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RESEARCH ARTICLE

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## CULTIVATION, ANALYSIS, AND NUTRITIONAL EVALUATION OF HOMEMADE TOMATO (*SOLANUM LYCOPERSICUM* L.) ICE MILK

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### ABSTRACT

Tomatoes were recognized as the most consumed fruit globally and the most cost-effective raw food. They possessed the highest lycopene content, whether fresh or dried, proving beneficial for overall health. The study utilized Tomato (*Solanum lycopersicum* L.) as the primary ingredient. Its main objective was the creation of nutritious ice milk, aiming to guarantee benefits for both the general populace and health-conscious individuals. The goal was to develop a product that could advocate for nourishment, health awareness, and a balanced lifestyle. Researchers formulated a four-sample recipe for homemade tomato (*Solanum lycopersicum* L.) ice milk, detailing the nutritional profile of the preferred formulation. Utilizing an experimental method involving 120 randomly selected individuals, the research determined the overall preference through sensory analysis. A 9-point hedonic scale was applied to evaluate taste, aroma, texture, aftertaste, and overall preference to distinguish the most favorable formulation. The study's results indicated that formulation 4 had the highest percentage based on the hedonic scale, prompting further analysis in the laboratory to verify its nutritional profile. The subsequent examination of Formulation 4 confirmed its overall preference and revealed a nutritional profile rich in Vitamin A (Retinol) (22.80%) and Vitamin C (Ascorbic Acid) (35.14%).

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## INTRODUCTION

In today's perspective, People are now concerned about their weight, appearance, and mostly their health. One main reason is that people wanted to live longer life. This COVID-19 pandemic has also caused people to change their lifestyles because people just sit around and eat a lot during the pandemic because they have nothing to do. A main reason during the pandemic, people eat a lot is because they are stressed, which has affected their mental, and physical health and changed in health behaviors of all. It resulted in an increase in different health risk diseases like heart attacks, high blood pressure, high cholesterol, overweight or obesity, cancer, and diabetes. Having these health risk diseases will result in death. People quickly realized that it was time to change their lifestyle by eating well-balanced meals and engaging in physical activity. Changing our diet and exercise habits will improve our lives in many ways, including keeping a healthy weight, having more energy, feeling better about ourselves, and, most importantly, preventing diseases. Pólya (2021), stated that Generation Z or Millennials (born from 1997 to 2012) are the most health-conscious of the different generations because they consider sustainable consumption, they listen to real experts like doctors or dietitians and they are also more concerned when it comes to environmental, sustainable, health and quality aspects. Lastly, they substitute various healthy alternatives when planning a nutritious

meal and exercise daily and Millennials also focus on their physical elements, image, and mental well-being. Arcellana and Jimeno (2020) stated that the Philippines was placed under extremely enhanced community quarantine and lockdown measures during the pandemic, limiting mobility and tightly regulated periods to purchase groceries, resulting in limited food options. It became tough for Filipinos to buy fresh food, and due to the quarantine system, Filipinos were forced to buy canned and processed food, which only lasts at least only until the market day. Some other reason is that Filipinos lack the financial ability to buy fresh, high-quality foods because of the absence of employment during the pandemic. As a result of their unhealthy eating habits and lack of exercise, Filipinos developed many health risk diseases, including diabetes. In relation to that, not only the Philippines, but the entire country has been experiencing this type of occurrence. The limitation of food intake for diabetic people is needed because food intake is one of the reasons it can cause diabetes. An example of foods that diabetic patients should avoid is carbohydrates that are rich in starch and sugar. However, carbohydrates are an important source of energy. Doctors suggest focusing on eating vegetables, fruits, and whole grains. Rice is part of every Asian meal wherein half of the typical plate consists of rice because it is a source of fiber, vitamins, minerals, and of course carbohydrates. Too much of this is one reason for diabetes and other illnesses. Carvalho et al., (2021) state that tomatoes have the highest source of lycopene. Lycopene is a red pigment with biological

properties such as antioxidant, cardioprotective, antihypercholesterolemic, antidiabetic, antimicrobial, photoprotector, and anti-cancer. The researchers chose tomato to add to the ice cream because this fruit has no sugar content and is a high source of lycopene and it is beneficial for which diabetic people who consume tomatoes will have a positive effect on their blood sugar level not only those tomatoes can have better progress of a persons' skin health, improve eyesight, good constipation and prevent all sorts of diseases like cancer, heart disease, and osteoarthritis. The researchers aimed to develop a homemade nutritious ice milk, particularly beneficial for health-conscious individuals or those with diabetes. This dessert was designed to offer essential nutrients while providing a healthy option for consumers. Their unique combination of ingredients aimed to enhance the quality of life for those with health concerns, notably exploring the effectiveness and health benefits of tomato powder. The study not only served as a basis for future research but also marked an innovative product in the market, fostering the researchers' personal and professional growth. By emphasizing nutrition, health awareness, and a balanced lifestyle, the researchers expanded their understanding of the nutritional value of ingredients, especially in utilizing the most widely consumed fruit, tomatoes, to create a beneficial dessert. This research benefited the community by educating them about the nutritional value of tomatoes, offering a product that could positively impact their physical and mental health, and serving as a tool to address dietary needs in the community.

## METHODOLOGY

The researchers utilized Experimental Research in this study to evaluate the potential benefits of tomato (*Solanum Lycopersicum* L.) ice milk for individuals. Various formulations of the product were tested, and through a 9-point hedonic scaling, one formulation was chosen by the respondents. The researchers conducted experimental tests to determine the nutritional content of the homemade tomato ice milk based on the chosen formulation. This methodology was chosen to characterize the nutritional profile and assess the hedonic scaling in terms of taste, aroma, texture, aftertaste, and overall preference of the homemade tomato ice milk. The study focused on regular citizens as its subject group, chosen to represent the general population's perspective on the taste, aroma, texture, and aftertaste of homemade tomato ice milk, while also considering its potential benefits for health-conscious individuals. To conduct the study, a sample size of 120 subjects was required, with specified parameters including an alpha error of .10, an effect size of 0.30, and a power of .90, calculated using G-power.

**Table 1. Materials and its Sources**

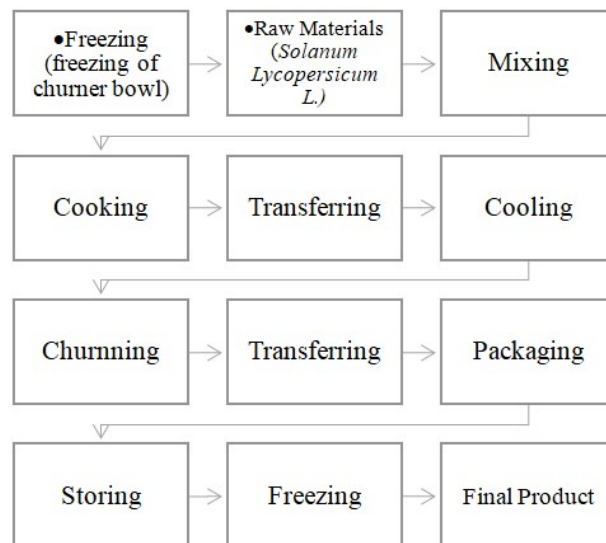
Variable/ Parameters	Levels	Description
Product	1	Home-Made Tomato ( <i>Solanum Lycopersicum</i> L.) Ice Milk
Samples	4	Formulation 1,2,3,4
Ingredients	6	Tomato Powder, Full Milk, Cornstarch, Brown Sugar, Salt, Vanilla Extract
Storage Condition	1	Freezing Temperature at 0°F (-18°C)
Packaging Material	1	Clear Plastic Container Cup
Sample Size	1	60 grams

All the ingredients that were used in during the formulation come from the local market. Including the full milk, cornstarch, brown sugar, salt, and vanilla extract. The packaging clear plastic container cup also comes from local stores and Cuisinart 2Lt Frozen Yoghurt-Sorbet & Ice Cream Maker is the machine that was used for churning the Home-made Tomato (*Solanum Lycopersicum* L.) Ice milk. Lastly, the tomato powder that was used comes from a local company and an FDA Approved raw material. Table 2 represents the four formulations of Home-made Tomato Ice Milk. The amount of tomato powder in each of the four formulations is different while the ice milk mixture is the same. The researchers decided to create four formulations with

different measurements of the tomato powder to determine the differences in terms of the color, taste, aroma, texture, aftertaste, general condition of senses while eating, and overall preference with the help of the subjects of the study which are the normal citizens.

**Table 2. Four Formulations of the Homemade Tomato (*Solanum Lycopersicum* L.) Ice Milk**

Ingredients	Formula I	Formula II	Formula III	Formula IV
Tomato Powder	15g	25g	35 g	45 g
Full Milk	800g	800g	800g	800g
Cornstarch	40g	40g	40g	40g
Brown Sugar	230g	230g	230g	230g
Salt	1g	1g	1g	1g
Vanilla Extract	8g	8g	8g	8g



**Figure 1. Preparation of Homemade Tomato (*Solanum Lycopersicum* L.) Ice Milk**

The researchers employed a 9-point hedonic scale to evaluate taste, aroma, texture, aftertaste, general senses while eating, and the overall preference of various formulations of homemade tomato (*Solanum Lycopersicum* L.) ice milk. Subjects used this scale to rate the four formulations via questionnaires. Once the preferred formulation was determined, nutritional analysis testing was conducted. The data collection and evaluation procedures were carried out in Santa Rosa, Laguna. Questionnaires were distributed to subjects, and data was collected using a batching method in October 2022. Test batches were conducted at different locations, including Santa Rosa Laguna and Lyceum of the Philippines Calamba, Laguna. Confidentiality was assured to subjects, and palates were cleansed before tasting. Subjects were asked to provide honest opinions about the product. Formulation 4, identified as the overall preference, underwent nutritional analysis at the Lipa Quality Control Center in Lipa City, Batangas, revealing its Vitamin A and C content after a two-week analysis period. The procedure for making homemade tomato ice milk involved several steps: chilling the churner bowl, mixing ingredients, heating the mixture, chilling it, churning, and freezing before consumption. Ethical considerations involved obtaining consent from respondents, ensuring confidentiality per the Data Privacy Act of 2012, and meeting ethical standards for information confidentiality. Data analysis aimed to assess the nutritional profile, sensory characteristics, demographic profiles, and nutritional analysis of the chosen formulation using statistical tools such as frequency distribution, weighted mean, and Post Hoc Tests (Scheffe and Duncan).

## RESULTS AND DISCUSSIONS

Table 3 illustrates the composite mean results for the taste of Homemade Tomato (*Solanum Lycopersicum* L.) Ice Milk. It reveals that the subjects of the study moderately favored Formula 4,

attributing their preference to the well-balanced addition of tomato powder, creating a harmonious blend of sourness and sweetness within the ice milk. This observation aligns with previous studies by Kulshrestha (2017) and Kukanoor et al. (2021), emphasizing that a higher content of tomato powder not only enhances nutritional value but also intensifies the distinct sour flavor. Conversely, the subjects slightly favored the taste of Formulation 3, which, according to Achimugu et al. (2021) and Kukanoor et al. (2021), lacked the distinctive flavor of tomato powder, resulting in a less preferred taste due to the absence of desired sourness and excessive bitterness from other ingredients.

**Table 3. Sensory Evaluation in terms of Taste of the Four Formulations of Homemade Tomato (Solanum Lycopersicum L.) Ice Milk**

Variable/Sample	Mean	VI	Rank
Taste1	7.08	Like Moderately	2
Taste2	6.89	Like Moderately	3
Taste3	6.48	Like Slightly	4
Taste4	7.26	Like Moderately	1
Composite Mean	7.26	Like Moderately	

**Table 4. Sensory Evaluation in terms of Aroma of the Four Formulations of Homemade Tomato (Solanum Lycopersicum L.) Ice Milk**

Variable/Sample	Mean	VI	Rank
Aroma 1	6.92	Like Moderately	2
Aroma 2	6.74	Like Moderately	3
Aroma 3	6.63	Like Moderately	4
Aroma 4	7.38	Like Moderately	1
Composite Mean	7.38	Like Moderately	

**Table 5. Sensory Evaluation in terms of Texture of the Four Formulations of Homemade Tomato (Solanum Lycopersicum L.) Ice Milk**

Variable/Sample	Mean	VI	Rank
Texture1	6.99	Like Moderately	2
Texture 2	6.78	Like Moderately	3
Texture 3	6.42	Like Slightly	4
Texture 4	7.33	Like Moderately	1
Composite Mean	7.33	Like Moderately	

Table 4 outlines the composite mean results regarding the aroma of the Homemade Tomato (Solanum Lycopersicum L.) Ice Milk. It indicates that the subjects of the study moderately favored the aroma of Formula 4 (scoring 7.38). This preference is linked to the strong and pleasant scent originating from the tomato powder within this formulation, providing a well-balanced and pleasant sour aroma. This observation is supported by Ali et al. (2020) and Owureku-Asare et al. (2022), emphasizing that carotenoids and bioactive phenolic compounds found in tomato powder contribute to a strong and appealing aroma. Conversely, the subjects also moderately favored the aroma of Formulation 3 (scoring 6.63). However, this preference was comparatively lower as this formulation lacked the desired sour scent from the tomato powder, as highlighted by Essuman et al. (2022), suggesting that low scores in the aroma of a product indicate a lack of desired scent, possibly leading to reduced consumer desirability. Table 5 presents the composite mean results concerning the texture of the Homemade Tomato (Solanum Lycopersicum L.) Ice Milk. It indicates that the subjects of the study moderately favored Formula 4 (scoring 7.33) due to its smooth, creamy texture, attributed to the presence of cornstarch, providing an all-around better texture. Ali et al. (2020) and Mehta et al. (2018) suggest that higher amounts of tomato powder contribute to an excellent, soft texture in the product. Mehta et al. (2018) further indicate that a good quantity of tomato powder ensures a pleasant, chewy, and springy texture. Jarén et al. (2016) note that consumers' preferences for food texture significantly impact their enjoyment and interest in food products. Conversely, the subjects slightly favored the texture of Formula 3 (scoring 6.42). Formula 3's churning process resulted in a gritty

texture with ice crystals that melted before refreezing, causing a grainy or sandy mouthfeel, as suggested by Bhat et al. (2020) and Mehta et al. (2018), indicating that a lower addition of tomato powder leads to a harder texture over time and is less acceptable in terms of texture.

**Table 6. Sensory Evaluation in terms of Aftertaste of the Four Formulations of Homemade Tomato (Solanum Lycopersicum L.) Ice Milk**

Variable/Sample	Mean	VI	Rank
Aftertaste 1	7.03	Like Moderately	2
Aftertaste 2	6.88	Like Moderately	3
Aftertaste 3	6.69	Like Moderately	4
Aftertaste 4	7.28	Like Moderately	1
Composite Mean	7.28	Like Moderately	

Table 6 presents the composite mean results regarding the aftertaste of the Homemade Tomato (Solanum Lycopersicum L.) Ice Milk. It indicates that the subjects of the study moderately favored Formula 4 (scoring 7.28) due to its tamarind and sweet-sour aftertaste, attributed to the combination of tomato powder and ice milk, providing a gradual and enjoyable taste experience. Some participants also noted a hint of banana flavor in the aftertaste. Gluchowski et al. (2021) suggest that aftertaste is a crucial sensory profile aspect in product development, as an overly strong or weak aftertaste can significantly influence the liking of the product. Conversely, the participants only slightly appreciated the aftertaste of Formula 3 (scoring 6.69) as it lacked both the flavor of tomato powder and the tamarind aftertaste. Gluchowski et al. (2021) note that lower likability in the aftertaste can potentially influence overall product perception based on respondents' scores.

**Table 7. Sensory Evaluation in terms of General Condition of Senses while Eating of the Four Formulations of Homemade Tomato (Solanum Lycopersicum L.) Ice Milk**

Variable/Sample	Mean	VI	Rank
Gcond 1	7.08	Like Moderately	2
Gcond 2	6.97	Like Moderately	3
Gcond 3	6.58	Like Moderately	4
Gcond 4	7.34	Like Moderately	1
Composite Mean	7.34	Like Moderately	

**Table 8. Sensory Evaluation in terms of Overall Preference of the Four Formulations of Homemade Tomato (Solanum Lycopersicum L.) Ice Milk**

Variable/Sample	Frequency	Percent	Rank
Formula 1	33	27.5	2
Formula 2	12	10	4
Formula 3	16	13.3	3
Formula 4	59	49.2	1
Total	120	100	

Table 7 shows the results in terms of the general condition of senses while eating. In terms of the general condition of senses, while eating, the subjects of the study moderately liked formula 4 (7.34). This signifies that they moderately liked formula 4 due to its perfectly balanced taste, smell, appearance, and texture of the formula 4. The majority of the subjects of the study also stated that formula 4 had the best mouthfeel when consuming it and this formula 4 had the perfect balance of sweet and sour, a good sweetness balance, a smooth and creamy texture, and lastly a perfectly dark red appearance coming from the tomato powder. The same table also shows that the study subjects moderately liked formula 3 (6.58) in terms of the general condition of senses while eating. This is due to the grainy and sandy texture, a medium red appearance of the tomato ice milk, a too-sweet taste, and lastly formula 3 quickly melts. This formula 3 also developed an ice crystal which is a negative outcome when producing an ice milk mixture. Table 8 displays the Overall Preference results for the Homemade Tomato (Solanum Lycopersicum L.) Ice Milk. Most subjects in the study favored Formula 4 (scoring 49.2),



indicating their preference for its well-balanced sweet and sour taste derived from the combination of tomato powder and ice milk, its creamy texture, vibrant red appearance, and tamarind aftertaste. Conversely, the subjects did not prefer Formula 2 (scoring 10) due to its lacking tomato powder, light red appearance, excessive sweetness, and absence of the desired sour taste from the tomato powder. Guzek et al. (2021) explain that food preferences are evaluative attitudes individuals hold toward foods, linked to their subjective evaluations and the degree of liking or disliking particular products. These preferences develop early in life and are shaped by various factors, including individual, parental, community, and environmental influences. While these preferences tend to remain stable into adulthood, changes in sensory perception throughout life can influence taste and smell perceptions, impacting food choices.

**Table 9. Demographic Profile of the Subjects of the Study**

Age	Frequency	Percent	Rank
15 to 25	57	47.5	1
26 to 36	17	14.2	2
37 to 47	13	10.8	4
48 to 58	16	13.3	3
59 to 69	6	5	6
70 to 80	11	9.2	5
Total	120	100	
Sex	Frequency	Percent	Rank
Female	67	55.8	1
Male	53	44.2	2
Total	120	100	

The study's demographic data presents notable implications for health awareness and engagement among different age groups. Generation Z, primarily represented within the study by individuals aged 15 to 25, emerges as a highly health-conscious cohort, demonstrating a strong interest in balanced dietary choices, physical activity, and a focus on sustainable and quality food attributes. These findings align with existing studies by Pólya (2021) and Hoque et al. (2018), emphasizing Generation Z's inclination towards health-focused behaviors and the influence on the functional food market. In contrast, Boomers II or Generation Jones, aged 59 to 69, reveal a lower participation rate in the study, potentially indicating reduced interest in exploring new health-related products. This generation's lower engagement suggests potential health risks, such as diabetes and obesity, due to diminished physical activity and a lack of health awareness. Studies by Smith et al. (2016) and Kolb & Martin (2017) highlight the significance of a balanced diet and physical activity in managing diabetes, highlighting potential concerns within this age group. Additionally, the study's gender distribution, with a higher representation of females compared to males, suggests a gender disparity in health awareness and engagement in health-related studies. This data implies varying levels of health consciousness and interest in health-related products or research between males and females.

**Table 10. Laboratory Results of Formula 4 of the Homemade Tomato (*Solanum Lycopersicum L.*) Ice Milk**

Test Parameter Results	Replicates	Test Method	RDA
Vitamin A (Retinol), IU/g	22.72; 23.07; 22.62	High Performance Liquid Chromatography Method (HPLC)	700mcg (2,333)IU-900mcg (3,000)IU
Vitamin C (Ascorbic Acid), Mg/kg	34.33; 34.43; 36.66	High-Performance Liquid Chromatography Method (HPLC)	75g-90g

Table 11 provides a comprehensive breakdown of the vitamin content in Formulation 4 of the Homemade Tomato (*Solanum Lycopersicum L.*) Ice Milk. The results indicate that this particular formulation contains 22.80% of Vitamin A (Retinol) and 35.14% of Vitamin C (Ascorbic Acid), both derived from the tomato powder present in the product. The presence of these vitamins highlights the nutritional

value of the ice milk, supporting the studies of Gholami et al. (2021) and Blaner (2019), which emphasize the positive effects of tomato powder on antioxidant properties and the role of Vitamin A in preventing metabolic diseases, supporting immune function, and its contribution to cellular immune responses. Similarly, Vitamin C, sourced from tomatoes, acts as a potent antioxidant, supporting various physiological functions in the body, as elucidated by Gholami et al. (2021), Paciolla et al. (2019), Patterson et al. (2021), and Zeratsky (2022). These vitamins play vital roles in maintaining good health, supporting immune responses, and preventing diseases, aligning with the recommended daily intakes for men and women. Moreover, the comparison between the Homemade Tomato Ice Milk produced by the researchers and commercially available ice cream reveals several advantages of the former. The researchers' product contains fewer ingredients, focuses on nutritional benefits from the inclusion of tomato powder, and boasts a lower fat content compared to store-bought ice cream. This aligns with studies by Kulshrestha (2017) emphasizing the nutrients in tomato powder and its potential benefits for individuals with diabetes. Additionally, the low-fat nature of the homemade ice milk, as highlighted by Goff (2018), offers a healthier alternative to high-fat ice creams commonly found in the market. The excessive fat and sugar content in store-bought ice cream, as mentioned in studies such as Deosarkar et al. (2015), can pose health risks, whereas the homemade ice milk presents a more health-conscious and beneficial dessert option. Overall, the laboratory results validate the nutritional value of the Homemade Tomato Ice Milk, making it a suitable and advantageous choice for both men and women.

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