3 Assessment of Crude Protein

Jam's nitrogen content was calculated using the Kjeldahl method. The concept of this approach is to digest the material with a digestion mixture and concentrated sulfuric acid (H_2SO_4). This results in the oxidation and breakdown of protein, as well as the conversion of organic nitrogen into ammonia, which is subsequently kept as ammonium bisulphate in the acid mixture. Additionally, this leads to the conversion of organic nitrogen into ammonia.

After the digest has been made alkaline and the ammonia that has been produced has been distilled into a standard acid solution, titration is used to determine the concentration of ammonia nitrogen in the digest.

Clean, dry 100 ml Kjeldahl flasks were equipped with a 0.5g sample and a piece of nitrogen-free filter paper. The contents of the digestion chamber were purified after being heated for six hours and having 10 ml of concentrated H2SO4 and a 1:1 gm digestion mixture added to it. Once digestion was complete and the beaker had cooled, the digested liquid was transferred to a 100 ml volumetric flask and diluted with distilled water until the desired consistency was reached.

After adding ten milliliters of the solution to a micro Kjeldahl distillation device, five milliliters of NaOH with a concentration of 50% and two and a half milliliters of Na2SO3 with a concentration of 15% were added. This solution underwent a steam distillation process that lasted for ten minutes. The distillate was collected in a solution containing 2% boric acid, and the solution was then titrated with 0.01N HCl. Boric acid was used as an indicator throughout this process. When drugs were not present, the digestive processes continued on in the same order as before.

Calculation:

Estimates for percent nitrogen or percent protein must be modified based on the kind of receiving solution and any dilution variables utilized in the distillation process. The symbol "N" in the following expressions denotes normality. "ml blank" refers to the milliliters of standard acid required to titrate a reagent blank when boric acid is utilized as the receiving solution. "ml blank" refers to the milliliters of base required to back-titrate a reagent blank when standard acid is used as the receiving solution. The following equation is utilized when boric acid is used as the receiving solution:

$$\text{Nitrogen \%} = \frac{(\text{ml standard acid} - \text{ml blank}) \times \text{N of acid} \times 1.4007}{\text{Weight of sample in gram}}$$

3.5.4 Estimation of Crude Fiber

Crude fiber, the insoluble fraction of carbohydrates, is mostly made up of the three components cellulose, hemicellulose, and lignin. By boiling a predetermined amount of fat-free food in a weak acid solution (1.25 percent H2SO4) for 30 minutes, then in a weak alkaline solution (1.25 percent NaOH) for 30 minutes at constant volume, and finally by subtracting the ash from the residue, its digestibility can be estimated. The AOAC method was utilized in order to ascertain the crude fiber content (2016). After that, the waste was combusted for between four and six hours in a muffle furnace at temperatures ranging from 550 to 600 degrees Celsius (white ash).

Procedure

A 500 ml beaker was weighted down with about 20.4731 g of sample.

↓

It was then given 200 ml of boiling 0.255 N (1.25 percent w/v) sulfuric acid.

↓

Adding water at periodic intervals allowed the mixture to boil for 30 minutes while sustaining the same volume.

↓

At the end of this time, a glass rod was placed inside the beaker aids in smooth boiling.

↓

After straining the mixture through a shirting towel, the leftovers were washed in hot water to neutralize any remaining acid.

↓

Following that, the substance was moved to the same beaker and 200 ml of boiling 0.313 N (1.25 percent) NaOH was added.

↓

The mixture was boiled for 30 minutes while maintaining the same volume, and then filtered via shirting cloth.

↓

The residue was washed with an equal volume of ether and alcohol until all traces of alkali were removed, and then dried.

↓

It was then moved to a crucible, dried for the next day at 80 to 100 C, and weighed.

↓

After being weighted once more, the crucible was heated for two to three hours at 650 ºC in a muffle furnace.

↓

The numerical disparity revealed the crude Fiber's mass.

Calculation:

Calculation of the crude fiber percentage as follows:

$$\textbf{\% Crude fiber} = \frac{\textbf{(W−W1)}}{\textbf{W2}} \times \textbf{100}$$

Here,

W= Weight of crucible, crude fiber and ash

W1=Weight of crucible and ash

W2= Weight of sample

3.5.5 Ash content

The ash percentage was calculated using techniques outlined by the AOAC (2016). Ash content refers to the amount of inorganic materials that remain after all biological material has been burned. A crucible containing 10 grams of dried jam was pre-weighed and dried in advance. Next, it underwent the charcoal-making process. Once all of the charcoal had been removed, it was burned in a muffle furnace at a temperature of about 600 °C for four hours. It was at this point that the crucible was taken out of the oven. It was refrigerated in a desiccator before being weighed.

Procedure:

After removing the empty crucible, it was placed in a desiccator for an hour, heated to 105 degrees Celsius, and then weighed in order to keep the same weight throughout the experiment. The sample weighed about one gram, and it was placed in the weighted but empty crucible. The specimen was then burned over a low flame in the crucible after one drop of nitric acid had been added to the container. After that, the crucible was completely annealed by subjecting it to heating in a muffle furnace at a temperature of 650 degrees Celsius for approximately four to five hours. While the weight of the crucible was being determined, the crucible that contained the ash was removed from the oven, allowed to cool, and then placed in a desiccator.

Calculation:

The following formula was used to calculate the ash content.

$$Ash\% = \frac{\text{The amount of the ash supplied sample}}{\text{Sample weight}} \times 100$$

3.5.6 Determination of total carbohydrate

The other proximate components' divergence from 100 was determined by measuring the Nitrogen Free Extractive (NFE) minus the carbohydrate content.

Calculation: So, it was estimated using the following equation:

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

3.6 Determination of Antioxidant capacity by DPPH scavenging method

Extract preparation

1 gram sample was placed in a Felcon tube. The mixture was then treated with 10 ml of 100 percent methanol and left to settle for 72 hours. Four hours of rest were followed by repeated exertion. After 72 hours, methanoic extract was discovered in the supernatant.
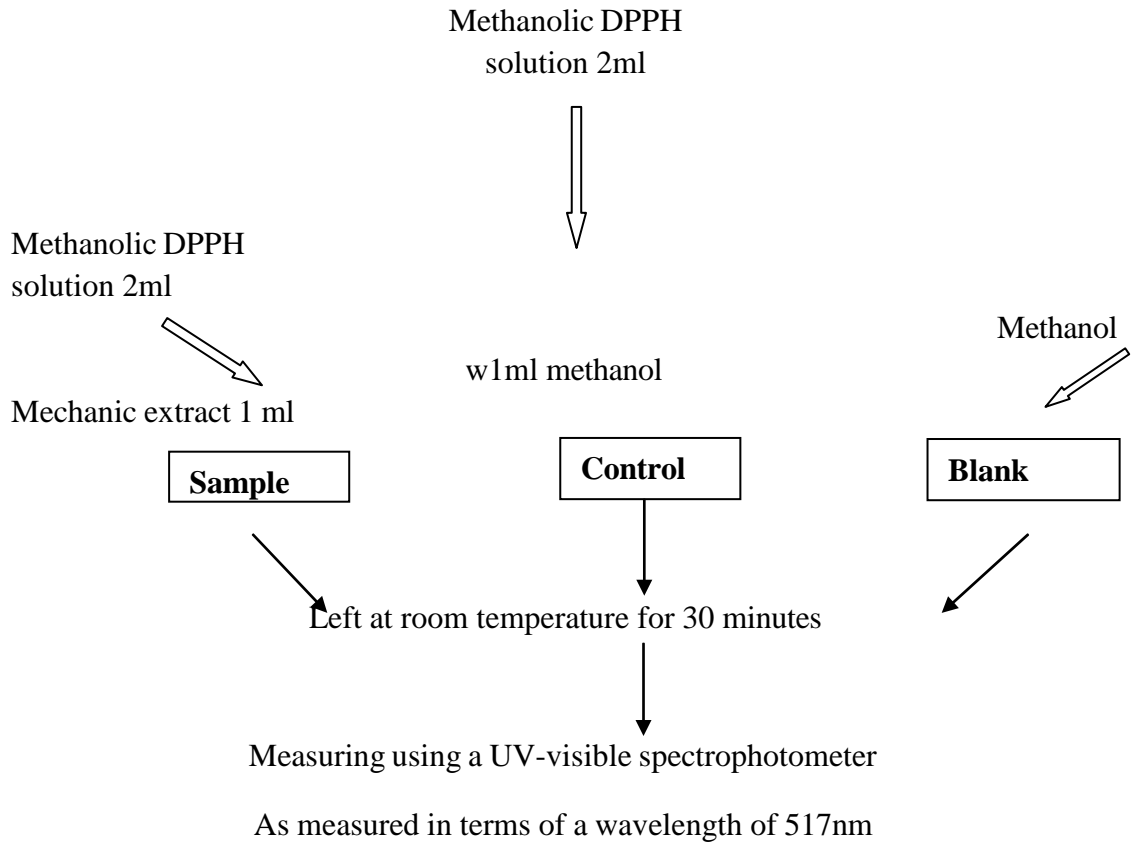
Procedure

Extracts' antioxidant permeability was measured using the DPPH assay, with some tweaks made to the method described by Azlim et al (2010). Methanoic DPPH was made by dissolving 6 mg of DPPH in 100 mL of pure methanol.

To that 1 ml of methanoic extract, 2 ml of DPPH solution was added. The mixture was stirred for 30 minutes and then left to sit at room temperature and out of the light. We used a UV-VIS spectrophotometer to determine the absorbance at 517 nm (UV-2600, Shimadzu Corporation, and USA).

A mixture of 1 mL of methanol and 2 mL of DPPH solution served as a blank and control, respectively. Methanol was used as the control, with trolox as the benchmark (Akther, 2020). The degree to which the samples' luminosities dropped in comparison to that of the DPPH standard solution provided a measure of scavenging's portability. Antioxidant capacity was determined by measuring the extracts' ability to neutralize DPPH free radicals using the following formula:

$$\% \text{ of inhibition} = \frac{\text{Blank absor bance} - \text{Sample absorbance}}{\text{Blank absorbance}} \times 100$$

Calibration was performed using the TEAC composite (Trolox equivalent antioxidant mobility), which was also used as the reference. These numbers represent the amount of Trolox equivalents (TE) per gram of powder, given as a function of dry weight (DW).

Methanolic DPPH
solution 2ml

Methanolic DPPH
solution 2ml

Methanol

w1ml methanol

Mechanic extract 1 ml

| Sample | Control | Blank |

Left at room temperature for 30 minutes

Measuring using a UV-visible spectrophotometer

As measured in terms of a wavelength of 517nm

3.7 Glycemic Index analysis

Glycemic Index assessment research: The study was conducted using a widely recognized GI assessment method (F et al., 2005).

Subjects of Research: Ten healthy, non-smoking employees were selected at random. Exclusion criteria included being obese, dieting, having a low glucose tolerance, being in poor health, having a food allergy, or using a large quantity of medicine. Every participant agreed both verbally and in writing.

Procedure for the experiment: Subjects were given glucose (Galaxose D powder, GalaxoseSmithkline Company, BD) as a placebo, and in addition to other ingredients, each test jam sample contained 25g of readily accessible carbohydrate. The reference glucose was diluted with water to a concentration of 1% in a volume of 250 mL. Jam was made into samples for the experiment the day before. Jam samples were produced

and chilled to 4 degrees Celsius in the refrigerator overnight. Participants received 250 cc of tap water and predetermined amounts of jam, both of which were weighed on the day of the experiment. Over the course of ten minutes, everyone ate their jam and drank their drinks. This study's experimental procedures are briefly described as follows: (Bronus et al., 2005) Between Day 0 and Day 8, participants participated in the six-session study with samples (glucose and jam samples). The study subjects ate light meals similar to their regular diets right before they began fasting. At the beginning of each experiment, participants had their blood drawn via finger prick at 8 or 9 in the morning. The sensitivity of blood glucose responses appears to be greatest in the capillaries of the fingers (Bronus et al., 2005). During the whole course of the experiment, glucose was only consumed at the beginning and end. Six additional blood samples were taken from each individual via finger prick throughout each experimental session, the first four at 15-minute intervals up to 1 hour (60 minutes) after feeding and the last three at 30-minute intervals up to 2 hours (120 minutes). Rapid analysis of blood samples allowed for the measurement of glucose levels (Details given below).

Determination of Blood Glucose and Glycemic Index

The glucose concentration was calculated using a Gluco Dr. (Korea) AGM 2100 blood glucose test meter. The incremental area under the glucose response curve (IAUC) was determined by plotting blood glucose concentration against time (0-120 minutes at 15-minute intervals) over a period of two hours. Wolever et al (1990) .'s method was used to determine the GI for each participants. For each person, the glycemic index was determined by dividing the individual's IAUC from the reference food by 100. The following equation was used:

$$GI = \frac{\text{IAUC for tested Food}}{\text{IAUC for Reference Food}} \times 100\%$$

 IAUC – Incremental Area Under the blood glucose response Curve. The final glycemic index for each test food was calculated as the mean of the respective GI's of the ten individuals.

When determining the final GI value to be reported, the group mean GI value was used. An increase in the area under the blood glucose response curve was observed 2

hours after consuming 25 g of easily absorbed carbs in the form of jam. The area below the blood glucose response curve expands after ingestion of 25 g of reference glucose. Statistical analysis was performed on 100 samples of data from the proximity, sensory, and glucose incremental regions stored in a Microsoft Excel 2007 file. After that, SPSS 17 was used to analyze the data (SPSS Inc., 233 South Wacker Drive, 11th Floor, Chicago, IL 60606-6412). All of the information was entered, coded, and stored in SPSS 17 before any analysis was performed. Proximal and sensory data were analyzed separately using a one-way ANOVA with a 95% confidence interval to identify statistically significant differences (CI). Differences between groups were calculated using a post hoc (Tukey) test. A glycemic index was constructed in Microsoft Excel, and then significant differences between the three groups were shown using a one-way analysis of variance (ANOVA) and a post hoc test with a 95% confidence interval. Descriptive statistics like frequency, percentage, averages, standard deviation, and mean standard error were computed for each jam sample.

3.8 Bio-active compound analysis

Tests Extract preparation

The materials were broken up into tiny pieces using a spoon. The samples were then placed in beakers containing 100 percent ethanol and stirred for 72 hours at room temperature. The residue was separated following the removal of the solvent. Residues were extracted twice more with new solvent while filtrates were separated and stored at room temperature. The filtrates were combined and evaporated in a rotary evaporator at 60 °C under reduced pressure to produce the crude extracts. We weighed the raw materials and stored them in a refrigerator at four degrees Celsius.

3.8.1 Total flavonoid analysis

The total flavonoids content of jam was determined using a modified version of the colorimetric method reported by Willet (2002). 4.3 ml of distilled water, 0.1 ml of 10% aluminium chloride, 0.1 ml of 1 M potassium acetate, and aqueous ethanol extracts were mixed (0.5 ml). The absorbance at 415 nm was measured using a Spectro spectrophotometer (Thermo Fisher Scientific, model 4001/4) after the mixture was incubated at room temperature for 30 minutes. Utilizing quercetin, the calibration

curve was constructed. The total quantity of flavonoids in the extracts was determined in triplicate, and the results were then averaged.

3.8.2 Total phenol analysis

The Red Kidney seed Cheese extracts' total polyphenol content (TPC) was determined using the Folin-Ciocalteu method. (Sarwar et al., 2019). 1 mg/mL extract stock solutions were prepared. 1.5 mL of FC reagent (1:10) was pipetted into a cuvette, followed by the transfer of 0.3 mL of extracts using a micropipette. The solutions were mixed and held for three minutes at room temperature. The mixture was then pipetted with 1.5 mL of a 7.5 percent sodium carbonate solution and incubated for an additional 60 minutes at room temperature. Utilizing a UV-VIS Spectrophotometer, the absorbance at 765 nm was measured (UV-2600, Shimadzu Corporation, USA). In a separate cuvette, ethanol served as the blank. A Gallic acid standard curve with varying values was constructed to determine the Total Polyphenol Content (TPC).

Preparation of standard gallic acid solution

Approximately 10 mg of gallic acid was dissolved in 10 ml of distilled water to create a stock solution with a concentration of 1 mg/ml. Then, through serial dilution, numerous concentrated solutions (2 g/ml, 4 g/ml, 8 g/ml, 16 g/ml, and 32 g/ml) were created.

Procedure

The Folin-Ciocalteu method, as reported by Wojdyo et al. (2007), was used to quantify the total phenol content of Aloe vera jam using gallic acid as a standard. Following the addition of samples to test cuvettes, 0.8 mL of 7.5% Na_2CO_3 and 1.0 mL of Folin-reagent were added. Ciocalteu's Using a Shimadzu UV-Vis spectrophotometer, the absorbance of each sample was measured at 760 nm after 1.5 hours of incubation at 30 °C. Results were expressed as milligrams of gallic acid equivalent (GAE) per gram of fresh weight. Without any extract or reference sample, the complete reagent mixture formed the blank solution. Using a gallic acid standard curve, the total phenolic content was measured, and the results were represented in milligrams of gallic acid equivalent (GAE) per gram of dried weight. Each determination was performed by three individuals in duplicate.

3.9 Sensory evolution analysis

Affective test

This test will determine the acceptability of "Aloe vera jam." It was conducted by 20 panelists, evenly divided between men and women, on CVASU grounds. Untrained personnel administered the examination. It was requested that the panelists rank the three jam compositions according to their level of acceptability.

The characteristics of the sample were rated on a 5-point scale, with values ranging from 1 (great hate) to 5 (moderate dislike) (like extremely). Color, odor, texture, flavor, and general approbation were the sensory aspects evaluated by the panelists.

Table 3.2: Grading system for sensory assessment

Ranks	Score
like a lot	5
like a little	4
neither like nor dislike	3
dislike little	2
dislike a lot	1

3.10 Statistical Analysis

Minitab 14.0 was utilized for statistical analysis purposes. On the gathered data, a one-way analysis of variance was conducted (ANOVA). The Fisher's LSD test, with a significance level of 0.05, was applied using statistical software to determine whether there were statistically significant differences between them (p 0.05).

3.11 Energy estimation

Using the following equation, the amount of protein, fat, and carbohydrate in each food type, as well as its energy content, was determined (Baer et al., 1997).

Energy = (Protein $\times$ 4.1) + (Fat $\times$ 9.2) + (Carbohydrate $\times$ 4.1)

Chapter 4: Results

4.1 Proximate composition of Aloe vera pulp

The proximate composition of Aloe vera used in this experiment is presented in Table 4.1. Aloe vera was discovered to contain a greater quantity of moisture (98.58 ± 0.07), fiber (11.40 ± 0.30) and ash (18.34 ± 0.47), and characterized by lower amount of fat (2.98 ± 0.10), protein (3.15 ± 0.50), and carbohydrate ($64.78 \pm .21$).

Table 4.1: Proximate composition of aloe vera

Variables	Aloe vera pulp
Moisture	98.58 ± 0.07
Crude fiber	11.40 ± 0.30
Ash	18.34 ± 0.47
Crude fat	2.98 ± 0.10
Crude protein	3.15 ± 0.50

4.2 Sensory Evaluation

Table 4.2 displays the sensory features of various experimental jams. The median color score varied between 3.1 and 4.7. The results indicated that there was a visible distinction between products A and Band C. There was no noticeable change in smell between product A and product C, but there was a discernible difference between sample A and sample B, as well as sample B and sample C. The range of smell mean ratings was between 3.5 and 4.2. The average taste score varied from 3.4 to 4.6, indicating that there was no visible difference between products A and B, while there was a discernible difference between sample A and C. The change in sweeteners did not significantly alter the texture. Product B's overall texture was superior than that of products A and C. Product A and B had the highest overall approval, while product C was drastically different.

Table 4.2: Sensory score of Experimented Processed jam

Products	Color	Smell	Taste	Texture	Overall acceptability
(A)Aloe vera with sugar	3.1 ± 0.87^b	3.7 ± 0.53^b	4.5 ± 1.17^a	4.1 ± 0.94^a	4.3 ± 0.96^a
(B)Aloe vera with honey	4.7 ± 0.67^a	4.2 ± 1.10^a	4.6 ± 0.51^a	4.4 ± 0.84^a	4.7 ± 0.97^a
(C)Aloe vera with jaggery (khejurgur)	3.2 ± 0.42^c	3.5 ± 0.55^b	3.4 ± 0.51^b	4.2 ± 0.67^a	2.5 ± 0.52^b
P value	**0.0002**	**0.0003**	**0.0001**	**0.006**	**0.0003**

Legends: Mean ±SD and values in the same column with the different superscripts are statistically significant ($p < 0.05$) for color, smell, taste , texture and overall acceptability.

4.3 Proximate composition of aloe vera jam

The nutritional value of aloe vera jam is presented in Table 4.3; practically all sample differences are statistically significant. Samples A and B had the highest proportion of crude protein (0.96-0.88%), while sample B had the highest amount of fat (1.8%) and sample A had the highest proportion of crude fiber (0.18 0.03%). Sample B contained the lowest concentration of CHO (65.510.01).

Table 4.3: Proximate compositions of Aloe vera jam sample

Variables	(A)Aloe vera jam with sugar	(B)Aloe vera jam with honey	(C)Aloe vera jam with jaggery (khejurgur)	P value
Crude fiber %	0.18 ± 0.01^a	0.12 ± 0.02^b	0.13 ± 0.04^{ab}	**0.02**
Crude protein %	0.61 ± 0.06^b	0.96 ± 0.05^a	0.88 ± 0.03^a	**0.01**
Crude fat %	1.51 ± 0.05^b	1.80 ± 0.03^a	1.32 ± 0.06^c	**0.001**
Ash %	0.04 ± 0.02^c	0.61 ± 0.04^b	1.33 ± 0.23^a	**0.001**
Moisture	28.34 ± 0.02^b	31.00 ± 0.02^a	26.53 ± 0.2^c	**0.02**

Total Carbohydrate	69.32±0.05[a]	65.51±0.01[b]	69.81±0.05[a]	**0.001**

Legends: Mean ±SD and values in the same column with the different superscripts are statistically significant ($p < 0.05$).

4.4 Glycemic Index

Figure 4.1 depicts the mean blood glucose response curves for the glucose and jam samples. Up until 45 minutes, the reaction curves in every sample increased steadily before progressively dipping below the response curve in the control glucose sample. Between sample types, there were significant ($p<0.05$) differences in the mean GI values (Figure 5). In comparison to reference glucose, two samples (Aloe vera jam with sugar and honey, respectively) showed reduced mean GI values ($p < 0.05$) but Aloe vera jam with jaggery ($P>0.05$) showed no significant difference. The mean GI value in samples B (P- value 0.004) and C (P- value 0.024) was significantly lower than in sample sample C (P- value 0.242) in a pair-wise comparison with reference glucose. In comparison to sample B, sample A exhibited a lower mean GI value ($p <0.05$).
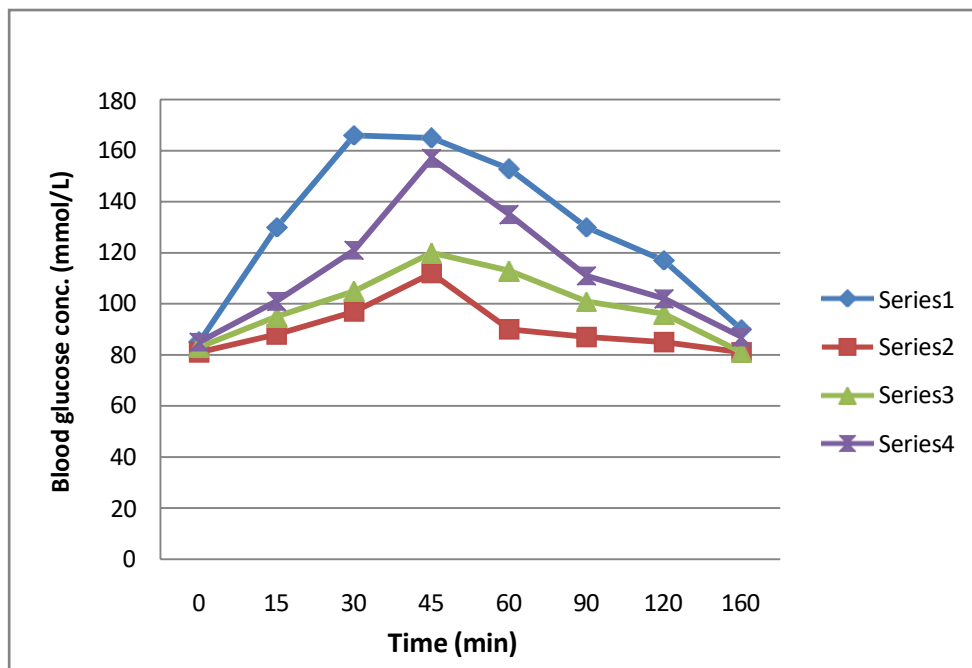

**Figure 4.1 :Blood Glucose response curve of glucose and jam samples**

Where,
Serise 1= Mean blood glucose response curve for reference glucose sample
Serise 2= Mean blood glucose response curve for sample B(Aloe vera jam with honey)
Serise3= Mean blood glucose response curve for sample A(Aloe vera jam with sugar)
Serise4= Mean blood glucose response curve for sample C(Aloe vera jam with jaggery)
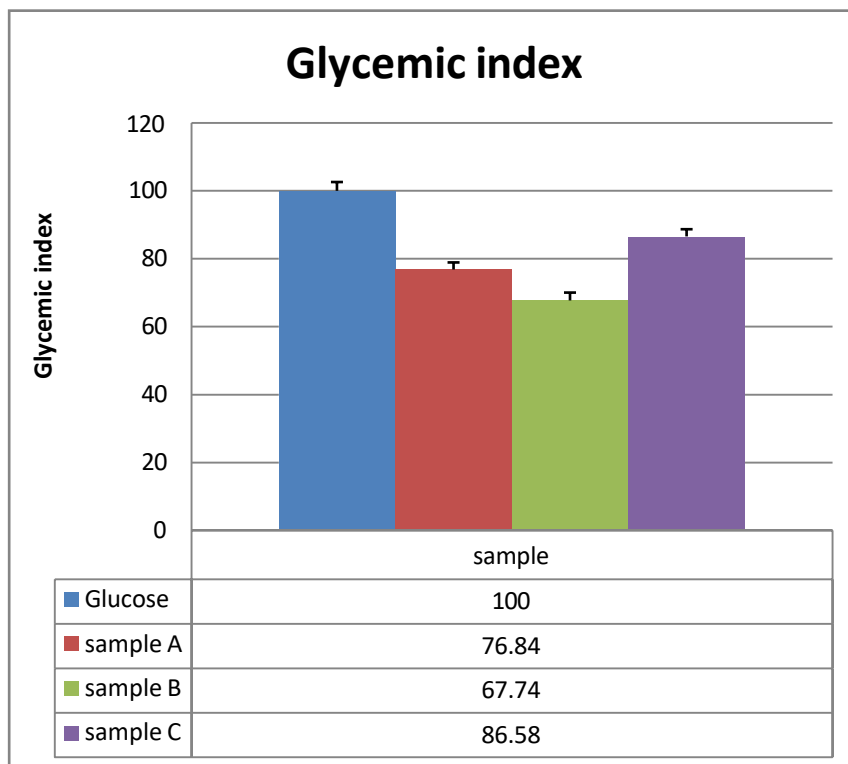
Data expressed as mean ± standard error

Figur 4.2: Glycemic index of Glucose and jam samples

Where,
Glucose= Mean glycemic index for reference glucose sample
Sample A= Mean glycemic index for aloe vera jam with sugar
Sample B= Mean glycemic index for aloe vera jam with honey
Sample C= Mean glycemic index Aloe vera jam with jaggery

4.5 Antioxidant capacity

In the table 4.4, Antioxidant capacity was substantially greatest (3.053 0.002mg TE/100 g) in sample C (Aloe vera with jaggery) and significantly lowest (0.85 0.002mg TE/100 g) in sample A (Aloe vera with sugar).

Table 4.4: Antioxidant capacityin different formulations ofofAloe vera jam

Formulations	Total Anti-oxidant Capacity (TAC) (mg TE/100 g)
A (Aloe vera with sugar)	0.854 ± 0.002^c
B (Aloe vera with honey)	1.815 ± 0.001^b
C (Aloe vera with jaggery)	3.053 ± 0.002^a
P value	0.000

4.6 Total Polyphenol Content present in different formulations of Aloe vera jam

From the table 4.5, total polyphenol content was shown to be significantly highest (5.685±0.020mg GAE/100 g) in C (Aloe vera with jaggery) and significantly lowest (0.312±0.020mg GAE/100 g) in A (Aloe vera with sugar).

Table 4.5: Total Polyphenol Content present in different formulations of Aloe vera jam

Formulation	Total Polyphenol Content (mg GAE/g)
A (Aloe vera with sugar)	0.312 ± 0.020^c
B (Aloe vera with honey)	0.543 ± 0.004^b
C (Aloe vera with jaggery)	5.685 ± 0.020^a
P value	0.000

Mean values along with the standard deviation are presented as obtained data.

4.7 Total Flavonoid Content present in different formulations of Aloe vera jam

From the table 4.6, total polyphenol content was shown to be significantly highest (6.894 ±0.002mg QE/100 g) in C (Aloe vera with jaggery) and significantly lowest (27.523 ± 0.002mg QE/100 g) in A (Aloe vera with sugar).

Table 4.6: Total flavonoid content indifferent formulations ofaloe vera jam

Formulation	Total Flavonoid Content (mg QE/g)
A (Aloe vera with sugar)	6.894 ± 0.002^c
B (Aloe vera with honey)	9.312 ± 0.001^b
C (Aloe vera with jaggery)	27.523 ± 0.002^a
P value	0.000

Mean values along with the standard deviation are presented as obtained data.

4.8 Energy content

Based on Figure 4.3, sample C had the highest Energy content (301.97kcal/100g), while sample B had the lowest (289.08kcal/100g).
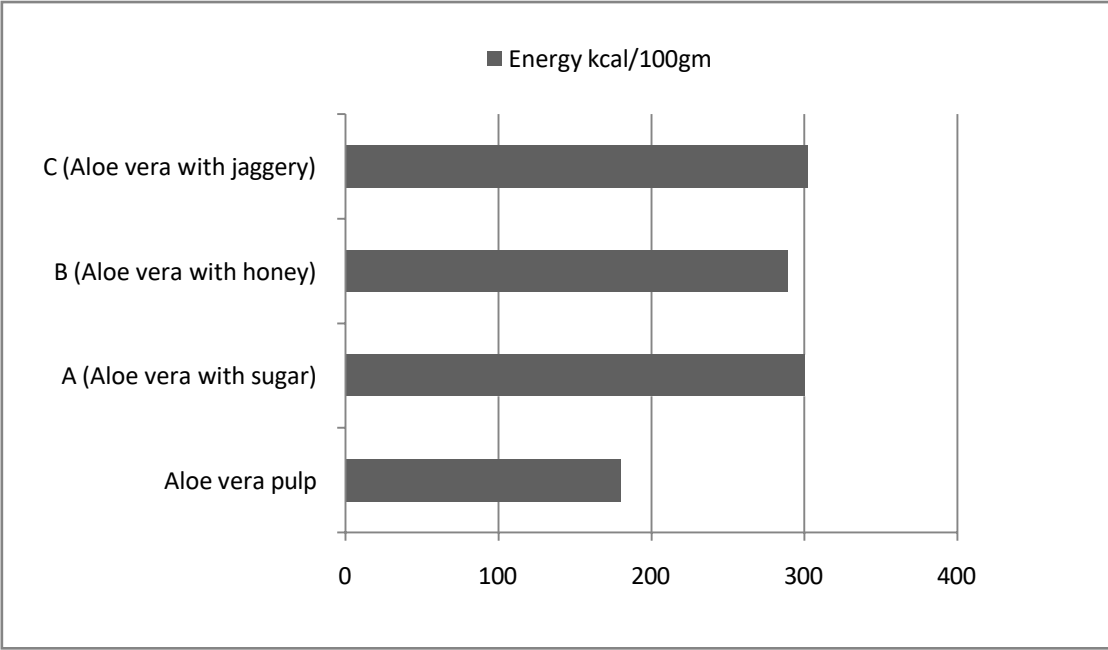
Figure 4.3: Energy content comparison between aloe vera pulp and jam

Chapter 5: Discussions

5.1 Proximate composition of Aloe vera jam

There was a wide range of variation in the moisture percentage of the jam samples, ranging from 26.53 to 31.00%. The results for aloe vera combined with honey were the greatest, while the values for aloe vera combined with jaggery were the lowest. The moisture content that was measured in this experiment was quite low when compared to the results that Ali et al. (2021) achieved for peach jams that included aloe vera, which were 35%. The amount of moisture that is contained in the food can, in many cases, be used as an indicator of how long it will remain fresh (Fellows, 2000). Jams that contain a relatively modest amount of moisture can be stored for a considerable amount of time. There were statistically significant differences (P <0.05) in the moisture content of the jam samples.

For protein content, sample A had the lowest value while samples B and C had the highest value (Table 4.3), which is comparable to the protein content of peach and Aloe vera gel mixed jam (0.42%). (Ali et al, 2021). According to the nutrition label, the most common components of jam are pulp, sugar, pectin, and citric acid. This study reveals that the protein content of jams is low since none of the used components are a rich source of protein. There was a statistically significant difference (p <0.05) between the protein content of the three types of jam evaluated.

The fat percentage varied between 1.32% and 1.80%. Sample B contained considerably (P <0.05) more fat than other jam samples. This study's fat content was lower than the 3.2% fat content documented by Kanojia (2018) for Aloe vera jam with apple.

Sample A has the highest fiber concentration (0.18%), whereas samples C and B had the lowest fiber amounts (0.13% and 0.12%, respectively).

The ash percentage ranged anywhere from 0.40 percent to 1.33 percent. A significant amount of several minerals were found in the sample. The experiment resulted in a significant amount of ash being created due to the high mineral content of both aloe vera and jaggery.

5.2 Bioactive compounds

All of the samples in table 4.4 demonstrate a significant difference in antioxidant capacity. DPPH was a substrate that was utilized frequently for the purpose of determining whether or not a substance possessed antioxidant activity. This was especially true in the context of research involving the ability of biological and chemical substances to scavenge free radicals. According to the data, the antioxidant capacity of aloe vera jam ranged from (0.854 ±0.002) mg TE/100g to (3.053± 0.002) mg TE/100g for a variety of various sweeteners. The antioxidant capacity of sample C was 3.053, which is a considerably higher level than that of sample A (0.854). According to the findings of Rebeka et al., (2020), aloe vera jelly made with honey received a higher mean score (22.04) than aloe vera jelly made with sugar (21.933).

5.3 Sensory Evaluation

Sample B (Aloe vera jam with honey) received the highest mean score (4.7) for color acceptance, suggesting that the panel deemed honey to be aesthetically pleasant. Sample B had the highest average score for scent (4.2), indicating that the panelists deemed this honey used as a sweetener to be the most aromatic. Aloe vera jam with sugar (sample A) and aloe vera jam with jaggery (sample C) were given respective ratings of 3.7 and 3.5. In this attribute test, sample Band A had the same mean score (4.6 and 4.5) as sample Band B, indicating that panelists regarded the aloe vera jam made with both sugar and honey to be the most palatable. The similar flavor of jaggery added to the other jam may have a negative impact on the flavor. Sample B obtained the highest mean texture score (4.4) among the panelists. Sample A obtained the second-highest texture rating (3.7). Samples B and A attained the highest mean score for overall acceptability (4.7 and 4.3, respectively). Rebeka et al. (2020) conducted a study on Aloe vera jelly with several sweetening agents, including honey, sugar, and aspartame. Of the three jams, aloe vera jelly with honey exhibited superior organoleptic qualities, more overall acceptability, and a more robust textural profile.

Sensory analysis of sample jams revealed that the aroma and flavor of honey-based Aloe vera jam were considerably superior to those of sugar-based and jaggery-based jams (P <0.05), suggesting that sugar's lack of flavor and jaggery's distinct flavor may

have a negative effect on jam. This is an excellent conclusion, given that the quality of jam can be assessed in part by its taste, texture, and smell.

5.4 Glycemic index

Overall, the GI values of three samples of aloe vera jam made with three different sweeteners increase and decrease gradually after 45 minutes of consumption, and when compared to reference glucose, two samples A and B (Aloe vera jam made with sugar and honey, respectively) showed reduced mean GI values ($p < 0.05$), whereas Aloe vera jam made with jaggery ($P > 0.05$) did not demonstrate a significant difference. The sample with the lowest GI value was sample B (67.74%), followed by samples A (76.84%) and C (86.53%). This suggests that aloe vera jam prepared with honey reduces the glycemic index of the blood and that the carbohydrates in aloe vera jam made with honey are slowly metabolized and absorbed, resulting in minor and minimal blood sugar spikes. In the current investigation, just one glucose detection method was utilized. However, the validity of glucose estimation may have been enhanced if multiple methods for measuring glucose concentration in blood had been employed.

Chapter 6: Conclusion

Jam is one of the beneficial meals that is easy to eat, digest, and absorb into the human system. All the nutrients required for the body to be in excellent health are present in it. The Aloe vera plant can be used to make products including cake, jam, and jelly. On the other hand, the production of jam from aloe vera pulp significantly increased the amount of nutraceutical qualities such antioxidant activity, total polyphenol, and total flavonoids. In this study, three different jams made with aloe vera pulp and three different sweeteners sugar, honey, and jaggery were compared on the basis of sensory assessment, total antioxidant capacity, bioactive compounds (total polyphenol), and bioavailable antioxidants. The jams made with sugar and honey were both deemed to be of the highest quality, while the jam made with jaggery was deemed to be less acceptable. Additionally, the study demonstrates that the antioxidant potential, or total polyphenol, of various sweeteners in jam varies. Aloe vera with honey has the best results, with all three forms of jam having lower glycemic index values than the reference glucose level. According to the findings of the research, the nutritional, antioxidant capacity, bioactive compounds and effect on glycemic index. It can be concluded that Sample B (honey aloe vera jam) was superior to that of Sample A (sugar aloe vera jam) and sample C (jaggery aloe vera jam). Since there are so few studies on the use of aloe vera as a bio-preservative, particularly in non-vegetarian products, it is important to learn how its bioactive components interact with food products to extend shelf life. In the future, this research may also look at how it preserves other types of food, such as cereals and beverages..

Chapter 7: Recommendations and Future Perspectives

Aloe vera's potential uses in food, particularly in the cereal and beverage industries, are currently being researched. There are very few research on its use in various food industries, including dairy, confectionery, bakery, etc. There aren't many studies on aloe vera's use as a bio-preservative, particularly in goods that aren't vegetarian. Additionally, it is important to determine which bioactive components of aloe vera interact with food products to lengthen their shelf lives. This investigation could be repeated to confirm the experimental findings.

a) The recipe can be altered further, and different pulp ratios can be produced using different recipes.

b) It is possible to determine how the bioactive ingredient in aloe vera jam changes with time and storage temperature.

c) To increase the quality of aloe vera jam, more modern packaging and storage techniques would be implemented.

d) Aloe vera jam may be induced in diabetic rat models of type 1 and type 2 to determine its direct influence on blood glucose level.

e) From a therapeutic standpoint, the findings will be advantageous because they have medical importance.

f) Even if the sample had adequate information to conduct statistical correlations between the analytical findings. Due to the small sample size and the need for results to be confirmed by a larger study, our finding should be taken with caution.

g) Sufficient efforts need to be made to enhance the nutritional value of jam that is commercially available.

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Appendices

Appendix A: Questionnaire for Sensory test of Biscuit

Date: ....

Name: ....

Instruction

You are given two samples. Please rinse your mouth with water before starting. Taste each sample, from left to right. Rinse your mouth with water between samples. Evaluate the following attribute(s) these samples of jam. Make a circle on the horizontal line based on your preference.

Color
```
--|---------|---------|---------|---------|-----
  1         2         3         4         5
```

Smell
```
--|---------|---------|---------|---------|-----
  1         2         3         4         5
```

Taste
```
--|---------|---------|---------|---------|-----
  1         2         3         4         5
```

Texture
```
--|---------|---------|---------|---------|-----
  1         2         3         4         5
```

Overall
Acceptability
```
--|---------|---------|---------|---------|-----
  1         2         3         4         5
```

Note:

5= Lke a lot

4=Like a little

3= Nither like nor dislike

4= Dislike a little

5=Dislike a lot

Appendix B: Sensory evaluation panelist work

Sensory panelist don't do it

1. Eat, drinks or smoke within 90 minutes prior to test.
2. Use gum, mints etc flavored item within 30 minutes
3. Wear perfumes, cologne and fragrance item during test
4. Talk and comment during evaluation
5. Taste if you have a lot of prior knowledge about the manufacturing which you may dislike
6. Taste if you have a cold.
7. Share the product with other.

Sensory panelists should

1. Be attractively dressed and well groomed.
2. Display sensitivity and regard for the exhibitors.
3. Exhibit a cheerful demeanor; smile; be prompt.
4. Avoid consulting with audience members.
5. Hide personal dislikes and preferences.
6. Be knowledgeable of the products being evaluated.
7. Take the time to form an overall impression of the submissions.
8. Acknowledge quality standards
9. Do not award first place if the entries are not deserving.
10. If the outcomes obtained are satisfactory, don't rule out unfamiliar methods of doing things. Consider the actual outcomes rather than what "might" have been done.
11. Make prompt and decisive decisions.
12. Provide justifications for decisions and encourage the exhibitor to continue, learn, and advance.
13. Provide compliments and constructive feedback.
14. Be fragrance neutral
15. Participate regularly
16. Take sensory evaluation seriously
17. Take time and focus during test
18. Follow the method and instruction precisely

19. Be confident in initial judgment

20. Rest and cleanse your palate for next sample

Remember

No food entry is so poorly executed that it does not merit a positive response. No food entry is so well-executed that it cannot be enhanced in any way.

Appendix C: Photo Gallery

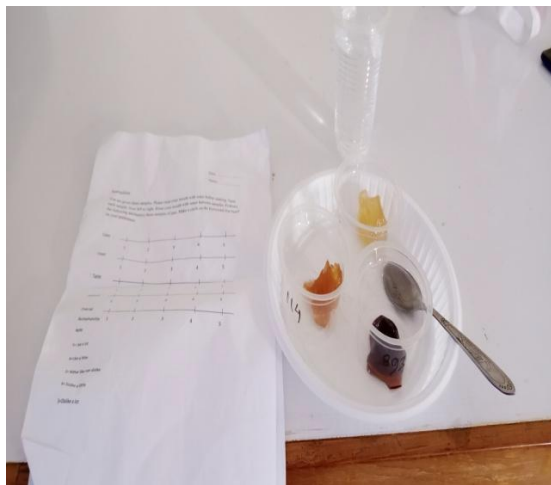Appendix C1: Pictorial Presentation of aloe vera jam processing.

Appendix C 2 Jam making process

Appendix C3: Sensory Evaluation

Appendix C4: Proximate Analysis

Crude Fiber

Fat determination

Protein Digestion

Antioxidant measurement

Appendix C5: Bioactive compounds and anioxident analysis

Appendix C6: Blood glucose concentration testing

Brief Biography

Amrin Jahan passed the Secondary School Certificate Examination in 2012 from Cox'sbazar Govt. Girls' High School, and then Higher Secondary Certificate Examination in 2014 from Chittagong Govt. Women College, Nasirabad, Chattogram. She received her Bachelor of Science with Honors in Food Science and Technology from the Faculty of Food Science and Technology at Chattogram Veterinary and Animal Sciences University in Bangladesh. Now, she is pursuing a Master of Science in Applied Human Nutrition and Dietetics at Chattogram Veterinary and Animal Sciences University's Department of Applied Food Science and Nutrition (CVASU). She has a strong desire to improve people's health through good guidance and recommendations, as well as to raise their understanding of food security and nutrition.