

## **FORMULATION AND ORGANOLEPTIC PROPERTIES OF BANANA APPLE VINEGAR**

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### **Abstract**

This research is aimed at producing vinegar from the substrate of apple and vinegar. The process involves two stage fermentation with baker's yeast (*saccharomyces cerevisiae*) for 2-3 weeks and one month for initial and second fermentation. It utilized experimental method of research. Moreover, a sensory evaluation was administered to determine the acceptability of the developed product in terms of flavor, texture, aroma, appearance and color. This research revealed the best formulation of banana-apple vinegar. The ingredients in making banana apple vinegar comprised of the following ingredients: 22 % banana, 22 % apples, 44% distilled water, 2.5 % muscovado sugar, 5 % baker's yeast, 9 % mother vinegar. The preparation method comprised of the following steps namely harvesting banana and apples in equal ripeness, washing and disinfecting, weighing ingredients, pureeing the fruits thru the use of blender, measure the sugar content, fermenting the mixture for 2-3 weeks, decanting the mixture from a container to a sterilized container for the second fermentation, adding mother vinegar and fermenting it to 1-2 months, packaging and pasteurizing at 70 °C for 20 minutes. Thus, treatment 3 of has the highest mean on the sensory evaluation.

**Keywords:** vinegar, fermentation, banana, apple

## **THE PROBLEM AND ITS BACKGROUND**

### **INTRODUCTION**

Most of the Filipinos are fond of eating foods with sauces. Amongst food that is eaten with vinegar are street foods and home-made dishes. Vinegar adds character to the taste of the food. The acidity or sourness of vinegar brightens the flavor of food and adds balance to a rich dish. In addition, it can also be used by pickling which is one of the most used traditional preserving method in the Philippines. According to Soleri and Giudici(2009), vinegar in some countries is taken as a healthy drink. Moreover, it is also found in hundreds of different processed foods, bread and bakery products, canned foods, marinades and the current falling wine consumption have favored an increase in vinegar production (De Ory et al., 2002).

Fruits and grains may be used in vinegar production like blackcurrant, raspberry, quince, tomato, malt and rice It can be produced using different methods and from various raw materials. Morales et al., (2001) mentioned that vinegar production ranges from traditional procedures which uses wood casks and surface culture to submerged fermentation.

Although useful as a food ingredient for flavor and functional properties, the potential health benefits of vinegar varieties are leading researchers to further consider this long-used food

product (Tan 2005). On the other hand, vinegar also finds applications in the healthcare and cleaning industry.

Banana (*Musa* sp.) is a large perennial herb with leaf sheaths that form trunk-like pseudo stem. It is rich in vitamin B6, which helps fight infection and is essential for the synthesis of heme—the iron containing part of hemoglobin. Banana is also rich in potassium and is a great source of fiber. A good quality alcoholic base for producing vinegar containing 5-6% acetic acid was obtained.

As eloquently stated by Simmonds (1966), banana pulp and peel may be used to make a vinegar. The Philippines is one of the major banana exporters and was ranked no. 2 following Ecuador. Due to a high rate of productivity of bananas in the Philippines, they are easily available and available at low prices in the market. As bananas have a short shelf-life, there is a rapid rate of deterioration of this fruit (Akubor et al., 2003). Vinegar production from banana may enhance minimize cost of production and is eco-friendly.

The Fuji apple is an apple cultivar developed by growers at Tohoku Research Station in Fujisaki, Aomori, Japan. It originated as a cross between two American apple varieties—the Red Delicious and old Virginia Ralls Janet (sometimes cited as "Rawls Jenet") apples. Fuji apples have gained popularity to various consumers worldwide.

Apples can also be grown in the Philippines which is seen in Kapatagan Apple Orchard, Rare Fruit Farm, and Nursery which is the first ATI-certified Learning Site for Agriculture (LSA) for apple production in the Philippines.

Apples have a good preservation capacity. They are available year-round in markets, at relatively low prices and they are seen as a healthy food. Besides being consumed fresh, apples can also be transformed into many different kinds of apple products, according to the processing technology used.

Apple vinegar is part of vinegar fruit apples obtained by biotechnological process of double fermentation, alcoholic and acetic. The natural sugars within the fruit are broken down by the yeast and bacteria and turned into alcohol. The alcohol then undergoes a second fermentation process to produce vinegar.

Apples are packed with vitamins and minerals that gives apple cider vinegar its myriad benefits. Also, it contain pectin, which has been shown to aid in digestion. This type of vinegar is able to act as a cleansing agent and assist the colon in ridding the body of toxins and waste that have built up over time. The pectin in this type of vinegar forms a gel-like substance that attaches to debris in the digestive system and helps carry it away naturally.

Vinegars can be differentiated by how they are being produced. The most common production method was submerged culture which improved the general fermentation conditions like aeration, stirring, heating, etc. (De Ory et al., 1999). However, there are many techniques that have been developed to improve industrial production of vinegar.

Hence, this study is conducted to determine the suitability of banana and apple as a substrate for vinegar production. Specifically, it aims to produce vinegar from banana and apple.

Moreover, this study is conducted to test the level of acceptability of banana and apple vinegar in terms of flavor, texture, aroma, appearance and color.

### Objectives of the Study

The purpose of this study was to come up with a new process and composition of producing vinegar made from substrate of banana and apple.

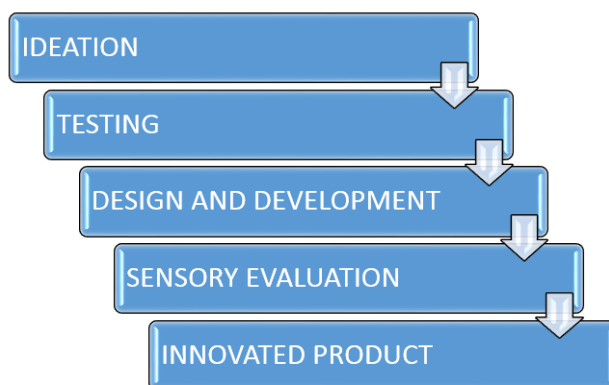
Specifically, it aimed to:

1. Determine the best formulation of banana apple vinegar.
2. Determine the level of acceptability of banana apple vinegar in terms of:
  - 2.1 Flavor
  - 2.2 Texture
  - 2.3 Aroma
  - 2.4 Appearance
  - 2.5 Color
3. Determine if there is a significant difference of the evaluator's evaluation on the three formulations in making banana apple vinegar in terms of flavor, texture, aroma, appearance and color.

### Hypothesis

There is no significant difference among the three treatments of banana apple vinegar

### Study Framework



The figure above shows the study framework of the research. The researchers brainstorm to come up a formulation to innovate vinegar. They have selected banana and apple as the main ingredient on the formulation of the product. On the testing period, the researchers identified a standard procedure that shall be used on all formulations. After that, all the formulations were created with the help of experts in food product development. The researchers subjected their

product for their sensory evaluation by experts and consumers for the best formulation and sensory acceptability of the product. Moreover, the researchers analyzed and interpreted the gathered data, evaluated to come with an innovated product.

### Scope and Delimitation

The study is limited to the development and sensory acceptability of banana apple vinegar. The first phase is the development of the product which consist of banana, apples, distilled water, muscovado sugar, baker’s yeast, mother vinegar different percentages. A standard procedure was used in all formulations. The second phase was the sensory evaluation by the randomly selected evaluators.

### Methodology

#### Research Design

This research aimed to determine the best formulation and the acceptability of the banana apple vinegar. The research employed the experimental research design to innovate a new version of vinegar. Different formulations were done to arrive at an acceptable product.

The three formulations of banana apple vinegar are as follows:

Formulation 1	Formulation 2	Formulation 3
11 % Banana	33% Banana	22 % Banana
33 % apple	11 % apple	22 % apple
44 %distilled water	44 %distilled water	44 %distilled water
2.5 % muscovado sugar	2.5 % muscovado sugar	2.5 % muscovado sugar
.5% baker’s yeast	.5% baker’s yeast	.5% baker’s yeast
9%mother vinegar	9%mother vinegar	9%mother vinegar

The following procedure was utilized in the formulation of banana apple vinegar:

- a. **Harvesting.** Select bananas and apples of equal ripeness free from rotten part.
- b. **Washing and Disinfecting.** Wash and soak the bananas and apples in boiling water for 30 mins at 100 degrees Celsius. Peel the bananas and cut into pieces. Peel and core the apples.
- c. **Weighing ingredients.** The disinfected fruits are weighed.
- d. **Blending.** Puree the banana and apple using a blender. In a mason jar, pour 500ml hot distilled water and add the banana and apple puree.
- e. **Initial Fermentation.** Add one-teaspoon baker’s yeast for every kilo of fruit used. Plug mouth container with two layers of cheesecloth to protect it from dust and fruit flies. Ferment the juice for two to three weeks. Stir the mixture for 1 minute every two days for two weeks.
- f. **Decanting.** Pour fermented liquid into a sterilized container leaving solid particles behind.
- g. **Second Fermentation.** Add 100 ml of mother vinegar to every kilo of fruit used. Plug

mouth container with two layers of cheesecloth to protect it from dust and fruit flies. Ferment for one to two months.

- h. Filtering.** Filter the mixture in a coffee filter to remove unwanted sediments of the mixture.
- i. Packaging.** Pour the mixture into the desired packaging bottle.
- j. Pasteurizing.** Pasteurize for 20 minutes.

### Research Respondents

Respondents were ten (10) food experts including chefs/cooks, food technology teachers and culinary subject teachers for identifying the best formulation. On the other hand, thirty (30) random people who are consumers of any food that is eaten with vinegar sauce evaluated its acceptability.

### Research Instrument

There were two instruments used for the study. The first questionnaire used a 9-point Hedonic Scale for the sensory evaluation of banana apple vinegar in terms of flavor, texture, aroma, and color to determine the best formulation. The second questionnaire used 5-point Likert Scale for the level of acceptability of the banana apple samples.

### Data Gathering Procedure

There were three formulations (treatments) that were used in the evaluation process. All treatments have different quantities of ingredients. Each preparation has been evaluated by the food technology and culinary teachers to come up with the best formulation. This was done to determine the best formulation of banana apple vinegar. After determining the best formulation, it was evaluated by random consumers. The evaluators assessed the banana apple vinegar in terms of flavor, texture, aroma, appearance and color. The research participants were given instructions on how to evaluate the food product.

### Statistical Tool

This study made use of the following statistical tools, needed in the analysis of the data. Weighted mean was used to determine the best formulation of banana apple vinegar using the 9-point Hedonic scale and verbal interpretation below:

Scale Value	Mean Range	Descriptive Scale
9	8.12-9.00	Like Extremely
8	7.23-8.11	Like Very Much
7	6.34-7.22	Like Moderately
6	5.45-6.33	Like Slightly
5	4.56-5.44	Neither Like or Dislike
4	3.67-4.55	Dislike Slightly
3	2.67-3.66	Dislike Moderately
2	1.89-2.77	Dislike Very Much
1	1.00-1.88	Dislike Extremely

For the acceptability of the product, weighted mean was used. The 5-point Likert scale was used for the verbal interpretation:

Scale Value	Mean Range	Descriptive scale
5	4.20-5.00	Highly Acceptable
4	3.20-4.19	Very Acceptable
3	2.60-3.19	Moderately Acceptable
2	1.80-2.59	Fairly Acceptable
1	1.00-1.79	Poorly Acceptable

Analysis of Variance (ANOVA) was used to test significant differences of the evaluator's assessment on the three treatments of banana apple vinegar in terms of acceptability.

## RESULTS AND DISCUSSION

This part of the paper presents the results and discussion of the study. The researchers carefully consider all possible explanations for the study results.

**Table 1: Summary of the Sensory Evaluation of Banana Apple Vinegar for Best Formulation**

Treatments	Criteria for Food/Product Evaluation	Weighted Mean	Descriptive Scale
Formulation 1	Flavor	5.06	Neither Like or Dislike
	Texture	5.42	Neither Like or Dislike
	Aroma	5.52	Like Slightly
	Appearance	5.64	Like Slightly
	Color	5.76	Like Slightly
	Overall Mean	5.48	Like Slightly
Formulation 2	Flavor	6.16	Like Slightly
	Texture	6.14	Like Slightly
	Aroma	6.28	Like Slightly
	Appearance	6.32	Like Slightly
	Color	6.36	Like Moderately
	Overall Mean	6.25	Like Slightly
Formulation 3	Flavor	7.26	Like Very Much
	Texture	7.04	Like Moderately
	Aroma	7.22	Like Moderately
	Appearance	7.20	Like Moderately
	Color	7.28	Like Very Much
	Overall Mean	7.20	Like Moderately

The table 1 shows the sensory evaluation for best formulation of banana apple vinegar. As to flavor, both formulation 2 and 3 obtained a weighted mean of 6.16 and 7.26 respectively. However, formulation 3 got the highest mean of 7.20 with a descriptive scale of "Like Moderately" followed by Formulation 2 with a mean of 6.25 with a descriptive scale of "Like Slightly" and Formulation 1 got the lowest mean of 5.48 with a descriptive scale of "Like

Slightly”. This indicates that treatment 3 is the most acceptable as to flavor or taste. For texture, formulation 3 is evaluated with the highest weighted mean score of 7.04 and formulation 1 with the lowest weighted mean score of 5.43. This finding indicates that formulation 1 has very good texture and the most acceptable.

With respect to aroma, formulation 3 also was evaluated with the highest weighted mean score of 7.22 followed formulation 2 with a weighted mean score of 6.28 and formulation 1 with a weighted mean score of 5.52. This finding implies that formulation 3 has excellent aroma and the most acceptable as to the aroma. This can be attributed to the strong aroma of the vinegar.

On appearance and color, formulation 3 also got the highest mean of 7.20 and 7.28 respectively. This implies that formulation three is the most accepted formulation in terms of appearance and color.

Finally, as regards to overall or composite evaluation of the treatments, formulation 3 obtained the highest composite mean score of 7.20 followed by formulation 2 with composite mean of 6.25 and formulation 1 with composite mean of 5.48. This indicates that among the three treatments, the most acceptable formulation is formulation 3. The data further shows the best formulation is 22 % Banana, 22 % apple, 44 %distilled water, 2.5 %muscovado sugar, .5% baker’s yeast, 9%mother vinegar.

**Table 2: Summary of Evaluation on the Level of Acceptability of Banana Apple Vinegar**

Criteria for Food/Product Evaluation	Weighted Mean	Descriptive Scale
Flavor	4.24	Highly Acceptable
Texture	4.16	Very Acceptable
Aroma	4.28	Highly Acceptable
Appearance	4.28	Highly Acceptable
Color	4.40	Highly Acceptable
Overall Mean	<b>4.27</b>	Highly Acceptable

The table 2 shows the weighted mean on the level of acceptability of Banana Apple Vinegar on random evaluators. As to flavor, the best formulation got a weighted mean of 4.24 which is highly acceptable. This shows that the flavor of the vinegar is acceptable among all evaluators of the product. For texture, the product has a mean of 4.16 which is very acceptable for the evaluators. This can be attributed to the filtering process in making the banana apple vinegar. This research also determined that the best formulation is highly acceptable in terms of aroma, appearance and color with a weighted mean of 4.28, 4.28 and 4. 40 respectively.

Finally, the best formulation obtained a weighted mean of 4.27 which is highly acceptable in terms of the over-all or composite evaluation of the said formulation.

**Table 3: Test of Difference on the Three Formulations of Banana Apple Vinegar using Analysis of Variance**

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2.9625	2	1.48125	3.795374	0.035274	3.354131
Within Groups	10.5375	27	0.390278			
Total	13.5	29				

The results of the study showed that the null hypothesis is rejected, hence alternative hypothesis is accepted because the probability value is less than alpha of 0.05. Therefore, the three formulations based on the evaluation of the respondents have significant difference at 0.05 level of significance.

### Summary, Conclusions and Recommendations

This section of the paper presents findings, conclusions and recommendations of the study.

#### Summary of Findings

This study investigated on the best formulation and acceptability of vinegar made of banana and apple with three formulations of different volumes. This study also utilized a preparation method and cooking procedures developed by the researchers.

This study made use of experimental design to determine the best formulation and the level of acceptability of the banana apple vinegar.

To determine the most acceptable formulation and level of acceptability, the trials developed were subjected to sensory evaluation by trained evaluators and random consumers.

The results of the evaluation revealed that the most acceptable formulation was formulation 3 followed by formulation 2 and the least acceptable was formulation 1 in all aspects during the sensory evaluation and level of acceptability.

With regard to the test of difference among the treatments, the result reveals that there is significant difference on the three treatments.

### CONCLUSION

Considering the findings of the study, the following conclusions were made:

1. Formulation 3 is the best formulation among all the trials in terms of flavor, texture, aroma, appearance and color.
2. The study reveals that the best formulation which was evaluated by experts is formulation 3 which composed of 22 % Banana, 22 % apple, 44 % distilled water, 2.5 % muscovado sugar, .5% baker's yeast, 9% mother vinegar.
3. The flavor, texture, aroma, appearance and color of formulation 3 are acceptable by the respondents.



4. The equal measurement of banana and apple yielded a high weighted mean of 7.20 with is acceptable.

### **Recommendations**

Based on the findings of the study and the conclusions derived at, the following are recommended:

1. That formulation 3 can be adopted for commercial purposes.
2. That the researchers will apply for utility model patent of the product developed.
3. That the food product developed be subjected to laboratory tests to ensure food safety like:
  - a. Ph level and acid level
  - b. Marketability
  - c. Packaging
  - d. Shelf life
  - e. Nutritional Value
4. That further studies be conducted to further improve the product.

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