

Effect of Variations in Sugar Addition to the Quality of Bamboo Shoot Syrup (*Dendrocalamus asper*)

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Abstract

*Betung bamboo (*Dendrocalamus asper*) is a clumping plant that has a phase of growing through shoots (bamboo shoots). Bamboo shoots contain phosphorus, vitamin A, vitamin C, mineral fiber, and protein. The purpose of this study was to determine the effect of variations in the addition of sugar to the quality of bamboo shoot syrup. The method used in this study was an experimental method with a completely randomized design (CRD) to test organoleptic properties. Variations in the addition of sugar used in this study were 50%, 55%, 60%, and 65%. The results of the vitamin C test were 2.112%, 3.256%, 4.136%, and 5.016%, respectively. Protein test results for each treatment were 0.25%, 0.15%, 0.24% and 0.17%. The results of the water content test showed 0.073%, 0.063%, 0.056% and 0.056%. As well as the results of organoleptic tests (thickness, taste, and liking) showed the best treatment found at 65% sugar concentration with a value of 3.8000, 3.4667, and 3.6000. The results indicate there is an effect of sugar variation on vitamin C, water content, and organoleptic, but does not have an effect on protein content. Further research is needed to determine the nutritional value of fat, carbohydrates, Vitamin A, vitamin B1 (Thiamine), Vitamin B2 (Riboflavin), Fe, K, Ca, P, Na, and microorganism tests.*

Keywords: syrup; vitamin C; sugar; bamboo shoots.

1. INTRODUCTION

Betung bamboo (*Dendrocalamus asper*) is a clumping plant belonging to the Gramineae tribe. This plant species is spread in the tropics, subtropics to temperate regions. Bamboo Betung has essential benefits for the community because it can be used for building construction, as household furniture and as food.

The young shoots can be processed into a variety of foods, such as crackers, flour, and nuggets (Rizkiyani *et al.*, 2016; Harrower, 2014; Silaban *et al.*, 2017). It has a good taste and also contains potassium to reduce blood pressure, phosphorus, vitamin A, vitamin C, mineral fibers, and protein (Rizkiyani *et al.*, 2016). Other products created from bamboo shoots is syrup. This concentrated sugar solution is usually made from fruits, easily dissolved in water, contains vitamin C and anthocyanins (Wulansari, 2013).

The proportion of sugars in the syrup is affecting the color, taste, durability, and consistency of syrup (Fitri *et al.*, 2017; Andita, 2016). The most common sugars used in syrup are white sugar and palm sugar.

Ordinary people have known sugar as a simple carbohydrate commonly consist of monosaccharides (glucose, fructose, and galactose) and disaccharides (sucrose, maltose, lactose, and trehalose) ((Salamba, 2018). According to Hartanto (2014), sugar is useful as a flavor enhancer and preservative in syrup. It also determines the quality of the product. Based on the description, this study aimed to find out the effect of sugar additions to the quality of bamboo shoot syrup that including the taste, viscosity, vitamin C, and protein content.

2. RESEARCH METHODS

Place and time of research

This research was conducted at the Biology Laboratory of Artha Wacana Christian University from July to August 2019. Vitamin C level was measured in the Chemistry Lab FKIP Nusa Cendana University, whereas protein content was measured in BPOM Lab in Kupang.

Tools and Materials

Tools used in this study are counterweight, blender, plastic bowl, bucket, stove, pan, measuring cups 500 mL (Pyrex), stopwatch,

plate, beaker glass, spoon, funnel (Pyrex), bottle (Glass), and thermometer.

Materials used in this study are bamboo shoot juice 250 mL, citric acid 0,2%, food coloring FDA approved, white sugar, aquadest, standard iodine, sulfuric acid 2%, bromocresol green 0.1%, alcohol 95%, methyl red 0.1%, hydrochloric acid 30%, and sodium hydroxide.

Research methods

It is an experimental study using a completely randomized design (CRD) with five treatments of sugar concentration, namely 0%, 5%, 55 %, 60 %, and 65 %.

Work procedures

The making bamboo shoot syrup is explained as follows:

Cooking preparation for syrup

Fresh and clean bamboo shoots are cut into small pieces, weighed, washed in running water for 30 minutes, rewashed with salt solutions, and then steamed for about one hour. After steaming, it is washed and drained for a couple of times (Gervacia, 2017). These soft shoots are blended until it reached pulp-like consistency, and filtered with a fine sieve to obtain shoot juice. Citric acids (0,2%), water, and food coloring then added. The mixture is added with sugars according to the concentration treatments while heated. The next step is bottling, pasteurization, and cooling down at room temperature (Wulansari, 2013).

Vitamin C Test (Iodimetry Method)

Iodimetric titration is used to test the vitamin C content in the syrup. Iodometric titration is a titration based on the reaction between iodine as the reactant. The basis of this method is the nature of reducing vitamin C and titration with iodine standard solution.

An Amylum solution (0,1%; 0,5 mL) is added to 10 mL of syrup. Potassium iodide solution 0,01N is dropped onto the syrup solution until form a slight blue color (Content and Wine, 2015). The percent of vitamin C is calculated using the following formula:

$$\% \text{ Vitamin C} = \frac{\text{Vol Iod} \times \text{BE}}{v} 100\%.$$

Voi iod = iodime volume.

BE = Weight equivalent to vitamin C (0,88).

V = sample volume.

Protein Test (Kjeldahl Method)

The Kjeldahl method is used to measure the protein content. The working procedure in the Kjeldahl is divided into two stages: preparation for the reagent solution and the testing stage. The formula to determine the protein content is as follows:

$$\frac{(v_1 - v_2) \times N \times 0,014 \times f_k \times f_p}{W}$$

v₁: 0.01 N HCl volume used in the sample

v₂: 0.01 N HCl volume used as a blanko.

N: Normality of HCl.

Fk: Conversion factor for protein.

Fp: Dilution factor.

W: Sample weight.

Moisture Test

The moisture test is carried out following Permatasari (2012). The Moisture formula is as follows:

$$\% \text{ Water content} = \frac{B - C}{B - A} \times 100$$

A: Empty weight cup (g).

B: Weight of the cup filled with sample (g).

C: Weight of the cup with the sample dried (g).

Organoleptic test.

The test is carried out with the *hedonic scale scoring* method using 30 semi-trained respondents consisting of 15 fruit ice traders and 15 students. The criteria assessed include thickness, taste, and likeness (Magelang *et al.*, 2017). Table 1 presents the criteria for each organoleptic indicators.

Table 1. Test Scores for Taste, Viscosity, and Preference.

Score	Viscosity	Taste	Preference
4	Very thick	Very sugary	Really like
3	Thick	Sugary	Like it
2	Not thick	Neutral	Neutral
1	Not thick enough	Not Sugary	Do not like

(Magee *et al.*, 2017)

Data analysis technique.

All the qualitative data are analyzed using one-way ANOVA, followed by DMRT (Putri, 2016).

3. RESULTS AND DISCUSSION

Level of Vitamin C

The level of vitamin C is presented in Table 2.

Table 2. Contents of Vitamin C in Bamboo Shoot Syrup.

No	Sample Code	Vitamin C levels (%)
1	P1	2,112
2	P2	3,256
3	P3	4,136
4	P4	5,016

Based on Tabel 2, the value of vitamin C different in each treatment. The higher the sugar concentration, the higher the value of vitamin C. (P is code for sugar concentrations). The concentration of sugar 65% has the highest levels of vitamin C, which is 5,016%. Sugar has hygroscopic properties. It absorbs water from the cell walls of shoots during cooking. Vitamin C might come out along with water to the surrounding. Sugar is not a source of vitamin C, but the administration of sugar accompanied by a heating process can accelerate sugar to bind water and vitamin C from within the cell walls of plants (Rahmasari and Susanto, 2014; Ngginak et al., 2019). However, vitamin C is also easily oxidized if exposed to high temperatures or excessive mechanical actions.

Protein Content

Table 3 presents the result of the Kjeldahl method.

Tabel 3. The Protein Content of the syrup

No	Sample Code	Protein Analysis Results (%)
1	P1	0,25
2	P2	0,15
3	P3	0,24
4	P4	0,17

The highest value is in the treatment of 50% sugar, while the lowest value of protein content is in the treatment of 55% sugar. Sugar does not

provide a positive correlation on protein content. The sole source of protein provided by the shoot. There is 2.5% protein for each 100 g of raw bamboo shoot (Wahanani, 2014). The result showed much lower protein content due to denaturation during heating process. Filtering might play a role in decreasing protein as well because most proteins were left intact in the tissue. Protein is easily denatured or damaged when given mechanical treatment and excessive heat exposure. The protein will break the peptide bonds that support the secondary, tertiary, and quaternary structures of the polypeptide chains (Manis et al., 2017).

Moisture Content

The water analysis was measured using the gravimetric test.

Table 4. Water Content

No	Sample Code	Water Analysis Results (%)
1	P1	0.073
2	P2	0,063
3	P3	0,056
4	P4	0,056

Table 4 implies that the water content is reduced or inversely proportional to the sugar concentration. The higher the sugar concentration, the less water content. It is due to the ability of sugar to absorb and reduce water. Sugar has hygroscopic properties due to the presence of free and reactive polyhydroxyl groups. Polyhydroxyl groups are capable of binding to hydrogen because of ambient temperature and pH (Andika, 2015). Polyhydroxyl and aldehyde groups in sugars have a significant role in chemical reactions such as hydrolysis, oxidation, and reduction. Osmotic pressure during the heating process might also affect the water content of the syrup.

Organoleptic Test

Table 5. ANOVA Test on the organoleptic Parameters of Viscosity.

Viscosity	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	31.892	3	10.631	16.56	0.000
Within Groups	74.433	116	.642		

Table 5. ANOVA Test on the organoleptic Parameters of Viscosity.

Viscosity	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	31.892	3	10.631	16.56	0.000
Within Groups	74.433	116	.642		
Total	106.325	119			

The p-value is <0.05 shows that there is a difference in viscosity between treatments. The DMRT is presented in Table 6.

Table 6. DMRT result of viscosity.

Viscosity	N	Subset for alpha = 0.05	
		1	2
P2	30	2.4667	
P3	30	2.7000	
P1	30	2.7333	
P4	30		3.8000
Sig.		.228	1.000

Note: ** Very significant difference in DMRT test, P1: 50% sugar, P2: 55% sugar, P3: 60% sugar, P4: 65% sugar.

The 65% sugar concentration has the highest viscosity, according to respondents. It gets a value of 3.8000 higher compared to 50% (2.7333), 60% (2.7000), and 55% sugar (2.4667). The high viscosity is due to the presence of dissolved sugar particles. The higher the total amount of dissolved solids, the higher the viscosity value (Pratama *et al.*, 2014).

Table 7 presents the Anova result of flavor quality.

Table 7. Anova Test on the flavor.

Taste	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	10.692	3	3.564	5.035	0.003
Within Groups	82.100	116	.708		
Total	92.792	119			

The p-value is <0.05 shows that there is a difference in flavor between treatments. The DMRT is presented in Table 8.

Table 8. DMRT result of flavor.

Taste	N	Subset for alpha = 0.05	
		1	2
P2	30	2.7000	
P1	30	2.8333	
P3	30	2.8333	
P4	30		3.4667
Sig.		.567	1.000

Note: ** Very significant difference in DMRT test, P1: 50% sugar, P2: 55% sugar, 60% sugar P3, P4: 65% sugar.

The 65% sugar concentration has the best flavor, according to respondents. It gets a value of 3.4667 higher. Apart from giving a sweet taste, sugar also inhibits the growth of fungi and bacteria in food ingredients (Susanti, 2016).

Table 9 present the Anova result of preference.

Table 9. Anova results in the syrup preference.

Preference	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	10.692	3	3.564	5.035	0.003
Within Groups	82.100	116	.708		
Total	92.792	119			

The p-value is <0.05 shows that there is a difference in preference between treatments. The DMRT is presented in Table 10.

Table 10. DMRT result of preference

Passions	N	Subset for alpha = 0.05	
		1	2
P3	30	2.8000	
P2	30	2.9667	
P1	30	3.0333	
P4	30		3.6000
Sig.		.270	1.000

Note: ** Very significant difference in DMRT test, P1: 50% sugar, P2: 55% sugar, 60% sugar P3, P4: 65% sugar.

The 65% sugar concentration treatment has a different effect on preference parameters because it gets a higher value of 3.6000 compared to the 50% sugar (3.0333), 55% sugar (2.9667), and 60% sugar (2.8000). The 65% sugar concentration treatment is most preferred

by panelists because it has a thicker texture and has a sweeter taste. This result is consistent with the commentary sheet on the questionnaire filled by panelists.

4. CONCLUSION

The sugar concentrations affect the vitamin C level and water content but don't influence protein content. The most recommended sugar concentration based on the organoleptic test is 65% sugars.

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