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DEVELOPMENT OF ORGANIC VINEGAR USING OREGANO *(Origanum vulgare)*, LEMONGRASS *(Cymbopogon citratus)*, AND GINGER *(Zingiber officinale)*: HEALTH BENEFITS AND ECONOMIC POTENTIAL IN THE PHILIPPINES

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ABSTRACT

This study explored the development and acceptability of organic vinegar made from oregano, lemongrass, and ginger. The production process involved selecting, washing, boiling, fermenting, and bottling each type of vinegar. The study aimed to assess the vinegars' sensory characteristics—sourness, smell, and color. Evaluations from different respondent groups revealed high acceptability across all characteristics, with Lemon Grass vinegar rated the highest for sourness and Oregano vinegar for smell and color. ANOVA results showed no significant differences in acceptability based on age or professional background. Shelf-life analysis indicated that the vinegars maintained their sensory qualities for up to 21 days at normal temperatures without spoilage. The findings suggest these organic vinegars meet high acceptability standards and exhibit good shelf stability. Recommendations include further research on enriched food products, validation of shelf life, and appropriate packaging. Farmers and producers are encouraged to cultivate more oregano, lemongrass, and ginger to benefit economically. This study provides a valuable reference for future research in organic vinegar production.

Keywords: *Organic vinegar, Sensory characteristics, Acceptability, Shelf-life, Oregano, Lemongrass, Ginger*

INTRODUCTION

Vinegar is a widely used sour condiment known for its versatility in culinary applications and household benefits. As a food condiment, it plays a significant role in the food industry, offering both flavor enhancement and preservation properties. Vinegar can be derived from various raw materials, including grains such as sorghum, rice, wheat, and other grains, as well as fruits like grapes and apples. Additionally, vinegar can be fermented from sugar and alcohol, providing a diverse range of sources for its production (Budak et al., 2014).

The production of vinegar involves fermentation processes that yield acetic acid, the primary component responsible for its characteristic sour taste and antimicrobial properties. This acid makes vinegar an effective agent against bacteria, molds, and germs, and it is environmentally safe. Traditional vinegar production utilizes local materials such as sugarcane, bananas, pineapples, and coconuts, undergoing infusion or fermentation to produce the final product (Johnston & Gaas, 2006).

According to Yong et al. (2013), different types of vinegar share common main components: water and acid. Vinegar contains several acids, including acetic, citric, lactic, malic, oxalic, and succinic acids. These nutrients contribute to the total acidity content (TAC), which is closely linked to the quality of vinegar.

Ison (2019) reported that in response to the government's efforts to eliminate "fake" vinegar from the market, the Department of Agriculture (DA) and the Philippine Coconut Authority (PCA) initiated nationwide training for farmers and women's groups. This training focused on producing natural vinegar using agricultural products to address the anticipated supply gap. Vinegar production involves a two-step fermentation process where yeast consumes sugar or starch from a substrate such as fruits, grains, potatoes, or rice, converting it into alcohol. Subsequently, the alcohol undergoes further fermentation in the presence of oxygen and Acetobacter bacteria, producing acetic acid over several weeks or months.

The use of local ingredients like oregano, ginger, and lemongrass in making organic vinegar presents an opportunity for Filipinos to engage in a promising business venture. These ingredients are commonly grown in backyards across the Philippines, making them accessible and sustainable.

Oregano (Origanum vulgare) is known for its medicinal properties, including its use in treating coughs, colds, inflammatory disorders, headaches, and rheumatism. Oregano oil, derived from this herb, is utilized in cooking and as an efficascent oil for relieving muscle and nerve pain. Oregano's bioactive compounds are essential for treating various illnesses and diseases (Agriculture Monthly, 2015). Sakkas and Papadopoulou (2016) highlighted oregano's widespread use as a condiment and its essential oil's antiseptic and antispasmodic effects. Oregano also possesses potent antioxidant properties due to its high thymol and carvacrol content, though its strong smell can limit its use as a food preservative.

Lemongrass (Cymbopogon citratus) is another valuable ingredient. Hasim et al. (2015) found that ethanol extract of lemongrass leaves contains alkaloids, saponins, tannins, flavonoids, phenols, and steroids, which are beneficial for preventing oil oxidation.

Ginger (Zingiber officinale Rosc.) is extensively used worldwide as a spice and traditional herbal medicine. It is employed to manage symptoms such as colds, digestive disorders, rheumatism, neuralgia, colic, and motion sickness. Ginger is also widely used to flavor foods and beverages (Yeh et al., 2014).

Vinegar's diverse applications, including its use as a healthful treatment, cleaner, condiment, preservative, and key cooking ingredient, make it a versatile product. Its therapeutic uses extend to digestive aids, antimicrobial wound dressings, and cough remedies. Today, vinegar is often promoted as a remedy for various ailments, from minor aches to chronic disorders (Johnston & Gaas, 2006).

This study aims to utilize oregano, lemongrass, and ginger in producing organic vinegar, benefiting the people of Quirino Province and Isabela. By promoting the use of popular indigenous herbal elements known for their health benefits, this research seeks to improve local health conditions and support farmers' economic well-being.

Research Questions

This study was conducted to determine the development and acceptability of Oregano, Lemongrass, and Ginger as organic vinegar.

Specifically, it sought to answer the following questions:

1. What are the processes involved in the development of organic vinegar made of oregano, lemongrass, and ginger?
2. What is the level of acceptability of vinegar made of lemongrass, ginger, and oregano in terms of:
   a. sourness
   b. smell; and
   c. color?
3. Is there a significant difference in the level of acceptability of organic vinegar made of oregano, lemongrass, and ginger as evaluated by:
   a. teenagers
   b. adults
   c. faculty and staff
   d. food experts
4. What is the shelf life of organic vinegar made of oregano, lemongrass, and ginger at normal room temperature?

METHODOLOGY

Materials

The following utensils, tools, and ingredients were used in the conduct of the study.

Table 1. Tools and equipment used in the conduct of the study

Preparation Tools	Measuring Tools	Mixing Tools	Cutting Tools	Equipment
Basin	Measuring spoon	Wooden spoon	Knife	Gas Range
Bottle	Measuring Cup	Spoon	Chopping board	
Funnel		Mixing bowl		
Muslin cloth/cotton				
Saucepan				
Strainer				

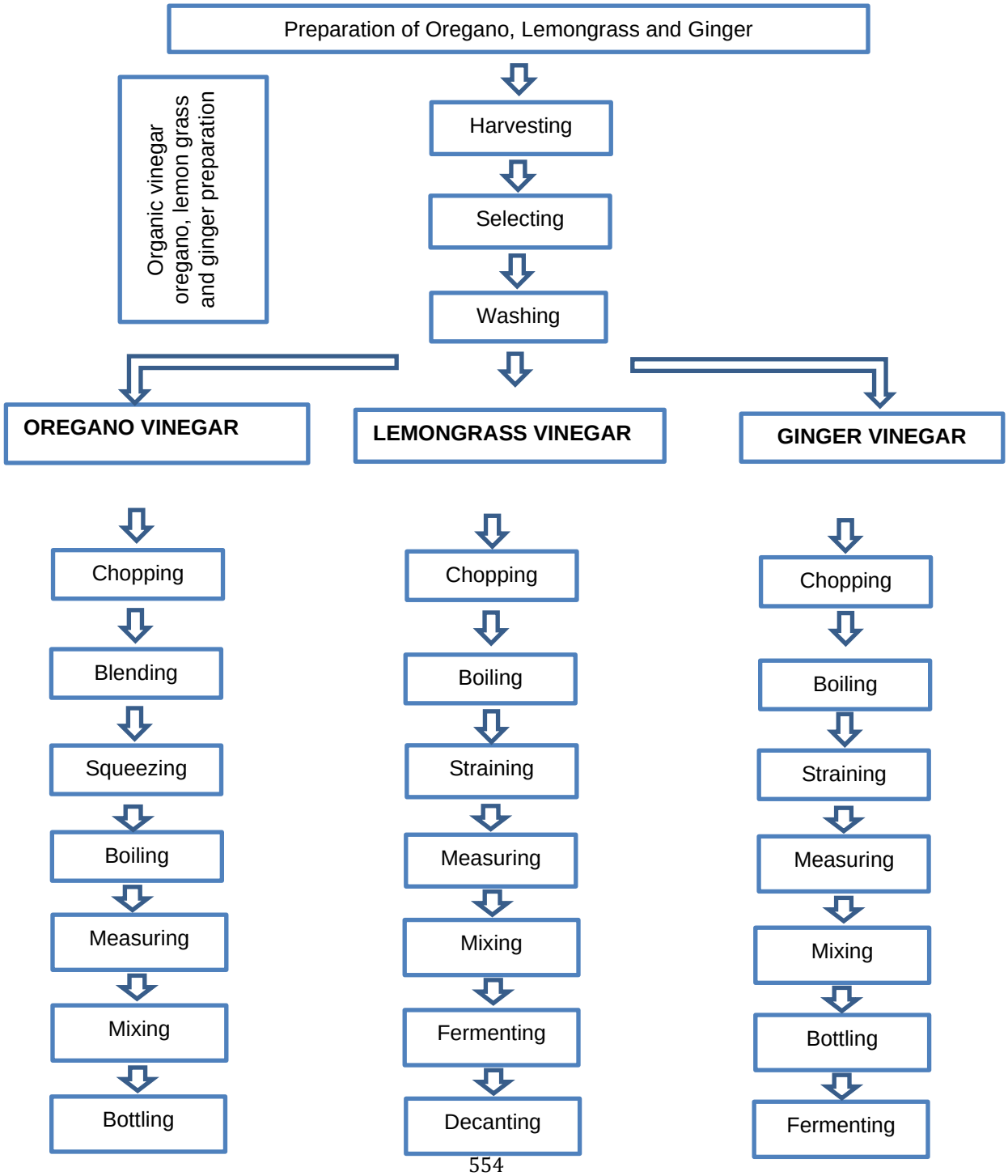
Ingredients

Table 2. Ingredients and measurements used in the preparation of homemade vinegar

Ingredients	Measurement	Ingredients	Measurement	Ingredients	Measurement
Oregano extract	2 ½ cup	Lemongrass Boiled water	2 ½ cup	Ginger boiled water	2 ½ cup
Sugar	¼ cup	Sugar	¼ cup	Sugar	¼ cup
Yeast	1 tsp	Yeast	1 tsp	Yeast	1 tsp

Developmental Procedure

This study used organic materials such as oregano, lemongrass, and ginger as main ingredients in preparing vinegar. The development procedure began with selecting organic herbs such as oregano, lemongrass, and ginger. After the preparation of organic, the preparation of all ingredients in vinegar making comes next.



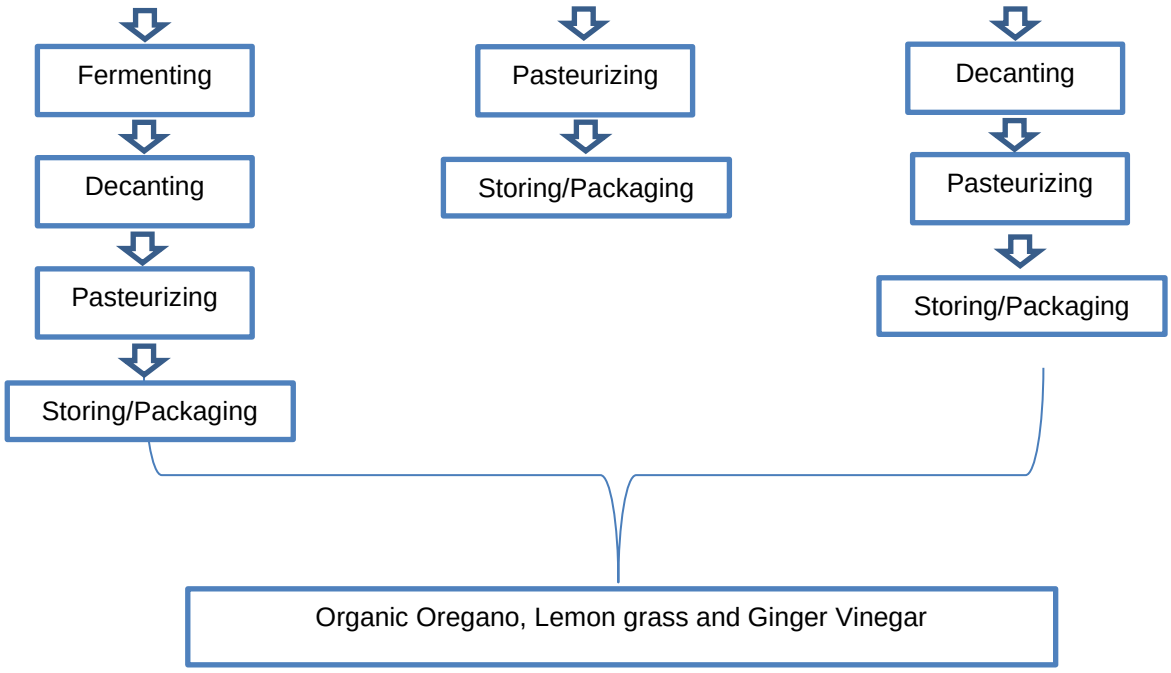


Figure 1. Flow Diagram of the Procedure in Homemade vinegar from Oregano, Lemongrass and Ginger

The finished products were subjected to sensory evaluation. Forty (40) evaluators among varied age groups were selected and properly oriented on what and how to evaluate the products using the scorecard depicting the sample code. The evaluators comprised household members of Brgy. Poblacion Sur Maddela, Quirino and faculty members of Maddela Comprehensive High School in Quirino, Province.

The finished products were served on the table. Each evaluator was asked to taste a sample of each organic vinegar. Data on the sourness, smell, color, and general acceptability of organic vinegar were collected, decoded, and subjected to statistical analysis.

A score sheet was used for qualitative analysis, determining the acceptability of the organic vinegar. The responses as to the level of acceptability of vinegar using the different organic (oregano, lemongrass, and ginger) in terms of sourness, smell, and color were solicited using the five-point Likert Scale and given as shown below.

Table 3. The range of numerical ratings and their descriptive equivalent

Scale	Numerical Rating	Descriptive Rating
5	4.50 - 5.00	Highly Acceptable
4	3.50 - 4.49	Moderately Acceptable
3	2.50 - 3.49	Acceptable
2	1.50 - 2.49	Slightly Acceptable
1	0.50 - 1.49	Not Acceptable

RESULTS AND DISCUSSION

Product Development

The organic vinegar process underwent different stages of development starting from selecting, washing, cutting, extracting, boiling, measuring, blending, bottling, fermenting, and packaging. Through these stages of development, careful observation and analysis were done to come up with organic vinegar.

The developmental procedure began with the preparation of the three-organic vinegar. The procedure started with selecting fresh young oregano leaves, lemongrass stalk, and ginger. The three were thoroughly cleaned and washed to remove any dirt or insecticide residues; boiled the lemon grass and ginger for three (3) minutes separately, blended the oregano leaves using a food processor, squeezed to get the extract, and boiled for one (1) minute.

Preparation of Organic Oregano Vinegar

Ingredients:

- 2 ½ cups Oregano extract
- ¼ cup Brown Sugar
- 1 tsp Yeast

To prepare organic oregano vinegar, begin by selecting fresh oregano leaves. Thoroughly wash the leaves to remove any dirt or insecticide residues. Blend the oregano leaves using a food processor to obtain the extract. Use a clean cloth to strain the extract from the blended leaves. Next, boil the strained oregano extract for one minute and let it cool. Measure 2 ½ cups of the oregano extract into a bowl. Add ¼ cup of brown sugar and 1 teaspoon of yeast to the bowl, stirring the mixture well. Pour the mixture into a sterilized bottle and cover it with a muslin cloth. Allow it to ferment for 3-4 weeks. After fermentation, decant the vinegar to remove any sediments or residues. Pasteurize the vinegar, then transfer it into a clean bottle. Finally, cover, label, and store the organic oregano vinegar.

Preparation of Lemon Grass Vinegar

Ingredients:

- 2 ½ cups Lemon grass boiled water
- ¼ cup Brown Sugar
- 1 tsp Yeast

To prepare lemongrass vinegar, start by harvesting fresh lemon grass. Wash the stalks thoroughly to remove any dirt or insecticide residues. Chop the lemon grass stalks and boil them in water for three minutes. Strain the boiled lemon grass water and let it

cool. Measure 2 ½ cups of the boiled lemon grass water into a bowl. Add ¼ cup of brown sugar and 1 teaspoon of yeast to the bowl, stirring the mixture well. Pour the mixture into a sterilized bottle and cover it with a muslin cloth. Allow it to ferment for seven days. After fermentation, decant the vinegar to remove any sediments or residues. Pasteurize the vinegar, then transfer it into a clean bottle. Finally, cover, label, and store the lemon grass vinegar.

Preparation of Ginger Vinegar

Ingredients:
- 2 ½ cups Ginger boiled water
- ¼ cup Brown Sugar
- 1 tsp Yeast

To prepare ginger vinegar, begin by thoroughly cleaning and washing fresh ginger to remove any dirt or insecticide residues. Slice the ginger and boil it in water for three minutes. Strain the boiled ginger water and let it cool. Measure 2 ½ cups of the boiled ginger water into a bowl. Add ¼ cup of brown sugar and 1 teaspoon of yeast to the bowl, stirring the mixture well. Pour the mixture into a sterilized bottle and cover it with a muslin cloth. Allow it to ferment for seven days. After fermentation, decant the vinegar to remove any sediments or residues. Pasteurize the vinegar, then transfer it into a clean bottle. Finally, cover, label, and store the ginger vinegar.

Level of Acceptability of Organic Vinegar made of Oregano, Lemon Grass, and Ginger

Table 1 shows the level of acceptability of Organic Vinegar made of Oregano, Lemon Grass, and Ginger as perceived by the respondents in terms of sourness, smell, and color.

Table 4 . Level of acceptability of Organic Vinegar made of Oregano, Lemon Grass, and Ginger in terms of sourness, smell, and color

Sensory Characteristic	Sample 1 (Oregano)		Sample 2 (Lemon Grass)		Sample 3 (Ginger)	
	Means	Desc.	Means	Desc.	Means	Desc.
Sourness	4.80	HA	4.98	HA	4.85	HA
Smell	5.00	HA	4.90	HA	4.87	HA
Color	5.00	HA	5.00	HA	4.93	HA

**1.00-1.49: Not Acceptable (NA); 1.50-2.49: Slightly Acceptable (SA); 2.50-3.49: Acceptable (A); 3:50-4.49: Moderately Acceptable (MA); 4.50-5.00: Highly Acceptable (HA)*

In terms of sourness, all three samples received a “highly acceptable” rating with Lemon Grass (Sample 2) being the highest. Meanwhile, in terms of smell, Oregano

(Sample 1) received perfect acceptability, as well as for color, tied up with (Lemon Grass). It reveals that the level of acceptability of the three samples of Organic Vinegar was Highly Acceptable, with ratings 4.80-4.95 for sourness, 4.87-5.00 for smell, and 4.93-5.00 for color.

This implies that Organic Vinegar in three (3) treatments was acceptable regarding all its sensory characteristics since all the weighted means surpassed the baseline rating of 2.50 to be accepted.

This is similar to the findings of Kumare et al. (2017) in "Fermentative Production of Vinegar from Grapes and Guava Using Adsorbed Cells of Acetobacter aceti" where grape and guava vinegars were acceptable for the tasters. It has been shown that the results from both the vinegars produced by semi-continuous process as of standard quality and there is not much difference in the sensory qualities of commercially produced vinegars.

Comparison in the Level of Acceptability of Organic Vinegar made of Oregano, Lemongrass and Ginger

Table 5 shows the results of the comparison in the level of acceptability of Organic Vinegar made with Oregano, Lemon Grass, and Ginger as perceived by the evaluators grouped by age.

Table 5. Analysis of variance results comparing the level of acceptability of organic oregano vinegar by different groups of respondents

Profile Groups	N	Mean	SD
Teenagers	10	5.000	.000
Adults	10	4.900	.161
Faculty and Staff	10	4.933	.141
Food Experts	10	4.900	.161

The table shows the means and standard deviations on the level of acceptability of Organic Oregano Vinegar by the different groups of evaluators: Teenagers (M = 5.000, SD = .000); Adults (M = 4.900, SD = .161); Faculty and Staff (M = 4.933, SD = .141); and Food Experts (M = 4.900, SD = .161)

ANOVA Table

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.067	3	.022	1.241	**.309**
Within Groups	.644	36	.018		
Total	.711	39			

Legend: *significant at .05 level

The table above presents the analysis of the significant difference in the level of acceptability of Organic Oregano Vinegar as evaluated by the evaluators when grouped– the dependent variable being the profile group to which the evaluators were classified and the independent variable is the degree of the product's level of acceptability. The result of the ANOVA revealed that there was no significant difference in the level of acceptability of Organic Oregano Vinegar as evaluated by the evaluators when grouped by age: F(3,36) = 1.241, p = .309. This implies that the level of acceptability of Organic Oregano Vinegar is the same across age groups.

Table 6. Analysis of variance results comparing the level of acceptability of organic lemon Grass Vinegar as perceived by the evaluators.

Profile Groups	**N**	**Mean**	**SD**
Teenagers	10	4.967	.105
Adults	10	4.967	.105
Faculty and Staff	10	4.900	.225
Food Experts	10	5.000	.000

The table shows the means and standard deviations on the level of acceptability of Organic Lemon Grass Vinegar by the different groups of evaluators: Teenagers (M = 4.967, SD = .105); Adults (M = 4.967, SD = .105); Faculty and Staff (M = 4.900, SD = .225); and Food Experts (M = 5.000, SD = .000).

ANOVA Table

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.053	3	.018	.966	.419
Within Groups	.656	36	.018		
Total	.708	39			

*Legend: *significant at .05 level*

Table 6 presents the analysis of the significant difference in the level of acceptability of Organic Lemon Grass Vinegar as evaluated by the evaluators when grouped– the dependent variable being the profile group to which the evaluators were classified and the independent variable being the degree of the product's level of acceptability. The result of the ANOVA revealed that there was no significant difference in the level of acceptability of Organic Lemon Grass Vinegar evaluated by the different groups of respondents: F(3,36) = .966, p = .419. This indicates that the sensorial evaluation obtained the same acceptability level of the product regardless of the types of evaluators.

Table 7. Analysis of variance results comparing the level of acceptability of organic ginger vinegar as perceived by the evaluators.

Profile Groups	N	Mean	SD
Teenagers	10	4.833	.360
Adults	10	5.000	.000
Faculty and Staff	10	4.967	.105
Food Experts	10	4.733	.644

The table shows the means and standard deviations on the level of acceptability of Organic Ginger Vinegar by the different groups of evaluators: Teenagers (M = 4.833, SD = .360); Adults (M = 5.000, SD = .000); Faculty and Staff (M = 4.967, SD = .105); and Food Experts (M = 4.733, SD = .644).

ANOVA Table

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.456	3	.152	1.093	**.364**
Within Groups	5.000	36	.139		
Total	5.456	39			

*Legend: *significant at .05 level*

The table above reveals the analysis of the significant difference in the level of acceptability of Organic Ginger Vinegar by the different groups of evaluators. The result of the ANOVA revealed that there is no significant difference in the level of acceptability of Organic Ginger Vinegar as perceived by the evaluators: F(3.36) = 1.093, p = .364. Thus, the null hypothesis was accepted. This implies that the level of acceptability of Organic Ginger Vinegar did not differ across age groups.

These results imply that the evaluators are not a discriminating factor regarding the acceptability of the Organic Vinegar across all samples.

This is similar to the findings of Hasim et.al., (2015) in a study entitled " Potential of Lemon Grass Leaves Extract *(Cymbopogon citratus)* As Prevention For Oil Oxidation" Ethanol extract of lemongrass leaves contains alkaloids, saponins, tannins, flavonoids, phenols, and steroids. 70% ethanol extracts may be selected to obtain the highest antioxidant activity that is IC50 of 79.444 mg/But it was not significantly different with ascorbic acid as the reference and 77.65% with a protection factor of BHT (100%) as a comparison.

Shelf - Life of Oregano, Lemon Grass, and Ginger as Organic Vinegar

After having produced the three organic vinegars, the researcher put different proportions from the three organic vinegars in three bottles and stored these at normal temperatures.

The following were observed about the organic vinegar which was stored at a normal temperature.

First day. The organic vinegar had a perfect taste, aroma, and color.

Second day. Same observation as the first day, there was a perfect aroma, taste, and color.

Third day. Same observation as the 2nd day, the vinegar had perfect taste, aroma, and color.

Fourth day. The taste of the vinegar was still good, its aroma smelled good, and had a nice color.

Fifth day. Same observation as the fourth day. The taste was still good; its aroma was good, and had a nice color.

Sixth day. The vinegar still smelled good, was still appealing to the eye with perfect color

Seventh day. Same observation as the sixth day, the vinegar still had a good taste; smelled good, and had a perfect color

Eighth day. The vinegar had still a good smell, taste, and color.

Ninth day. Same observation as the Eighth day. The vinegar had still good taste, aroma, and color.

Tenth day. The taste of the vinegar was still good, smelled good, and the color remained appealing to the eye.

Eleventh day. Same observation as the tenth day.

Twelfth day. The taste of the three vinegars, their smell, and color were still good.

Thirteenth day. Same observation as the twelfth day.

Fourteenth day. Overall, the vinegar was still good

Fifteenth day. No signs of spoilage, and the vinegar was still good

Sixteenth day. The vinegar had still a good smell, taste, and color.

Seventeenth day. The taste of the vinegar was still good; it had a good aroma and a nice color

Eighteenth day. Same observation as the seventeenth day

Nineteenth day. The vinegar slightly changed its smell of lemon grass, its aroma of ginger increased, and the color was still appealing.

Twentieth day. Same observation as the nineteenth day

Twenty-first. No signs of spoilage, still good, and could be stored up to 21 days at normal temperature.

Conclusions

The research on the development and acceptability of organic vinegar made from oregano, lemongrass, and ginger demonstrates that all three kinds of vinegar are highly acceptable across various sensory characteristics such as sourness, smell, and color. The preparation processes for each type of vinegar—starting from selecting, washing, boiling, fermenting, and bottling—ensured the production of high-quality kinds of vinegar. Sensory evaluations revealed that all three vinegars scored highly acceptable ratings, with minor variations among different evaluator groups, indicating no significant differences in acceptability based on age or professional background. Additionally, shelf-

life analysis showed that the vinegars maintained their sensory qualities for up to 21 days at normal temperatures without signs of spoilage. These findings suggest that the produced organic vinegars not only meet high acceptability standards but also exhibit good shelf stability, making them viable products for consumer use.

Recommendations

In view of the aforementioned conclusions, the following are recommended by the study:

1. More research studies should be conducted in the making of quality food products.
2. More enriched food products may be made to determine the acceptability of organic vinegar
3. Similar studies may be done to test and validate the shelf life of the developed product.
4. Identification of appropriate packaging and labeling for the developed product be done.
5. Farmers and producers are strongly encouraged to plant/produce more oregano, lemon grass, and ginger to help benefit them economically.
6. The researchers may process and sell more oregano, lemon grass, and ginger as organic vinegar for profit.
7. Future researchers who want to use oregano, lemon grass, and ginger as an ingredient in producing vinegar can use this study as a guide and reference.

Compliance with Ethical Standards

The authors declare that this study was conducted in full compliance with ethical standards. Informed consent was obtained from all respondents, ensuring their understanding of the study and their voluntary participation. Respondents were given the freedom to withdraw from the study at any time without any consequences. The anonymity of the respondents was maintained throughout the research process to protect their privacy. The well-being of the respondents was safeguarded at all times. The authors assert that there is no conflict of interest in the conduct of this study. Strict measures were taken to avoid plagiarism, ensuring the originality of the work. The interpretation of the findings was unbiased, and the results were used solely for research purposes.

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