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Optimizing Bugnay mead wine – Wild berries (*Antidesma bunius*) for consumer preference

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Abstract

The primary objectives of this study were to develop a mead wine with bugnay fruit flavor, determine its alcohol content, and compare the sensory acceptability of two samples. A sensory evaluation was conducted to characterize the wines based on appearance, aroma, taste and texture. To measure consumer acceptance, a Likert scale was employed, with the highest score representing strong preference and the lowest indicating strong dislike. The t-test was used to analyze differences in acceptability between the two samples. The results indicated that the provided sample exhibited an alcohol content of 19.21%. Additionally, a sensory analysis revealed that sample 2 was significantly preferred across all evaluated quality attributes. Consequently, sample 2 demonstrated higher acceptability compared to sample 1. These findings suggest that mead wine with bugnay fruit flavor is highly acceptable and has potential as a small-scale income-generating enterprise for rural communities.

Keywords

acceptability; alcohol; bugnay; fermentation; honey; mead; sensory evaluation

Introduction

Honey is a delectable substance that has the consistency of jelly and is produced by bees from the nectar of flowers. It is mostly composed of monosaccharides of fructose and glucose in varying proportions. Due to its high sugar content, honey serves as an ideal medium for yeast fermentation, producing alcohol and carbon dioxide. Mead, an alcoholic beverage with an alcohol content of 9% to 18% by volume, is produced by fermenting honey. It may also include spices, fruits, and hops (1). Fruit wines are fermented alcoholic drinks produced from fruits other than grapes, and they may also contain flavours derived from flowers, herbs, and other fruits. Fruit wines can be effervescent or still. Worldwide, a variety of fruit wines are made, including sweet fruit wines, cryoextracted fruit wines, fortified or "Port-style" fruit wines, low-alcohol "cider style," dry, or "off-dry" fruit wines, and sparkling fruit wines (2). These beverages can be produced via a variety of fermentation processes. Honey is the primary ingredient in the production of mead, which is then fermented using yeast or bacteria and water. Due to the fact that it is the oldest alcoholic beverage on the planet, it is also known as the progenitor of all fermented beverages. Mead, which is some-

times referred to as the sacred drink, has been made and consumed for thousands of years all over the globe (3).

The production of mead involves a wide variety of ingredients (4), including fruits such as berries, apples, and apricots, as well as herbs like mint and cinnamon, spices, and grains. It is widely known that mead has medicinal properties due to its high antioxidant activity and drinking one or two glasses daily is believed to lower blood cholesterol levels and reduce the risk of cardiovascular disease, atherosclerosis, hypertension, certain cancers, type 2 diabetes, neurological disorders, and some metabolic syndromes. The health benefits of berries are well established (5,7, 8), with their favorable nutritional profiles and high (poly)phenol content contributing significantly to their unique potential (9-11). Commonly cultivated fruits like raspberries (12,13), blackberries (14), blueberries (6), and strawberries (13) have demonstrated benefits for cardiometabolic health, brain function, antioxidant activity, and inflammation reduction. Specific berries, such as elderberries and wild berries, also show health benefits, though studies on them are either less extensive (15, 16) or more specialized (17-20).

In popular parlance, Wild Berry fruit is referred to as Bugnay or Bignay, with its scientific name (*Antidesma bunius* L.) Spreng. This plant is indigenous to the Philippines and often thrives in mountainous regions with a tropical climate, is classified under the family of Euphorbiaceae (21). Fig. 1 shows the Bugnay fruit.The ovoid drupe fruits develop in clusters of thirty to forty, progressing from green to a reddish-black color upon maturation, with a characteristic of sweet-sour profile widely utilized in jam and wine production. Renowned for its bioactive properties, Bugnay is associated with reducing obesity, cholesterol, and cardiovascular risks while aiding in the management of urinary tract infection, blood pressure, diabetes, and providing antioxidant activity (22). Despite its abundance in towns of San Mariano and Benito Soliven, Isabela, Philippines, the fruit remains underexploited, highlighting the need for value-added utilization. Therefore, this research aimed to optimize the production of mead wines with bugnay fruit flavor and evaluate their acceptability terms of appearance, aroma, flavor, texture, general acceptability, alcohol content, and cost-return analysis.

Fig. 1. The Bugnay Mead Wine – Wild Berries (*Antidesma bunius*). Photograph licensed from Noel Singson. Source: Singson N. Bignai (Bignay) – Antidesma-bunius [Internet]. Carica.com.ph; [cited 2025 01 10]. Available from: https://carica.com.ph/bignai-bignay-antidesma-bunius.

Materials and Methods

Developmental procedure

This study used honey and bugnay fruits for wine production. The process began with selecting and washing fresh bugnay fruits, followed by extracting their juice. After extraction, the preparation for winemaking commenced (Table 1).

Materials

Table 1. Ingredients used in the study

Sample 1	Sample 2
600 mL honey	600 mL honey
300 mL Bugnay fruit juice	600 mL Bugnay fruit juice
35 grams yeast	35 grams yeast
2000 mL water	2000 mL water

The ingredients used in producing mead wine with bugnay fruit flavor were 600 mL pure Apis mellifera honey, 600 mL bugnay fruit juice extracted from sound riped fruits, 35 grams of yeast or *Saccharomyces cerevisiae*, and 2000 mL of water. The tools and equipment used were sterilized glass jar, measuring cups, weighing scale, basin, clean cheesecloth, casserole and LPG gas (Table 2).

Table 2. Tools, utensils, and equipment used in the conduct of the study

Name of tools, utensils, and equipment
Glass jar
Measuring cups
Weighing scale
Basin
Sterilized bottles with seal and cap
Cheese cloth
Casserole
LPG

Preparation of mead wines with Bugnay fruits flavor

The preparation of mead wine with Bugnay fruit flavor involved the following steps: (a) select and wash ripened Bugnay fruits and extract its juice using a clean cheesecloth, (b) sterilize all the materials needed, (c) measure all the ingredients, (d) mix 600 mL of honey in 500 mL of water then simmer for 20 min. Allow it to cool, (e) mix the 600 mL bugnay fruit juice, 35 grams yeast and the remaining 1500 mL water in honey-water mixture. Stir with a wooden ladle, (f) Transfer the mixture into a sterilized glass container and cover it with clean cheesecloth, (g) ferment the mixture for eight to fourteen days, (h) strain the fermented mixture with a clean cheesecloth and transfer in a sterilized bottle. (i) decant every 2 to 3 days until a clear output (wine) is achieved, and (j) Transfer to a sterilized bottle, seal, label, and store in a cool, dry place for three months to one year.

The analysis of the alcohol content of mead wine with bugnay fruit flavor was conducted at the Department of Science and Technology (DOST) Region 02, Tuguegarao, City, Cagayan through Steam Distillation/Pycnometer method which determined the amount of alcohol content present in wine sample.

The physical properties of mead wine infused with Bugnay fruit (*Antidesma bunius*) flavor, including its appearance, aroma, flavor, and texture, were assessed through an organoleptic evaluation to determine the product's overall acceptability. This evaluation was conducted using a structured sensory assessment involving a panel of thirty adult respondents, both male and female, who were carefully selected based on their expertise and general knowledge of wine appreciation. The panel consisted of a diverse group, including three professional chefs, ten members of the local community, seven experienced winemakers, and ten university teachers. All respondents were in good health and physically fit to participate in the sensory analysis.

To ensure an objective evaluation of the Bugnay mead wine, the panelists utilized a four-point Likert Scale to rate the product's sensory attributes. The scale ranged from 1.00 to 4.00, where higher scores indicated a strong preference or agreement, while lower scores signified strong dislike or disapproval of the product's characteristics. Each sensory parameter—appearance, aroma, flavor, and texture—was systematically rated based on the panelists' perceptions. The gathered data was then analyzed and interpreted in accordance with the predefined scale presented in Table 3, which provided a structured framework for determining the overall acceptability and market potential of the Bugnay mead wine.

Statistical Analysis

The weighted mean was used to analyze the necessary data to provide a better and more trustworthy result. This method was also utilized to define and compare the qualitative features of wines in terms of appearance, fragrance, taste, and texture. A t-test was performed to assess the statistical significance of differences between the two samples.

Table 3. Likert scale

Range	Description
3.26 – 4.0	Extremely like
2.51 – 3.25	Like
1.76 – 2.5	Dislike
1.00 – 1.75	Extremely dislike

Expected Output

This research aims to develop an acceptable mead wine with Bugnay fruit flavor. Moreover, the research will be a benchmark to help the adopted barangays of ISU- San Mariano, Isabela, Philippines to have a sustainable livelihood. The table below shows the report of analysis taken at the Department of Science and Technology Regional Standards and Testing Laboratory Regional Office 2 conducted last September 7, 2020.

Table 4 shows the alcohol content of the mead wine with bugnay (wild berry) fruit flavor sample. The alcohol content analysis was conducted at the Department of Science and Technology (DOST) using the Steam Distillation/ Pycnometer method, which quantified the alcohol content in a wine sample. Mead wine with bugnay (wild berry) fruit flavor contained 19.21g of percent of alcohol in 100g of the given sample. Based on the result of the alcohol content test on the sample, it can be understood that the product belongs to fortified wine classification because it contains alcohol content ranging between 17 and 22%. The result of the study also revealed that the length of fermentation, amount of yeast and temperature affected the alcohol content of mead wine with bugnay fruit flavor. In conclusion, mead wine with Bugnay fruit flavor is safe for consumption. However, as alcohol tolerance varies among individuals, the appropriate consumption level may differ.

Results and Discussion

Table 4. Report of the analysis, alcohol content of Mead wine with Bugnay (wild berry) fruit flavor

Sample Description	Parameter	Result (g/100g)	Method used
Mead wine with Bugnay	% Alcohol	19.21	Steam Distillation Pycnometer

The following presents the findings as well as a discussion of the analysis in the following order: the alcohol content of mead wine with bugnay fruit flavor; the sensory evaluation of respondents on the quality attributes of mead wine with bugnay fruit flavor in terms of appearance, aroma, flavor, and texture; the test of significance of the product; and the evaluation on the return on investment.

Results

The alcohol content of the mead wine with bugnay (wild berry) fruit flavour sample was analyzed by the Department of Science and Technology (DOST) using Steam Distillation/Pycnometer method.This analysis determined the amount of alcohol content in the wine sample.The mead wine with bugnay (wild berry) fruit flavor was found to contain 19.21% alcohol by weight (19.21 g of alcohol per 100g of the given sample). Based on the result, the product is classified as fortified wine, as its alcohol content falls within the range of 17 - 22%. The study also highlighted that factor such as fermentation duration, yeast quantity, and temperature significantly influence the alcohol content of mead wine with bugnay fruit flavor. To sum up, mead wine with bugnay fruit flavor is considered safe to consumption. However, as alcohol tolerance varies between individuals, it is difficult to recommend a specific amount that can be safely consumed by everyone.

Quality attributes of Mead Wine with Bugnay

It can be gleaned from Table 5 the sensory evaluation of respondents on the quality attributes of the two samples of mead wine with Bugnay (Wild Berry) Flavor. As to appearance, sample 2 (600 mL honey & 600 mL bugnay fruit juice) obtained a mean score of 3.8 with a qualitative

Table 5. Quality attributes of Mead wine with Bugnay

Variables	Sample 1		Sample 2	
	Weighted mean	Qualitative description	Weighted mean	Qualitative description
Appearance	3.17	Like	3.8	Extremely like
Aroma	3.23	Like	3.6	Extremely like
Flavor	3.0	Like	3.43	Extremely like
Texture	3.6	Extremely like	3.73	Extremely like
Overall	3.25	Like	3.64	Extremely like

description of “extremely like” while sample 1 (600 mL & 300 mL bugnay fruit juice) obtained a weighted mean of 3.17 with a qualitative description of “like” respectively. In terms of aroma, sample 2 got the highest weighted mean 3.6 “extremely like” while sample 1 has a weighted mean 3.23 with a qualitative description of “like”.

Respondents rated sample 2 higher than sample 1 in terms of taste, with a weighted mean score of 3.43 for “extremely like” compared to 3.0 for “like. The flavor profile of wine can vary significantly based on its processing (23). Sweeter wines are typically made from riper fruits and undergo a shorter fermentation process, resulting in lower alcohol content, while longer fermentation periods produce wines with higher alcohol levels. The alcohol content influences both the stability and sensory characteristics of the wine. Regarding texture, both samples were rated as “extremely like”, with mean scores of 3.6 for sample 1 and 3.73 for sample 2. Overall, respondents preferred sample 2 over sample 1, possibly due to its higher proportion of bugnay fruit juice as a flavoring agent.

Table 6 shows the test of significant difference on the acceptability of wines between two different samples. It reveals that the computed t-values of all the variables in terms of appearance (5.64), aroma (2.48), flavor (2.44) and texture (4.32) are greater than the critical value of 2.05, thus there is a significant difference on the acceptability of wines between two samples. Moreover, the results confirmed that sample 2 was accepted more than sample 1.

Table 6. Significant difference on the acceptability of Wines between 2 different samples of Mead wine with Bugnay fruit flavor

Variables	Computed t-value	Critical value	Critical value	Interpretation
Appearance	5.64	2.05	Reject	Significant
Aroma	2.48	2.05	Reject	Significant
Flavour	2.44	2.05	Reject	Significant
Texture	4.32	2.05	Reject	Significant
df = 29, @=0.05				

Cost and return analysis of Mead wine with Bugnay (wild berry) fruit flavor

Table 7 and 8 shows the cost and return analysis of mead wine with bugnay (wild berry) fruit flavor of sample 1 and sample 2. Based on the result of the computations, sample 1 has a net return (252.50) with return on investment (ROI) of 46.12%. On the other hand, Sample 2 has a higher net return of P 409.50 and an ROI of 69.34%. It implies that mead wine with bugnay fruit flavor has a positive net return and return on investment.

Table 7. Sample 1 - Cost and return analysis of Mead wine with Bugnay (wild berry) fruit flavor

Sample 1	
Expenses	
A. Cost of materials	
600 mL. honey	300.00
300 ml. bugnay fruits (juice)	5.00
35 g. yeast	10.50
2000 mL. water	10.00
4 bottles with seal & cap	152.00
B. Cost of labor & cooking	
LPG	20.00
Labor	50.00
Total Expenses	547.50
Output	
4 bottles @ 200.00/bottle	800.00
Net Return (P)	252.50
ROI (%)Sample 1	46.19

Table 8. Sample 2 - Cost and return analysis of Mead wine with Bugnay (wild berry) fruit flavor

Sample 2	
Expenses	
A. Cost of materials	
600 mL. honey	300.00
600 ml. bugnay fruits (juice)	10.00
35 g. yeast	10.50
2000 mL. water	10.00
5 bottles with seal & cap	190.00
B. Cost of labor & cooking	
LPG	20.00
Labor	50.00
Total Expenses	590.50
Output	
5bottles @ 200.00/bottle	1000.00
Net Return (P)	409.50
ROI (%)Sample 1	69.34

Discussions

The analysis of the alcohol content in mead wine with bugnay fruit flavor, conducted by the Department of Science and Technology (DOST) using the Steam Distillation/ Pycnometer method, revealed an alcohol content of 19.21% by weight, classifying it as fortified wine. Factors such as fermentation duration, yeast quantity, and temperature significantly influenced the alcohol content. While the product is safe for consumption, individual alcohol tolerance varies.The sensory evaluation showed that Sample 2, with a higher bugnay juice concentration, was rated higher in appearance, aroma, flavor, and texture compared to sample 1. Sample 2 received a mean score of 3.8 for appearance, 3.6 for aroma, 3.43 for flavor, and 3.73 for texture, all categorized as "extremely like." sample 1, with a lower bugnay juice concentration, had lower scores, indicating a preference for a higher fruit content. The t-test analysis confirmed a significant difference in acceptability, with Sample 2 being favored across all attributes. Economic analysis showed that Sample 2 had a higher net return (PHP 409.50) and ROI (69.34%) compared to sample 1 (Php 252.50 net return, 46.12% ROI). The results suggest that optimizing the bugnay juice concentration enhances sensory appeal and profitability, making Sample 2 a more viable option for commercialization.

Conclusion

The study aimed to (1) develop mead wine with bugnay fruit flavor, (2) analyze its alcohol content, (3) assess its acceptability in terms of appearance, aroma, flavor, and texture, and (4) evaluate its cost-return analysis. The study revealed that the alcohol content of bugnay-flavored mead wine is 19.21%. Sensory evaluation showed that sample 1 was rated “liked” for appearance, aroma, and, flavor, and “extremely liked” for texture, while Sample 2 was rated “extremely liked” across all attributes. A significant difference in acceptability was observed between the samples. Findings also revealed that mead wine with bugnay fruit flavor has a positive return on investments. These findings suggest that mead wine with bugnay fruit flavor has potential as a viable small-scale enterprise. Further research should focus on optimizing product quality, exploring seasonal variations in fruit flavor, and analyzing the wine’s nutritional composition.

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Authors’ contributions

EBC made an important contribution to the creation of mead wine with bugnay fruit flavor by inventing its formulation and conducting a detailed content analysis. This entailed experimenting with various components or flavorings, perfecting the mead wine’s combination and flavor, assuring product stability, and examining nutritional content to ensure quality and consumer appeal.

Compliance with ethical standards

Conflict of interest: The author has no conflict of interest.

Ethical issues: None

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) used ChatGPT in order to improve language and readability. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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