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Effect of Sugar Type Variation on Nata de Coco Growth

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Abstract

The utilization of old coconut still needs to be improved. Old coconut water that is wasted can pollute the soil because of the acetic acid content produced by the fermentation process. Waste of old coconut water can be used as a food product in the form of nata, which has economic value and reduces environmental pollution. Sucrose is a carbon source for making nata de coco because it is an energy source for *Acetobacter xylinum* bacteria. Varied carbon sources can have different effects on nata de coco growth. The study results are used as learning media in class X high school. This study aimed to determine the effect of coconut sugar, corn sugar, and rock sugar on the quality of nata de coco, the type of sugar that is best for nata de coco growth, and the feasibility of e-booklet learning media. This research used an experimental and one-factor, complete, randomized design. Data analysis used was organoleptic testing juxtaposed with hedonic test, wet weight calculation, thickness, and learning media validation. The results showed that sugar cubes had the highest average value with a wet weight of 292 gr and a thickness of 1.4 cm. The lowest average value is corn sugar, with an average wet weight of 172 grams and a thickness of 0.9 cm. Organoleptic and hedonic testing of corn sugar has the highest value of 14.09. The validated e-booklet has a percentage score of 88.18% with very feasible criteria. Based on the study results, the varied types of carbon sources significantly affect the quality of nata de coco assessed in terms of appearance and organoleptic aspects.

Keywords: *Acetobacter xylinum*, e-booklet, carbon type, nata de coco

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INTRODUCTION

Known as a country with high biodiversity, many Indonesians are farmers. Coconut is a high-production plantation commodity. West Java produced 2,159 tons of coconut in 2021 [1]. Coconut plants are known as versatile plants because all parts of the coconut plant can be used well by the community, especially the coconut fruit, which is favored because of the taste of its fresh meat and water. However, if the coconut fruit turns old, only the meat is usable, and coconut water is wasted and

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becomes waste in aquatic and soil. According to Amalia et al. [2], old coconut water is wasted around 30 thousand to 36 thousand liters daily, which can cause acetic acid pollution. In its processing, old coconut water waste can be utilized in food products with good nutritional value and quality, namely nata de coco.

Nata is an added value of fermented old coconut water that can reduce water and soil pollution. According to Ratnasari et al. [3], nata de coco is a food product in the form of a cellulose layer due to fermentation on a substrate containing sugar. *Acetobacter xylinum* bacteria use some glucose substrate for metabolic activities, and some are retrieved into gel-shaped polysaccharides (nata). The result of nata de coco fermentation has a slightly sour and sweet taste that comes from the addition of syrup. Nata de coco is a food that is rich in fiber and freshness and is often consumed during the day or when breaking the fast.

Making nata de coco requires a source of nutrients in the form of nitrogen, hydrogen, and carbon as a source of energy from *A. xylinum* bacteria. *A. xylinum* bacteria include lactic acid bacteria and anaerobic bacteria. The temperature and acidity of the media influence the activity of *A. xylinum* bacteria. Bacteria secrete cellulose microfibrils called pellicles and 97% water on the surface of liquid media. Old coconut water is a suitable medium because there are nutrients that *A. xylinum* bacteria can still utilize, but it still needs macronutrients such as carbon and nitrogen. The carbon sources such as sucrose, glucose, fructose, maltose, and flour can be added.

Sucrose is the main ingredient used in making nata de coco. The availability of many carbon sources that are still underutilized in the manufacture of products and their different contents will provide other benefits to a product. Carbon sources that have not been compared in making nata de coco are rock sugar, corn sugar, and coconut sugar, so variations in carbon sources can find better carbon sources in processed nata de coco products. Based on this, this research aims to study the effect of carbon sources on the quality of nata de coco and to determine the type of sugar that is best for nata de coco growth.

METHOD

This research is an experimental method and uses a one-factor complete randomized design. It consisted of 4 treatments, and each treatment was repeated six times so that there were 24 experimental units. The treatments in the study were granulated sugar (control), coconut sugar, corn sugar, and rock sugar. The tools and materials used in this research are a 650mL thin-wall basin, stirring rod, newspaper, measuring cup, knife, digital scale, vernier, rubber, old coconut water, granulated sugar, coconut sugar, rock sugar, corn sugar, vinegar acid, food-grade ZA, and A. *xylinum* bacteria were used. The research procedure is divided into two stages: making nata de coco and harvesting nata de coco, as shown in Figure 1.

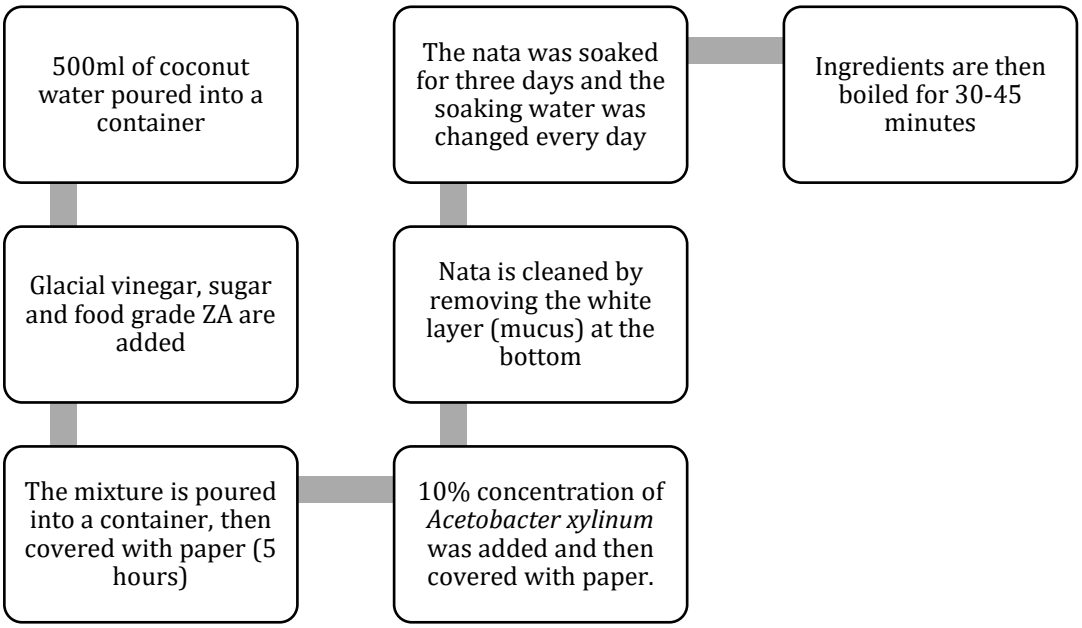

Figure 2. Research procedure

Data analysis in this study used two tests, namely organoleptic testing juxtaposed with hedonic testing using 4 Likert scales and testing the wet weight and thickness of nata de coco. In organoleptic testing, three parameters are tested: color, texture, and aroma. The data obtained were then analyzed by a one-factor analysis of variance (ANOVA) test with testing based on a significant level of 5% followed by Duncan's further test and Likert scale test for organoleptic and hedonic testing.

RESULTS AND DISCUSSION

Generally, nata is a fermented product that utilizes old coconut water and uses one of the lactic acid bacteria, *A. xylinum*. In fermentation, *A. xylinum* synthesizes old coconut water into a cellulose matrix. According to Putri et al. [4], nata is one of the fermentation products produced by A. *xylinum* bacteria on substrates containing sugar.

Wet weight and thickness

Duncan's further test results show that the best-wet-weight nata is nata treated with rock sugar, while the lowest-wet-weight nata is nata treated with corn sugar (table 1). However, the wet weight was not significantly different from the control treatment (granulated sugar), as indicated by the same superscript in the average results.

Table 1. Wet weight results

No	Treatment	Average
1.	Granulated sugar	263.83 ± 5.50^{bc}
2.	Coconut sugar	259.84 ± 24.2^{b}
3.	Corn sugar	172.32 ± 30.8^{a}
4.	Rock sugar	292.42 ± 4.63^{c}

The test results on thickness show that rock sugar has the highest value and corn sugar has the lowest value. It is shown in Table 2 that rock sugar shows a significant difference from the control treatment (granulated sugar), which is indicated by the superscript difference in the average results.

Table 2. Thickness result

No	Treatment	Average
1.	Granulated sugar	13.20 ± 0.66^{b}
2.	Coconut sugar	13.18 ± 0.52^{b}
3.	Corn sugar	9.78 ± 0.59^{a}
4.	Rock sugar	14.89 ± 0.43^{c}

The growth activity of nata de coco is influenced by several factors, such as temperature, cleanliness of tools, media conditions, nutrient sources, and fermentation time. Coconut water is the main ingredient because it is a medium for bacteria to multiply colonies. Tables 1 and 2 show that rock sugar has the highest wet weight and thickness test results. This is because the carbohydrate content in rock sugar has the highest value of 100 grams/100 grams of carbohydrates. In contrast, the carbohydrate content of granulated sugar, coconut sugar, and corn sugar is 94 grams per 100 grams, 95 grams per 100 grams, and 80 grams per 100 grams of sugar. Agree with Putri et al. [4], that carbohydrates are the content of raw materials that affect the results of nata during the fermentation process because carbohydrates are used as an energy source for *A. xylinum* bacteria in producing cellulose. Carbohydrates are a polysaccharide that is a carbon source for *A. xylinum* bacteria, so the higher the carbohydrate content, the thicker the nata, and the weight increases. This is because carbohydrates are broken down into sucrose, then broken down again to form glucose and fructose to be converted into cellulose biopolymers.

The more nutrients are available; the cellulose braid continues to bind to form a sturdy and compact network so that it can affect nata growth. Adequate nutrient sources stimulate *A .xylinum* bacteria in synthesizing cellulose. So, it impacts cellulose bond strength, increasing nata weight and thickness. The thickness of nata de coco can affect the wet weight of nata because of the tightness of the bonds followed by the water content in the cellulose layer. Granulated sugar, coconut sugar, and rock sugar are included in the sucrose sugar type, and corn sugar is included in the fructose sugar type.

It is known that sucrose has hygroscopic properties, so it is weaker to bind water because the higher the sucrose content, the lower the water content. While fructose has hygroscopic properties, so the higher the concentration of fructose, the more water is bound, causing an increase in water content. This will affect each treatment's thickness and wet weight and the organoleptic and hedonic assessment. Supported by the opinion of [5] that high fructose sugar can inhibit the growth of microorganisms with high osmosis pressure. This causes nata de coco with fructose carbon source treatment to produce the lowest value compared to other treatments.

The results of this study indicate that *A. xylinum* bacteria can plant well in sucrose sugar type because of its optimal growth, namely with a thickness of 1.3 cm - 1.4 cm. The other factors that affect the growth of nata de coco are the liquid media's height and the container surface's circumference. Incubation time and optimal conditions can also affect nata de coco, which is fermented for eight days at room temperature ranging from 27°C - 28°C at pH 4. The length of incubation time impacts the formation of thicker cellulose. However, along with the length of incubation time, the growth of nata will decrease slowly due to reduced sugar content in the media.

Organoleptic and Hedonic

Organoleptic testing includes color, aroma, and texture assessed by 30 untrained panelists and juxtaposed with hedonic testing regarding the level of panelist preference for the entire sample. This test uses the human sensory apparatus's ability to provide assessment criticism of the tested product according to the stimuli received by the receptor. Based on the results of organoleptic and hedonic tests, corn sugar has the highest value, followed by rock sugar, granulated sugar, and coconut sugar (table 3.).

Table 3. Average results of organoleptic and hedonic tests

Sample	Average				Total
	Color	Aroma	Texture	Hedonic	
A	3,57	3,40	3,57	2,87	13,41
B	1,63	3,00	3,47	1,97	10,07
C	3,43	3,73	3,73	3,2	14,09
D	3,43	3,57	3,73	2,77	13,50

Notes: A (granulated sugar), B (coconut sugar), C (corn sugar), D (rock sugar).

Organoleptic results show that corn sugar has the highest value. This is because the corn sugar treatment has a texture that is easier to bite. After all, it binds more water content and a brighter color that is more transparent and does not have a pungent aroma. Based on this, nata de coco with corn sugar treatment shows promising results to stimulate individuals to eat it. Twenty five women and five men conducted this test. According to [6], women generally have a higher sensitivity than men to taste preferences.

CONCLUSIONS

Based on the study's results, it can be concluded that different variations of carbon sources provide significant differences in nata de coco growth based on wet weight, thickness, and organoleptic and hedonic. Sugar that gives a real difference in thickness and wet weight is rock sugar, with an average wet weight of 292 grams and a thickness of 1.4 cm. However, the organoleptic and hedonic tests were on corn sugar. Suggestions are that testing needs to be continued to the stage of testing proximate or chemical content to have more supportive data and the need for variations in other raw material sources to find better formulations.

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