Jurnal Pijar MIPA
https://jurnalfkip.unram.ac.id/index.php/JPM
ISSN 1907-1744 (Print)
ISSN 2460-1500 (Online)

Physical and Sensory Characteristics of Guava Fruit Juice with the Addition of Cinnamon and Brown Sugar

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Received: February 18, 2025. Accepted: March 4, 2025. Published: March 24, 2025

Abstract: The development of healthy food has grown very rapidly. Healthy food is not expensive but food that can provide good health benefits. Making fruit juice drinks from red guava can increase public interest in consuming fruit to maintain health and food security. This study aims to test the physical and sensory properties of red guava juice with the addition of cinnamon and brown sugar. This study used a Completely Randomized Design (CRD) with six treatment combinations and one control. Red guava juice, adding cinnamon and brown sugar, has a pH value ranging from 4.73-5.82 and a viscosity value ranging from 255.4 - 365.8 cps. Adding cinnamon and brown sugar affects red guava juice's pH value and viscosity. The higher the addition of cinnamon and brown sugar, the higher the pH value and viscosity. Panellists liked sample P2 with 2% cinnamon and 6% brown sugar for sensory tests.

Keywords: Brown Sugar; Cinnamon; Guava; Sensory; Viscosity.

Introduction

The development of healthy food has increased very rapidly. Healthy food is not expensive but can provide good health benefits. Food manufacturers not only sell food products that are sensorially acceptable but also have high nutritional value. Healthy foods include fruits, vegetables, milk, eggs, and functional foods [1].

Fruit and vegetables are an important part of a healthy diet that provides essential nutrients for the body. Both are rich in vitamins, minerals, fiber, and phytochemical compounds that play a role in maintaining health and preventing various diseases. Regularly consuming fruits and vegetables can help improve the immune system, maintain digestive health, and reduce the risk of chronic diseases such as diabetes, hypertension, and heart disease [2].

In general, fruits and vegetables contain vitamins A, C, E, and several types of vitamin B complex, which are important for the body's metabolism. In addition, abundant minerals such as potassium, magnesium, and iron are found in fruits and vegetables [3]. The fiber contained in fruits and vegetables plays a role in facilitating the digestive system and helps control blood sugar and cholesterol levels. Antioxidants found in fruits and vegetables also play an important role in warding off free radicals that can cause premature ageing and various degenerative diseases [4].

One way to consume fruit more practically and enjoyably is through fruit juice. Fruit juice is a liquid obtained from the extraction of fresh fruit that contains most of the nutrients found in the original fruit. In addition to providing a fresh and delicious taste, fruit juice also facilitates the body's absorption of nutrients. Thus, consuming fruit juice can be a good alternative for those who want to get the benefits of fruit in a more practical and fast way.

Guava fruit is popular with the public because it has a sweet taste. In addition, the abundant nutritional content is the main value of this fruit. Guava contains protein, fat, vitamin B, vitamin C, phosphorus, calcium, potassium, iron, and sodium [5]. Red guava contains vitamin A, especially [6]. The high nutritional content makes guava a good fruit for health. Guava has properties as an antioxidant, anti-diabetic, anti-bacterial, anti-inflammatory, anti-hypertension, anti-fungal, anti-cancer, and is rich in other nutritional content [7].

Guava fruit production in 2019, 2020, and 2021 were 2,136 tons, 4,071 tons, and 3,637 tons, respectively [8]. To maintain the availability of guava fruit each year, processing guava into a product is important. One form of processed guava product is often made fruit juice products. Fruit juice is a type of processed product from fruit that has long been known to the public. Fruit juice is made by crushing and filtering the fruit flesh to obtain the liquid. Making fruit juice drinks from red guava can increase public interest in consuming fruit to maintain health and food security. The making of fruit juice is usually added with sugar to add sweetness. Brown sugar comes from coconut/palm sap that

How to Cite:
A. A. N. D. A. W. Putra, P. R. Sintyadewi, W. K. Yoga, and K. R. T. Anggaraeni, "Physical and Sensory Characteristics of Guava Fruit Juice with the Addition of Cinnamon and Brown Sugar", *J. Pijar.MIPA*, vol. 20, no. 2, pp. 310–315, Mar. 2025. https://doi.org/10.29303/jpm.v20i2.8589

has been evaporated and molded. In the food industry, brown sugar is used as an ingredient in soy sauce, cakes, bread, and drinks. Brown sugar is also an alternative export commodity to Singapore, Japan, Korea, the Netherlands, Germany, the Middle East and America. Brown sugar contains vitamins, minerals, protein, and a lower glycemic index than granulated sugar, making it a substitute for diabetics [9]. Another additional ingredient that can be used in making fruit juice is cinnamon. The cinnamon plant (*Cinnamomum burmanii*) is one of the spice commodities traded during the colonial era. Cinnamon plants can be processed into various products such as powder or essential oil. Cinnamon bark gives flavor and aroma to food and beverage products. Dry cinnamon bark contains polyphenols that are efficacious in preventing Alzheimer's disease [10]. Based on the description above, this study aims to test red guava juice's physical and sensory properties by adding cinnamon and brown sugar.

Research Methods

This study used a Completely Randomized Design (CRD) with six treatment combinations and one control. This experiment was carried out 3 times to produce 21 experimental units. Samples will be analyzed for acidity, viscosity, and sensory.

Table 1. Research Treatment Combinations

No.	Combination	Cinnamon : Brown Sugar
1	P0	Kontrol (0%:0%)
2	P1	2% : 3%
3	P2	2% : 6%
4	P3	2% : 9%
5	P4	4% : 3%
6	P5	4% : 6%
7	P6	4% : 9%

The tools used in this study include knives, juicers, cutting boards, stoves, pans, glass bottles, plastic cups, tissues, and label paper. The materials used are red guava fruit, brown sugar, cinnamon powder, and mineral water.

Product Making

Sorting**:** Aims to obtain good quality raw materials so that the result will have good guava juice criteria. Sorting can be done manually to select good-quality guava. The criteria for good guava include Optimal age and no biological, microbiological, or chemical damage**.** Weighing: Weighing is done to get the right formula to produce a good final product. Washing: Aims to clean up any remaining post-harvest dirt that may still be attached to the raw guava. Washing is done using clean running water until the material is clean from dirt. Peeling: Peeling aims to separate the fruit flesh from the fruit skin, this is done so that the color of the resulting product matches the color of the guava itself. Size reduction: Size reduction is done using a knife to reduce the size of the guava so that it will make it easier and speed up the guava crushing process. Crushing: This was done by adding 3 liters of boiled water for every 1 kg of raw material used. Crushing aims to extract guava and dissolve it in water. Filtration: Aims to separate the dissolved fruit juice from other components such as guava seeds and skin. After filtration, 2 products will be obtained, namely guava juice and pulp. Filtration can be done using a plastic filter or using a filter cloth that has been previously sterilized. Pasteurization: the guava juice obtained is then pasteurized to a temperature of 65-80ºC for 15 minutes. The purpose of this process is to inhibit the growth of microorganisms and prevent enzyme activity. Cinnamon and brown sugar are added to the juice during the pasteurization process according to the treatment. After pasteurization, a second filtration can be carried out to ensure the juice is clean from foreign particles in the sugar.

Acidity Degree Analysis

The acidity degree (pH) measurement uses the SNI 06-6989.11-2004 method on How to Test Acidity Degree (pH) Using a pH Meter. Before measuring the pH, the pH meter is calibrated with a buffer solution according to the instructions of the pH meter 300/310.

In principle, pH measurement is based on the electrochemical potential between the solution contained in the glass electrode (glass membrane), which has been known, and the solution outside the glass electrode, which is unknown. This is because a thin layer of glass bubbles will interact with hydrogen ions, which are relatively small and active; the glass electrode will measure the electrochemical potential of hydrogen ions. A comparison electrode is needed to complete the electrical circuit. As a note, this tool does not measure current but only measures voltage [11].

Viscosity Testing

Viscosity testing is carried out using a Viscometer [12]. The viscometer is turned on, and then the spindle is installed. In this study, the viscosity/thickness test of fruit juice was carried out using the Digital Viscometer NDJ-5S. The spindle used was spindle no. 2 with a 60 rpm/min speed. Before use, the tool was cleaned and washed first, then dried using tissue. The results of the viscosity value can be read directly on the tool, with units of mpa. s

Sensory Test

Consumer preference testing was carried out by 30 panelists, with the criteria for panelists ranging in age between 18-25 years. The panelists selected were students at the Bali Institute of Technology and Health. The preference assessment was carried out by tasting the sample and assessing the preference level. The range of scores given was 1-5, starting from (1) very dislike, (2) dislike, (3) like, (4) somewhat like, and (5) very like.

Data Analysis

The obtained acidity and viscosity data were analyzed statistically using "Analysis of Variance" (ANOVA). If the results differed significantly at $p \leq 0.05$, the analysis continued with Duncan's multiple range test to see the differences between treatments. The average value was used for the sensory test because it was only to see the general tendency of which products were preferred.

Results and Discussion

Acidity analysis

The acidity (pH) measurement was done using the SNI 06-6989.11-2004 method on How to Test Acidity (pH) Using a pH Meter. The results of the acidity test on red guava juice with the addition of cinnamon and brown sugar are as follows:

Table 2. Acidity Test Results

Sample	Cinnamon : Brown Sugar	pH value
P0	Control (0%:0%)	4.73 ± 0.14^{a}
P1	2% : 3%	5.39 ± 0.08^{b}
P2	2% : 6%	5.32 ± 0.02^{b}
P3	2% : 9%	5.57 ± 0.12^{c}
P4	4% : 3%	4.81 ± 0.02^{a}
P5	4% : 6%	5.42 ± 0.09^{bc}
P6	4% : 9%	5.82 ± 0.12^{d}

Table 3. ANOVA Test Results

Tests of Between-Subjects Effects

Dependent Variable: PHVALUE

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2.797^{a}	6	.466	3157.710	.000
Intercept	589.784	1	589.784	3995311.000	.000
SAMPLE	2.797	6	.466	3157.710	.000
Error	.002	14	.000		
Total	592.583	21			
Corrected Total	2.799	20			

a. R Squared = .999 (Adjusted R Squared = .999)

Based on Table 3, it was found that the pH value between treatments was significantly different ($p<0.05$). The control pH value (P0) was 4.73. Cinnamon and brown sugar treatments increased the pH value, reducing the product's acidity.

The degree of acidity, or pH, expresses a solution's acidity or alkalinity level. The pH scale ranges from 0 to 14, where pH <7 indicates acidic properties, pH = 7 indicates neutral properties, and pH > 7 indicates basic or alkaline properties [13].

Guava is known to contain high levels of vitamin C, causing the pH value to be low. The vitamin C content in guava is 228.3 mg [14]. The addition of brown sugar can cause an increase in pH. The higher the sugar content added, the lower the vitamin C content in the fruit juice [15]. Then, adding sugar causes more water to come out of the ingredients, and water can dissolve vitamin C so that the vitamin C from the ingredients is reduced [16]. Factors that affect the pH value of food products are the type of food ingredient, processing process, microbes, water content, storage conditions, and use of food additives [17].

Viscosity Test

The viscosity test was carried out to determine the thickness of the fruit juice. Testing the viscosity value of red guava with cinnamon and brown sugar showed significant effects ($p<0.05$).

Table 4. Viscosity Test Results

Sample	Cinnamon : Brown Sugar	Viscosity value
P0	Control (0%:0%)	255.4 ± 0.13^{a}
P1	2% : 3%	272.3 ± 0.07^{b}
P2	2% : 6%	293.3 ± 0.04^{c}
P3	2% : 9%	310.6 ± 0.12^{cd}
P4	4% : 3%	322.7 ± 0.02^{a}
P5	4% : 6%	342.4 ± 0.06^{bc}
P6	4% : 9%	365.8 ± 0.13^{d}

Based on Table 5, it was obtained that the viscosity values between treatments were significantly different ($p<0.05$). The control viscosity value (P0) was 255.4. Giving cinnamon and brown sugar treatments increased the viscosity value of the product.

Viscosity is a measure of the thickness of a liquid or fluid that indicates how much resistance the fluid has to flow. In simple terms, viscosity describes a fluid's internal resistance to flow. The higher the viscosity of a fluid, the more difficult it is to flow, while fluids with low viscosity will flow more easily [18].

The role of viscosity in food products is very important in determining product consistency and affects texture, product stability, and control during processing [19]. Factors affecting food products' viscosity include ingredient composition, temperature, and thickening agents [20]. In viscosity testing, the thicker the product is due to the increasing content of dissolved ingredients [21]. The concentration of cinnamon and brown sugar increases, which causes the red guava juice to become thicker.

Table 5. ANOVA Test Results

Tests of Between-Subjects Effects

Dependent Variable: VISCOSITY

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	26746.098[a]	6	4457.683	25446.854	.000
Intercept	2004050.538	1	2004050.538	11440199.334	.000
SAMPLE	26746.098	6	4457.683	25446.854	.000
Error	2.452	14	.175		
Total	2030799.088	21			
Corrected Total	26748.550	20			

a. R Squared = 1.000 (Adjusted R Squared = 1.000)

Sensory Test

The test was conducted to determine the panellists' assessment of the taste, colour, texture, and overall acceptance of red guava juice with the addition of cinnamon and brown sugar.

Table 6. Hedonic Taste Test Score Results

Sample	Cinnamon : Brown Sugar	Value		
P0	Control (0%:0%)	4.0	±	0.13[a]
P1	2% : 3%	3.7	±	0.07[b]
P2	2% : 6%	4.2	±	0.04[c]
P3	2% : 9%	3.5	±	0.12[cd]
P4	4% : 3%	3.0	±	0.02[a]
P5	4% : 6%	2.8	±	0.06[bc]
P6	4% : 9%	2.8	±	0.13[d]

Description: 1 = really don't like it; 2 = don't like; 3 = somewhat like it; 4 = like; 5 = really like it

Table 7. Results of Color Hedonic Test Scores

Sample	Cinnamon : Brown Sugar	Value		
P0	Control (0%:0%)	4.0	±	0.13[a]
P1	2% : 3%	4.0	±	0.07[b]
P2	2% : 6%	3.5	±	0.04[c]
P3	2% : 9%	3.0	±	0.12[cd]
P4	4% : 3%	3.0	±	0.02[a]
P5	4% : 6%	2.8	±	0.06[bc]
P6	4% : 9%	2.8	±	0.13[d]

Description: 1 = really dislike; 2 = dislike; 3 = rather like; 4 = like; 5 = really like

Table 8. Results of the Texture Hedonic Test Score

Sample	Cinnamon :Brown Sugar	Value		
P0	Control (0%:0%)	4.0	±	0,13[a]
P1	2% : 3%	4.0	±	0.07[b]
P2	2% : 6%	3.5	±	0.04[c]
P3	2% : 9%	3.5	±	0.12[cd]
P4	4% : 3%	3.0	±	0.02[a]
P5	4% : 6%	3.5	±	0.06[bc]
P6	4% : 9%	3.5	±	0.13[d]

Description: 1 = really dislike; 2 = dislike; 3 = somewhat like; 4 = like; 5 = really like

The hedonic test is an evaluation method used to measure consumer preference or acceptance of a product, especially food and beverage products, based on sensory perceptions such as taste, aroma, texture, appearance, or other attributes. In this test, panellists (usually ordinary people or consumers who are the target market) are asked to assess their preferences, such as stating how much they like or dislike a product. Compared to other sensory tests, the advantage of the hedonic test is that it is easy to understand because this method is simple and can be used by untrained panellists, so it is suitable for general consumer evaluation [22].

The sensory test used was the hedonic test. In the hedonic taste test, panellists liked the P2 treatment, which was 2% cinnamon and 6% brown sugar. According to the panellists, adding cinnamon gave a slightly spicy sensation, but a higher concentration produced a bitter, unpleasant taste. In the colour and texture sensory test, panellists liked the P1 treatment, which was 2% cinnamon and 3% brown sugar. In this treatment, the fruit juice still had an attractive colour. Adding more cinnamon and brown sugar caused the colour of the fruit juice to become brown and far from the original colour of the red guava juice. The texture of the P2 treatment was not too thick so that the panellists still felt comfortable when the product was drunk.

Conclusion

Adding cinnamon and brown sugar increased the pH and viscosity of red guava juice and affected its sensory characteristics, such as taste, aroma, and texture. Panellists tended to prefer a combination that provided a balance of sweetness, a little spice, and a thicker texture, such as in sample P2. This suggests that the formulation with 2% cinnamon and 6% brown sugar can produce a fruit juice that is more organoleptically acceptable. This finding implies that adding cinnamon and brown sugar can increase the sensory appeal of red guava juice, making it preferred by consumers. In addition, increasing viscosity can provide a richer and smoother drinking experience, while the distinctive aroma of cinnamon can add a warm and appetizing impression. Thus, this formulation can increase market acceptance and product differentiation of red guava juice compared to similar products without adding cinnamon and brown sugar.

Author's Contribution

Anak Agung Ngurah Dwi Ariesta Wijaya Putra: lead researcher, research implementer; Putu Rima Sintyadewi: research implementer, data collector; Wahyu Krisna Yoga; data collector, data analysis; Komang Rosa Tri Anggaraeni: data analysis.

Acknowledgements

Thank you to the Bali Institute of Technology and Health for providing Internal Research Grant funds. Thank you also to the Food Analysis Laboratory, Faculty of Agricultural Technology, Udayana University for providing the author to conduct research. We would also like to thank the PIJAR MIPA Journal for allowing this article to be published. Hopefully this article is useful for all of us.

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