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Utilization of Manzanita in Making Jam Spread

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ABSTRACT

This study was conducted to explore the use of manzanita fruit in the production of jam spread. Furthermore, the aim is to examine the sensory characteristics, macronutrient composition, shelf life, and return on investment (ROI) of the products. The three (3) sweeteners were combined with manzanita fruits. Each sweetener was composed of three formulations (1, ¾, and 1/2 cup). The treatments were prepared using the standard method.

The microbial analysis method was conducted first to determine the microbial load of each treatment. A sensory examination was conducted to assess the attributes (appearance, aroma, texture, and taste) of each treatment. The evaluation composed of 30 participants, including 10 teachers, 15 students and 5 food business owners from the Abra State Institute of Sciences and Technology, Bangued Campus. The products were evaluated using a 5-point hedonic scale. Every test was conducted, and the resulting data was examined using standard methods. The proximate analysis of the most effective treatments of manzanita jam was found using standardized AOAC procedures. The shelf life assessment was performed immediately following the proximate analysis, during which the microbial load was measured for a period of 30 days. Finally, the return on investment (ROI) of the products was also computed.

The result of the study led to the conclusion that manzanita fruits with different sweeteners and proportions are well-accepted by the respondents. However, the best formulation is treatment 1, which is composed of 1 cup of manzanita fruits and 1 cup of sugar. The study also determined the impact of different sweeteners on the qualities of the manzanita jam spread, most especially the appearance, aroma, taste, and texture. Macronutrients were determined for the best formulation of manzanita jam. The manzanita jam has a moisture (30.85 g/100 g) and carbohydrate (66.99 g/1/2 cup) content but minimal ash (0.86 g/1/2 cup) and crude fats (0.06 g/1/2 cup). This indicates that the macronutrients are at a normal value and are safe to consume, but in moderation due to their sugar content. The manzanita jam can last for 12 days. Undoubtedly, manzanita jam spread has potential in the market due to the 233% ROI from the manzanita jam with 1 cup of sugar.

Keywords: manzanita fruits, jam spread, sweeteners

CHAPTER I
INTRODUCTION

Background of the Study

The Philippines is home to a large population of the manzanita tree, which is scientifically known as Muntingia Calabura Linn. It was brought and introduced during the Spanish era in the Philippines, where it was semi-cultivated and became the locals' wild food. Its origins are in Tropical America, and it was carried and introduced in the Philippines. The word "manzanita" refers to a baby apple and is the Spanish diminutive of the word "manzana," which means apple. In addition to its more common names, this plant can also be referred to as a Calabur tree, Kerson fruit, Cherry tree, or Jamaica cherry. It can be

found in many places throughout the humid, tropical parts of the region.

The Kerson Fruit, or Manzanita in Ilocano, is a fast-growing, 5 to 10-meter-tall tree with slender, spreading branches. The leaves are 8–13 centimeters long, oblong, and light green with serrated margins. White flowers have lengthy pedicels, a diameter of 2 centimeters, and are either solitary or in pairs. The fruits have a diameter of 1 centimeter, are smooth, light red, and contain numerous small seeds. The tree begins to bear fruit in the summer, when its white blossoms bloom, and the fruit is initially green and bitter. The optimal harvesting period typically begins when the fruit's skin turns from green to a deep red color, becomes soft and juicy, and falls to the ground during the wet season. A second peak occurs during the winter-summer seasons.

Manzanita plants are tolerant of a variety of soil types, but they thrive in well-drained, sand-rich soils. However, they are also resistant to corrosive and alkaline environments, as well as drought. For optimal seed germination, they should be planted in direct sunlight and have a maximum lifespan of 30 years. However, the tree is sensitive to frost and does not thrive in colder regions; however, it can tolerate occasional low winter temperatures.

The manzanita fruit is well known among Filipino children for its unique flavor and cotton candy-like aroma. Children share the same fascination with these fruits as do birds and fruit bats. When the fruit is mature, it is simple to harvest by shaking the branches. The fruit contains antioxidant, anti-inflammatory, antipyretic, analgesic, cytotoxic, hepatoprotective, gastroprotective, cardioprotective, antibacterial, antiulcer, insecticidal, tyrosinase-inhibiting, and antifungal properties, according to studies. It is also demonstrated that the fruit contains bioactive compounds that are beneficial as a diabetes treatment.

Due to its versatility and health benefits, this tree and its fruits are utilized in numerous ways across the world. Manzanita is processed into fruit syrup, a substitute for sugar that is fermented like wine or cider. The blossoms are used to produce honey of superior quality. The foliage is utilized as both feed and tea. Manzanita branches are commonly used as culinary garnishes and table centerpieces. Today, manzanitas are predominantly cultivated in urban backyards and tropical forests, as opposed to vast plantations. Even when it is in season, it is difficult to locate in grocery stores.

Jams is a variety of spreads that contain similar ingredients, such as fruit, sugar, water, pectin, and acid, but differ in texture, appearance, and method of fruit preparation. Jams contain fruit pieces or particles and have a softer consistency. Jam contain between 48 and 54% sugar, according to Lang A. (2019). Equal amounts of sucrose are sufficient to prevent the growth of microorganisms. Therefore, sugar is required for effective jam production, regardless of the sweetener employed.

Here in Abra, manzanita trees are dispersed and can be spotted as one travels between municipalities. When ripe fruits frequently tumble to the ground, people leave them there and do not mind picking them. Not everyone can tolerate its odor, particularly when it is abandoned. It causes the manzanita fruit around the tree to be crushed. Despite all these innovations, it appears that many Filipinos do not enjoy the flavor of manzanita and are unaware of its health benefits. If matured fruits are not consumed, they will fall to the ground, hence this study.

Objectives of the Study

The objectives of the study were to explored the potential use of Manzanita as an ingredient in making manzanita jam spread, with a particular focus on identifying the most suitable sweeteners for making Manzanita Jam Spread. The research attempted to address the following inquiries:

1. Determine the microbial analysis of the different formulations.
2. Determine the level of acceptability of in making manzanita jam spread in terms of;

a. Appearance,
b. Aroma,
c. Taste,
d. Texture,

3. Determine the significant difference in terms of acceptability of manzanita jam spread.
4. Determine the proximate analysis of the most acceptable manzanita jam spread.
5. Determine the shelf life analysis of the most acceptable manzanita jam spread.
6. Determine the return of investment of manzanita jam spread.

Importance of the Study

The result of the study would benefit the following:

Researchers. The research given below can serve as a valuable source of reference data for future studies or for assessing the reliability of other relevant findings. It has the potential to facilitate the development of manzanita research.

Entrepreneurs. This research will aid in expanding their knowledge and comprehension of Manzanita. It will allow them to commercialize and introduce innovative new manzanita products to the market.

Academe. This project aims to provide educators and learners with a comprehensive understanding of the significance of manzanita's benefits through rigorous research and innovative approaches. Motivate individuals to engage in the development and execution of research endeavors aimed at promoting the growth and development of the local community.

Consumers. This research will increase consumer awareness of the health benefits derived from manzanita. They will appreciate the natural flavor of manzanita fruits and be introduced to the newer flavors of jams spreads.

Industry. This study aims to generate insights towards enhancing the production process of manzanita within the food manufacturing business.

Time and Place of the Study

The production of manzanita jams spread, the microbial analysis, proximate analysis and shelf life analysis of the treatments were carried out during the month of August in the year 2023.

Definition of Terms

The following terms are defined as they were used in the study:

Microbial analysis. It pertains to the test used in detecting the microorganisms present in food causing spoilage and poisoning.

Appearance. It refers to the physical aspects or how the sample look like.

Aroma. It refers to the quality of pleasing scent of the manzanita jam spread.

Taste. It refers to the overall flavor of the manzanita jam spread.

Texture. It refers to the physical appearance or consistency of the manzanita jam spread.

Sensory Attributes. It refers to the different characteristics of Manzanita jams by using our senses.

Hedonic Scale. It refers to the sensory rating test determining how much the evaluators like or dislike the sample.

Shelf Life. It refers to the length of time of manzanita jam spread are safe to consume.

Proximate Analysis. It pertains to the values of macronutrients in the products.

Spread Test. It refers to the method used in checking the doness of the manzanita jam spread.

Return of Investment. It refers to the performance measure used to evaluate the efficiency or probability of an investment.

Review of Literature

This section presents a review of the literature and studies on the Manzanita jams which have been useful in the conduct of the study.

On Manzanita (*Muntingia Calabura Linn*.)

Muntingia Calabura, the sole species in the genus Muntingia, is a flowering plant native to the Philippines, Southern Mexico, the Caribbean, Central America, and western South America. Common names include (English) Jamaican cherry, Panama berry, Singapore cherry, Ba tree, Strawberry tree; (Filipino) Aratiles and sarisa.

It is a fast-growing tree of disturbed lowland neotropical forests that has been introduced as an ornamental and fruit tree in many Old-World countries. It is now widespread and naturalized in Southeast Asia, Australia, and islands of the Pacific Ocean, in part due to its ability to disperse by bats and birds. It is often regarded as an environmental weed, but has not yet become a severe widespread problem cited by Areces-Berazain F. (2016).

Despite its widespread, it also possesses remarkable medicinal value which warrants further and in-depth studies that the aratiles reviewed, M. calabura possessed various pharmacological activities (e.g., cytotoxic, antinociceptive, antiulcer, anti-inflammatory), which supported the folklore claims and could be attributed to its phytoconstituents according to the study entitled "Muntingia Calabura: A review of its traditional uses chemical properties and pharmacological observations." by Mahmood N.D., Nasir N.L., et al. (2014). Other studies show high levels of antioxidant activity in the fruit extracts as stated in the present study by Preethi, K., Vijayalakshmi, N., Shamna, R. and Sasikumar, J. M. (2010) entitled "In vitro antioxidant activity of extracts from fruits of Muntingia Calabura Linn." from India. There was a correlation between antioxidant activity and phenolic flavonoid contents.

It has a potential antibacterial property that is comparable to the standard antibiotics used. It is also stated that aqueous extract of Muntingia Calabura showed significant antinociceptive activity against chemically and thermally induced noxious stimuli.

Moreover, Gayathri, T., Mohan, T. C. K. and Murugan, K. (2007) cited in their "Purification and Characterization of Polygalacturonase-3 from Muntingia Calabura Linn." that the molecular mass of the Endo-polygalacturonase-3 (PG-3), the key enzyme of fruit ripening was purified to near homogeneity was determined as 85 kD, by size exclusion chromatography. SDS-PAGE of PG-3 revealed two dissimilar bands of 62 and 21 kD as heterogeneous subunits. The optimum pH of PG-3 was found to be 4.0. The enzyme had an optimum temperature of 40°C and was relatively stable at 50°C and 60°C. Km for the substrate polygalacturonic acid was found to be 0.27%. The purified enzyme was a glycoprotein with a 6.6% carbohydrate content.

On Maturity Level of Manzanita to be Used

According to the study of MSA Fakir., MM Rahman., MM Hasan., et.al (2018), cherry fruit or Manzanita fruit length and diameter was almost similar at 35 DAT (average 0.53 cm) followed by gradual increase and reached steady at 55 DAT (at PM) (1.00 and 1.17 cm, respectively) with an average fruit dry weight of 0.53 g. Harvest maturity of china cherry was attained around 53 DAT when the deep green berries turned into yellowish pink.

The ripe fruit is filled with tiny yellowish seeds that exude when the fruit is squeezed. Thus, this research will use mature - yellowish pink colored fruits in making jam.

On Manzanita as a source of sugar

Studies have shown that ripe manzanita berries are very sweet due to the high content of soluble solids

(10.24°Brix) and low total titratable acidity (0.11 g citric acid per 100 g fruit, pH 5.64). Besides being very appreciated for its flavor and color, the fruit has been reported to contribute to the intake of carbohydrates (14.64%), proteins (2.64%), lipids (2.34%), fibers (1.75%) and minerals (1.28%), with low total energy value by Pereira, Tomé, et al. (2016).

The calabura fruits showed high content of glucose, fructose and sucrose, and low content of 1-kestose, maltopentaose, maltohexaose and maltoheptaose. Only trace content of the nystose, 1F-β-fructofuranosylnystose, maltotriose and maltotetraose were detected (≤LOQ), whereas raffinose, stachyose and verbascose (galactooligosaccharides, GOS), and xylitol, mannitol and sorbitol (polyols) were not detected cited by G.A. Pereira and H.S. Aruuda (2018)

The total content of sugars in calabura fruits (7.52 g/100 g fw, fresh weight) was similar to cherry (7.26 g/100 g fw), blackberry (6.8 g/100 g fw) and raspberry (6.58 g/100 g fw), lower than the content in grape (22.71 g/100 g fw), blueberry (17.29 g/100 g fw), mulberry (11.61 g/100 g fw) and black currant (9.85 g/100 g fw), and higher than strawberry (3.62 g/100 g fw).The calabura showed however total content of FOS (0.01 g/100 g fw) lower than the content of the fruits mentioned above studied by Jovanovic-Malinovska, Kuzmanova, & Winkelhausen, (2014).

Liza (2009) stated also that manzanitas fruit extract as an alternative source of sugar is effective as an alternative for sugar in the sense that they have the same taste and odor but they only differ in texture.

On sweeteners

Sweeteners are food additives that are used to improve the taste of foods and used as preservatives. Hence, Sugar is essential part of the preservation of jam making as it bound up with the water molecules that the microorganisms needed to survive and proliferate. Some of these sweeteners are honey, syrup, molasses, and sucrose. Natural sweeteners are sweeteners that are extracted from natural products without any chemical modifications during the production or extraction process. Natural sweeteners are well known and their production process has been perfected over time making their cost low and leaving their demand high cited by A. Lebedev, J. Park, and R. Yaylaian (2012).

On jam process

Jam recipes mostly comprise equal weights of fruit and sugar. You can play with this 1:1 ration as much as you want, but too much fruit and you may lose the preserving effects of the sugar; too much sugar and it may crystallize during storage according to A. Connelly (2013). Once the water and sugar have gone off, the pectin is left to forms a gel when mixed with acid.

Jam spreads provide number of macronutrients and comprise about 48–54% sugar. Vitamin and mineral compositions depend on the types of fruits used and whether pectin is added. For example, spreads prepared without added pectin require a longer cooking time, which may reduce their content of heat-sensitive nutrients like vitamin C. According to A. Lang (2019), Some of the potential health benefits of jams is related to their pectin content. Pectin has prebiotic effects that feeds the gut's friendly bacteria to stimulate their growth, which improves gut health. However, pectin may inhibit dangerous toxins produced by E. coli, a harmful bacterium. That said, even though jams may provide some benefits, they're high sugar products, and consuming too much sugar may lead to weight gain, cavities, heart disease, and type 2 diabetes. Therefore, you should consume them in moderation.

In the light of the studies reviewed, the following studies which were used as a review of the literature were formulated that the Manzanita fruit can be utilize in jam making using different sweeteners.

CHAPTER II
MATERIALS AND METHODS

This chapter presented the rationale behind the choice of the researcher, the sources of data, research instruments, data gathering procedures and statistical analysis.

Materials

The important materials that were used in this study were:

Tools	Equipment
Knife Chopping Board Ceramic Bowls Saucepan Wooden Spatula Stove Ceramic Plate Funnel Sterilized Jam Jars	Food Processor Digital Weighing Scale Gas and Stove Refrigerator Cooling Rack

Ingredients

- 1 cup - Manzanita Fruits
- 1 cup, ¾ cup, and ½ cup Sweeteners
  - Granulated sugar
  - Honey
  - Molasses
- 0.10g. - (2 drops) lemon juice

Methods

This section presented the research design and treatments, experimental procedure, data gathering treatment, and statistical analysis for the study.

Research Design and Treatments

The researchers used the experimental method which involves the cause and effect relationship in making jam spread using manzanita fruits. It was determined the sensory acceptability of Manzanita (Muntingia Calabura Linn.) jam spread in terms of appearance, aroma, taste, and texture. The microbial analysis, shelf life, proximate analysis, and the return of investment.

This study used of nine (9) treatments, and are as follows:

Factor Sweeteners

S – Granulated Sugar

H - Honey

M - Molasses

Treatments

Treatment 1 with Granulated Sugar as Sweeteners

S1 – 1 cup Manzanita Fruits + 1 cup sugar + Basic Ingredients

S2 – 1 cup Manzanita Fruits + ¾ cup sugar + Basic Ingredients

S3 – 1 cup Manzanita Fruits + ½ cup sugar + Basic Ingredients

Treatment 2 with Honey as Sweeteners

H1 – 1 cup Manzanita Fruits + 1 cup honey + Basic Ingredients

H2 – 1 cup Manzanita Fruits + ¾ cup honey + Basic Ingredients

H3 – 1 cup Manzanita Fruits + ½ cup honey + Basic Ingredients

Treatment 3 with Molasses as Sweeteners

M1 – 1 cup Manzanita Fruits + 1 cup Molasses + Basic Ingredients

M2 – 1 cup Manzanita Fruits + ¾ cup Molasses + Basic Ingredients

M3 – 1 cup Manzanita Fruits + ½ cup Molasses + Basic Ingredients

Experimental Procedure

A. Preparation of Tools, Equipment and Materials

The researcher gathered all of the ingredients, tools, and equipment, as well as a selection of mature manzanita fruit. To avoid contamination, the equipment and tools used were washed and sanitized before the actual preparation and properly arranged according to use in the preparation table to make it accessible to the researcher.

B. Preparation of Manzanita Fruits

Following the preparation of manzanita fruits, the researcher measured all of the ingredients that

PROCESS	PROCEDURAL LIMIT
HARVESTING	Semi-ripe manzanita fruits were harvested, and the stems were removed.
RINSING	The fruits were washed twice with clear running water in order to remove any dirt or bacteria that may have been present.
CUTTING	Divide the fruit into two equal halves.
CRUSHING	The fruits were crushed using the food processor.
MEASURING	Measure the desired crushed manzanita, then set aside.

Figure 1. Methods in the Preparation of Crushed Manzanita Fruits

had been gathered

C.1. Preparation of Manzanita Jam Spread with Granulated Sugar

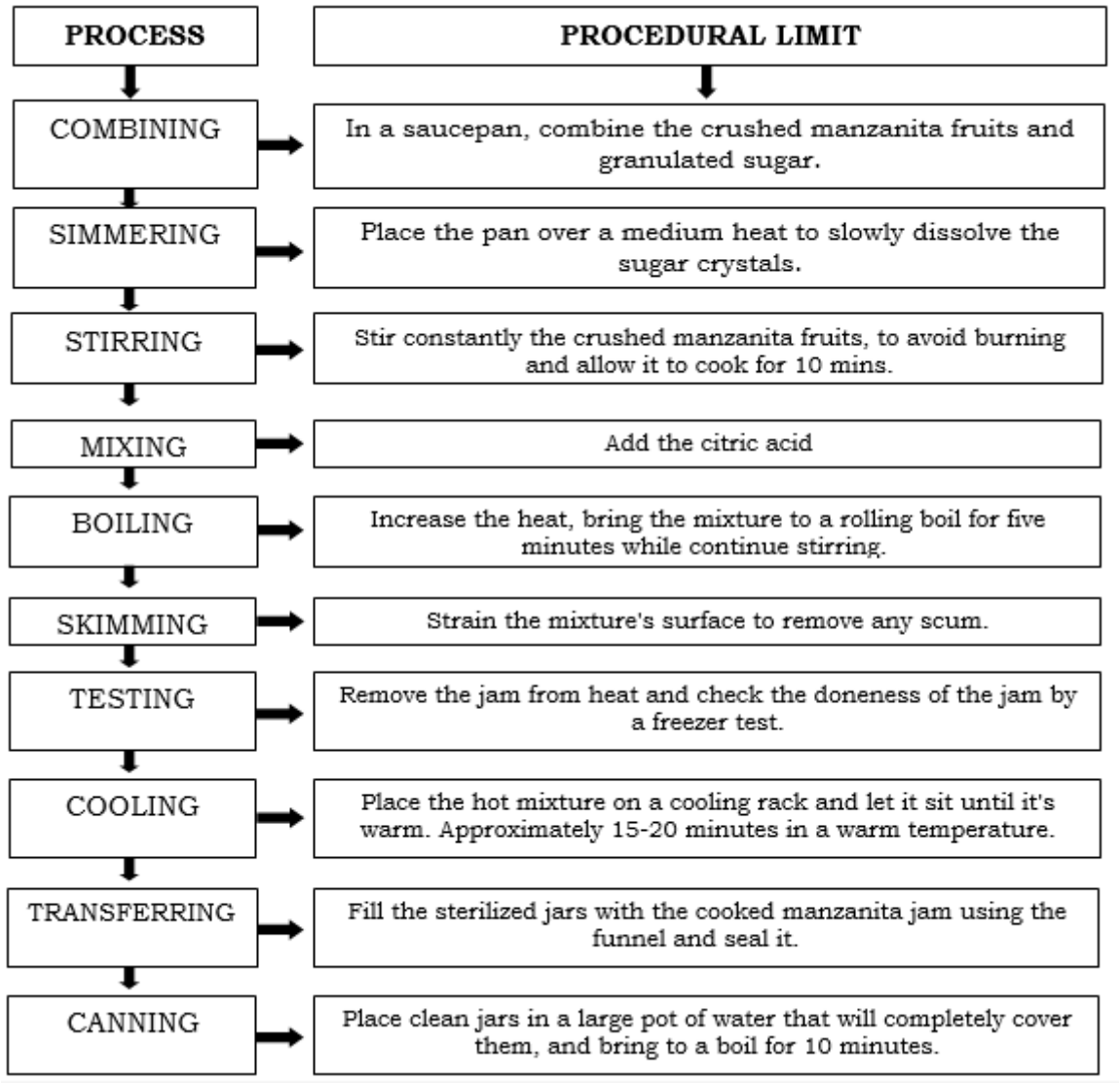

Figure 2. Methods in the Preparation of Manzanita Jam Spread with Granulated Sugar

A.1.2. The Procedure in Making Manzanita Jam Spread with Granulated Sugar

1. Combine the crushed manzanita fruits and granulated sugar in a sauce pan. Simmer it over a medium heat to slowly dissolve the sugar crystals for 10 minutes while constantly stirring the jam mixture to avoid burning the crushed manzanita fruits.
2. Mix the citric acid then bring the mixture to a rolling boil for five minutes while continue stirring. Regularly strain the mixture's surface to remove any scum. After 5 minutes;
3. Remove the jam from heat and check the doneness of the jam by a freezer test. Pour a tablespoon of jam onto the frozen plate then place the platter in the freezer for a few minutes. After a few minutes,

check to see if the jam has gelled and formed. If the jam hasn't set, your finger will glide straight through the jam sample, and you'll need to simmer the jam for a little longer.

4. Cool for approximately 15-20 minutes until it's warm in a cooling rack.
5. Transfer the cooked manzanita jam in a sterilized jar with the cooked using the funnel and seal it. Lastly, place clean jars in a large pot of water that will completely cover them, and bring to a boil for 10 minutes.

C.2. Preparation of Manzanita Jam Spread with Honey

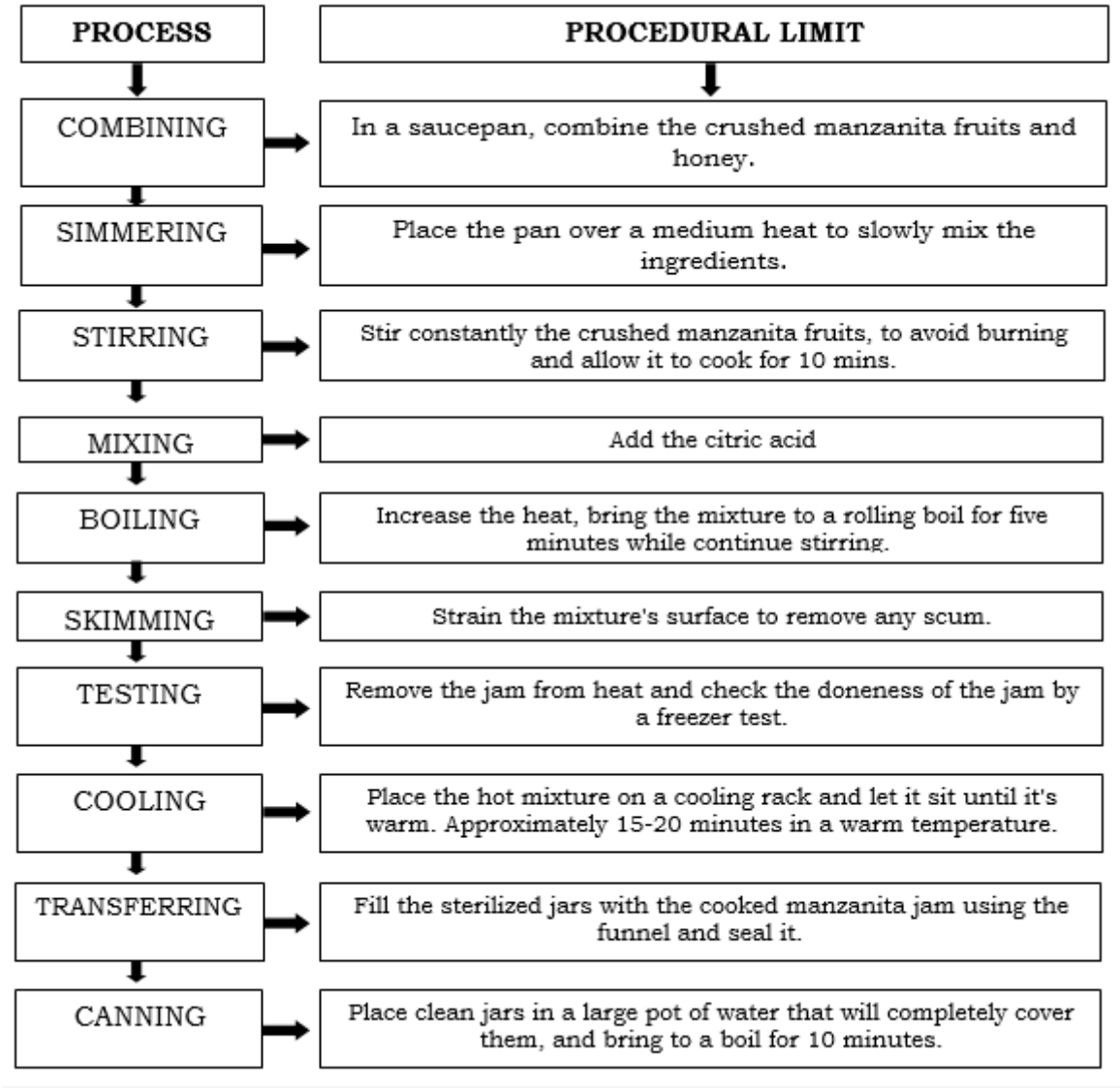

Figure 3. Methods in the Preparation of Manzanita Jam Spread with Honey

A.1.2. The Procedure in Making Manzanita Jam Spread with Honey

1. Combine the crushed manzanita fruits and honey in a sauce pan. Simmer it over a medium heat for 10 minutes while constantly stirring the jam mixture to avoid burning the crushed manzanita fruits.
2. Mix the citric acid then bring the mixture to a rolling boil for five minutes while continue stirring. Regularly strain the mixture's surface to remove any scum. After 5 minutes;
3. Remove the jam from heat and check the doneness of the jam by a freezer test. Pour a tablespoon of jam onto the frozen plate then place the platter in the freezer for a few minutes. After a few minutes,

check to see if the jam has gelled and formed. If the jam hasn't set, your finger will glide straight through the jam sample, and you'll need to simmer the jam for a little longer.

4. Cool for approximately 15-20 minutes until it's warm in a cooling rack.
5. Transfer the cooked manzanita jam in a sterilized jar with the cooked using the funnel and seal it. Lastly, place clean jars in a large pot of water that will completely cover them, and bring to a boil for 10 minutes.

C.3 Preparation of Manzanita Jam Spread for Molasses

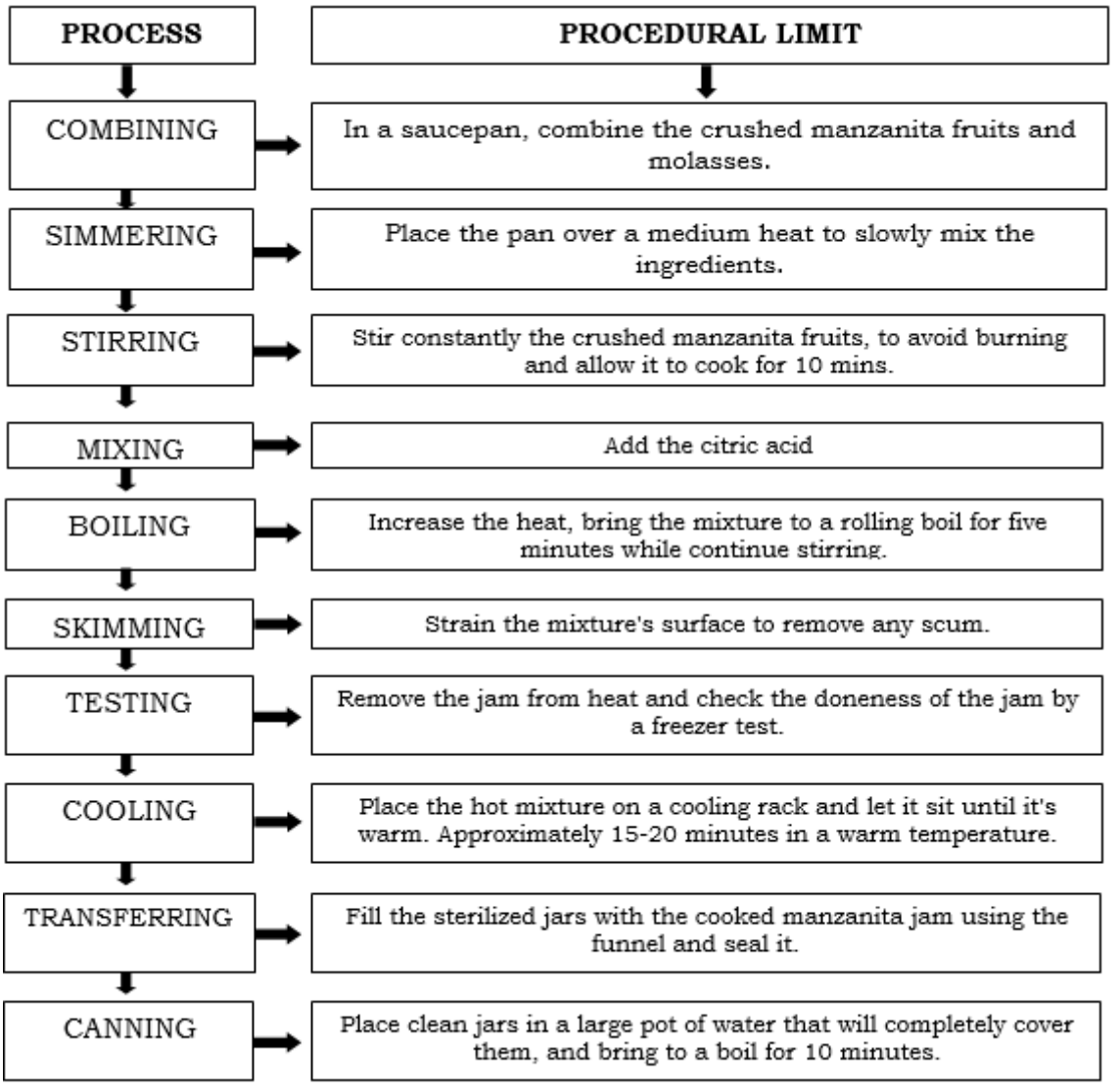

Figure 4. Methods in the Preparation of Manzanita Jam Spread with Molasses

A.1.3. The Procedure in Making Manzanita Jam Spread with Molasses

1. Combine the crushed manzanita fruits and molasses in a sauce pan. Simmer it over a medium heat to slowly dissolve the for 10 minutes while constantly stirring the jam mixture to avoid burning the crushed manzanita fruits.
2. Mix the citric acid then bring the mixture to a rolling boil for five minutes while continue stirring. Regularly strain the mixture's surface to remove any scum. After 5 minutes;

3. Remove the jam from heat and check the doneness of the jam by a freezer test. Pour a tablespoon of jam onto the frozen plate then place the platter in the freezer for a few minutes. After a few minutes, check to see if the jam has gelled and formed. If the jam hasn't set, your finger will glide straight through the jam sample, and you'll need to simmer the jam for a little longer.
4. Cool for approximately 15-20 minutes until it's warm in a cooling rack.
5. Transfer the cooked manzanita jam in a sterilized jar with the cooked using the funnel and seal it. Lastly, place clean jars in a large pot of water that will completely cover them, and bring to a boil for 10 minutes.

Respondents of the Study

The respondents of this study were thirty (30) respondents' evaluators namely; fifteen (15) students, ten (10) teachers, and five (5) food business owners selling jams and other food products at Abra State Institute of Sciences and Technology, Bangued, Abra.

Data Gathering Instrument

1. **Microbial Analysis**

The microbial analysis of the jam was determined through laboratory tests at Mariano Marcos State University's Molecular Microbiology and Biotechnology Laboratory in Batac City, Ilocos Norte. All treatments underwent microbial analysis to detect the presence or absence of the test microbes and determine if the product was safe for human consumption.

2. Sensory Evaluation of the Products

Thirty (30) respondents were composed of ten (10) teachers, fifteen (15) students, and five (5) food business owners in Abra State Institute of Sciences and Technology Bangued Campus. Upon the approval of the request letter to conduct the research in ASIST, the respondents used the rubric assessment tool to assess the appearance, aroma, taste, and texture of the nine (9) treatments. The Sensory evaluation of manzanita jam treatments were carried out according to the sensory evaluation of food cited by Lawless & Heymann (2013) on Hedonic scale.

Samantha L.H., Arini B., Valerie M. Friesen, E. M. Konieczynski, and Jesse T. K., et al. (2023), titled "the sensory acceptability of biofortified foods and food products: a systematic review," mentioned that hedonic testing measures a consumer's liking, acceptance, or preference for a given product. Scales can vary from 1 to 5, 7, 9, or higher, with a 9-point scale being the most popular. The researcher was guided to use the 5-point hedonic to assess the sensory acceptability of the different products of manzanita jam. The indicators are scored using the 5-point scale: 5-Like a lot, 4- Like a little, 3- Neither like nor dislike, 2- Dislike a little, 1- Dislike a lot.

The evaluation of sensory acceptability of manzanita jam spreads was conducted three (3) times in a well-lit area, where the respondents were asked to assess each jam treatments following the given timeframe. The researcher displayed the jam packed in a bottle with labels and described the evaluation process before proceeding to the evaluation. In addition, water, 5-gram transparent containers, and plastic spoons are given to the respondents. The score reflected in the evaluation sheet was recorded, tabulated, analyzed, and interpreted.

3. Proximate Analysis

Micronutrient analysis determines the nutrient content of the manzanita jam spread using the AOAC method. Proximate analysis for the best formulation from each product was done according to the

standard AOAC (AOAC, 2016). Moisture content, crude fat, and ash were analyzed and calculated. This was conducted in DOST San Fernando City, La Union. Moreover, the protein content of the products was analyzed and calculated in the DOST3 building center, Brgy. Maimpis City, San Fernando, Pampanga. All formulations weighed approximately 250 grams.

4. Shelf-Life Analysis

A shelf-life analysis for manzanita jam spread requires understanding of the product's characteristics, packaging, storage settings, microbiological development, and regulatory requirements. A shelf-life analysis may guarantee the product's quality, safety, and marketability while lowering the risk of contamination and food waste. The results are the basis for creating effective preservation procedures and storage practices to prolong the shelf life of a product and maintain its quality over time. It also dictated the shelf life of manzanita jam.

5. Return of Investment

The calculation of manzanita jam total expenses were calculated to determine the income of the products.

Statistical Treatment of Data

The data gathered are treated statistically through the following tools:

1. **Mean.** This was used to determine the values of the formulations of Manzanita jams in terms of aroma, appearance, taste, and texture mean was employed.
2. **One Way Analysis of Variance (ANOVA).** This was used to determine the significant difference between and among the different treatments.
3. **Turkey Kramer Multiple Comparison Test.** This was used to measure the significant differences among the treatments.

Data Categorization

The different preparations were evaluated by respondents as to appearance, aroma, taste, and texture using the following rubric.

Appearance			
Point Scores	**Range Interval**	**Indicators**	**Descriptive Rating**
5	4.21 – 5.00	The jam is opaque with glossy sheen & has manzanita bits	Like a lot
4	3.41 – 4.20	The jam is slightly opaque with glossy sheen & has manzanita bits	Like a little
3	2.61 – 3.40	The jam is slightly opaque appearance with glossy sheen & has little manzanita bits	Neither Like nor Dislike
2	1.81 – 2.60	The jam is not opaque with glossy sheen & has no manzanita bits	Dislike a little
1	1.00 – 1.80	The jam has not met the specifications	Dislike a lot

Aroma			
Point Scores	**Range Interval**	**Indicators**	**Descriptive Rating**

5	4.21 – 5.00	The jam has a very "cotton candy-like smell that is pleasing	Like a lot
4	3.41 – 4.20	The jam has a “cotton candy-like smell that is pleasing	Like a little
3	2.61 – 3.40	The jam has a slightly “cotton candy-like smell that is pleasing	Neither Like nor Dislike
2	1.81 – 2.60	The jam has no “cotton candy-like smell that is pleasing	Dislike a little
1	1.00 – 1.80	The jam has no smell at all	Dislike a lot

Taste			
Point Scores	**Range Interval**	**Indicators**	**Descriptive Rating**
5	4.21 – 5.00	The jam has a very sweet manzanita flavor	Like a lot
4	3.41 – 4.20	The jam has a sweet manzanita flavor	Like a little
3	2.61 – 3.40	The jam has a slightly sweet manzanita flavor	Neither Like nor Dislike
2	1.81 – 2.60	The jam has no sweet manzanita flavor	Dislike a little
1	1.00 – 1.80	The jam has no detectable fruit flavor at all	Dislike a lot

Texture			
Point Scores	**Range Interval**	**Indicators**	**Descriptive Rating**
5	4.21 – 5.00	The jam is very chewy, has firm and sticky texture	Like a lot
4	3.41 – 4.20	The jam is chewy, has slightly firm and sticky texture	Like a little
3	2.61 – 3.40	The jam is slightly chewy, has firm and sticky texture	Neither Like nor Dislike
2	1.81 – 2.60	The jam is slightly not chewy, has no firm and sticky texture	Dislike a little
1	1.00 – 1.80	The jam has not met the specifications	Dislike a lot

CHAPTER III
RESULTS AND DISCUSSION

In this chapter, it provides a detailed description of the data collected, the methodology used for data analysis, and the statistical tests employed to analyze the results. It also presents the empirical evidence gathered. These sensory attributes such as texture, taste, appearance, and aroma were considered.

Findings

1. To Determine the microbial analysis of the different formulations.

Table 1. Microbial Analysis of Manzanita Jam Spread

Product Sample Code	Aerobic Plate Count (cfu/g) 10^4	Detection of Pathogens			
		Escherichia coli	Salmonella sp.	Staphyloccus aureus	Molds
T1 – 1 cup manzanita fruits + 1 cup granulated sugar	7.0	negative	negative	negative	negative
T2 – 1 cup manzanita fruits + 1 cup honey	9.0	negative	negative	negative	negative
T3 – 1 cup manzanita fruit + 1 cup	10.0	negative	negative	negative	negative

As indicated in Table 1, Treatment 1 (1 cup sugar) has the lowest microbial load of 7.0. Seconded by treatment 2 (1 cup honey) with aerobic plate count of 9.0. Finally, Treatment 3 (1 cup molasses) obtained the highest aerobic plate count of 10.0. All treatments are within the acceptable range, and no pathogens were found in the manzanita jam spread treatments.

This demonstrated that the researcher had correctly followed the sanitary method and that, in order to attain safe food handling, the practice must be continued.

2.1 To determine the level of acceptability in making manzanita jam spread in terms of Appearance.

Table 2.1. Sensory Acceptability Level and Significant Difference of Manzanita Jam Spread in terms of Appearance

Treatments	$\bar{x}$	DR
T1S1. 1 cup manzanita + 1 cup sugar	4.56a	Like a Lot
T1S2. 1 cup manzanita + 3/4 cup sugar	4.46a	Like a Lot
T1S3. 1 cup manzanita + 1/2 cup sugar	4.40a	Like a Lot
T2H1. 1 cup manzanita + 1 cup honey	4.46a	Like a Lot
T2H2. 1 cup manzanita + 3/4 cup honey	4.33a	Like a Lot
T2H3. 1 cup manzanita + 1/2 cup honey	4.32ab	Like a Lot
T3M1. 1 cup manzanita + 1 cup molasses	4.08bc	Like a Little
T3M2. 1 cup manzanita + 3/4 cup molasses	3.98c	Like a Little
T3M3. 1 cup manzanita + 1/2 cup molasses	3.97c	Like a Little
F-test	14.173^{**}	

Legend: >0.05 = not significant <0.05 = * <0.01 = **

Means with the same letter are not significantly different

As gleaned from the table, T1S1 (1 cup manzanita + 1 cup sugar) obtained a mean rating of 4.56, as the most acceptable formulation by the respondents in terms of appearance, with a descriptive rating of

"Like a Lot," seconded by T1S2 (1 cup manzanita + 3/4 cup sugar) with a mean rating of 4.46, followed by T2H1 (1 cup manzanita + 1 cup honey) with a mean rating of 4.46, T1S3 (1 cup manzanita + 1/2 cup sugar) obtained a mean rating of 4.40, T2H2 (1 cup manzanita + 3/4 cup honey) obtained a mean rating of 4.33, T2H3 (1 cup manzanita + 1/2 cup honey) obtained a mean rating of 4.32, All of the treatments obtained the same descriptive rating of "Like a Lot" respectively. T3M1 (1 cup manzanita + 1 cup molasses) obtained a mean rating of 4.08, T3M2 (1 cup manzanita + 3/4 cup molasses) obtained a mean rating of 3.98 and T3M3 (1 cup manzanita + 3/4 cup molasses) having the lowest mean rating of 3.97, all of the molasses treatments obtained the same descriptive rating of "Like a Little" respectively.

In addition, the test shows that there was high significant difference amongst the 9 treatments [F=14.173, p=0.000 (<0.01)]. Post-hoc test further revealed that pin-point exactly where the differences were located; T2H3 (1/2 cup) with a mean rating of 4.32 was significantly different from the means of T3M2 (3/4 cup) with p-value of 0.02 and high significantly different in T3M3 (1/2 cup) with p-value of 0.01. Similarly, both T3M2 and T3M3 have a high significant difference between the means of the T1S1 (1 cup), T1S2 (3/4 cup), T1S3 (1/2 cup), T2H1 (1 cup), T2H2 (3/4 cup) with p-value of 0.00 (<0.01).

Aside from the physical properties of manzanita jam, the color is the most distinguishing factor that supports the favorable acceptance of the respondents' evaluations. As Amos N. and Madoka H. (2023) remarked that the color intensity has an effect on the consumer's overall acceptance of the appearance. This supports that the difference between manzanita jam that is sweetened with molasses differed in color intensity of the sugar and honey treatments; jam sweetened with sugar and honey is golden brown in color, whereas jam sweetened with molasses has a dark brown color.

However, T1S1 to T2H3 showed no significant difference between the treatment's means [p = 0.196 (>0.05)]. The Institute of Food Science and Technology (Carbohydrates: Caramelization, 2018) states that further heating transforms the sugar from white to golden brown to dark brown. This proved that both sweeteners only have minor changes in the color of manzanita jam and are almost identical in color intensity. In addition, T2H3 and T3M1 also showed no significance, despite having different color intensities. Manzanita jam with the least concentration of sweetener tends to have a dull appearance, as stated by Benedek et al. (2020), which makes the jam less attractive than the other sugar and honey treatments.

2.2. To determine the level of acceptability in making manzanita jam spread in terms of Aroma.

Table 2.2. Sensory Acceptability Level and Significant Difference of Manzanita Jam Spread in terms of Aroma

Treatments	$\bar{x}$	DR
T1S1. 1 cup manzanita + 1 cup sugar	4.21	Like a Lot
T1S2. 1 cup manzanita + 3/4 cup sugar	4.10	Like a Little
T1S3. 1 cup manzanita + 1/2 cup sugar	4.08	Like a Little
T2H1. 1 cup manzanita + 1 cup honey	4.01	Like a Little
T2H2. 1 cup manzanita + 3/4 cup honey	3.98	Like a Little
T2H3. 1 cup manzanita + 1/2 cup honey	3.96	Like a Little
T3M1. 1 cup manzanita + 1 cup molasses	3.69	Like a Little
T3M2. 1 cup manzanita + 3/4 cup molasses	3.68	Like a Little
T3M3. 1 cup manzanita + 1/2 cup molasses	3.67	Like a Little
F-test	2.094^{NS}	

Legend: >0.05 = not significant <0.05 = * <0.01 = **

Means with the same letter are not significantly different

As reflected from the table, T1S1 (1 cup manzanita + 1 cup sugar) obtained a mean rating of 4.21 described as "*Like a Lot*," indicating high satisfaction with the treatment's aroma after opening the package. Seconded by T1S2 (1 cup manzanita + 3/4 cup sugar) obtained a mean rating of 4.10, followed by T1S3 (1 cup manzanita + 1/2 cup sugar) obtained a mean rating of 4.08, T2H1 (1 cup manzanita + 1 cup honey) obtained a mean rating of 4.01, T2H2 (1 cup manzanita + 3/4 cup honey) obtained a mean rating of 3.98, T2H3 (1 cup manzanita + 1/2 cup honey) obtained a mean rating of 3.96, T3M1 (1 cup manzanita + 1 cup molasses) obtained a mean rating of 3.69, T3M2 (1 cup manzanita + 3/4 cup molasses) obtained a mean rating of 3.68 and T3M3 (1 cup manzanita + 1/2 cup molasses), which obtained the lowest mean rating of 3.67, all obtained the same descriptive rating of "*Like a Little*" respectively.

As mentioned by Urszula T. and Maria T. E. (2017) A wide range of concentrations of aroma compounds may not only be found in the ingredients but also in their odor thresholds, which will contribute to the overall VOC equilibrium. According to Thomas Osborne, MD, on his blog, manzanita fruits have a cotton candy-like smell, which is what the researcher was aiming for. The study further revealed in terms of means level, however, sugar treatments are more favored by the respondents than honey and molasses. Erbao C., Huanlu S., Shuna Z., et al. (2021) noted that granulated brown sugar has fewer odor components than molasses with distinct scent of slight smoky or burnt sugar. In addition, the composition of honey can vary significantly from region to region or due to the variation of plants present (Colorado State University Extension, 2022), which explains why the aroma of honey is less uniform in composition due to variations in plants. Not to mention the study of Christy E. M., Roland N. N., and Anna M. C. (2011) states that honey produced from different floral sources may have distinctly different aromas due to differences in volatile composition and geographical origins. In that case, the honey's aroma affects the natural smell of the manzanita fruits as jam.

Hence, the idea that the aroma compound in granulated sugar has a minor impact on the overall aroma of manzanita jam and maintains the cotton-candy-like smell of the fruit leads to the highest mean value 4.21 compared to other treatments.

2.3. To determine the level of acceptability in making manzanita jam spread in terms of Taste.

Table 2.3. Sensory Acceptability Level and Significant Difference of Manzanita Jam Spread in terms of Taste

Treatments	$\bar{x}$	DR
T1S1. 1 cup manzanita + 1 cup sugar	4.56a	Like a Lot
T1S2. 1 cup manzanita + 3/4 cup sugar	4.58a	Like a Lot
T1S3. 1 cup manzanita + 1/2 cup sugar	4.36ab	Like a Lot
T2H1. 1 cup manzanita + 1 cup honey	4.27abc	Like a Lot
T2H2. 1 cup manzanita + 3/4 cup honey	4.40ab	Like a Lot
T2H3. 1 cup manzanita + 1/2 cup honey	4.27abc	Like a Lot
T3M1. 1 cup manzanita + 1 cup molasses	3.89abc	Like a Little
T3M2. 1 cup manzanita + 3/4 cup molasses	3.60bc	Like a Little
T3M3. 1 cup manzanita + 1/2 cup molasses	3.41c	Like a Little
F-test	**5.582****	

Legend: >0.05 = not significant <0.05 = * <0.01 = **

Means with the same letter are not significantly different

Table 2.3 shows the results of Sensory Acceptability Level and Significant Difference of Manzanita Jam Spread in terms of Taste. T1S2 (1 cup manzanita + 3/4 cup sugar), obtained the highest mean rating of 4.58 and a descriptive rating of "*Like a Lot*" among the respondents. Seconded by T1S1 (1 cup manzanita + 1 cup sugar) obtained the mean rating of 4.56, T2H2 (1 cup manzanita + 3/4 cup honey) obtained the mean rating of 4.40, T1S3 obtained the mean rating of 4.36, T2H1 (1 cup manzanita + 1 cup honey) obtained the mean rating of 4.27, T2H3 (1 cup manzanita + 1/2 cup honey) obtained the mean rating of 4.27, all of the treatments obtained the same descriptive rating of "*Like a Lot*" respectively. Hence, T3M1 (1 cup manzanita + 1 cup molasses) obtained the mean rating of 3.89, T3M2 (1 cup manzanita + 3/4 cup molasses) obtained the mean rating of 3.60, and T3M3 (1 cup manzanita + 1/2 cup molasses) obtained the lowest mean of 3.41, All of the treatments obtained the same descriptive rating of "Like a Little" respectively.

The taste of the mansanitas jam spread, like scent, helps to determine the overall flavor of food products. As stated by Urszula T. & Maria T.E. (2017). If the volatile molecules were not detected by the sense of smell, the sense of taste would be the deciding factor in determining flavor. The sensory description of jam with a distinct manzanita flavor served as the basis for respondents to rate the taste of the jam treatments.

The ANOVA analysis of this study indicates that the computed F value of 5.582, with a p-value of 0.001 (<0.01), demonstrates a highly significant difference between the various jam treatments. The data was subjected to further analysis using a post-hoc test to identify the specific differences. The T1S1 (1 cup) showed a significant difference with the T3M2 (3/4 cup) with a p-value of 0.03 and a high significant difference with the T3M3 (1/2 cup) with a p-value of 0.01. Similarly, T1S2 (3/4 cup) also showed a significant difference with T3M2 [p = 0.02 (<0.05)] and high significance with T3M3 [p = 0.00 (<0.01)]. The T1S1 and T1S2 exhibits a notable difference in taste compared to other treatments. The reason for this is that the sugar in manzanita jam did not fully modify the taste of the manzanita fruit. According to Winarno, F.G. (2004), flavor can be influenced by various elements such as chemical composition, temperature, concentration, and the interaction with other flavor components. With this, the respondents were able to detect the difference between sugar and molasses. This is because manzanita jam sweetened with molasses has an intense bittersweet taste, while granulated sugar tastes are innate. Additionally, there are significant differences between T3M3 v T1S3 (1/2 cup) with a p-value of 0.03 and T3M3 v T2H2 (3/4 cup) with a p-value of 0.02.

Despite their distinct flavors, the results also show that there are no significant differences between T1S1 and T3M1. In terms of means, however, sugar treatments have the highest approval with a descriptive rating of "like a lot." In honey treatments, T2H2 is higher than T2H1. This is because honey treatment exhibits a distinct flavor that can mask the natural flavor of the manzanita fruit, especially if there is too much concentration of honey, as mentioned by Winarno, F.G. (2004). Therefore, the respondents preferred a balance of concentration between the fruit and sweetener. Lastly, molasses treatments received the lowest means than honey; this is because molasses has an intense bittersweet taste, whereas honey offers a delicate floral sweetness, but both treatments were still accepted by the respondents.

2.4. To determine the level of acceptability in making manzanita jam spread in terms of Texture

Table 2.4. Sensory Acceptability Level and Significant Difference of Manzanita Jam Spread in terms of Texture

Treatments	$\bar{x}$	DR
T1S1. 1 cup manzanita + 1 cup sugar	4.51a	Like a Lot

T1S2. 1 cup manzanita + 3/4 cup sugar	4.48ab	Like a Lot
T1S3. 1 cup manzanita + 1/2 cup sugar	4.29bcd	Like a Lot
T2H1. 1 cup manzanita + 1 cup honey	4.48ab	Like a Lot
T2H2. 1 cup manzanita + 3/4 cup honey	4.57a	Like a Lot
T2H3. 1 cup manzanita + 1/2 cup honey	4.37abc	Like a Lot
T3M1. 1 cup manzanita + 1 cup molasses	4.30bc	Like a Lot
T3M2. 1 cup manzanita + 3/4 cup molasses	4.20cd	Like a Lot
T3M3. 1 cup manzanita + 1/2 cup molasses	4.09d	Like a Little
F-test	**14.648****	

Legend: >0.05 = not significant <0.05 = * <0.01 = **
Means with the same letter are not significantly different

Table 2.4 reveals that Manzanita jam sweetened with 3/4 cup of honey (T2H2) has the greatest mean rating value of 4.57 and a descriptive rating of "*Like a Lot*". Seconded by T1S1 (1 cup manzanita + 1 cup sugar) obtained the mean rating of 4.51, Followed by T1S2 (1 cup manzanita + 3/4 cup sugar) obtained the mean rating of 4.48, T2H1 (1 cup manzanita + 1 cup honey) obtained the mean rating of 4.48, T2H3 (1 cup manzanita + 1/2 cup honey) obtained the mean rating of 4.37, T3M1 (1 cup manzanita + 1 cup molasses) obtained the mean rating of 4.30, T3M2 (1 cup manzanita + 3/4 cup molasses) obtained the mean rating of 4.20, all of the treatments obtained the same descriptive rating of "*Like a Lot*" while T3M3 (1 cup manzanita + 1/2 cup molasses) obtained the lowest mean of 4.09 with a descriptive rating of "*Like a Little*."

Furthermore, the ANOVA test results indicates that there was a high statistically significant difference among the treatments [F = 14.648, p = 0.000 (<0.01)]. A post hoc test was utilized to precisely identify the locations of the differences. Treatment 1 sweetened with 200 g of sugar (T1S1) was significantly different from the means of T1S3 (100 g), with a p-value of 0.03. The respondents were able to detect the difference between T1S1 and T1S3 due to the rheological properties of both treatments. According to Mathlouthi and Génotelle (1995), the viscosity of sugar solutions increases with higher sugar content, which the T1S3 lacks. In addition, T1S1 was also significantly different from the means of T3M1 (1 cup) with a p-value of 0.04, and there were high significant differences with T3M2 (3/4 cup) and T3M3 (1/2 cup) with a p-value of 0.000. This is due to molasses, a byproduct of sugar, having a thicker consistency when melted and unevenly sized granules that affect the texture of the jam. Similarly, T2H2 (3/4 cup) has a high significant difference between the T1S3, T3M2, and T3M3 and low significance with T3M1 [p = 0.01 (<0.01)]. According to the study of Bolaji, O.T., Adeyeye, S. A. O., Ayodeji, F.R., and Fashakin, J.F. (2019) they found out that jams made with varying quantities of carrot and cucumber fruits with honey as a sweetener exhibited rheological and pseudo-plastic fluid behavior, both of which are required for jam making. Both T1S2 (3/4 cup) and T2H1 (1 cup) have high significance between T3M2 and T3M3. Lastly, T2H3 (1/2 cup) has a high significant difference with T3M3.

Based on the means level, almost treatments received a high approval from the respondents. The comparison of T2H2, T1S1, T2H1, T1S2, and T6M1 revealed no statistically significant difference in the regimens' means, with a p value of 0.059 (>0.05). In terms of means, however, T2H2 received a higher mean score than T1S1 due to the easy to scoop and firm texture of the jam treatment.

Therefore, manzanita sweetened with honey garnered the highest rating from respondents due to its chunkier and sticky texture, which appeared to have a pleasing mouthfeel. Finally, manzanita with molasses as a sweetener received the lowest rating but was nevertheless acceptable by the respondents.

2.5. To determine the Overall Acceptability Level and Significant Difference of Manzanita Jam Spread

Table 2.5. Overall Acceptability Level and Significant Difference of Manzanita Jam Spread

Treatments	x̄	DR
T1-S1. 1 cup manzanita + 1 cup sugar	4.46a	Like a Lot
T2-S2. 1 cup manzanita + 3/4 cup sugar	4.40a	Like a Lot
T3-S3. 1 cup manzanita + 1/2 cup sugar	4.28bc	Like a Lot
T4-H1. 1 cup manzanita + 1 cup honey	4.30bc	Like a Lot
T5-H2. 1 cup manzanita + 3/4 cup honey	4.34a	Like a Lot
T6-H3. 1 cup manzanita + 1/2 cup honey	4.23ab	Like a Lot
T7-M1. 1 cup manzanita + 1 cup molasses	4.00bc	Like a Little
T8-M2. 1 cup manzanita + 3/4 cup molasses	3.86c	Like a Little
T9-M3. 1 cup manzanita + 1/2 cup molasses	3.79c	Like a Little
F-test	**12.003****	

Legend: >0.05 = not significant <0.05 = * <0.01 = **

Means with the same letter are not significantly different

Table 2.5 shows the Overall Acceptability Level and Significant Difference of Manzanita Jam Spread, results shows that manzanita sweetened with 1 cup sugar (T1S1) obtained the highest mean rating of 4.46, described as “Like a Lot.” Seconded by manzanita jam with 3/4 cup of sugar (T1S2) obtained the mean rating of 4.40 with a descriptive rating of "*Like a Lot*.” Undoubtedly, because sugar is the traditional sweetener in making jam (T. Kurotobi, T. Hoshino, Y. Kazami, et al., 2018). Manzanita jam sweetened with 3/4 cup of honey (T2H2) obtained the third highest mean rating of 4.34. Followed by T2H1 (1 cup manzanita + 1 cup honey) obtained the mean rating of 4.30, T1S3 (1 cup manzanita + 1/2 cup sugar) obtained the mean rating of 4.28, T2H3 (1 cup manzanita + 1/2 cup honey) obtained the mean rating of 4.23, All of the treatments obtained the same descriptive rating of “Like a Lot”. T3M1 (1 cup manzanita + 1 cup molasses) obtained the mean rating of 4.00, T3M2 (1 cup manzanita + 3/4 cup molasses) obtained the mean rating of 3.86, and T3M3 (1 cup manzanita + 1/2 cup molasses) obtained the lowest mean rating of 3.79, all of the treatments obtained the same descriptive rating of “Like a Little”.

The ANOVA test results reveals a statistically significant variation among the treatments [F = 12.003, p = 0.000 (<0.01)]. A post hoc test was employed to accurately determine the specific locations of the differences. T1S1 exhibited a significant and substantial difference [p = 0.000 (<0.01)] in means compared to T3M1, T3M2, and T3M3. Similarly, T1S2 shows a statistically significant difference with T3M2, T3M3 (p = 0.000, which is less than 0.01), and T3M1 (p = 0.01, likewise less than 0.01). T3M2 exhibits a substantial disparity in importance when compared to T1S3, T2H1, and T2H2, but demonstrates a minimal disparity in significance when compared to T2H3. Similarly, T3M3 holds greater significance in comparison to T1S3, T2H1, T2H2, and T2H3.

In general, manzanita sweetened with sugar, honey, and molasses have distinct qualities that can be easily identified by the respondent evaluators in terms of overall attributes, as mentioned in the above discussions. However, the comparison of T1S3, T2H1, and T2H3, revealed no statistically significant differences in the regimens' mean values of all the treatments.

As a result of overall acceptability, manzanita jam sweetened with 1 cup sugar is the most preferred treatment by the respondents’ evaluator.

3. To determine the proximate analysis of the most acceptable manzanita jam spread.

Table 3. Proximate Analysis of Manzanita Jam Spread

Analysis Name	Jam	Methodology
Ash (g/1/2 cup)	0.86	Based on AOAC Official Method, 20th Edition, 2016
Moisture Content (g/1/2 cup)	30.85	Based on AOAC Official Method, 20th Edition, 2016
Crude Fat (g/1/2 cup)	0.06	Based on AOAC Official Method, 20th Edition, 2016
Total Carbohydrates (g/1/2 cup)	66.99	Based on AOAC International 21st Edition, 2019

Proximate compositions of jam spread were determined using the AOAC standard method. It was conducted on the most well-accepted jam treatment. As shown in Table 3, the ash content of jam is reported to be 0.90g per 1/2 cup of jam. This value indicates that the inorganic residue that remains after a food sample has been completely burned or ashed has a low level of mineral content. The moisture content of the jam was 30.85 g/100 g, which, when compared with a similar work produced from tropical fruits, ranged from 24.92% to 49.02% (Emelike and Akusu, 2019). This concludes that the manzanita jam has a slightly high moisture content but still remains at the normal level, which was preferable as this gave the product enough shelf life. The jam contains 0.06 g. of crude fats, which refers to the product having a low total fat content. On the contrary, the carbohydrate is 66.99 g. is high. This could be due to the high amounts of sugar (more than 40%) as well as the fruit peel used in the formulation (Suzy R. G., Koh C. C., et. al., 2019).

4. To determine the shelf life analysis of the most acceptable manzanita jam spread.

Table 4. Shelf-life of the Manzanita Jam Spread

Food Products *Samples for 33-day observation*	**Microbial Load (Total Plate Count) is 10^3 Period of Observation**				
Manzanita Jam	**Day 1**	**Day 3**	**Day 6**	**Day 9**	**Day 12**
	12.0 (N)	12.0 (N)	17.0 (N)	20.0 (N)	22.0 Molds
	Day 15	**Day 18**	**Day 21**	**Day 24**	**Day 27**
	22.0 Molds	25.0 Molds	26.0 Molds	28.0 Molds	31.0 Molds
	Day 30	**Day 33**			
	30.0 Molds	32.0 Molds			

The presence of mold in the jam was seen on the 12th day, as indicated in Table 4. Stating that the product must be consumed within a maximum of 12 days from the date of production. This implies that a decrease in moisture content is necessary to extend the longevity of the product. The microbial load of both goods falls within an acceptable limit and does not include any pathogens.

5. To determine the return of investment of manzanita jam spread.

Table 5. Cost and Return Analysis of Manzanita Jam Spread

Particulars									
Treatment	**T1S1**	**T1S2**	**T1S3**	**T2H1**	**T2H2**	**T2H3**	**T3M1**	**T3M2**	**T3M3**
Yields	2.5/ 3/4 cup	2/ 3/4 cup	1.5/ 3/4 cup	2.5/ 3/4 cup	2/ 3/4 cup	1.5/ 3/4 cup	2.5/3/ 4 cup	2/3/4 cup	1.5/3/4 cup
Sales	200	150	120	200	160	120	200	160	120
Total Expenses	60	55	50	165	133	101	101	85	70
Net Income	140	105	70	35	27	19	99	75	50
ROI's	**233%**	**190.90%**	**140%**	**21.21%**	**20.30%**	**18.81%**	**98.01%**	**88.23%**	**71.43%**

Table 5 presents a cost-benefit analysis of raw components for manzanita jam made with various sweeteners. Manzanita jam yields are equivalent across treatments due to the uniformity of jam bottles used (100 ml) and bottle weight capacity (180g). Treatment 2 can yield two bottles of manzanita jam; Treatment 3 can fill a bottle of one and an additional half-bottle; and Treatment 1 can fill a bottle of two and an additional half-bottle for each treatment.

Treatments sweetened with honey has the highest total expenses of the production of manzanita jam spread, followed by treatments with molasses as sweeteners. On the other hand, treatments with sugar demonstrates the lowest cost. Their production costs differ solely in the cost of sweeteners, with honey being the highest cost worth 250 pesos per 700ml bottle and sugar being the least expensive for only 50 pesos per 500g. The cost of preserves in the Philippines can vary depending on the brand, fruit type, and packaging materials. Online, there is a wide range of fruit jams available for purchase at various rates, starting from 60 pesos and going up. All Treatment are priced at 80 pesos. Thus, sugar treatments have the largest net income, resulting in a return on investment (ROI) of T1S1 (233%), T1S2 (190.90%), and T1S3 (140%) and honey have the lowest ROI than molasses.

Conclusions

The findings of this study have led to several important conclusions.

1. Manzanita jam spread, sweetened with sugar, is the most accepted in terms of appearance, aroma, and taste, followed by honey by its texture.
2. All manzanita jam spread formulations are accepted by the respondents. Therefore, honey and molasses are suitable alternative to sugar in making manzanita jam spread.
3. The amount of carbohydrates is within the usual range; therefore, a daily carbohydrate intake guideline is roughly 45 to 65 percent of daily calories, which equates to approximately 225 to 325 grams. Even so, the manzanita jam spread should be consumed in moderation due to its sugar content.
4. The manzanita jam spread has low shelf life over the course of 12 days of storage.

Recommendations

From the conclusion, the following recommendations are hereby given.

1. The texture of manzanita sweetened with sugar should be improved.
2. Future researchers should investigate and develop a method to reduce the carbs in manzanita spread products. Lowering carbohydrate intake can help diabetics manage their glucose levels.
3. Specific mineral contents of manzanita jam spread should be studied further in order to improve the health benefits.
4. Future researches should look into the best formulations and procedures for increasing the shelf life of Manzanita products.
5. A feasibility study is recommended in order to determine the marketability of the manzanita jam spread.

References

A. Published Books

1. Liza Angelica D. Barral, BAR Digest October-December 2012 Issue (Vol. 14 No. 4)
2. Preethi, K., Vijayalakshmi, N., Shamna, R. and Sasikumar, J. M. (2010). "In vitro, the antioxidant activity of extracts from fruits of Muntingia Calabura Linn Food Sci" p. 23-34.
3. MSA Fakir1, MM Rahman, MM Hasan, S Moonmoon, and MM Rahman, (2018). "Flower morphology and fruit maturity of four minor fruits (Diospyros peregrina, D. discolor, Muntingia calabura and Careya arborea) of Tropics and subtropics". International Journal of Minor Fruits, Medicinal and Aromatic Plants. Vol. 4 (2): 18-27 December (2018) https://www.ijmfmap.in/pdf_vol4_2/vol_4_2_4.pdf
4. H. Lawless & H. Heymann (2013). "Sensory Evaluation of Food: Principles and Practices" Springer Science & Business Media, Dec 11, 2013 - Technology & Engineering - 827 pages

B. Journals

Winarno, F.G., 2004. Kimia Pangan dan Gizi. [Food Chemistry and Nutrition]. PT Gramedia Pustaka Utama, Jakarta, Pages: 253.

C. Online Journals

1. Stuart PD, Braley (2016). "The biosynthesis and nutritional uses of Manzanita (Muntingia Calabura Linn)". Prog in Lip Res 43:228-265.
2. Gayathri, T., Mohan, T. C. K. and Murugan, K. (2007) cited in their "Purification and Characterization of Polygalacturonase-3 from Muntingia Calabura Linn."
3. Mahmood N.D., Nasir N.L., et al. (2014) "Muntingia Calabura: A review of its traditional uses chemical properties and pharmacological observations." Pharmaceutical Biology Volume 52-Issue 12, pages 1598-1623. Online: https://doi.org/10.3109/13880209.2014.908397
4. Areces-Berazain F, (2016). Muntingia calabura (Jamaica cherry). "Invasive Species Compendium." Wallingford, UK: CABI. Online: https://www.cabi.org/isc/datasheet/35164
5. G.A. Pereira, H.S. Arruda et al. (2018). "Carbohydrates, volatile and phenolic compounds composition, and antioxidant activity of calabura (Muntingia calabura L.) fruit". Food Research International Volume 108, pages 264-273. https://www.sciencedirect.com/science/article/pii/S0963996918302229
6. A. Lang (2019). "What's the difference between Jam and ?". Nutrition – Healthline https://www.healthline.com/nutrition/-vs-jam

7. K. Urbaniec, M. Grabowski, J. Wernik (2013). "Applications of Process Integration Methodologies in Beet Sugar Plants". Handbook of Process Integration (PI). Pages 883-913. https://www.sciencedirect.com/topics/engineering/sugar-production
8. Samantha L.H., Arini B., Valerie M. Friesen, E. M. Konieczynski, and Jesse T. K., et al. (2023), titled "the sensory acceptability of biofortified foods and food products: a systematic review." Nutrition Reviews, nuad100, https://doi.org/10.1093/nutrit/nuad100
9. Bolaji O.T., Adeyeye, S. A. O., Ayodeji, F.R., Fashakin, J.F. (2019). "Physicochemical, Rheological and Sensory Attributes of Honey Sweetened Jam Produced from Blends of Carrot and Cucumber." Journal of Food Stability, 2 (2): 1-14 DOI: 10.36400/J.Food.Stab.2.2.2019-0012
10. Amos N. and Madoka H. (2023), Title: "Use of Hydrocolloids to Control Food Appearance, Flavor, Texture, and Nutrition." First Edition published 2023, John Wiley & Sons Ltd. Production Since 1807, page 40-48. Htpps://leen.loc.gov/2022048787
11. Erbao Chen, Huanlu Song, Shuna Zhao, Chen Liu, Long Tang, and Yu Zhang (2021), Titled: Comparison of odor compounds of brown sugar, muscovado sugar, and brown granulated sugar using GC-O-MS. LWT-Food Science and Technology, Volume 142, May 2021, 111002.
12. Christy E. Manyi-Loh, Roland N. Ndip, and Anna M. Clarke (2011), Title: "Volatile Compounds in Honey: A Review on Their Involvement in Aroma, Botanical Origin Determination and Potential Biomedical Activities." Published online 2011 Dec 20. doi:10.3390/ijms12129514
13. Kurotobi, T., Hoshino, T., Kazami, Y., Hayakawa, F., & Hagura, Y. (2018). Relationship between sensory analysis for texture and instrument measurements in model strawberry jam. Journal of Texture Studies, 49(4), 359–369. https://doi.org/10.1111/jtxs.12348
14. Gindi, S. R. A., Koh, C. C., Chua, S. P. L., & Ling, H. S. (2019). Physicochemical Characteristics and Proximate Analysis of Fruit Jam from Baccaurea angulata Peel. Borneo Journal of Sciences and Technology. https://doi.org/10.35370/bjost.2019.1.2-11
15. Okudu, H. (2015). The chemical and sensory properties of juice developed from two varieties of monkey kola (Cola parchycarpa, Cola lepidota). African Journal of Food Science and Technology, 06(06). https://doi.org/10.14303/ajfst.2015.048
16. Clemente-Suárez, V. J., Mielgo-Ayuso, J., Martín-Rodríguez, A., Ramos-Campo, D. J., Redondo-Flórez, L., & Tornero-Aguilera, J. F. (2022). The burden of carbohydrates in health and disease. Nutrients, 14(18), 3809. https://doi.org/10.3390/nu14183809
17. Carbohydrates: caramelisation. (2018, June 22). Institute of Food Science and Technology. https://www.ifst.org/lovefoodlovescience/resources/carbohydrates-caramelisation
18. Benedek, C., Bodor, Z., Merrill, V. T., Kókai, Z., Gere, A., Kovács, Z., Dalmadi, I., & Abrankó, L. (2020). Effect of sweeteners and storage on compositional and sensory properties of blackberry jams. European Food Research & Technology, 246(11), 2187–2204. https://doi.org/10.1007/s00217-020-03564-2
19. Colorado State University Extension. (2022b, September 7). Sugar and sweeteners – 9.301 - Extension. Extension. https://extension.colostate.edu/topic-areas/nutrition-food-safety-health/sugar-and-sweeteners-9-301