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Development of an alcoholic beverage based on sweet cucumber (Solanum Muricatum), for application in cocktails

Desarrollo de una bebida alcohólica a base de pepino dulce (Solanum Muricatum), para la aplicación en coctelería

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Abstract.
The present work is focused on the alcoholic fermentation of sweet cucumber (Solanum Muricatum) for its subsequent implementation in the cocktail bar. Based on the foregoing, bibliographic studies were carried out to obtain information that supports the creation of the three experimental designs developed, by means of a quantitative methodology; had a fermentation time of twenty days, measuring pH, temperature, Brix degrees and their alcoholic content. The results achieved were led to an analysis of the aromatic profile of attributes, which gave the effect that their correct temperature ranges between 14 and 16 ° C, highlighting citrus and fruit aromas, greatly facilitating combinations of the realization of the cocktails, which were subjected to a hedonic test, concluding that the product with greater acceptability is the cocktail by direct method of tree tomato and grape.

Key words.
Fermentation, Solanum Muricatum, Experimentation, Aromatic Profile, Cocktails.

Resumen.

El presente trabajo se encuentra enfocado en la fermentación alcohólica del pepino dulce (Solanum Muricatum) para su posterior implementación en la coctelería. Basados en lo anterior se procedió a realizar estudios bibliográficos para obtener información que abalen y sustenten la creación de los tres diseños experimentales desarrollados, por medio de una metodología cuantitativa; los cuales tuvieron un tiempo de fermentación de veinte días, midiendo pH, temperatura, grados Brix y su contenido alcohólico. Los resultados alcanzados fueron llevados a un análisis de perfil aromático de atributos, los que dieron como efecto que su servicio ideal en boca oscila entre los 14 y 16°C, resaltando aromas cítricos y frutales, facilitando en gran medida las combinaciones de la realización de los cócteles, mismos que fueron sometidos a una prueba hedónica, llegando a la conclusión que el producto con mayor aceptabilidad es el cóctel por método directo de tomate de árbol y uvilla.

Palabras clave.
Fermentación, Solanum Muricatum, Experimentación, Perfil Aromático, Cócteles.

1. Introduction

This work aims to develop an alcoholic beverage based on the fermentation of sweet cucumber (Solanum Muricatum) for use in mixology. It is carried out as a result of the limited knowledge of the fruit within the country.

According to [1] “This is because its cultivation is generally intended for export, with approximately sixty thousand tons being exported annually, leaving only the rejects for domestic consumption."

As studied by [2] ouis Pasteur discovered fermentation in 1822 and described it as a metabolic process where yeast acts on different compounds to convert them into ethanol, butyric acid, and lactic acid, which help extend the shelf life of foods.

It can be defined that "To achieve a good fermentation process, it must develop an anaerobic reaction" [3].

1.1. Fermentation

Fermentation, discovered by Louis Pasteur in 1822, is a metabolic process in which yeasts and other bacteria transform organic chemical compounds in sugars to convert them into ethanol, butyric acid, and lactic acid.

These processes have been used by humans for more than 4,000 years to preserve food and produce grocery beverages. [2].

One of its most important characteristics is that it has an anaerobic reaction, meaning it occurs in the absence of oxygen, and its most common fermentations include wine, bread, and beer [3].

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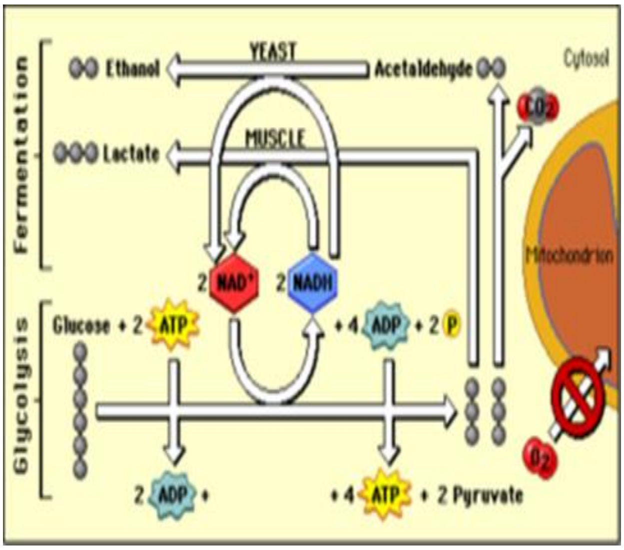


Figure. 1. Fermentation as a Mechanism of Energy Production
Source: Taken from [4]
https://www.lifeder.com/fermentacion/

1.2. Alcoholic Fermentation

The most common among all fermentations is the transformation of sugars, typically glucose, fructose, and sucrose, into ethanol. Its primary function is to provide anaerobic energy to unicellular microorganisms in the absence of oxygen and to produce carbon dioxide in the presence of yeasts [5]

Saccharomyces cerevisiae is the species most frequently used, although it can also be developed from fungi such as Zymomonas mobilis, but its utilization in the industry is lower.

These yeasts, in the context of fermentation, are considered one of the primary raw materials, so it is important to control their cultivation, growth, and longevity. Temperature plays the most important role, with 29ºC to 35ºC being the optimal range. If temperatures rise above this range, the microorganisms will begin to die, causing the fermentation process to stop. It is necessary to follow a specific order to ensure a stable fermentation [6].

Its chemical equation for ethanol production is C6H12O6 (glucose) → 2 C2H5OH (ethanol) + 2 CO2 (carbon dioxide) (Mazliah, 2015).

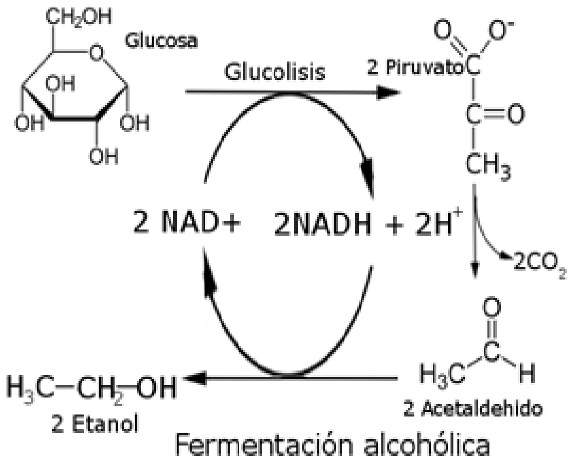


Figure. 2. Alcoholic Fermentation Proces
Source: Taken from [4]
https://www.lifeder.com/fermentacion/

1.3. Types of Alcoholic Fermentation

Industrial Fermentation. A method that takes place using a device called a fermenter, to which different substances that make up a culture medium are added. These substances are transformed through microbial reactions into metabolites and biomass [7].

The containers are airtight, allowing for the removal of remaining carbon dioxide through channels. Throughout the process, microorganisms increase their concentration while changing their chemical properties, creating new products through anabolic reactions [8].

Natural Fermentation. This occurs spontaneously in the environment as long as sugars are present and the atmosphere has low oxygen levels; for this reason, it is common to see some fruits undergoing a ripening process, such as melons or coconuts. [8]

Specific Fermentation. These are fermentations manipulated by humans to produce alcohol. They primarily use fruits, cereals, and milk; the production of beverages depends on the local environment and the available raw materials. For example, in Latin America, corn is used; in Asia, rice; and in the Mediterranean, grapes. This explains why the fermentation process varies by country. [8]

1.4. Factors Influencing Alcoholic Fermentation.

Substrate Concentration. Alcoholic fermentation should begin with a concentration between 12º and 22º Brix. If the concentration is too low, the alcohol content will be deficient, but if it is too high, fermentation will not occur because the osmotic pressure exerted on the yeast is too great, preventing them from acting on the sugars. [9]

1.5. Uses of Alcoholic Fermentation

Fermentation has four main purposes.

- Enrichment of daily intake through the variety of aromas, textures, and flavors in food.
- Preservation of food through acetic and lactic acid fermentations, alkaline fermentations, and ethanol.
- Detoxification during food fermentation processes.
- Reduced cooking time. [10]

Fermentation can produce or eliminate nutrients and antinutrients; additionally, foods tend to be better preserved, inhibiting the growth of undesirable microorganisms.

1.6. Disadvantages of Alcoholic Fermentation

These can occur as a result of improper use of products and requirements needed for fermentation. The most common issue is temperature, which can alter cell anabolism and decrease overall productivity. [11]

Another factor is the density of nutrients in the medium; if this is exceeded, osmotic pressure causes water loss, leading to a reduction in the volume of fermentation. Similarly, alcohol concentration can affect cell management, impairing nutrient transport. [12]

1.7. Yeast

The INEN standard mentions that yeasts are:
Fungi whose usual and predominant growth form is unicellular. They have highly variable morphology: spherical, ovoid, pyriform, cylindrical, triangular, or even elongated, in the form of true or false mycelium. Their size exceeds that of bacteria. Like molds, they cause spoilage in food products, especially in those with high acidity and osmotic pressur [13].

Undoubtedly, yeasts have a very positive impact on human life, providing significant benefits in various areas, such as food, beverages, and even pharmaceuticals. They are so important that they are found in the three most consumed foods worldwide: wine, bread, and beer [14]

Table 1.
Chemical Composition of Yeasts.

Carbohydrates	18 – 44%
Nucleic Acid	4 – 8 %
Proteins	36 – 60%
Lipids	4 – 7 %
Total Inorganics	6 – 10 %
Sulfate	0,4 %
Phosphorus	1 – 3 %

Note: Taken from "Evaluation of Cane Molasses as a Substrate for the Production of Saccharomyces Cerevisiae" [15] The table shows the standard chemical composition of yeast, where carbohydrates are the highest percentage and lipids the lowest. This determines how stable each one is, as the composition may be affected depending on the family, genus, or medium of use.

2. Materials and Methods.

2.1. Design.

First. The must will be extracted from the sweet cucumber, which is of the elongated and small species. The juice will be extracted by processing the fruit, and with the help of a sieve and cloth, it will be clarified to remove impurities from the must. This preparation will be called (CL), named so because only yeast belonging to the Saccharomyces Cerevisiae genus will be added to the must, aiding in the fermentation process.

Second. The must will be extracted from the sweet cucumber, which is of the elongated and small species. The juice will be extracted by processing the fruit, and then clarified with the help of a sieve and cloth to remove impurities from the must. This preparation will be called (CCA10%), named because yeast belonging to the Saccharomyces Cerevisiae genus and 10% sugar will be added to the must.

Third. The must extracted from the sweet cucumber will be of the elongated and small species. The juice will be extracted by processing the fruit, and with the help of a sieve and cloth, it will be clarified to remove impurities from the must.
This preparation will be called (CLCA20%), named so because 20% sugar and yeast belonging to the Saccharomyces Cerevisiae genus will be added to the must, helping to accelerate the fermentation process.

2.2. Materials and Equipment - Concepts and Brands Used in the Fermentation Process

- *Balance*: Utensil used to measure weight or volume. (Brand: CAMRY model EK9450)
- *pH-meter*: Sensor used to measure the dissipation of a food. (Brand: McolorpHast – TM series 1.09535.001)
- *Alcoholmeter*: Device used to measure the alcohol level in a liquid or gaseous substance, as well as the alcohol level in humans. (Brand: "Al-AmbikR" number C2135, measurement scale 60%)
- *Thermometer*. Instrument used to measure temperature in the environment, human body, and food; can be made of glass or liquid crystals. (Brand: Celex, model 512060/110/150)
- *Processor*. Appliance used to process food. (Brand: Osterizer blender classic, series 4655: capacity 1.25 liters, 3 speeds.)

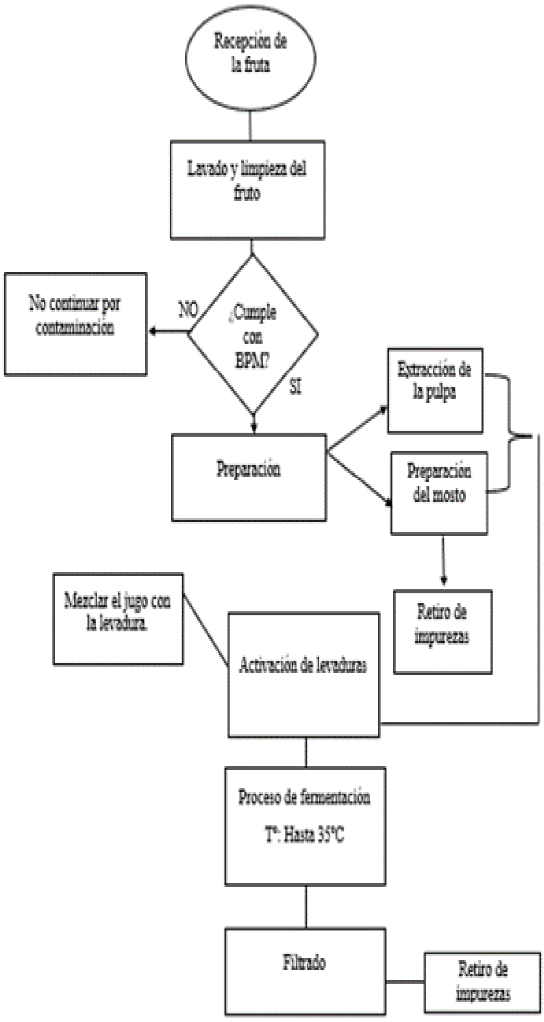
- *Refractometer*: Device used to measure solutions with a high sugar level. (Brand: Abbemat, model Abbemat200)
- *Sieve*: Kitchen utensil used to separate substances, available in different thicknesses to effectively remove impurities. (Brand: TORPLAS)
- *Containers*: Instrument used to store large quantities of liquids. (Brand: REY, capacity 2 gallons)
- *Cloth*: Medium primarily used to retain impurities from a substance, allowing only the solution to pass through.
- *Stove*: Equipment used to transfer heat. (Brand: Indurama)
- *Tongs*: Utensil used to dip or remove generally hot food. (Brand: Stainless-INOX)
- *Knife*: Utensil used to cut food. (Brand: HOWWAY, number ISO8442-1S)
- *Spoon*: Utensil generally used to serve food. (Brand: STAINLESS STEEL)
- *Graduated Cylinders*: Instrument used to measure volumes accurately. (Brand: Hecht, 25 ml glass)

2.3. Substances and Reagents

- Sweet cucumber juice
- Sugar (yeast food)
- Citric or sulfuric acid (pH regulator)
- Saccharomyces cerevisiae yeast (fermenting microorganism)

2.3.1. Alcoholic Fermentation

- For the selection of raw material, fruits without bruises or microorganisms that could affect or alter the fermentation process, such as molds, will be chosen.
- The sterilization of utensils will be done with a 70% alcohol solution and then left in boiling water for 5 minutes.
- When washing the fruit, the order indicated in the standard (NTE INEN 2870, 1992) will be followed to reduce microbial contamination risks.
- Once both the sanitization and sterilization of the fruit, as well as the utensils, are ready, the seeds will be removed.
- To remove juice impurities, it will be passed through a cloth, thus altering the fermentation process.
- With the help of a refractometer and a pH meter, the initial Brix degree and pH will be taken.
- Depending on the different variables, the different experimental designs will be carried out, with the first being CL, the second CLCA10%, and the third CLCA20%, thus starting the fermentation process.
- The fermentation process will last for 20 days in a place free from ultraviolet rays, at a temperature range of up to 35 ºC. It should not be left for longer than the indicated time, as it will then start the process for making vinegar.
- Daily pH and temperature samples will be taken to monitor the changes.
- After the fermentation period, the product will be matured through storage [16].



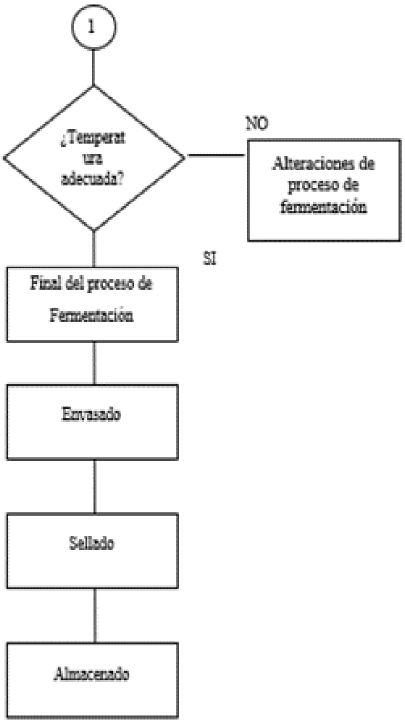


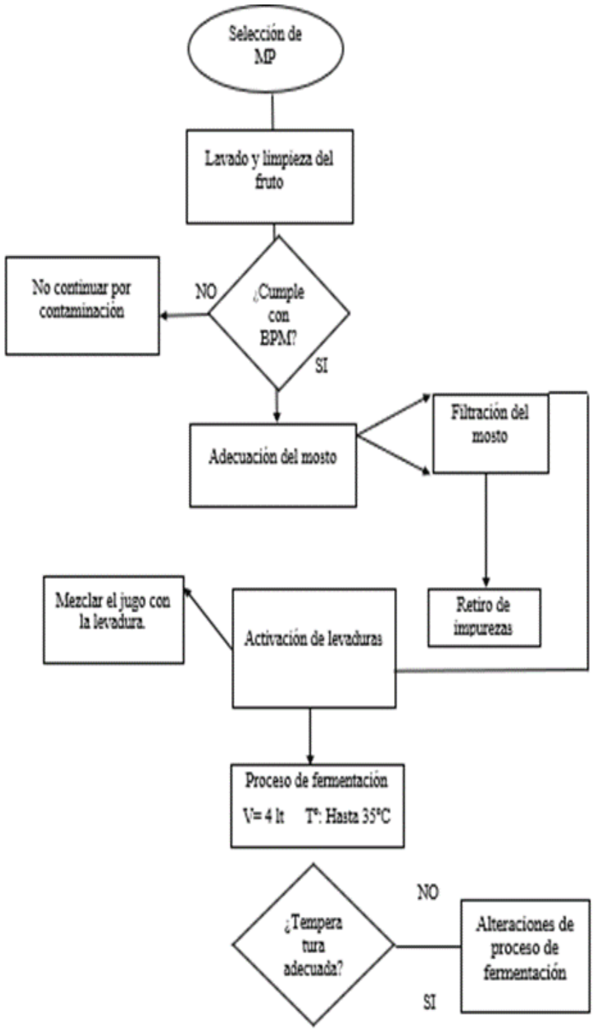
Figure. 3 Flowchart of Alcoholic Fermentation with Fruits
Source: Taken from "Ibero-American Journal of Sciences, Technology, and Society" [17]

2.3.2 Ethanol Determination.
Daily samples of the three designs will be taken to verify the changes that occur in each of them and subsequently measure their attributes.

With the help of an alcoholmeter, the alcohol degree can be measured and determined, which must reach a minimum of 8º and must not exceed 96º to prevent the production of methanol (a naturally harmful gas for humans) in the case of the distillation process [18].

2.3.3. pH and Temperature Control.

Daily samples will be taken to monitor their pH, which in the final stage of fermentation must reach 4 as established in the NTE INEN 0374 standard. This procedure will be carried out with the help of pH meter strips, and the temperature must not exceed 35ºC to avoid affecting the fermentation process.



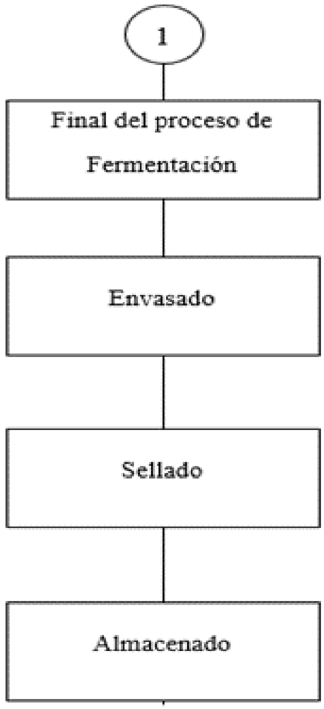


Figure. 4 Flowchart of the Fermentation and Distillation Process of the Experimental Procedure

2.3.4. Experimental Data

Creation of the Airlock for the Fermentation Process.
To carry out the fermentation process, the Airlock was first created, using the following elements:

- Three glass jars
- Three 1-meter hoses
- Plastic caps
- Drill for making holes in the center of the caps
- Three plastic buckets with valves to be used as fermentation vessels.

Next, sanitization, disinfection, and sterilization of each element to be used were performed, following the Good Manufacturing Practices (GMP). The instruments were washed with neutral soap and then boiled in water at 80ºC for five minutes for sterilization to eliminate any microorganisms.

After completing the procedure, the instruments were placed on kitchen towels to dry, and then sprayed with 71% alcohol to ensure they were free of microorganisms.

The three glass jars, which were used to expel carbon dioxide, were filled with 350 ml of water and 50 ml of alcohol to prevent any microorganisms, although this is not strictly necessary.

The jars should not be sealed completely, as this will facilitate the expulsion of carbon dioxide (CO2).

Preparation of Sweet Cucumber Juice for Fermentation.
To prepare the sweet cucumber juice, the fruit was first disinfected according to the standard [19], which specifies placing the fruit in a tray of water and adding 15 ml of baking soda, vinegar, or lemon for 20 minutes to eliminate nearly 100% of toxic substances present. The person handling the food must have disinfected their hands beforehand, as well as all surfaces and utensils to be used. Fruits with cuts, lesions, or damage should be discarded, and all fruit should be cleaned with cold water before consumption.

After cleaning and disinfecting, the fruit was cut, processed, and strained through a sieve. This last step was repeated three times for each design to remove as many impurities as possible. A total of 12,000 ml of substance was used, with each design receiving 4,000 ml for subsequent fermentation.

Results of the CL Experiment.

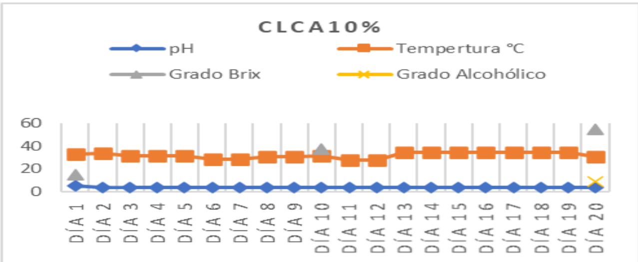


Figure. 5 Schematic of the Curve for the CL Experiment Design

A total of 4,000 milliliters of natural juice was obtained, with no additional substances added, as the goal was to demonstrate that the fermentation process would not occur due to a lack of nutrients. On the first day, its color was dark brown, and its pH was 5.

As time passed, its color gradually lightened to a light brown and eventually turned golden, but its odor became increasingly unpleasant until, by the fifth day, the substance was entirely compromised.

According to the literature reviewed, this happened because the substrate content was too low, with the Brix degrees not exceeding the minimum value (12°), resulting in the process not being completed.

The design ended with a Brix level of 10 degrees, rendering the experiment invalid. The odor remained unpleasant, the color stayed a light golden, and the pH dropped to 2.

Results of the CLCA10% Experiment Design.

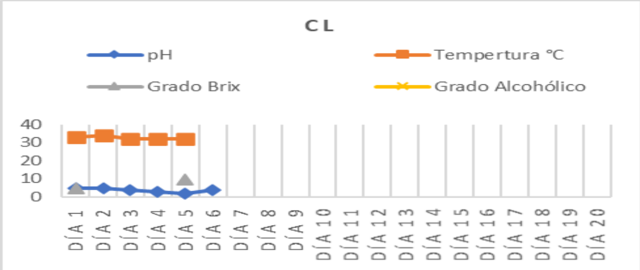


Figura. 6 Schematic of the Curve for the CLCA10% Design
Note: Prepared by the Authors

To the 4,000 milliliters of content, 22 grams of yeast were added, as 11 grams should be added for every 2,000 ml, along with 500 grams of sugar. On the first day, its pH was 5, the temperature was 33°C, the Brix degree was 15, the color was dark brown, and it maintained a pleasant odor. On the second day, the pH dropped to 4, the temperature was 34°C, and the other organoleptic characteristics remained the same. By the third and fourth days, the pH remained at 4, the temperature was 32°C, the color lightened to a light brown, and the yeast began to settle. The carbon dioxide bubbles were much faster during the sixth, seventh, eighth, and ninth days. The pH remained at 4, the color turned to a light golden, the odor was pleasant, and the carbon dioxide bubbles slowed down significantly. The yeast had settled by 65%, with temperatures of 29°C on the sixth and seventh days and 31°C on the eighth and ninth days. In the following days, the yeast had fully settled by 100%.

On the tenth day, the Brix degree was 37.6, the pH remained at 4, and the temperature was 32°C. On the eleventh and twelfth days, the temperature was 28°C, and from the thirteenth to the nineteenth day, it was 35°C. On the final day, the temperature was 31°C, the sugar level ended at 55 degrees Brix, and the alcohol content was 9%

Results of the CLCA20% Experiment Design.

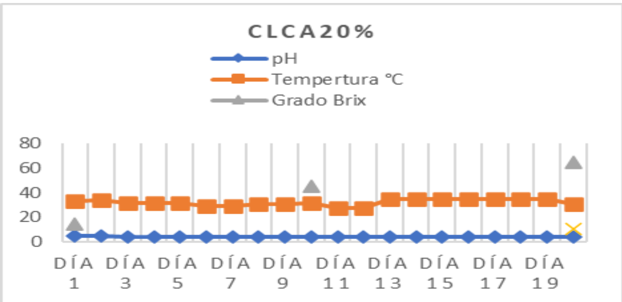


Figura. 7 Schematic of the Curve for the CLCA20% Design
Note: Prepared by the Authors

The 4,000 ml of substance was used, to which 1,000 ml of sugar and 11 grams of yeast were added. On the first day, the pH was 5, the color was dark brown, and the aroma was similar to that of a melon, with a temperature of 33ºC. On the second day, the pH remained at 5, and the other organoleptic characteristics were maintained, with a temperature of 34ºC. On the third day, the pH dropped to 4, the color lightened to a light brown, and the carbon dioxide bubbles became larger and more frequent, with a temperature of 32ºC. On the sixth and seventh days, everything remained the same, but the temperature rose to 29ºC. By the eighth and ninth days, the color changed to cream, the aroma became stronger, and the temperature was 31ºC. The carbon dioxide bubbles slowed down, and on the tenth day, the color turned to a light golden, the aroma intensified, the flavor became much stronger, and the pH remained at 4. The Brix degrees were 45.3, and the temperature was 32ºC. On the eleventh and twelfth days, the temperature was 28ºC. From the thirteenth to the nineteenth day, it was 35ºC, and on the last day, it was 31ºC. The final product had a strong golden color, an aroma similar to melon, and a flavor reminiscent of melon or peach. The Brix degrees were 65, and the alcohol content was 11%.

Attribute Profile Analysis

After completing the fermentation process, it was deemed necessary to conduct an aromatic profile analysis of the beverage obtained, to guide possible combinations with other products or ingredients. The final product was evaluated by three certified tasters from the institution "Catadores Profesionales del Ecuador S.A." The analyses were conducted at temperatures of 10°C, 14°C, and 16°C for optimal aromatic expression.

CLCA10% Result:

The sample presents a coppery yellow color. At 10°C, it has an aroma of pear, overripe apple, and low alcoholic warmth. At 14°C, notes of citrus zest, sweet cucumber, watermelon melon, sweet potato, and ripe naranjilla are perceived. At 16°C, the notes of cucumber intensify, and hints of peach, ripe squash, guava, banana, papaya, carrot, and acacia flowers are added.

On the palate, it is dry, well-attenuated, with some alcoholic warmth and medium-low acidity. The aftertaste reveals sour and slightly bitter tones. The mouth aromas are reminiscent of sweet cucumber and overripe naranjilla, achieving a good aromatic expression.
Possible combinations include fruits such as watermelon, melon, pineapple, guava, and strawberry.

CLCA20% Result:

The sample has a moderate to high golden copper tone. At 10°C, it is clearer than the 10% sample, with tones of peach, low-intensity cucumber, and ethyl acetate. At 14°C, naranjilla aromas emerge, while the notes of cucumber and peach remain, and the tones of alcoholic warmth increase. At 16°C, the aromas of cucumber, sweet squash, mandarin, and to a lesser extent, peach, guava, and banana are emphasized, along with an increase in alcohol content. It has a warm presence with greater mouth volume than the 10% sample, with high fruity acidity. The mouth aromas are reminiscent of cucumber, cooked apple, and moderate to low-intensity guava, along with an increased presence of ethyl acetate and alcohol.

This sample is recommended for preparations with a high alcohol content, and fruits such as pomegranate, orange, grapefruit, blackberry, strawberry, kiwi, blueberry, and goldenberry can be used.

3. Results

<u>Application of Fermented Sweet Cucumber (Solanum Muricatum) Beverage in Mixology</u>

In relation to the results of the aromatic profile analysis in the previous chapter, various experiments will be conducted to create cocktails, aiming to find the best formulations before performing the corresponding hedonic test.

3.1. Experiments: Variables

After completing the aromatic profile analysis, the formulations for the creation of the cocktails will be executed, each consisting of three variables (alcoholic, flavoring, tonic). All bases will be combined in different volume measures until a good cocktail is achieved.

In their preparation, methods such as frozen, maceration, direct, and shaker will be used. Frozen involves crushing ice with mechanical force to achieve a texture similar to ice cream or slush. Maceration involves placing the ingredients in a shaker and using a muddler to extract their juices; these types of cocktails are usually served in short and tall glasses. Direct, as the name suggests, involves placing all bases directly in the glassware, with derivatives like the pousse-café, which is a layered drink. Shaker involves placing and shaking all bases in a cocktail shaker.

3.1.1. Sweet Pumpkin Cocktail

Table 2.

Ingredients and Measurements for the Sweet Pumpkin Cocktail.

Ingredients	Alcoholic Base Ounces			Tonic Base Ounces			Flavoring Base Ounces		
	V 1	V 2	V 3	V 1	V 2	V 3	V 1	V 2	V 3
Cucumber Liqueur	2	3,5	4						
Sweet Pumpkin							2	3,5	4
Condensed Milk							2	2	2
Ice				35	45	100			

Note: Prepared by the Authors

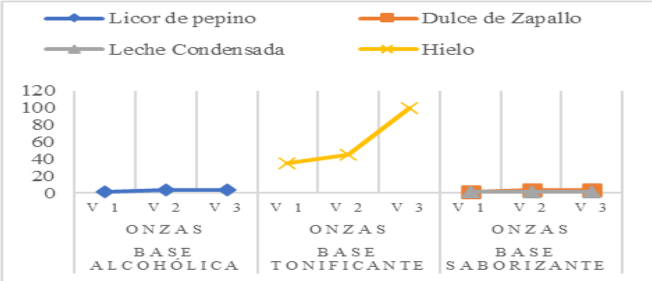


Figure. 8 Variables of the Sweet Pumpkin Cocktail
Note: Prepared by the Authors

The sweet pumpkin cocktail was prepared using the frozen method. In formulation V1, the expected results were not achieved due to the use of a small amount of ice, low alcohol content, and sweet pumpkin. This led to the creation of formulation V2, which achieved a positive effect in terms of taste, but two of the desired organoleptic properties were not met. Therefore, in formulation V3, more ice and sweet pumpkin were added to improve its texture and color.

3.1.2 Lemon and Mint Cocktail

Table 3.

Ingredients and Measurements for the Lemon and Mint Cocktail.

Ingredients	Alcoholic Base Ounces			Tonic Base Ounces			Flavoring Base Ounces		
	V 1	V 2	V 3	V 1	V 2	V 3	V 1	V 2	V 3
Cucumber Liqueur	2	3,5	4						
Sugar							1/2	1/2	1
Mint									
Lemon							1	1	1
Ice				15	20	25			

Note: Prepared by the Authors

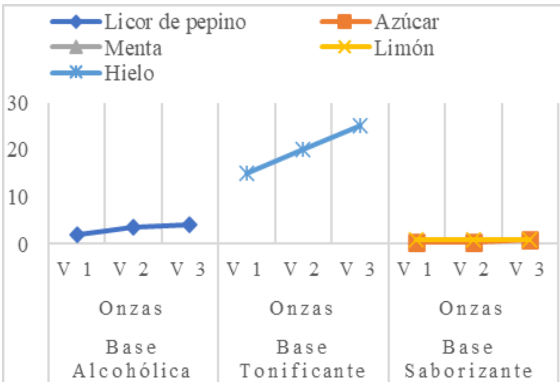


Figure. 9 Variables of the Lemon and Mint Cocktail
Note: Prepared by the Authors

The lemon and mint cocktail was prepared using the maceration method. In formulation V1, the expected effects were not achieved due to its low alcohol content, which made the flavoring base stand out more than the others. In formulation V2, the alcohol base was as expected, but the flavoring base was not satisfactory. Therefore, in formulation V3, more sugar and half an ounce more of alcohol were added to balance the different bases.

3.1.3 Passion Fruit Cocktail

Table 4.
Ingredients and Measurements for the Passion Fruit Cocktail..

		Alcoholic Base			Tonic Base			Flavoring Base		
		Ounces			Ounces			Ounces		
		V 1	V 2	V 3	V 1	V 2	V 3	V 1	V 2	V 3
Ingredients	Cucumber Liqueur	2	3,5	4						
	Sugar							1/2	1/2	1
	Lemon							1/2	1/2	1/2
	Passion Fruit							2	4	4
	Ice				20	40	60			

Note: Prepared by the Authors

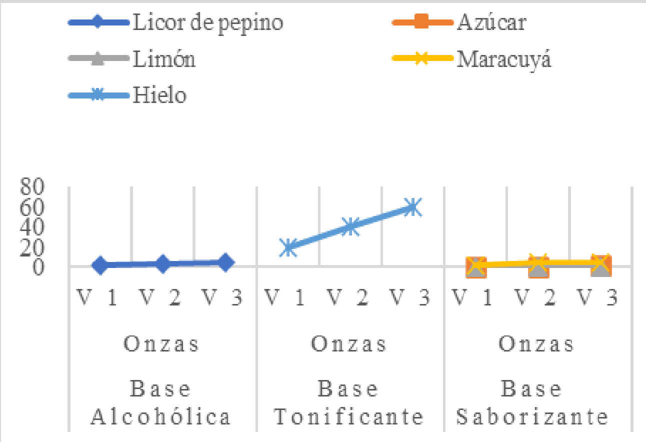


Figure. 10 Variables of the Passion Fruit Cocktail
Note: Prepared by the Authors

The passion fruit cocktail was prepared using the maceration method. Formulation V1 failed due to its low alcohol content, which caused the flavoring base to stand out more than the others. In formulation V2, the alcohol level was as desired, but the flavoring base did not meet the required effects due to its low sugar content, which highlighted the excessive acidity of the passion fruit. Therefore, in formulation V3, more sugar and alcohol were added, resulting in a balance of its organoleptic properties.

3.1.4 Tree Tomato and Uvilla Cocktail

Table 5.
Ingredients and Measurements for the Tree Tomato and Uvilla Cocktail.

		Alcoholic Base			Tonic Base			Flavoring Base		
		Ounces			Ounces			Ounces		
		V 1	V 2	V 3	V 1	V 2	V 3	V 1	V 2	V 3
Ingredients	Cucumber Liqueur	2	3,5	4						
	Tree Tomato Juice							1	1	1/2
	Sugar							1/2	1/2	1
	Uvilla Juice							2	3	3,5
	Ice				20	40	60			

Note: Prepared by the Authors

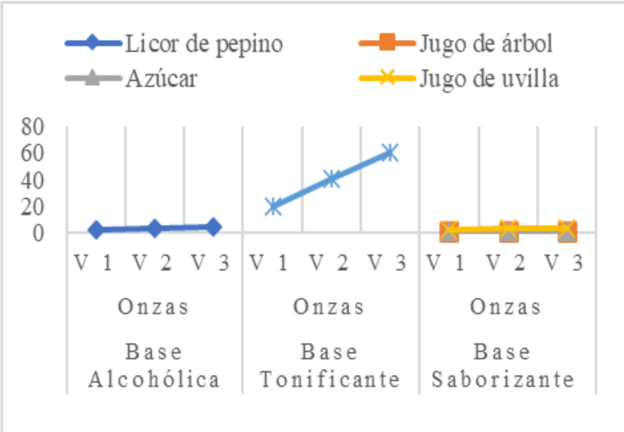


Figure. 11 Variables of the Tree Tomato and Uvilla Cocktail
Note: Prepared by the Authors

The tree tomato and uvilla cocktail was prepared using the direct method with layered presentation. In formulation V1, its low alcohol content caused the flavoring base (tree tomato) to stand out more than the other bases. Therefore, in formulation V2, the alcohol content and the flavoring base (uvilla) were increased to counteract the strong flavor of the tree tomato, but the results were still not as expected. Finally, in formulation V3, it was decided to decrease the flavoring base (tree tomato) and increase the other bases, achieving the desired effect.

3.1.5 Apple Cocktail

Table 6.
Ingredients and Measurements for the Apple Cocktail.

		Alcoholic Base Ounces			Tonic Base Ounces			Flavoring Base Ounces		
		V 1	V 2	V 3	V 1	V 2	V 3	V 1	V 2	V 3
Ingredients	Cucumber Liqueur	2	3,5	4						
	Apple Purée							3,5	3,5	4
	Condensed Milk							2	2	2
	Ice				35	45	100			

Note: Prepared by the Authors

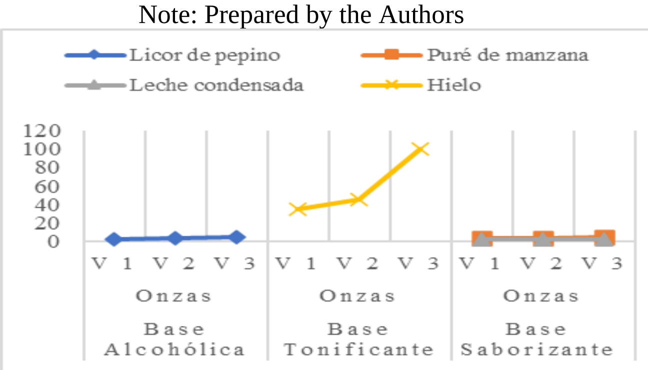


Figure. 12 Variables of the Apple Cocktail
Note: Prepared by the Authors

The apple cocktail was made using the frozen method. In formulation V1, the expected results were not achieved due to the use of too little ice, low alcohol content, and insufficient apple purée, which resulted in a mixture that was too liquid with ice chunks. In formulation V2, a positive effect was achieved in terms of its taste properties, but it did not reach one of its desired organoleptic properties. Therefore, in formulation V3, more ice and apple purée were added to improve its texture.

3.1.6 Mamey Cocktail

Table 7.
Ingredients and Measurements for the Mamey Cocktail.

		Alcoholic Base Ounces			Tonic Base Ounces			Flavoring Base Ounces		
		V 1	V 2	V 3	V 1	V 2	V 3	V 1	V 2	V 3
Ingredients	Cucumber Liqueur	2	3,5	4						
	Tomatillo Juice							1	1	1/2
	Condensed Milk							1/2	1/2	1
	Uvilla Juice							2	3	3,5
	Ice				20	40	60			

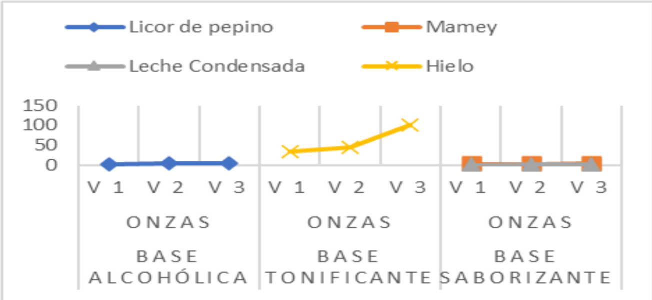


Figure. 13 Variables of the Mamey Cocktail
Note: Prepared by the Authors

This is another cocktail made using the frozen method. Formulation V1 was discarded because it did not achieve the expected results. The texture was too liquid, the flavor was bland, and it had a dull color due to the use of insufficient ingredients in all its bases. In formulation V2, a positive effect was achieved in terms of visual characteristics, but the taste was not satisfactory due to low flavoring base content (condensed milk). Therefore, in formulation V3, more content was added to all bases to achieve structured organoleptic characteristics, with the mamey content increased in the final process to maintain its color.

Cocktail Color Preference Level

Table 8.
Cocktail Color

Color Preference		Sweet Pumpkin Cocktail	Sweet Sweet Potato Coctail	Apple Purée Coctail	Mamey Coctail	Passion Fruit Coctail	Lemon and Mint Coctail	Tree Tomato and Uvilla Cocktail
Like Very Much	3	56	19	32	24	46	32	62
Moderately Like	2	11	8	15	11	24	32	12
Slightly Like	1	3	13	13	34	8	14	
Neither Like Nor Dislike	0	1	3	16	10	2		2
Slightly Dislike	-1	5	10	4	1		2	2
Moderately Dislike	-2	3	7					
Dislike Very Much	-3	1	20					2

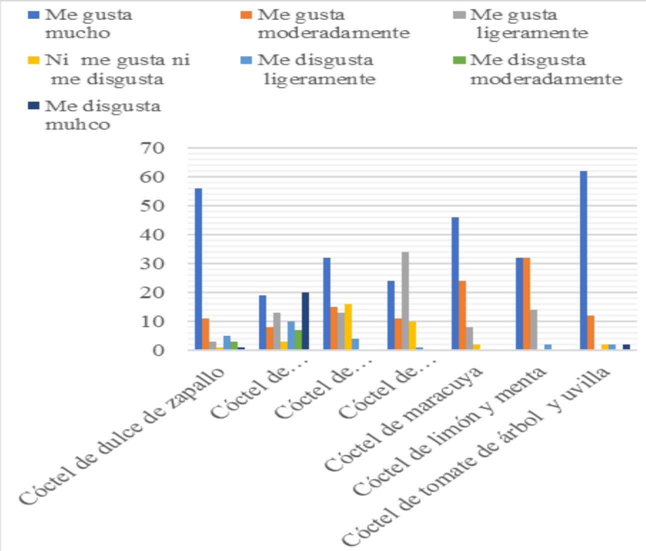


Figure. 14 Results of the Hedonic Test (based on Color)

The graph shows that out of one hundred percent, seventy-seven percent have a preference for the tree tomato uvilla cocktail, while the sweet potato cocktail, with twenty-three percent, is the least favored.

4. Conclusions.

In this research, it can be concluded that fermentation is not a complex process, allowing for the creation of new fermented products using native fruits that are not well known in the country. The designs yielded different results; the CL sample was affected on the fifth day, altering its organoleptic characteristics (taste and smell) due to insufficient nutrients (degrees Brix), and was therefore discarded. The CLCA10% and CLCA20% samples achieved 9% and 11% alcohol content, respectively, and were subjected to an aromatic profile evaluation, revealing tones ranging from yellow to golden copper with citrus, fruity, and floral aromas.

Through monitoring the hedonic test, the opinions of the target group were gathered to develop the standard recipe proposals, which were prepared using established cocktail methods such as frozen, macerated, shaken, and direct. The result showed that the sweet potato cocktail was not well received due to its rapid oxidation and strong banana flavor.

It is recommended that future research explore other methods of yeast adaptation or the use of other microorganisms that could improve the adaptability of the process, aiming to bring new knowledge to society.

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