International Journal of Sustainable and Integrated Studies
Volume 1, Issue 4 | ISSN: 3155-6361
DOI: https://doi.org/10.65339/ijsis.V1.I4.266

Tino-Tino Juice Drink

Sygi B. Saligumba[1], Josephine G. Gonzaga[2], Roberto L. Gornez[3]
[1]*Instructor I, University of Southern Mindanao - Kidapawan City Campus, Kidapawan City, North Cotabato, Philippines*
[2]*Assistant Professor IV, University of Southern Mindanao - Kidapawan City Campus, Kidapawan City, North Cotabato, Philippines*
[3]*Associate Professor II, University of Southern Mindanao - Kidapawan City Campus, Kidapawan City, North Cotabato, Philippines*

Email of Corresponding Author: sygisaligumba1@gmail.com

Publication history:
Received: September 30, 2026 Accepted: November 5, 2026
Revised: November 1, 2026 Published: November 6, 2026
International Journal of Sustainable and Integrated Studies, Vol. 1, No. 4, pp. 139–146, November 2026.

Abstract

This study aimed to develop a ready-to-drink Tino-tino (Physalis peruviana) juice beverage blended with pineapple juice and evaluate its sensory quality and shelf-life-related microbial characteristics. A descriptive quantitative research design was employed in Barangay Lanao, Kidapawan City, North Cotabato, involving 30 purposively selected respondents aged 18-40 years. Three formulations containing varying concentrations of Tino-tino tea were evaluated for appearance, aroma, and taste using a five-point sensory evaluation instrument. Data were analyzed using weighted means, while yeast and mold counts were examined during two weeks of nonrefrigerated storage. Results revealed that Treatment 1, containing ½ teaspoon of Tino-tino tea and 250 mL of pineapple juice, obtained the highest appearance and taste ratings, with a taste mean of 4.03. Treatment 3 received the highest aroma rating (4.59) but the lowest taste rating (1.59), indicating increased bitterness at higher concentrations. Treatment 1 also maintained yeast and mold counts below 100 CFU/mL throughout the storage evaluation. The findings identified Treatment 1 as the most favorable formulation for appearance, taste, and observed microbial quality. Further research is recommended to reduce bitterness, examine preservative effectiveness, and determine nutritional composition. The study was limited to 30 respondents and selected sensory and nonrefrigerated storage conditions. The findings provide a foundation for further Tino-tino beverage development and the value-added utilization of locally available plant resources.

Keywords: Beverage Development, Microbial Quality, Pineapple Juice, Product Formulation, Sensory Evaluation, Shelf Life, Tino-Tino Juice

1. Introduction

The development of plant-based beverages has gained attention because of increasing interest in natural ingredients, nutritional value, and innovative food products. Tino-tino (Physalis peruviana), commonly known as Cape gooseberry or goldenberry, contains vitamins, minerals, and bioactive compounds that support its potential application in beverage processing. However, the bitterness associated with traditional preparations of Tino-tino plant materials may affect consumer acceptability. This study focused on developing a ready-to-drink Tino-tino juice beverage using pineapple juice to improve its sensory characteristics. Specifically, it evaluated appearance, aroma, and taste across three formulations and examined product shelf life through microbial analysis. The research also considered the potential contribution of locally available plant resources to food innovation, agricultural utilization, and sustainable livelihood opportunities.

Tino-tino (Physalis peruviana) is a fruit-bearing plant belonging to the Solanaceae family and is recognized for its nutritional composition and potential applications in food processing. Its fruits are enclosed in a papery calyx and turn yellow to orange as they ripen. Goldenberry contains vitamins, dietary fiber, minerals, carotenoids,

phenolic compounds, and other phytochemicals that contribute to its nutritional and functional characteristics. These properties have encouraged research into its utilization in juices, nectars, jams, and other processed products (Olas, 2025; Prat & Sáenz, 2024). The fruit contains ascorbic acid, tocopherols, potassium, phosphorus, and various secondary metabolites. Recent investigations have identified antioxidant activity and other biological properties in goldenberry fruit and calyx extracts, although their clinical effectiveness requires further investigation. These findings highlight the nutritional and phytochemical characteristics of the plant and support further investigation of its potential applications (Añibarro-Ortega et al., 2025). Tino-tino has also been associated with traditional medicinal practices. Ethnopharmacological literature has documented the historical use of plants belonging to the Physalis genus for conditions involving inflammation, metabolic disorders, and other health concerns. Their biological properties have been investigated through phytochemical and pharmacological studies, particularly those involving steroidal compounds, flavonoids, and other plant metabolites (Liang et al., 2024). Despite these potential applications, the bitter taste of traditionally prepared Tino-tino plant materials presents a challenge to beverage acceptability. Incorporating pineapple juice offers a formulation approach intended to improve flavor while developing a ready-to-drink product from locally available ingredients. The study therefore examined the sensory quality and shelf-life-related microbiological characteristics of Tino-tino juice formulations.

The nutritional composition and food processing potential of goldenberry have received increasing research attention. Recent studies have identified vitamins, carotenoids, polyphenols, and dietary fiber as important constituents of the fruit. These compounds contribute to its potential as an ingredient in functional food formulations. The processing of goldenberry into juice, nectar, and other products also provides opportunities to expand its utilization beyond fresh consumption (Olas, 2025; Prat & Sáenz, 2024). Product formulation is an important consideration when developing beverages from plant-based ingredients. Acurio Arcos et al. (2024) investigated the effects of different sweeteners on the sensory, physicochemical, nutritional, and microbiological characteristics of goldenberry juice. Their findings demonstrated that ingredient composition influenced aroma and overall acceptability. Similarly, Bazalar Pereda et al. (2024) developed goldenberry nectar using optimized proportions of fruit pulp and sucrose, demonstrating the importance of balancing sensory characteristics and bioactive compound content during beverage formulation. Sensory evaluation provides essential information about consumers' perceptions of beverage quality. Appearance, aroma, and taste influence overall acceptability, while processing conditions may alter flavor compounds, color, and other sensory attributes. Zia et al. (2024) emphasized that thermal and nonthermal processing techniques can affect the sensory properties of fruit juices, highlighting the importance of evaluating product quality throughout beverage development. Previous research has also examined Cape gooseberry beverages under different storage conditions. Hemalatha et al. (2018) developed a ready-to-serve beverage from Cape gooseberry juice and evaluated its physicochemical characteristics, microbial quality, and sensory acceptability. Their study demonstrated that refrigerated storage helped preserve important beverage properties over the evaluated storage period. This earlier investigation remains relevant because it directly established the feasibility of processing Cape gooseberry into a ready-to-serve beverage. Microbiological stability is another important consideration in determining beverage shelf life. Fruit juices are susceptible to changes caused by microorganisms, processing conditions, and storage environments. Mandha et al. (2023) demonstrated that pasteurization and storage conditions influenced the microbial, physicochemical, and nutritional quality of fruit juices, including pineapple juice. Their findings emphasized the importance of appropriate processing and storage practices in maintaining product quality. Thermal processing techniques, including high-temperature short-time pasteurization, are widely investigated for reducing microbial activity and preserving beverage characteristics. However, processing conditions must be appropriate for the particular beverage formulation because temperature and treatment duration can influence enzymes, nutrients, and sensory attributes (Polak et al., 2024). Processing technologies have also been explored specifically for goldenberry products. Arias et al. (2023) investigated flash vacuum expansion as a method for producing goldenberry puree and evaluating its quality and shelf life. Their findings demonstrated the potential of processing technologies to improve microbial stability while retaining desirable product characteristics. Collectively, these studies emphasized the importance of ingredient formulation, sensory evaluation, microbiological quality, and storage conditions in developing fruit-based beverages.

Globally, goldenberry has been cultivated and processed into different food products because of its nutritional composition and versatility. Its applications include juices, nectars, purees, preserved fruits, and other processed foods. Research has also examined technologies intended to improve product quality, reduce postharvest losses, and expand opportunities for value-added processing (Arias et al., 2023; Olas, 2025). International studies have demonstrated that goldenberry can be incorporated into beverage formulations with acceptable sensory characteristics. Research involving goldenberry nectar and juice has highlighted the importance of ingredient concentration, sweetening agents, processing conditions, and quality evaluation in producing consumer-oriented beverages (Acurio Arcos et al., 2024; Bazalar Pereda et al., 2024). In the Philippines, Tino-tino is locally available and has traditionally been used in herbal preparations. However, its potential application in ready-to-drink beverages using dried plant materials and pineapple juice provides another approach to local product development. Transforming the plant into a flavored beverage offers an opportunity to investigate the acceptability of an alternative preparation and the practical utilization of available agricultural resources. The study was conducted

in Purok 3–Buragay, Barangay Lanao, Kidapawan City, North Cotabato, involving 30 respondents who consumed juice drinks. The investigation evaluated three Tino-tino juice formulations based on appearance, aroma, and taste through sensory evaluation sheets and checklist questionnaires. Microbial analysis using yeast and mold counts was also conducted as part of the product's shelf-life assessment. The local setting provided a basis for examining consumer responses to a beverage developed from Tino-tino plant materials.

The study was guided by the relationship between ingredient formulation, sensory quality, and beverage stability. Beverage development requires consideration of how ingredient concentrations and processing conditions influence product characteristics. Previous investigations involving goldenberry juice and nectar demonstrated that modifying formulation components could improve sensory acceptability while maintaining desirable physicochemical properties (Acurio Arcos et al., 2024; Bazalar Pereda et al., 2024). The conceptual framework followed an input-process-output approach. The inputs consisted of three treatments prepared using different quantities of dried Tino-tino plant materials combined with one cup of pineapple juice. Treatment 1 contained ½ teaspoon of Tino-tino tea, Treatment 2 contained 1 teaspoon, and Treatment 3 contained 1½ teaspoons. Dried Tino-tino leaves, fruits, stems, and roots served as the principal plant materials used in the formulations. The process involved drying, grinding, extracting, boiling, and labeling the prepared ingredients, followed by microbial analysis. The treatments underwent the same preparation procedure and differed only in the quantity of Tino-tino tea incorporated into the beverage. The output consisted of three ready-to-drink Tino-tino juice formulations evaluated according to appearance, aroma, and taste. Yeast and mold counts served as microbiological indicators in the shelf-life assessment. This approach reflected the importance of combining sensory and microbiological evaluation when examining beverage quality, as emphasized in contemporary research on fruit juice processing and storage stability (Mandha et al., 2023; Zia et al., 2024).

Existing research has examined the nutritional composition, bioactive compounds, processing methods, and beverage applications of goldenberry. Previous studies have also developed ready-to-serve Cape gooseberry beverages and evaluated their sensory characteristics, microbial stability, and storage conditions (Hemalatha et al., 2018; Acurio Arcos et al., 2024). However, these investigations primarily focused on formulations prepared from goldenberry fruit juice, pulp, or nectar. The present study addressed a specific research gap by evaluating the sensory quality and shelf-life-related microbiological characteristics of beverages combining dried Tino-tino leaves, fruits, stems, and roots with pineapple juice at three concentrations. The bitterness of traditionally prepared Tino-tino plant materials provided the principal rationale for investigating flavored juice formulations. Although previous beverage studies established the relevance of formulation optimization, sensory evaluation remained necessary to determine the acceptability of the particular ingredients and concentrations used in this investigation. Research on fruit juice processing also demonstrated that microbiological quality and storage conditions were important considerations in evaluating beverage stability (Mandha et al., 2023; Polak et al., 2024). Accordingly, the study aimed to develop a ready-to-drink Tino-tino juice beverage and evaluate its product quality in terms of appearance, aroma, and taste. It also sought to determine the product's shelf life through microbial analysis, particularly yeast and mold counts. The investigation was limited to the three formulations and the specified sensory and microbiological parameters. The research provided a basis for evaluating Tino-tino as an alternative beverage ingredient. Its potential applications were relevant to consumers interested in plant-based products, entrepreneurs exploring beverage development, farmers seeking additional uses for cultivated plants, and researchers investigating food product innovation.

The study aligned with selected Sustainable Development Goals through its emphasis on food product development, microbiological quality, local agricultural utilization, and innovation. The United Nations Department of Economic and Social Affairs (2025) emphasized the importance of sustainable food systems, economic opportunities, and innovation in advancing the 2030 Agenda for Sustainable Development. The research was relevant to SDG 3 (Good Health and Well-Being) because it examined aspects of beverage quality associated with consumer health, particularly microbiological characteristics. The evaluation of yeast and mold counts contributed to understanding microbial stability, while the study's focus on a plant-based ingredient provided a basis for further food quality investigations. This contribution concerned beverage development rather than demonstrating medicinal effectiveness. The study also related to SDG 8 (Decent Work and Economic Growth) by exploring the potential development of a locally sourced beverage that could create opportunities for small-scale entrepreneurship and additional agricultural income. Its relevance to SDG 9 (Industry, Innovation and Infrastructure) was reflected in applying beverage processing and formulation techniques to develop an alternative product from Tino-tino plant materials. Furthermore, the investigation supported aspects of SDG 12 (Responsible Consumption and Production) by examining the productive utilization of locally available ingredients and considering quality and shelf-life-related characteristics in beverage development. These objectives reflected the broader importance of product innovation and sustainable food production practices (United Nations Department of Economic and Social Affairs, 2025).

The development of Tino-tino juice demonstrated the relationship among food technology, agriculture, public health, entrepreneurship, and community-based innovation. From a food technology perspective, the study

examined how different concentrations of dried plant materials influenced beverage appearance, aroma, and taste. Its focus on formulation and sensory evaluation was consistent with contemporary approaches to improving the quality and acceptability of fruit-based beverages (Acurio Arcos et al., 2024; Zia et al., 2024). In relation to public health sustainability, the study considered microbiological quality as an important aspect of beverage development. The inclusion of yeast and mold analysis provided information relevant to product stability. Contemporary food processing research has emphasized the importance of microbiological assessment and appropriate processing conditions in maintaining the quality of fruit-based products (Mandha et al., 2023; Polak et al., 2024). From an agricultural and socioeconomic perspective, Tino-tino beverage development presented an opportunity to explore the productive utilization of locally available plant resources. Previous research demonstrated that processing goldenberry into value-added products could support agricultural diversification and reduce dependence on fresh-fruit marketing alone. Product development approaches that consider processing efficiency and storage stability may also contribute to opportunities for agricultural enterprises (Arias et al., 2023). The study further contributed to educational and technological sustainability by providing a reference for future investigations involving herbal beverage formulation, sensory evaluation, and microbial quality. The broader importance of evidence-based research, innovation, and responsible utilization of traditional plant resources has also been recognized in the World Health Organization's strategy for traditional, complementary, and integrative medicine (World Health Organization, 2025). Overall, the research contributed to multidisciplinary sustainability by examining the potential transformation of Tino-tino into a value-added beverage through ingredient formulation, sensory evaluation, and microbiological assessment. Its significance centered on connecting locally available agricultural resources with food product innovation, consumer acceptability, and potential livelihood opportunities.

2. Material and Methods

2.1 Research Design

The study employed a descriptive quantitative research design to assess the product quality of Tino-tino juice drink using numerical data obtained from sensory evaluations. Descriptive quantitative research provides a systematic approach to examining observable characteristics and summarizing responses through statistical analysis (Creswell & Creswell, 2023). Three formulations were evaluated: Treatment 1 contained ½ teaspoon (2.5 mL) of Tino-tino tea and 250 mL of pineapple juice; Treatment 2 contained 1 teaspoon (5 mL) of Tino-tino tea and 250 mL of pineapple juice; and Treatment 3 contained 1½ teaspoons (7.5 mL) of Tino-tino tea and 250 mL of pineapple juice. Each formulation was assessed according to appearance, aroma, and taste. Evaluating formulations through sensory attributes is an established approach in fruit beverage development and consumer acceptance research (Martins et al., 2022).

2.2 Locale of the Study

The study was conducted in Purok 3, Barangay Lanao, Kidapawan City, North Cotabato, where the Tino-tino juice drink was prepared and subjected to sensory evaluation. Additional product testing was conducted through the Department of Science and Technology (DOST) in Koronadal City, South Cotabato, particularly for yeast and mold count analysis.

2.3 Respondents of the Study

The study involved 30 residents of Barangay Lanao, Kidapawan City, North Cotabato, aged 18–40 years. The respondents were individuals who enjoyed drinking juice and were selected to evaluate the sensory characteristics of the Tino-tino juice drink. Each participant assessed the three formulations based on appearance, aroma, and taste using the prepared sensory evaluation instrument.

2.4 Sample and Sampling Procedure

The study utilized purposive sampling to select 30 respondents who met the established criteria, particularly residency in Barangay Lanao, an age range of 18–40 years, and an interest in drinking juice. Purposive sampling involves selecting participants based on characteristics relevant to the research objectives, allowing researchers to obtain information from individuals who satisfy specific inclusion criteria (Andrade, 2021). This approach enabled the researcher to gather sensory evaluations from respondents whose beverage preferences were relevant to the study.

2.5 Research Instrument

The study utilized a sensory evaluation score sheet adapted from a previous papaya tea study and validated by food and beverage experts. The instrument employed a five-point Likert scale to evaluate the appearance, aroma, and taste of the three Tino-tino juice drink formulations. Sensory evaluation is widely used in beverage development to assess product characteristics and consumer perceptions, particularly in relation to appearance, flavor, and overall acceptability (Arilla et al., 2023; Martins et al., 2022). Appearance was assessed according to clarity, color, cloudiness, and visible residue, with responses ranging from very appealing to not appealing. Aroma was evaluated based on grassy, light, and fresh characteristics, using ratings from strongly agree to disagree. Taste

was assessed according to freshness, sweetness, bitterness, and the distinct Tino-tino flavor, with ratings ranging from very tasty to strongly not tasty. The numerical responses served as the basis for evaluating the sensory quality of each formulation.

2.6 Data Gathering Procedure

The researcher initially prepared a formal request addressed to the Barangay Captain of Barangay Lanao, Kidapawan City, North Cotabato, seeking permission to conduct the study. Following the request, the researcher prepared the ingredients, materials, and equipment needed to produce the three Tino-tino juice drink formulations. The preparation began with thoroughly washing the Tino-tino leaves, stems, roots, and fruits under running water. The plant materials were cut into smaller pieces and sun-dried for approximately 6–8 hours on trays covered with netting to maintain cleanliness. Once dried, the materials were measured according to the required treatment quantities. Pineapples were sliced and processed using a fruit juicer. Water was boiled, sugar was dissolved, and the measured Tino-tino tea was steeped for approximately 8–10 minutes. Pineapple juice, lemon juice, and honey were subsequently added to complete the beverage formulation. The prepared juice was transferred into clean, sterilized bottles, tightly sealed, and stored under refrigeration. The production process utilized a saucepan, portable grinder, drying trays, fruit juicer, knife, cutting board, strainer, funnel, measuring spoons, and measuring cups. The required ingredients, packaging materials, and laboratory testing expenses were documented as part of the production costs. Following product preparation, the researcher personally administered the sensory evaluation to the 30 selected respondents. Each participant received samples of the three treatments and evaluated their appearance, aroma, and taste using the sensory evaluation score sheet. Product samples were also submitted to the Department of Science and Technology in Koronadal City, South Cotabato, for yeast and mold count analysis. Microbiological testing is relevant to beverage quality assessment because yeast and mold growth can affect the stability and sensory characteristics of fruit juices (Aluko et al., 2023). The study followed a five-month production schedule covering planning and designing, fabrication, testing, revising, and evaluation. After completing the sensory evaluation and product testing procedures, the researcher organized, tallied, computed, and interpreted the collected information for the preparation of the final manuscript.

2.7 Data Analysis Techniques

The collected data were analyzed using descriptive statistics, particularly the weighted mean, to determine the sensory quality ratings of the three Tino-tino juice drink treatments. The weighted mean summarized the respondents' evaluations of appearance, aroma, and taste based on the five-point rating scale. The resulting values were interpreted using the corresponding verbal descriptions to assess the perceived quality of each formulation. Sensory rating analysis provides a quantitative basis for describing consumer responses to different beverage formulations (Arilla et al., 2023; Martins et al., 2022).

3. Results and Discussion

3.1 Development and Product Quality of Tino-tino Juice Drink

3.1.1 Development of Tino-tino Juice Drink

The Tino-tino juice drink was developed through repeated formulation trials and recipe standardization. Three treatments were prepared using Tino-tino granules placed in tea bags and mixed with 250 mL of pineapple juice. Treatment 1 (T1) contained ½ teaspoon (2.5 mL), Treatment 2 (T2) contained 1 teaspoon (5 mL), and Treatment 3 (T3) contained 1½ teaspoons (7.5 mL) of Tino-tino granules. These formulations were evaluated to identify differences in sensory quality. The standardized formulations allowed the comparison of appearance, aroma, and taste across treatments. Kumari et al. (2025) similarly demonstrated that variations in fruit juice and herbal ingredient formulations influenced sensory acceptability in ready-to-serve beverages. The development process therefore provided a basis for identifying the Tino-tino concentration associated with the most favorable sensory characteristics.

3.1.2 Product Quality in Terms of Appearance

Treatment 1 obtained the highest weighted mean of 4.78, described as "Very Appealing," followed by Treatment 2 with 4.60, also interpreted as "Very Appealing." Treatment 3 recorded the lowest mean of 4.18, classified as "Appealing." Treatment 1 exhibited greater clarity, brighter color, and minimal visible residue, making it the most visually appealing formulation among the three treatments. The findings indicated that the lowest concentration of Tino-tino granules produced the most favorable appearance. The greater clarity and lighter color contributed to respondents' positive evaluations. This finding is consistent with Wirivutthikorn (2022), who reported that varying the proportions of mulberry leaf tea and pineapple juice affected beverage appearance, color, and sensory characteristics. The results emphasized the importance of ingredient proportions in maintaining desirable visual quality.

3.1.3 Product Quality in Terms of Aroma

Treatment 3 obtained the highest weighted mean of 4.59, interpreted as "Strongly Agree," indicating a pronounced grassy, light, and fresh aroma. Treatment 2 followed with a mean of 4.17, while Treatment 1 recorded 4.10, both

classified as "Agree." These findings showed that Treatment 3 received the highest aroma evaluation among the formulations. The stronger aroma of Treatment 3 was associated with its higher concentration of Tino-tino granules, which produced a more noticeable herbal scent. Moreira et al. (2024) emphasized that aroma is an important sensory quality of tea infusions and that differences in composition and processing contribute to distinct aromatic characteristics. Similarly, Wirivutthikorn (2022) demonstrated that ingredient proportions influenced odor characteristics in a tea-and-pineapple beverage. These findings support the relevance of formulation differences in evaluating the aroma of Tino-tino juice drink.

3.1.4 Product Quality in Terms of Taste

Treatment 1 obtained the highest weighted mean of 4.03, described as "Tasty," indicating a fresh, sweet flavor with a noticeable Tino-tino taste. Treatment 2 recorded a mean of 1.99, classified as "Slightly Tasty," because of its reduced sweetness and slight bitterness. Treatment 3 obtained the lowest mean of 1.59, interpreted as "Not Tasty," indicating a predominantly bitter flavor with minimal sweetness. Treatment 1 therefore received the most favorable taste evaluation. The superior taste of Treatment 1 was associated with its lower concentration of Tino-tino granules, which maintained the perceived sweetness of pineapple juice while reducing bitterness. Increasing the concentration produced a more pronounced bitter taste and reduced sensory acceptability. Kumari et al. (2025) demonstrated that the proportions of fruit and herbal ingredients influenced sweetness, flavor, and overall acceptability in a formulated beverage. These findings highlight the importance of balancing ingredient concentrations to achieve favorable taste characteristics.

3.2 Shelf Life and Microbial Quality of Tino-tino Juice Drink

Microbial analysis examined yeast and mold counts during two weeks of nonrefrigerated storage. During the first week, Treatment 1 recorded less than 100 colony-forming units per milliliter (CFU/mL), Treatment 2 recorded 390 CFU/mL, and Treatment 3 recorded 26×10^5 CFU/mL. During the second week, Treatment 1 remained below 100 CFU/mL, while Treatment 2 increased to 11×10^4 CFU/mL. Treatment 3 recorded 99×10^3 CFU/mL, lower than its first-week count. Treatment 1 consistently exhibited the lowest reported microbial counts, while Treatments 2 and 3 showed higher levels of contamination. The original study identified approximately one week as the product's nonrefrigerated shelf-life period, although the microbial results varied across formulations. The findings demonstrated the importance of microbial monitoring in evaluating beverage stability. Aluko et al. (2023) reported that storage temperature and preservative use influenced microbial growth and shelf life in cashew apple juice. Similarly, Kumari et al. (2025) observed changes in yeast and mold counts during the storage of fruit-based beverages containing herbal ingredients. In the Philippines, the Food and Drug Administration (2022), through FDA Circular No. 2022-012, established updated microbiological requirements for certain prepackaged processed foods. The findings demonstrated differences in microbial quality among the treatments, emphasizing the importance of formulation-specific evaluation when determining microbiological shelf life.

4. Conclusion & Recommendations

The study concluded that the developed tino-tino juice drink demonstrated favorable sensory acceptability in terms of appearance, taste, and aroma. Treatment 1, consisting of ½ teaspoon of tino-tino tea and 1 cup of pineapple juice, received the highest ratings for appearance (4.78) and taste (4.03), indicating that it was the most preferred formulation for these attributes. Meanwhile, Treatment 3 obtained the highest aroma rating (4.59). Microbial analysis indicated that the product had a shelf life of approximately one week without chilling. Overall, the findings demonstrated the potential of tino-tino as an ingredient in juice drink development.

Based on the findings, further studies are recommended to determine the shelf life of tino-tino juice drink with the use of preservatives and explore methods of reducing its bitterness to improve sensory acceptability. Additional research may investigate the potential application of tino-tino in liqueur production and determine the nutritional content of the developed juice drink. These investigations may contribute to further product development and improvement.

The study was limited to evaluating the sensory characteristics of the developed tino-tino juice drink and its shelf life under non-chilled conditions. Further investigations may assess preservative effectiveness, bitterness reduction, potential applications in liqueur production, and nutritional composition to expand the findings of the present study. These limitations provide opportunities for further investigation to better understand the product's characteristics and potential applications.

5. Compliance with Ethical Standards

The study involved 30 respondents aged 18–40 years from Barangay Lanao, Kidapawan City, North Cotabato, who participated in the sensory evaluation of three Tino-tino juice drink formulations. The researcher prepared a formal request addressed to the Barangay Captain seeking permission to conduct the study. Data were collected using a sensory evaluation score sheet assessing the appearance, aroma, and taste of the developed beverages.

REFERENCES

Acurio Arcos, L. P., Valencia Toapanta, M. F., Pacheco Tigselema, M. T., & Teneda Llerena, W. F. (2024). Effect of low-calorie sweeteners on sensory, physicochemical, and quality attributes of goldenberry (Physalis peruviana L.) juice. Current Nutrition & Food Science, 20(1), 92–102. https://doi.org/10.2174/1573401319666230519142822

Aluko, A., Kassim, N., & Makule, E. (2023). Investigating the optimal treatment to improve cashew apple juice quality and shelf life. Journal of Food Processing and Preservation, 2023, Article 4155761. https://doi.org/10.1155/2023/4155761

Andrade, C. (2021). The inconvenient truth about convenience and purposive samples. Indian Journal of Psychological Medicine, 43(1), 86–88. https://doi.org/10.1177/0253717620977000

Añibarro-Ortega, M., Dias, M. I., Petrović, J., Mandim, F., Núñez, S., Soković, M., López, V., Barros, L., & Pinela, J. (2025). Nutrients, phytochemicals, and in vitro biological activities of goldenberry (Physalis peruviana L.) fruit and calyx. Plants, 14(3), Article 327. https://doi.org/10.3390/plants14030327

Arias, C., Rodríguez, P., Soto, I., Vaillant, R., Cortés, M., & Vaillant, F. (2023). Flash vacuum expansion, a low-cost and energy-efficient alternative process to produce high-quality fruit puree: Application to Physalis peruviana. Heliyon, 9(6), Article e16969. https://doi.org/10.1016/j.heliyon.2023.e16969

Arilla, E., Martínez-Monzó, J., Chiş, M. S., Fărcaş, A. C., Socaci, S. A., Codoñer-Franch, P., García-Segovia, P., & Igual, M. (2023). Sensory evaluation, physico-chemical properties, and aromatic profile of pasteurised orange juice with resistant maltodextrin. Foods, 12(21), Article 4025. https://doi.org/10.3390/foods12214025

Bazalar Pereda, M. S., Nazareno, M. A., & Viturro, C. I. (2024). Physalis peruviana fruit nectar as a rich source of bioactive molecules and good sensory acceptability. In M. F. Ramadan (Ed.), Handbook of goldenberry (Physalis peruviana): Cultivation, processing, chemistry, and functionality (pp. 389–398). Academic Press. https://doi.org/10.1016/B978-0-443-15433-1.00032-7

Creswell, J. W., & Creswell, J. D. (2023). Research design: Qualitative, quantitative, and mixed methods approaches (6th ed.). SAGE Publications. https://us2.sagepub.com/en-us/nam/research-design/book270550

Food and Drug Administration. (2022). Guidelines on the microbiological requirements and assessment of certain prepackaged processed food products repealing FDA Circular No. 2013-010 entitled “Revised guidelines for the assessment of microbiological quality of processed foods” (FDA Circular No. 2022-012). https://naro.law.upd.edu.ph/issuances/425

Hemalatha, R., Kumar, A., Prakash, O., Supriya, A., Chauhan, A. S., & Kudachikar, V. B. (2018). Development and quality evaluation of ready to serve (RTS) beverage from Cape gooseberry (Physalis peruviana L.). Beverages, 4(2), Article 42. https://doi.org/10.3390/beverages4020042

Kumari, S., Tripathi, A. D., Nandan, A., Tripathi, A., & Agarwal, A. (2025). Development of mango-Mentha functional ready-to-serve (RTS) beverage and its shelf-life evaluation. Discover Applied Sciences, 7, Article 669. https://doi.org/10.1007/s42452-025-07275-9

Liang, Y., Liang, L., Shi, R., Luo, R., Yue, Y., Yu, J., Wang, X., Lin, J., Zhou, T., Yang, M., Zhong, L., Wang, Y., & Shu, Z. (2024). Genus Physalis L.: A review of resources and cultivation, chemical composition, pharmacological effects and applications. Journal of Ethnopharmacology, 324, Article 117736. https://doi.org/10.1016/j.jep.2024.117736

Mandha, J., Shumoy, H., Matemu, A. O., & Raes, K. (2023). Characterization of fruit juices and effect of pasteurization and storage conditions on their microbial, physicochemical, and nutritional quality. Food Bioscience, 51, Article 102335. https://doi.org/10.1016/j.fbio.2022.102335

Martins, I. B. A., Barbosa, I. C. C., Rosenthal, A., Ares, G., & Deliza, R. (2022). Development of tropical mixed juice with low added-sugar content: Sensory and nutritional aspects. Food Science and Technology International, 28(5), 440–450. https://doi.org/10.1177/10820132211020844

Moreira, J., Aryal, J., Guidry, L., Adhikari, A., Chen, Y., Sriwattana, S., & Prinyawiwatkul, W. (2024). Tea quality: An overview of the analytical methods and sensory analyses used in the most recent studies. Foods, 13(22), Article 3580. https://doi.org/10.3390/foods13223580

Olas, B. (2025). Physalis peruwiana fruits and their food products as new important components of functional foods. International Journal of Molecular Sciences, 26(8), Article 3493. https://doi.org/10.3390/ijms26083493

Polak, N., Kalisz, S., & Kruszewski, B. (2024). High-temperature short-time and ultra-high-temperature processing of juices, nectars and beverages: Influences on enzyme, microbial inactivation and retention of bioactive compounds. Applied Sciences, 14(19), Article 8978. https://doi.org/10.3390/app14198978

Prat, L., & Sáenz, C. (2024). Chemical characteristics, bioactive compounds, and advances in processing of Physalis peruviana. In M. F. Ramadan (Ed.), Handbook of goldenberry (Physalis peruviana): Cultivation,

processing, chemistry, and functionality (pp. 473–484). Academic Press. https://doi.org/10.1016/B978-0-443-15433-1.00044-3

United Nations Department of Economic and Social Affairs. (2025). The sustainable development goals report 2025. United Nations. https://unstats.un.org/sdgs/report/2025/

Wirivutthikorn, W. (2022). Appropriate ratios of mulberry leaf and pineapple on qualities of mulberry leaf and pineapple juice. King Mongkut's Agricultural Journal, 40(2), 178–186. https://li01.tci-thaijo.org/index.php/agritechjournal/article/view/248514

World Health Organization. (2025). Global traditional medicine strategy 2025–2034. https://www.who.int/publications/i/item/9789240113176

Zia, H., Slatnar, A., Košmerl, T., & Korošec, M. (2024). A review study on the effects of thermal and non-thermal processing techniques on the sensory properties of fruit juices and beverages. Frontiers in Food Science and Technology, 4, Article 1405384. https://doi.org/10.3389/frfst.2024.1405384