Journal of Chemistry and Nutritional Biochemistry
https://jcnb.sabapub.com
E ISSN: 2709-5932

2025 Volume 6, Issue 1: 82–97
DOI: https://doi.org/10.48185/jcnb.v6i1.1607

Development of Non-Alcoholic Turmeric (Curcuma Longa) Drink

Julian, Christine Joy I..[1, *] , Peñalber, Martina R.[2]

[1]Department of Education, Santiago City National High School, Santiago City, 3311, Philippines
[2]Commission on Higher Education, College of Education, Isabela State University- Main Campus, San Fabian, Echague, Isabela 3309, Philippines

Received: 07.03.2025 • Accepted: 24.04.2025 • Published: 14.05.2025 • Final Version: 30.05.2025

Abstract: This study aimed to develop turmeric-based non-alcoholic beverage using varying proportions of turmeric powder and to evaluate its sensory characteristics and economic viability. Five formulations were formulated by adjusting the amount of turmeric powder while keeping other ingredients constant. The fermentation process lasted 56 days, followed by a one-month aging period. Sensory evaluation was conducted with 70 adults, assessing appearance, aroma, taste, texture, and overall acceptability using a 9-point Hedonic Scale. Results showed that Formulation 3 (1000g turmeric powder) was rated highest in color, aroma, and flavor, while Formulation 1 excelled in texture and general acceptability. Statistical analysis using ANOVA and DMRT confirmed significant differences among formulations, with preferences influenced by age and sex. Alcohol content analysis was conducted by the Department of Science and Technology (DOST), and due to the low alcohol content of the formulations they are not considered as wine. The cost and return analysis demonstrated economic viability. The development of non-alcoholic Turmeric drink presents a promising opportunity for promoting health-conscious non-alcoholic beverages while supporting local turmeric farmers and entrepreneurs. The study contributes to the sustainable development goals, particularly in health, economic growth, and responsible consumption. Future research is recommended to refine production processes, investigate broader demographic preferences, and explore other potential raw materials for beverage production.

Keywords: Non-alcoholic Turmeric drink, sensory evaluation, fermentation, economic viability, health beverage, sustainable development

1. Introduction

Juice is among the widely consumed beverages globally. It holds cultural and ceremonial significance in many parts of the world, including the Philippines, where raising a glass in a during a toast is a cherished tradition during celebrations and special occasions. Traditionally, juice is made by extracting the liquid content of fruits. However, innovations in technology have expanded juice production to include a variety of tropical fruits. Research has shown that with the correct balance of sugar and acidity, nearly any fruit can serve as a base for juicemaking. This has led to the emergence of fruit wines made from bananas, apples, oranges, pineapples, strawberries, coconuts, and other tropical produce (Idise, 2023).
A growing body of literature supports the feasibility of using diverse fruits in juice production. Fruits such as mango, jamun, litchi, guava, and strawberries have all been successfully utilized, reflecting an increasing trend toward exploring local and underutilized agricultural

* Corresponding Author: Ceej0404@gmail.com

resources. Some studies have even examined the use of non-fruit materials like tea leaves, rice, and nipa palm in making various beverages. In the Philippine context, wines derived from tropical fruits, rice, and sugarcane are the most prevalent (Fiscal & Chavez, 2016).

One underexplored but promising ingredient for wine production is turmeric—known locally as *Luyang Dilaw*. Turmeric has a rich history dating back nearly 4,000 years to ancient India, where it was prized not only as a culinary spice but also as a key component of religious rituals and traditional medicine (Prasad & Aggarwal, 2011). Today, turmeric is widely cultivated in the Philippines and across Asia, serving as an essential ingredient in local cuisine. According to Johns Hopkins Medicine, turmeric is a deep golden-orange root spice from the ginger family, revered for its flavor, color, and health benefits.

Turmeric's significance extends far beyond the kitchen. In both Ayurvedic and traditional Chinese medicine, turmeric has long been used for its therapeutic properties. Its primary active compound, curcumin, has drawn scientific attention for its potential to treat a wide range of health issues. As noted by Gunnars (2023), turmeric has powerful anti-inflammatory effects and is a very strong antioxidant and it boost brain-derived neurotrophic factor. Research further supports turmeric's broad spectrum of medicinal properties, including antibacterial, antiviral, anti-inflammatory, antioxidant, antiseptic, antitumor, cardioprotective, hepatoprotective, nephroprotective, and gastrointestinal benefits (Prasad & Aggarwal, 2011).

Additional potential health benefits which are as follows: Curcumin may help delay aging and fight age-related chronic diseases; Curcumin has benefits against depression and encourages brain plasticity; curcumin appeared to have helped reduce arthritis, -related inflammation; Turmeric may help prevent cancer and Curcumin may lower your risk of heart disease. enumerated by (Gunnars, 2023)

Recognizing turmeric's medicinal potential and its cultural relevance, this study is initiated to develop a novel non-alcohol turmeric-based drink. This innovative product seeks to merge the traditional practice of juice making with the health-enhancing properties of turmeric. Designed to appeal to both young and mature adults, the beverage offers not only a unique flavor profile but also potential wellness benefits—including immune support, which is especially pertinent in the context of the ongoing COVID-19 health crisis.

Beyond health, the project also holds socio-economic value. It presents an opportunity to uplift local turmeric farmers, vendors, and small-scale entrepreneurs by creating a new market for turmeric-based products. The commercialization of this non-alcoholic Turmeric drinkcould contribute to the economic empowerment of agricultural communities, particularly in rural areas.

While numerous studies have explored the production of fruit juices using tropical fruits such as bananas, pineapples, guavas, and mangoes, there remains a significant lack of research on the utilization of *turmeric* as a primary ingredient in juice making. Most existing literature focuses on turmeric's medicinal and culinary applications, particularly its active compound, curcumin, which is recognized for its health-enhancing properties such as anti-inflammatory, antioxidant, and immune-boosting effects. However, there is minimal scientific investigation into how these health benefits can be preserved and translated into a fermented alcoholic beverage.

Moreover, limited attention has been given to the potential of non-alcoholic Turmeric drinkto serve not only as a functional drink but also as a livelihood innovation for local farmers and small-scale producers, particularly in the Philippine context. There is a research gap in assessing the feasibility, acceptability, and marketability of non-alcoholic Turmeric drinkas a novel product that aligns with both health and economic sustainability goals. Addressing this gap would contribute to the diversification of functional alcoholic beverages and support agricultural value-adding initiatives in local communities.

1.1 Statement of the Problem

This study was conducted to develop non-alcoholic Turmeric (Curcuma longa) drink using turmeric *(C. longa)* powder as a main ingredient and determine its alcohol content.

Specifically, it aimed to answer the following questions:

1. What is the acceptability of the five formulations of non-alcoholic Turmeric (Curcuma longa) drink in terms of:
    a. appearance;
    b. aroma;
    c. taste;
    d. mouthfeel, and;
    e. general acceptability?
2. Which among the formulations is most acceptable based on the Acceptability Consumer Index?
3. What is the difference of the acceptability of the non-alcoholic Turmeric *(Curcuma longa)* drink when the respondents are grouped according to their age and sex?
4. What is the Return-on-Investment computed for the different formulations of the non-alcoholic Turmeric *(Curcuma longa)* drink?
5. What instructional material may be developed based from the result of the study?

2. Materials and Methods

This study utilized experimental methods to develop a non-alcoholic Turmeric *(Curcuma longa)* drink using varying proportions of turmeric powder and assess its sensory and economic viability. The primary materials used included turmeric powder, sugar, yeast, and water, with different formulations designated as formulations F1 to F5. Each formulation varied in turmeric quantity, while sugar (800g), yeast (15g), and water content were adjusted accordingly to maintain the fermentation balance. Specifically, the turmeric proportions were 750g (F1 and F2), 1000g (F3), 1250g (F4), and 1500g (F5). The turmeric powder used in this study was sourced from Isabela State University's College of Agriculture, a product of a research initiative led by Dr. Artemio A. Martin Jr.

In preparing the non-alcoholic Turmeric *(Curcuma longa)* drink, all tools and ingredients were sanitized thoroughly. The turmeric powder was weighed and mixed with the sugar and yeast in water before being transferred into a fermentation container. The mixture underwent fermentation for 56 days, followed by a one-month aging period. Filtration was conducted in phases to ensure clarity, and the final product was then bottled for evaluation. The procedure was adapted from Zhao (2006), with modifications applied to suit the local ingredients and study requirements.

Various tools and equipment were used throughout the process, including measuring utensils, stainless steel knives, graters, fermenting barrels, juice bottles, decanters, siphons, and food-grade containers. For the sensory evaluation, shot glasses, evaluation scorecards, and writing tools were provided.

To determine the beverage's alcohol content, samples were submitted to the Department of Science and Technology Region II's Regional Standards and Testing Laboratory in Carig Sur, Tuguegarao City, Cagayan. Sensory evaluation was then conducted in Santiago City, Isabela, involving 70 participants (35 males and 35 females), all aged 18 and above and identified as alcohol consumers. Using the 9-Point Hedonic Scale, the panel assessed the wine based on appearance, aroma, flavor,

texture, and overall acceptability. Standard sensory evaluation protocols were observed to ensure reliable results.

The study employed a randomized complete block design, with age used as the blocking factor. The collected data were tabulated and analyzed using Analysis of Variance (ANOVA) to determine significant differences across formulations. Furthermore, Least Significant Difference (LSD) was used to identify which means are different.

Additionally, a cost and return analysis was carried out to evaluate the economic potential of commercializing the non-alcoholic turmeric drink. This involved documenting all costs related to ingredient procurement, production, and packaging, followed by computing the Return on Investment (ROI) for each formulation. The analysis aimed to assess the product's market viability, especially in support of local turmeric farmers and entrepreneurs.

3. Results

This section presents the analysis and interpretation of data gathered from the foregoing study non-alcoholic turmeric drink's potential to be a nutritious and functional beverage with various health benefits.

Table 1. Distribution of evaluators by Sex

	Frequency	*Percent*
Male	59	84.29
Female	11	15.71
Total	*70*	*100.00*

Sex. Table 1 presents the demographic profile of the evaluators when categorized as male and female. It shows that the majority of the evaluators are male with a frequency of 59 or 84.29% as compared to males.

Table 2. Distribution of evaluators by age

Age	Frequency	Percent
21-30	2	2.86
31-40	22	31.43
41-50	37	52.86
51-60	9	12.86
Total	70	100.00
MEAN AGE = 43		

Age. Table 2 presents the distribution of evaluators by age and there are 70 randomly selected evaluators, most are belong to the age range of 41 to 50 years old with a frequency of thirty seven (37) or 52.86%, followed by age range of 31 to 40 years old with a frequency of twenty-two (22) or 31.43%, nine (9) or 12.86% age range of 51 to 60 years old, and two (2) or 2.86% age range of 21 to 30 years old.

Alcohol Content

Table 3. Alcohol Content of the different formulations of non-alcoholic turmeric drink

FORMULATION	**Ethanol Content (g/100g) (g)**
F_1-750g Turmeric and 800g sugar	10.5%
F_2-750g Turmeric and 800g sugar	3.09%
F_3-1000g Turmeric and 800g sugar	4.62%
F_4 -1250g turmeric and 800g sugar	0.33%
F_5-1500g turmeric and 800g sugar	3.94%

Table 3 reflects the result of the Alcohol content analysis conducted by the Department of Science and Technology Regional Office 2-Regional Standards and Testing Laboratory, Tuguegarao City, Cagayan which shows that F3 (1000g Turmeric and 800g sugar) has the highest Ethanol content with 4.62% followed by F5 (1500g turmeric and 800g sugar) with 3.94%. F2 (750g Turmeric and 800g sugar) ranks third with 3.09% and lastly F4 has the least amount of Ethanol with only 0.33%.

Due to the low alcohol content of the various formulations, they are not considered wine. This is in congruence to the definition given by the International Organization of Vine and Wine (OIV) (2024) that says wine is a beverage derived from the fermentation of fresh grapes or grape must, with an actual alcohol content of not less than 8.5% by volume. This definition suggests that beverages with an alcohol content below 8.5% may not be considered wine under OIV standards.

Degree of Acceptability

Color/Appearance. Table 4 shows the degree of acceptability of the non-alcoholic Turmeric drinkin terms of color or appearance by the respondents.

Table 4. Degree of acceptability in terms of color or appearance of the non-alcoholic turmeric drink

FORMULATIONS	MEAN	QD
1	7.63	Like very much
2	6.37	Like moderately
3	7.99	Like very much
4	7.31	Like very much
5	7.74	Like very much

Table 4 shows the acceptability in terms of color or appearance of non-alcoholic turmeric drink. The table shows that all but one formulation has interpretation of “Like very much” and formulation 2 has mean of 6.37 and has interpretation of “Like moderately”. Moreover, formulation 3, which has mean of 7.99 and has description of “Like very much” has the highest acceptability compared to the other formulation. It was closely followed by formulation 5 with mean of 7.74. It implies that formulation 3 is the best formulation when it comes to color or appearance acceptability.

Odor/Aroma. Table 5 shows the degree of acceptability of non-alcoholic Turmeric drinkin terms of color or appearance by the respondents.

Table 5. Degree of Acceptability in Terms of Odor or Aroma of non-alcoholic turmeric drink

FORMULATIONS	MEAN	QD
1	7.26	Like very much
2	6.51	Like moderately
3	7.97	Like very much
4	6.44	Like moderately
5	7.70	Like very much

Table 5 shows that Formulations 1, 3, and 5 has QD of “Like very much” while formulation 2 and 4 with QD of “Like moderately”. Formulation 3 has the highest mean with 7.97 and followed by formulation 5 with mean of 7.70. This implies that formulation 3 is the best formulation when it comes to aroma and odor of non-alcoholic turmeric drink.

Taste/Flavor. Table 6 shows the degree of acceptability of non-alcoholic Turmeric drinkin terms of taste or flavor by the respondents.

Table 6. Degree of Acceptability in Terms of Taste and Flavor of non-alcoholic turmeric drink

FORMULATION	MEAN	QD
1	7.89	Like very much
2	7.00	Like moderately
3	8.04	Like very much
4	6.80	Like moderately
5	7.83	Like very much

The table shows that there is a high variation of mean and qualitative description when it comes to the acceptability of the taste and flavor. Formulation 4 has the lowest acceptability with mean of 6.80 and QD of "Like moderately". On the other hand, formulation 3, which has the mean of 8.04 and has qualitative description of "Like very much", has the highest acceptability compared to the other formulation. The results implies that formulation 3 is the best formulation when it comes to the taste and flavor of non-alcoholic turmeric drink.

Texture/Mouthfeel. Table 7 presents the degree of acceptability in terms of texture or mouthfeel of non-alcoholic turmeric drink.

Table 7. Degree of Acceptability in Terms of Texture or Mouthfeel of non-alcoholic turmeric drink

FORMULATION	MEAN	QD
1	8.13	Like extremely
2	6.77	Like moderately
3	8.10	Like very much
4	6.56	Like moderately
5	7.91	Like very much

The table shows that there is a high variation of mean and qualitative description when it comes to the acceptability of the texture. Formulation 4 has the lowest acceptability with mean of 6.56 and QD of "Like moderately". On the other hand, formulation 1, which has the mean of 8.13 and has qualitative description of "Like extremely", has the highest acceptability compared to the other formulation. The results implies that formulation 1 is the best formulation when it comes to the texture of non-alcoholic turmeric drink.

General Acceptability. Table 8 presents the general acceptability of non-alcoholic turmeric drink.

Table 8. General Acceptability of non-alcoholic turmeric drink

FORMULATION	MEAN	QD
1	8.14	Like extremely
2	6.27	Like slightly
3	8.06	Like very much
4	6.70	Like moderately
5	7.70	Like very much

The table shows that there is a high variation of mean and qualitative description when it comes to the acceptability of the texture. Formulation 2 has the lowest acceptability with mean of 6.27 and QD of "Like slightly". On the other hand, formulation 1, which has the mean of 8.14 and has qualitative description of "Like extremely", has the highest acceptability compared to the other formulation. The results imply that formulation 1 is the best formulation when it comes to the texture of non-alcoholic turmeric drink.

Acceptability Consumer Index

Table 9 shows the Acceptability Consumer Index of Non-alcoholic turmeric drink.

Table 12. Acceptability Consumer Index of Non-alcoholic turmeric drink

	Appearance	22	Aroma	19	Texture	19.5	Taste	39.5	100	RANK
F1	7.63	1.68	7.26	1.38	8.13	1.59	7.89	3.12	7.76	3
F2	6.37	1.40	6.51	1.24	6.77	1.32	7.00	2.77	6.72	5
F3	7.99	1.76	7.97	1.51	8.10	1.58	8.04	3.18	8.03	1
F4	7.31	1.61	6.44	1.22	6.56	1.28	6.80	2.69	6.80	4
F5	7.74	1.70	7.70	1.46	7.91	1.54	7.83	3.09	7.80	2

The table presents the mean score of each of the formulation based on the appearance, aroma, texture and taste, as well as the overall ranking. The lowest ranking garnering 6.72 is the formulation 2, followed by formulation 4 with 6.80. The 3rd in ranking is the formulation 1 with the overall score of 7.76 and the 2nd is formulation 5 with score of 7.80. The most accepted formulation based on the different factors is the formulation 3 with the score of 8.03. This implies that formulation 3 is the best overall formulation based on the different factors.

Table 10. Differences in the evaluation of panelist in terms of **COLOR** with age as blocking factor

Formulation	AGE BRACKET				MEAN
	21-30	31-40	41-50	51-60	
F1	6.50	7.55	7.65	8.00	7.43 bc
F2	5.50	6.45	6.41	6.22	6.15 d
F3	7.50	7.91	8.08	7.89	7.85 a
F4	7.00	7.45	7.30	7.11	7.22 c
F5	7.50	7.82	7.59	8.22	7.78 ab
CV	3.71				7.28
$F_{0.05}$	25.76**				

** - significant 1% level

The table 10 shows the differences in the evaluation of panelist in terms of COLOR with age as blocking factor. The table presents the different mean scores for each of the age bracket and formulation. It shows that the grand mean of the formulations is 7.28. Also, the F-value of the table is 25.76 and the critical value for the ANOVA is 3.71, this means that the result is significant. Therefore, there is significant difference between the formulations in terms of colors as with the age bracket.

Table 11. Differences in the evaluation of panelist in terms of **TASTE** with age as blocking factor

Formulation	AGE BRACKET				MEAN
	21-30	31-40	41-50	51-60	
F1	8.00	8.00	8.00	8.00	8.00 a
F2	7.00	7.00	7.00	7.00	7.00 b
F3	8.00	8.00	8.00	8.00	8.00 a
F4	7.00	7.00	7.00	6.00	6.75 b
F5	8.00	8.00	8.00	7.00	7.75 a
CV	3.65				7.50
$F_{0.05}$	18.33**				

** - significant 1% level

The table 11shows the differences in the evaluation of panelist in terms of taste with age as blocking factor. The table presents the different mean scores for each of the age bracket and formulation. It shows that the grand mean of the formulations is 7.50. Also, the F-value of the table is

18.33 and the critical value for the ANOVA is 3.65, this means that the result is significant. Therefore, there is significant difference between the formulations in terms of taste as with the age bracket.

Table 12. Differences in the evaluation of panelist in terms of **AROMA** with age as blocking factor

FormulationS	AGE BRACKET				MEAN
	21-30	31-40	41-50	51-60	
F1	7.00	7.00	7.43	7.22	7.16 b
F2	7.00	7.18	6.46	5.89	6.63 bc
F3	8.50	7.82	8.00	8.11	8.11 a
F4	6.00	6.55	6.46	6.22	6.31 c
F5	9.00	7.45	7.70	8.00	8.04 a
CV	6.29				7.25
$F_{0.05}$	12.64**				

** - significant 1% level

Table 12 shows the differences in the evaluation of panelist in terms of aroma with age as blocking factor. The table presents the different mean scores for each of the age bracket and formulation. It shows that the grand mean of the formulations is 7.25. Also, the F-value of the table is 12.64 and the critical value for the ANOVA is 6.29, this means that the result is significant. Therefore, there is significant difference between the formulations in terms of aroma as with the age bracket.

Table 13. Differences in the evaluation of panelist in terms of **TEXTURE** with age as blocking factor

Formulation	AGE BRACKET				MEAN
	21-30	31-40	41-50	51-60	
F1	7.00	6.77	7.22	7.67	7.17 ab
F2	8.00	6.55	6.97	6.22	6.94 b
F3	7.00	8.27	8.19	7.56	7.76 a
F4	6.00	6.59	6.59	6.44	6.41 b
F5	8.00	7.86	8.00	7.67	7.88 a
CV	7.36				7.23
$F_{0.05}$	5.21*				

** - significant 1% level

The table 13 shows the differences in the evaluation of panelist in terms of texture with age as blocking factor. The table presents the different mean scores for each of the age bracket and formulation. It shows that the grand mean of the formulations is 7.23. Also, the F-value of the table is 5.21 and the critical value for the ANOVA is 7.36, this means that the result is significant. Therefore, there is significant difference between the formulations in terms of texture as with the age bracket.

Table 14. Differences in the evaluation of panelist in terms of **GENERAL ACCEPTABILITY** with age as blocking factor

	AGE BRACKET				MEAN
	21-30	31-40	41-50	51-60	
F1	7.00	8.23	8.11	8.33	7.92 ab
F2	6.00	6.27	6.30	6.22	6.20 d
F3	9.00	8.18	7.97	7.89	8.26 a
F4	7.50	6.32	6.97	6.33	6.78 cd
F5	6.00	7.82	7.81	7.33	7.24 bc
CV	8.71				7.28
$F_{0.05}$	6.94**				

** - significant 1% level

The table 14 shows the differences in the evaluation of panelist in terms of general acceptability with age as blocking factor. The table presents the different mean scores for each of the age bracket and formulation. It shows that the grand mean of the formulations is 7.28. Also, the F-value of the table is 6.94 and the critical value for the ANOVA is 8.71, this means that the result is significant. Therefore, there is significant difference between the formulations in terms of general acceptability as with the age bracket.

Table 15. Differences in the evaluation of panelist in terms of **COLOR** with sex as blocking factor

Formulation	COLOR		
	Male	Female	Mean
1	7.71	7.18	7.45 ab
2	6.42	6.09	6.26 c
3	7.98	8.00	7.99 a
4	7.37	7.00	7.19 b
5	7.71	7.91	7.81 a
CV (%)	2.90		7.34
$F_{0.05}$	20.44**		

** - significant 1% level

The table 15 shows the differences in the evaluation of panelist in terms of color with sex as blocking factor. The table presents the different mean scores for each of the age bracket and formulation. It shows that the grand mean of the formulations is 7.34. Also, the F-value of the table is 20.44 and the critical value for the ANOVA is 2.29, this means that the result is significant. Therefore, there is significant difference between the formulations in terms of color as with the sex bracket.

Table 16. Differences in the evaluation of panelist in terms of **TASTE** with sex as blocking factor

Formulation	TASTE		
	Male	Female	Mean
1	7.86	8.00	7.93 a
2	6.93	7.36	7.15 b
3	8.03	8.09	8.06 a
4	6.78	6.91	6.85 b
5	7.83	7.82	7.83 a
CV (%)	1.57		7.56
$F_{0.05}$	40.52**		

** - significant 1% level

The table 16 shows the differences in the evaluation of panelist in terms of taste with sex as blocking factor. The table presents the different mean scores for each of the age bracket and formulation. It shows that the grand mean of the formulations is 7.56. Also, the F-value of the table is 40.52 and the critical value for the ANOVA is 1.57, this means that the result is significant. Therefore, there is significant difference between the formulations in terms of taste as with the sex bracket.

Table 17. Differences in the evaluation of panelist in terms of **AROMA** with sex as blocking factor

Formulation	AROMA		
	Male	Female	Mean
1	7.22	7.45	7.34 ab
2	6.37	7.27	6.82 bc
3	8.00	7.82	7.91 a
4	6.42	6.55	6.49 c
5	7.69	7.73	7.71 a
CV (%)	3.97		7.25
$F_{0.05}$	8.60**		

** - significant 1% level

The table 17 shows the differences in the evaluation of panelist in terms of aroma with sex as blocking factor. The table presents the different mean scores for each of the age bracket and formulation. It shows that the grand mean of the formulations is 7.25. Also, the F-value of the table is 8.60 and the critical value for the ANOVA is 3.97, this means that the result is significant. Therefore, there is significant difference between the formulations in terms of aroma as with the sex bracket.

Table 18. Differences in the evaluation of panelist in terms of **TEXTURE** with sex as blocking factor

Formulation	TEXTURE		
	Male	Female	Mean
1	7.20	6.73	6.97 b
2	6.71	6.73	6.72 bc
3	8.08	8.18	8.13 a
4	6.58	6.45	6.52 c
5	7.92	7.91	7.92 a
CV (%)	2.18		7.25
$F_{0.05}$	42.32**		

** - significant 1% level

The table 18 shows the differences in the evaluation of panelist in terms of texture with sex as blocking factor. The table presents the different mean scores for each of the age bracket and formulation. It shows that the grand mean of the formulations is 7.25. Also, the F-value of the table is 42.32 and the critical value for the ANOVA is 2.18, this means that the result is significant. Therefore, there is significant difference between the formulations in terms of texture as with the sex bracket.

Table 19. Differences in the evaluation of panelist in terms of **GENERAL ACCEPTABILITY** with sex as blocking factor

Formulation	GENERAL ACCEPTABILITY		
	Male	Female	Mean
1	8.17	8.00	8.09 a
2	6.29	6.18	6.24 c
3	7.98	8.45	8.22 a
4	6.68	6.82	6.75 bc
5	7.80	7.18	7.49 ab
CV (%)	3.87		7.36
`$F_{0.05}$	17.94**		

** - significant 1% level

The table 19 shows the differences in the evaluation of panelist in terms of general acceptability with sex as blocking factor. The table presents the different mean scores for each of the age bracket and formulation. It shows that the grand mean of the formulations is 7.36. Also, the F-value of the table is 17.94 and the critical value for the ANOVA is 3.87, this means that the result is significant. Therefore, there is significant difference between the formulations in terms of general acceptability as with the sex bracket.

Summary Computation of Cost and Return on Investment

Cost of Production. Table 20 shows the summary computation of the cost of production among all five formulations.

Table 20. Summary Computation of the Cost of Production

PARTICULARS	Formulations				
Ingredients	F1	F2	F3	F4	F5
Turmeric Powder	375.00	375.00	500.00	625.00	750.00
Sugar	68.00	68.00	68.00	68.00	68.00
Yeast	357.50	357.50	357.50	357.50	357.50
Water	66.25	66.25	63.00	60.00	56.00
Subtotal	**866.75**	**866.75**	**988.44**	**1110.12**	**1231.81**
Additional Expenses					
Packaging material	40.00	40.00	40.00	40.00	40.00
Label	5.00	5.00	5.00	5.00	5.00
Subtotal	**45.00**	**45.00**	**45.00**	**45.00**	**45.00**
Other Operating Expenses					
Electricity	5.00	5.00	5.00	5.00	5.00
Fare	5.00	5.00	5.00	5.00	5.00
Labor	20.00	20.00	20.00	20.00	20.00
Subtotal	**30.00**	**30.00**	**30.00**	**30.00**	**30.00**
Total Cost (Php)	**941.75**	**941.75**	**1063.44**	**1185.12**	**1306.81**

As shown in the Table 20, the cost of Turmeric Powder and Water used in the five formulations differed. For Formulation 2, (750g of Turmeric Powder and 5000g of Water) the Turmeric Powder costs Php375.00 while the Water costs Php66.25; F3 (1000g of Turmeric Powder and 4750g of Water), the Turmeric Powder costs Php500.00 while the Water costs Php63.00; F4 (250g of Turmeric Powder and 4500g of Water), the Turmeric Powder costs Php625.00 while the Water costs Php60.00; F5 (1500g of Turmeric Powder and 4250g of Water), the Turmeric Powder costs Php750.00 while the Water costs Php56.00;

For the other ingredients, the same quantity was used on all formulations thus, they have the same cost; Sugar, Php 68.00; Yeast 357.50

Considering all of the above expenses for the ingredients, the subtotal for F1, F2, F3, F4, and F5 were Php866.75, Php866.75, Php988.44, Php1,110.12, Php1231.81 respectively.

Additional expenses for all formulations amounted to Php45.50 which includes Packaging Material at Php40.00 and Label at Php5.00. In addition, other operating expenses such as Electricity and Fare which both cost Php5.00, and Labor amounting to Php20.00, totaled Php30.00.

Summing up all the above expenses, the total cost incurred in producing the products amounted to Php941.75, Php941.75, Php1.063.44, Php1,185.12 and Php1,306.81 for F1, F2, F3, F4 and F5 respectively.

Return on Investment. Table 21 shows the Summary Computation of Return on

Investment of each formulation.

Table 21. Summary Computation of the Return on Investment

PARTICULARS	**FORMULATIONS**				
	F1	F2	F3	F4	F5
Total Production Cost (Php)	941.75	941.75	1063.44	1185.12	1306.81
Number of bottles (750 ml)	5.5	5.5	5	4.5	4
Selling Price	350.00	350.00	350.00	350.00	350.00
Total Sale	1,925.00	1,925.00	1,750.00	1,575.00	1,400.00
Total Income	983.25	983.25	686.56	389.88	93.19
ROI	**104.41%**	**104.41%**	**64.56%**	**32.90%**	**7.13%**

As shown in the table, the cost analysis of the production costs, sales income and return on investment (ROI) for the five formulations of the non-alcoholic turmeric drink, reveals distinct profitability profiles for each formulation. Each formulation produces varied quantities of the non-alcoholic Turmeric drink and the selling price set was Php350.00 per bottle.

Formulations 1 and 2 stands out as the most profitable option. With a total production cost of Php941.75, it generates an income of Php983.25, resulting in a remarkable ROI of 104.41%. This high ROI indicates that F2 is highly efficient in converting production costs into substantial profits. Formulation 3 follows, with a production cost of Php1,063.44, yielding an income of Php686.56 and an ROI of 64.56%. This makes F3 a viable and attractive option with a strong return.

Formulation 4 shows moderate profitability, with a production cost of Php1,185.12 and an income of Php389.88, resulting in an ROI of 32.90%. While profitable, F3's ROI is lower when compared with F1, F2, and F3. This indicates a lesser but still reasonable return on investment.

Lastly, Formulation 5 has the highest production cost of Php1,306.81 and has the lowest income at Php93.19, resulting in the lowest ROI of 7.13%. Although F5 is still profitable, its low ROI indicates that is the least efficient in terms of cost-to-profit conversion among all formulations.

In conclusion, F1 and F2 offers the highest profitability and ROI, making it the best option for maximizing returns. Formulation 3 also presents a strong case with a significant ROI. Formulation 4, while profitable, provide moderate returns and Formulation 5, despite being profitable, is the least favorable due to its low ROI. This analysis helps in identifying the most profitable and efficient formulations for Non-alcoholic Turmeric drink production.

Development of Information, Education and Communication (IEC) Material

Figure 2 shows the Information, Education and Communication (IEC) Trifold Material developed for this study. This IEC Material aims to give information and promote a healthier alcoholic beverage options to the public. It is also advertises and disseminates the various health and wellness benefits that can be obtained by consuming this Non-alcoholic turmeric drink.

This features the name, ingredients and procedures in making product. It also provides a detailed description of what non-alcoholic Turmeric drinkis. The contact persons are also included in the material.

Figure 2. Developed Information, Education and Communication (IEC) Material.

4. Conclusion

The study successfully developed non-alcoholic Turmeric drink using varying proportions of turmeric powder and evaluated its sensory qualities and economic feasibility. The demographic profile of the evaluators revealed a higher participation rate among males (84.29%) and a dominant age range of 41 to 50 years old (52.86%), indicating that middle-aged male consumers were the most represented group in the sensory evaluation. Among the five formulations, Formulation 3—composed of 1000g turmeric powder, 800g sugar, 15g yeast, and 4750g water—was found to be the most favorable in terms of color, taste and flavor, odor or aroma, and general acceptability, making it the overall best formulation. Interestingly, Formulation 1 was rated best in terms of texture alone. Statistical analysis revealed significant differences among formulations regarding sensory attributes such as color, flavor, aroma, and overall acceptability, and these differences were found to be associated with both age and sex of the evaluators. These results suggest that non-alcoholic turmeric drink's sensory quality and consumer preference are affected not only by the formulation but also by demographic variables, implying the importance of tailoring product development to target market segments.

5. Recommendation

In light of the findings, the study recommends that future researchers further explore the influence of age and sex on consumer perception of non-alcoholic turmeric drink, especially to understand how demographic factors shape sensory preferences. Refinements in the juice production process should also be explored, potentially customizing the formulation and fermentation conditions to appeal to a broader range of consumers across different age groups and genders. Engaging with juice making experts is advised to enhance the fermentation, aging, and flavor development processes, ultimately improving the product's quality and market potential. Additionally, future studies should include in-depth analysis of the beverage’s alcohol content to ensure quality control and consumer safety. Finally, it is recommended to expand the scope of research by exploring the potential of using other rhizomes, fruits, herbs, or edible plants in juice production, thereby opening new avenues for product innovation and diversification in the local beverage industry.

Author Contributions

Julian C.J.I Conceptualized the idea, did the experiment, processed the experimental data and performed the data analysis. Peñalber M.R Supervised the work. Julian C.J.I and Peñalber M.R interpreted the results and wrote the manuscript.

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