



RESEARCH COMMUNICATION

Development and content analysis of Lubeg (*Syzygium lineatum*) Vinegar

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Abstract

The study discusses the development and composition analysis of Lubeg Vinegar. According to the Department of Agriculture Bureau of Agricultural Research, the lubeg fruit was previously an unutilized fruit. Since the fruit is easily accessible and often wasted, the researcher employed it as the primary ingredient in vinegar production. A total of 30 individuals from Isabela State University evaluated the Lubeg Vinegar. The research study utilized Mean (M) and Standard Deviation (SD). The acceptability and marketability scores of two samples of Lubeg (*Syzygium lineatum*) vinegar (brown sugar and white sugar) were compared using an independent samples t-test. The sizes were calculated using partial eta squared and interpreted according to Cohen's guidelines: 0.01 indicated a small effect, 0.06 a medium effect and 0.14 a large effect. Consequently, it became evident from the research that the method for making Lubeg vinegar from lubeg was highly successful and efficient. Furthermore, lubeg vinegar influenced consumer acceptability and was generally well-received by tasters. However, concerning color/appearance, aroma/smell, sour/acidity and respondents' willingness to purchase, Lubeg vinegar with white sugar was generally more acceptable than Lubeg vinegar with brown sugar. Moreover, the commercialization of Lubeg vinegar has yielded a profitable return on investment.

Keywords

Lubeg, *Syzygium lineatum*, vinegar, content, analysis, appearance, smell

Introduction

According to the Department of Agriculture's Bureau of Agricultural Research, the Lubeg tree was initially considered an underutilized fruit but is now celebrated as Apayao's pride and recognized as a potential native fruit tree abundant in Apayao and certain areas of Cagayan. The Myrtaceae family includes Lubeg (*Syzygium lineatum*), sometimes referred to as Malubeg and Alebadu locally. It is a fruit tree that can reach a height of 5 meters and often thrives in open, shaded regions. When its fruits fall from the tree, they are left to decay and go to waste on the ground.

Its leaves are simply linked to the stem, arranged oppositely, ovate to elliptical in shape, measuring 8-10 cm in length, and possess a sour flavor. Its blooms have a lower, regular, and entire ovary. Lubeg fruits emerge in clusters, initially pale and later turning red to purple when ripe. Locals describe it as a cherry-like fruit with a thick, meaty, spongy, and brittle rind that can be up to 13 mm long.

The Ministry of Agriculture's research team has developed various

products, including those using the Lubeg fruit. Due to the abundance of Lubeg fruit at the Isabela State University-San Mariano campus, especially during the season, different product versions were created to prevent wastage, and one of the identified products is vinegar.

For a long time, vinegar has been used as preservative agent for food, either naturally produced during the fermentation process or intentionally added as a seasoning. Vinegar prevents microbial development and enhances the sensory characteristics of a variety of foods (4). The broad range of vinegar, which includes products like sauces, ketchup, mayonnaise, and the recent decline in wine consumption, has led to an expansion in vinegar manufacturing (1). Vinegar is defined as an acidic and pungent liquid used as a seasoning and food preservative. It is created through double fermentation of an agricultural carbohydrate solution.

Vinegars are widely produced from diverse raw materials, including various fruits, rice, cereals, whey, and honey (9). In 2005, balsamic vinegar, derived from grapes, held roughly a third of the global market share, while apple cider vinegar had 7% (10). In addition to agricultural raw materials, vinegar may contain juices from various fruits, sugar, honey, whey, plant components or flavoring extracts, as well as salts (2). Additionally, some food additives, such as antioxidants, colouring, taste enhancers, and processing aids, including bacterial nutrients and clarifying agents, are permitted.

The FDA (Food and Drug Administration, USA) stated that vinegar includes no less than 4 g of acetic acid per 100 cubic centimeters, formed by alcohol and subsequent acetic acid fermentation of sugar and starch substrates (2).

To determine the precise ingredients for the formulation of Lubeg Vinegar, a thorough investigation and numerous trials were conducted. Creating vinegar from lubeg is especially beneficial to the Isabela State University campus, as it prevents the fruit from being discarded on the ground. Instead, it provides an opportunity for the fruits to be included in the campus' "One Campus One Product" initiative.

As a result, the goal of the study is to evaluate the developed product from Lubeg fruit produced at ISU-San Mariano to realize the full potential of Lubeg fruits readily available on campus. It study aimed to develop Lubeg (*Syzygium lineatum*) vinegar from Lubeg fruit, conduct sensory analysis of the developed Lubeg vinegar, determine the pH content and total acidity of Lubeg vinegar, and evaluate the return on investment.

Materials and Methods

The two samples of ingredients used in the development and analysis of Lubeg vinegar were as follows: in sample 1, 5 cups of extracted lubeg juice, ½ cup brown granulated sugar, 1 teaspoon yeast, and 3 tbsp. mother vinegar; and in sample 2, 5 cups of extracted lubeg juice, ½ cup white granulated sugar, 1 teaspoon yeast and 3 tbsp. mother vinegar.

The procedures involved in the development and analysis of Lubeg vinegar were as follows: (a) Ensure that all materials and equipment are thoroughly sterilize; (b) Select the freshly harvested lubeg to ensure its freshness; (c) Wash the freshly harvested lubeg thoroughly and drain; (d) Measure all the needed ingredients; (e) Crush the lubeg into a container, then extract the juice using cheese cloth; (f) Ferment the lubeg juice for 2 weeks by adding yeast, mother vinegar, and sugar in a fermentation container; (g) After 2 weeks, strain the fermented lubeg juice with a cheesecloth; (h) Bring the fermented lubeg extract into heat, but do not boil; (i) Let it cool, then transfer to a sterilized vinegar bottle; (j) Pasteurized the bottles; and (k) Label and keep in a safe place.

Research Design

The study employed an Experimental Approach in the development and analysis of Lubeg vinegar. The acceptability of Lubeg vinegar was determined based on color/appearance, aroma/smell, acidity/sour, and overall taste, including its marketability.

Data Analysis

In terms of the statistical treatment used in the study, the distribution of participants were assessed based on gender, civil status, ethnicity, age, and highest educational attainment, using frequency (*n*) and percentage (%).

The acceptability of Lubeg vinegar (using brown and white sugar) in terms of color/appearance, aroma/smell, acidity/sourness, and overall taste, including its marketability (respondents' willingness to purchase) was assessed using Mean (*M*) and Standard Deviation (*SD*).

The following guidelines were used to interpret the calculated mean scores:

An independent samples t-test was employed to ascertain if there was a significant difference in the acceptability and

For the five-point scale

Mean	Color, Aroma, acidity	Willingness to Purchase
1.00 to 1.49	Dislike very much	Definitely would not
1.50 to 2.49	Dislike moderately	Probably would not
2.50 to 3.49	Neither like nor dislike	Might or might not
3.50 to 4.49	Like moderately	Probably would
4.50 to 5.00	Like very much	Definitely would

For the three-point scale:

Mean	Overall Taste
1.00 to 1.49	Unacceptable
1.50 to 2.49	Acceptable
2.50 to 3.00	Taste Great

marketability scores between the two Lubeg vinegar samples (brown and white sugar). The effect sizes were calculated using partial eta squared and interpreted according to Cohen's guidelines: 0.01 for a small effect, 0.06 for a medium effect and 0.14 for a large effect.

Tasting Procedures

During the tasting phase, maximum judgment independence was encouraged, allowing each respondent to feel completely free to express their sensory preferences.

Additionally, responders were provided with

instructions on how to conduct the sensory analysis. Tasting involves assessing color/appearance, aroma/smell, acidity/sourness, and willingness to purchase, forming distinct aspects of perception.

All participants in the sensory evaluation of Lubeg vinegar had prior experience as product consumers, and their answers reflected this familiarity.

Results and Discussion

The following section present the results and discussions of the study in the following order: profile of the respondents, sensory evaluation, total acidity, and pH content of Lubeg Vinegar, and return on investment.

Table 1. Respondents' distribution as to profile

Profile	Categories	n	%
Gender	Male	15	50.0
	Female	15	50.0
Civil Status	Single	17	56.7
	Married	13	43.3
Ethnicity	Ilocano	19	63.3
	Ibanag	6	20.0
	Ifugao	2	6.7
	Tagalog	3	10.0
Age	Below 30 y/o	12	40.0
	31 to 39 y/o	10	33.3
	40 y/o or above	8	26.7
Educational Attainment	College graduate	11	36.7
	Master's graduate	12	40.0
	Doctorate graduate	7	23.3
	Total	30	100.0

Profile of the Respondents

The profile of the respondents, including information on gender, civil status, ethnicity, age, and educational attainment, is shown in Table 1. The distribution of participants by gender reveals an equal % of male and female respondents. The majority of respondents are single (56.7%); with the ethnic composition showing the most respondents were Ilocanos (63.3%); In terms of age, 40% of the respondents are below 30 years old, and 40% are college graduates.

Sensory Analysis of the Respondents

Table 2. Acceptability and Marketability of the Lubeg Vinegar using Brown Sugar

Criteria	M	SD	Description
Color/Appearance	3.86	0.77	Like Moderately
Aroma/Smell	3.73	0.78	Like Moderately
Acidity/Sour	3.53	0.62	Like Moderately
Willingness to Purchase	3.60	0.62	Probably would
Overall Taste	2.13	0.34	Acceptable

The respondents moderately liked the color/appearance, aroma/smell, and acidity/sourness of the Lubeg vinegar with brown sugar. They indicated a likelihood of purchasing the said vinegar, and its overall taste was acceptable to them.

Table 3. Acceptability and Marketability of the Lubeg Vinegar with White Sugar

Criteria	M	SD	Description
Color/Appearance	4.76	0.43	Like very much
Aroma/Smell	4.73	0.52	Like very much
Acidity/Sour	4.70	0.53	Like very much
Willingness to Purchase	4.56	1.07	Definitely would
Overall Taste	2.73	0.44	Taste great

The respondents highly favoured the color/appearance, aroma/smell, and acidity/sourness of the Lubeg vinegar with white sugar. Consequently, they expressed a definite intention to purchase the mentioned vinegar, as they unanimously agreed that it tasted great.

Table 4. Comparison Between the Two samples of Luber vinegar (brown sugar and white sugar)

Criteria	Lubeg Vinegar	M	SD	t	p	η^2
Color/Appearance	Brown Sugar	3.86	0.77	5.555	0.000	0.4052
	White Sugar	4.76	0.43			
Aroma/Smell	Brown Sugar	3.73	0.78	5.814	0.000	0.7583
	White Sugar	4.73	0.52			
Sour/Acidity	Brown Sugar	3.53	0.62	7.740	0.000	0.5144
	White Sugar	4.70	0.53			
Willingness to Purchase	Brown Sugar	3.60	0.62	4.271	0.000	0.2392
	White Sugar	4.56	1.07			
Overall Taste	Brown Sugar	2.13	0.34	5.793	0.000	0.3815
	White Sugar	2.73	0.44			

Table 4 indicates that Lubeg vinegar with white sugar was significantly and substantially more acceptable than the vinegar with brown sugar in terms of color/appearance ($t = 5.56; p < 0.01; \eta^2 = 40.62\%$), aroma/smell ($t = 5.18; p < 0.01; \eta^2 = 75.83\%$), sour/acidity ($t = 7.74; p < 0.01; \eta^2 = 51.44\%$), respondents' willingness to purchase ($t = 4.27; p < 0.01; \eta^2 = 23.92\%$), and overall taste ($t = 5.79; p < 0.01; \eta^2 = 38.15\%$).

Total Acidity and pH Content of Lubeg Vinegar

To determine the overall acidity of the Lubeg vinegar, an aliquot of the sample is diluted with properly prepared and cooled water until it appears faintly colored. Using phenolphthalein as an indicator, the solution from (a) is titrated with a 0.5 M standard sodium hydroxide solution. Through titrimetry, Lubeg vinegar with brown sugar exhibits a total acidity of 1.22, while Lubeg vinegar with white sugar has a total acidity of 1.10. This examination was conducted by the Department of Science and Technology, Region 02.

Lubeg vinegar with brown sugar has a total pH content of 2.77, while lubeg vinegar with white sugar has a pH content of 2.82.

According to Adam (1999), table vinegars typically have a pH of 2.7-3.2 and contain 4-5% acetic acid, of which 98% or more is dissociated.

Return on Investment

Table 5 presents the return on investment, including input, output, net income, and the percentage of ROI for the finished product, which is 13.92%. It also itemizes the

Table 5. Return on Investment of the Lubeg vinegar

Input	Unit Price
5 cups extracted lubeg fruit	40.00
½ cup white sugar	15.00
1 teaspoon yeast	3.00
3tbsp mother vinegar	5.00
10 bottles (100ml) with cap	95.00
Output	
10 Bottles of lubeg vinegar @18php/bottle	180.00
Net income (output-input)	22.00
Return on investment. (Net income/gross expenses x 100)	13.92%

various ingredients used in the preparation of Lubeg vinegar, along with their specific amounts per ingredient, to identify the price per bottle as well as the return on investment.

Conclusion

This study found that the procedure for producing Lubeg vinegar from lubeg fruit was highly successful and efficient. Lubeg vinegar has a significant impact on client perception and was widely accepted by taster respondents. However, in terms of color/appearance, aroma/smell, sour/acidity, respondents' readiness to purchase, and overall taste, Lubeg vinegar with white sugar was significantly more acceptable than Lubeg vinegar with brown sugar. Lubeg vinegar demonstrated a positive return on investment in terms of market commercialization.

Recommendation

Vinegar manufacturing is becoming increasingly popular, playing a critical role in food processing and flavoring. It is an essential ingredient in the preparation of meals and various delights. Consequently, many people are experimenting with different fruits to make vinegar, aiming to enhance both quantity and quality.

Further research on Lubeg vinegar as a preservative should be conducted to ensure the proper utilization of the produced vinegar. To increase food security by minimizing losses of lubeg fruits and other fruits throughout their seasons, additional studies on the use of smaller fruits in vinegar production should be performed, not only at the Isabela State University-San Mariano Campus but also on other campuses.

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Compliance with ethical standards

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

Ethical issues: None.

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