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UTILIZING KOPYOR COCONUT WATER IN PROCESSING OF NATA DE KOPYOR USING DIFFERENT FERMENTATION TIME AND SUCROSE CONCENTRATION

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ABSTRACT – Propagation of kopyor coconut can only be done through in vitro culture. However, there are several obstacles that need to be addressed, namely: (a) relative low rate of seedling production; (b) non-utilization of materials like coconut meat and coconut water; (c) accumulation of waste like husk and shell. Clean technology development can be done to overcome these problems by converting every part of the coconut into high value products. Our work in this research tried to process kopyor coconut water into nata de kopyor. Kopyor coconut water is a mix of juice consisting of coconut water (liquid endosperm) and broken cell contents that come from the solid endosperm. Using different fermentation time (7, 10, and 13 days) and concentration of added sucrose (6, 8, and 10%), the kopyor coconut water was processed into nata de kopyor. The results showed that kopyor coconut water could be processed into nata de kopyor under the optimum condition of 6-8% sucrose and 7 days fermentation. It was yellow-white, chewy and acidic. Some nata de kopyor showed high content of total sugar, crude fiber, yield, but less acidic.

Keywords: in vitro culture, kopyor coconut, water processing, zero-waste technology

INTRODUCTION

Kopyor coconut (*Cocos nucifera* L.) (2n = 2x = 32) together with the other palm species is a member of a family of monocotyledonous Aracaceae (Palmaceae). *Cocos nucifera* is the only species in the genus *Cocos*, subfamily Cocoideae (Harris 1990). Kopyor coconuts are coconuts which have abnormal endosperm (broken meat) and the embryos fail to germinate due to lack of energy for the growth of embryo. In a normal coconut, the source of energy is obtained from the degraded galactomannan (Balasubrahmaniam 1976). One of the degraded enzymes for galactomannan, α-D galactosidase, is not active (Mujer et al. 1984) in kopyor coconut, hence, disrupting the normal degradation of galactomannan.

To produce true-to-type kopyor seedling the only way is through in vitro technique. However, production of in vitro seedling of kopyor coconut generate secondary waste materials such as coconut water, meat, husk and shell. Recently, some laboratories produce kopyor coconut seedlings but strategies on the use of the secondary waste materials have not been looked into. One of the potentially valuable wastes is the kopyor coconut water. According to Reddy and Lakshmi (2014) coconut water contains several biologically active components like sugars, proteins, free amino acids, vitamins, minerals and growth promoting factors. The recent discovery of other medicinal values of coconut water signifies a good potential in improving human health.

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Coconut water is the liquid endosperm found within the cavity of the coconut, which begin to form around two months after the natural opening of the inflorescence. According to research, coconut water accounts for 25% of the weight of the fruit, and its basic composition is 95.5% water, 4% carbohydrates, 0.1% fat, 0.02% calcium, 0.01% phosphorous, 0.5% iron, amino acids, vitamin C, vitamin B complex and mineral salts (Aragão, 2004). Vigliar et.al (2006) reported that the biochemical profile of coconut water varied as the coconuts matured, observing reductions in the concentration of potassium, calcium, magnesium, chloride and osmolarity and also sucrose, but increase in the concentration of fructose and glucose. However, kopyor coconut water is slightly different from a normal coconut water. Kopyor coconut water is not only the liquid of the endosperm but also a mix of the contents of broken solid endosperm cell. So it is important to analyse the nutritient content of kopyor coconut water so that we can think of processing possibilities such as nata de kopyor maybe similar to that of nata de coco in normal coconuts.

Nata de coco is a cellulose compound produced from coconut water through a process that involves microbial fermentation known as *Acetobacter xylinum* (Santosa et. al. 2012). Nata de coco is used as a component of beverages and other food and non-food products. Presently, nata de coco is manufactured at an industrial scale not only in Malaysia but also in Indonesia and some are exported to countries like Japan. The major component of nata de coco was shown to be cellulose and not dextran, as was assumed in the past (Iguchi et. al. 2000). During the production of nata de coco, *Acetobacter xylinum* metabolizes glucose in the coconut water that act as carbon source and converts it into extracellular cellulose as metabolites (Cannon and Anderson 1991).

Even though many works have been done in the production of nata de coco, there are only few studies on the processing of kopyor coconut water to nata de kopyor. Kopyor coconut water very easily become rancid and rotten, and it contains high level of carbohydrates. We therefore decided to carry out this study with the following objectives: (1) to analyze the features of nata de kopyor at different time of fermentation; (2) to determine the optimum concentrations of sucrose for nata de kopyor production; (3) to identify the preference of consumer on the colour, flavour, and texture of nata de kopyor.

MATERIALS AND METHODOLOGY

Materials

Kopyor coconut water was obtained from kopyor fruit aged 11-12 months. The fruit was taken from the center of kopyor coconut plantation in Pati, Central Java. The nut was split at the middle and the water was collected in a basin. The bacteria *Acetobacter xylinum* was used as a starter and incubated by using a medium containing 0.3% urea and 0.3% ZA.

Fermentation

A total of 100 ml of coconut water was mixed with sucrose at different concentrations (6, 8, and 10%), 2 g of ZA, and 2 mL of acetic acid. The solution was then heated to a temperature of 80 ° C and continued cooling to 30 ° C. The fermentation process was done by mixing coconut water medium with beads containing cells of *Acetobacter xylinum* in a container with a cover. The solution was fermented at three different durations (7, 10, and 13 days).

Data Analysis

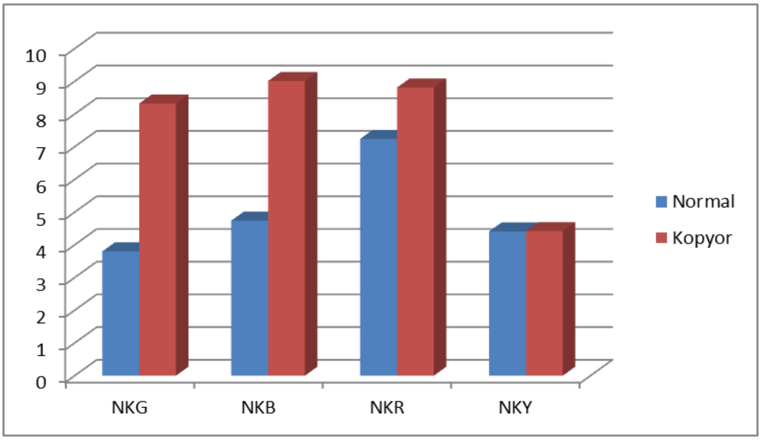
Sugar content of normal coconut and kopyor coconut was analyzed and compared. Meanwhile, data on fermentation were collected after formation of nata de kopyor. Data collection was done by recording the thickness of nata, total sugars, total acids, fiber, moisture content, and yield. Organoleptic scoring was done for texture, flavour and color by 20 male and female respondents.

RESULTS AND DISCUSSION

Features of Nata de Kopyor

a. Total Sugar of Normal and Kopyor Coconut Water

The analysis of total sugar between the normal coconut and kopyor coconut water is shown in Figure 1. Kopyor coconut water contained higher total sugar compared to normal coconut water, except for the yellow variety. Kopyor green and brown varieties contained two times the total sugar as compared to the normal coconut. Santoso et al. (1996) found that sucrose in kopyor coconut water could increase up to 8 folds compared to the liquid endosperm of normal coconut. This could be due to the bits and pieces of solid endosperm mixing with the kopyor coconut water. However, oleic acid, linoleic acid, and stearic acid (C18:0) were lower in the kopyor coconut water. High sucrose and lower lipid contents can make kopyor coconut water a healthy drink.



NKG= Normal and Kopyor Green Variety **NKR= Normal and Kopyor Red Variety**
NKB= Normal and Kopyor Brown Variety **NKY=Normal and Kopyor Yellow Variety**

Figure 1. Total sugar content of normal and kopyor coconut water from different varieties

b. The Water Content, Acidity, Total Sugar, Crude Fiber, Thickness and Yield

Biochemical test showed that nata de kopyor consisted of high water content with total sugar ranging from 9 to 16 % (Table 1). Nata de kopyor with 8% sucrose and 10 days fermentation had high total sugar and crude fiber but low acidity. High sugar (10%) with short fermentation time (7 days) produced nata de kopyor with low crude fiber, water content, and yield but high acid and total sugar.

Table 1. Water content, acidity, total sugar and crude fiber in the treatment of nata de kopyor under varying levels of sucrose and fermentation time.

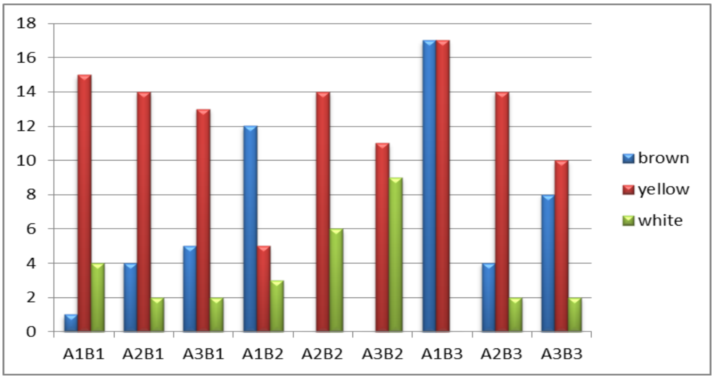
Sugar Content and Time of Fermentation	Water Content (%)	Acidity	Total Sugar (%)	Crude Fiber
Sucrose 6%, 7 days	91,740	0,430	9,125	2,430
Sucrose 8%, 7 days	91,200	0,555	7,655	2,360
Sucrose 10%, 7 days	88,150	0,630	14,805	1,565
Sucrose 6%, 10 days	94,240	0,085	16,420	4,665
Sucrose 8%, 10 days	93,180	0,205	9,935	1,775
Sucrose 10%, 10 days	92,805	0,310	9,060	2,295
Sucrose 6%, 13 days	94,330	0,095	9,250	2,380
Sucrose 8%, 13 days	93,240	0,250	16,310	2,325
Sucrose 10%, 13 days	90,295	0,495	15,150	2,370

The high production of nata de kopyor could be obtained from the processing of kopyor coconut water in the low sucrose (6%) and fermentation 7 days (Table 2). The longer the fermentation period (10 and 13 days) the lower the yield and thickness of nata de kopyor. This finding was different with the production of nata de cassava where the best yield, thickness, and organoleptic quality were obtained at 13 days of fermentation (Putriana and Aminah, 2013). Meanwhile Jagannath et.al (2008) found that the maximum thickness of nata was obtained at 10% sucrose and 0.5% ammonium sulphate at pH 4.0. These conditions also produced good quality nata-de-coco with a smooth surface and soft chewy texture.

Table 2. The thickness and the yield of nata de kopyor under various treatments of sucrose percentage and fermentation time.

Sugar Content and Time of Fermentation	Thickness (mm)	Yield
Sucrose 6%, 7 days	3,66	73,590
Sucrose 8%, 7 days	2,24	61,175
Sucrose 10%, 7 days	2,13	26,835
Sucrose 6%, 10 days	3,65	60,900
Sucrose 8%, 10 days	2,23	56,445
Sucrose 10%, 10 days	2,48	33,280
Sucrose 6%, 13 days	3,35	54,860
Sucrose 8%, 13 days	2,25	49,235
Sucrose 10%, 13 days	1,85	35,770

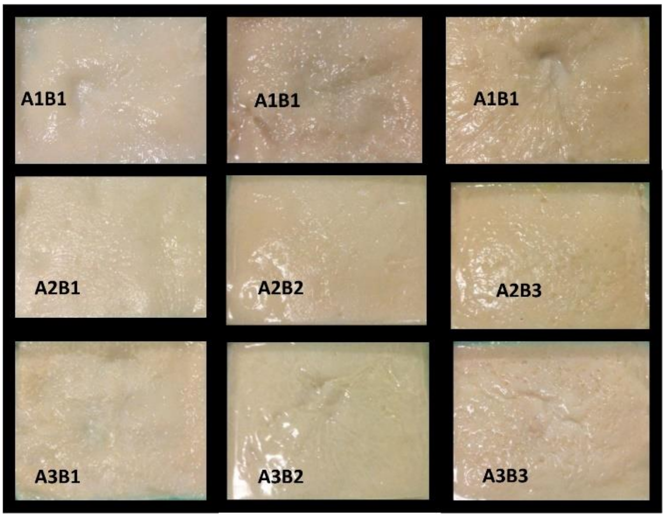
The Preference of Nata de Kopyor by Organoleptic Test



A1=6%, A2=8% and A3=10% sucrose; B1= 7, B2= 10 , B3= 13 days of fermentation

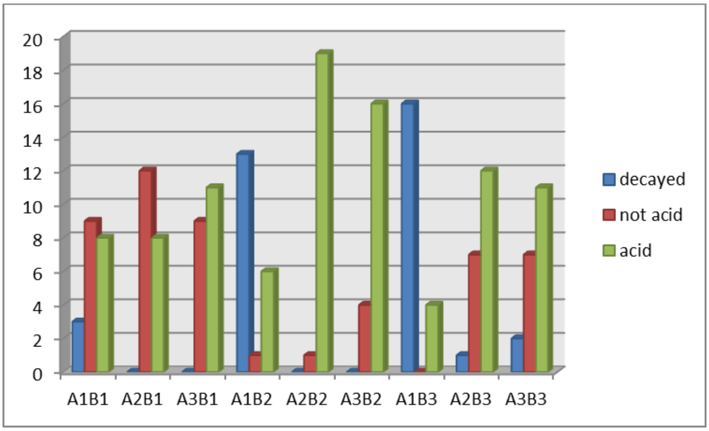
Figure 2. Organoleptic test for color of nata de kopyor which classified in three categories: brown, yellow and white.

Figures 2-5 showed the results of hedonic test (organoleptic) of 20 respondents to the color, aroma and texture of nata de kopyor. Based on observations of the respondents, all treatments had yellow or brown color and some said white color. Treatment A2B2 (sucrose 8% with 10-day fermentation) and A3B2 (sucrose 10% with 10-day fermentation) were yellow or white. Meanwhile treatment A1B3 (sucrose 6% by fermenting 13 days) was yellow or brown. The aroma of nata de kopyor was sour or not sour, while treatment A1B2 (sucrose 6% of fermentation 10 days) and A1B3 (sucrose 8% fermentation 13 day) had a foul smell.



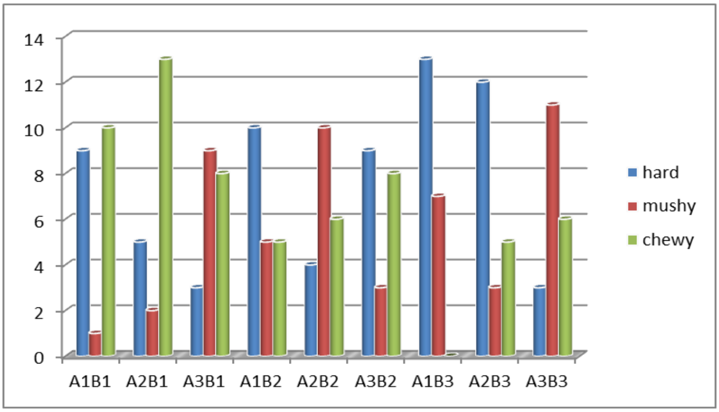
A1=6% sucrose, A2=8% sucrose and A3=10% sucrose
B1= 7 days, B2= 10 days, and B3= 13 days of fermentation

Figure 3. The features and color of nata de kopyor on sucrose content of 6%, 8%, and 10% and fermentation time of 7, 10 and 13 days.



A1=6% sucrose, A2=8% sucrose and A3=10% sucrose
B1= 7 days, B2= days, and B3= 13 days of fermentation

Figure 4. Organoleptic test on the flavour of nata de kopyor classified in three categories: rotten, not sour and sour.



A1=6% sucrose, A2=8% sucrose, and A3=10% sucrose
B1= 7 days, B2= 10 days, and B3= 13 days of fermentation

Figure 5. Organoleptic test on the texture nata de kopyor which classified in three categories: hard, mushy and chewy.

Texture of nata de kopyor according to the respondents was categorized as hard, mushy and chewy. Treatment A1B2, A3B2, A1B3 and A2B3 had hard texture. While treatment A1B1 and A2B1 had a chewy texture. On the other hand, treatment A3B1, A2B2, and A3B3 had a mushy texture. It could be concluded that the fermentation between 10-13 days produces nata de kopyor that is either mushy or hard depending on the concentration of sucrose used. The high sucrose (10%) tended to produce a mushy texture. Chewy texture occurred in 7 days of fermentation with a sucrose concentration of 6-8% (Figure 5).

CONCLUSION

In the production of kopyor coconut in vitro seedlings, waste such as the coconut water could be utilized and transformed into value-added food products such as nata de kopyor. Kopyor coconut water contain sugar higher than normal coconut water. This coconut water processed into nata de kopyor showed the following characteristics: high content of water, total sugar range from 6 to 16 %, acid to neutral, crude fiber 1.5 to 4.6, thickness between 2 and 3.5 mm and yield from 27 to 74%. Nata de kopyor processed with high sugar (10%) and sort fermentation time (7 days) had the following characteristics: low crude fiber, water content, and yield but high acid and total sugar. The best condition to produce nata de kopyor is 7 days fermentation with 6-8% sucrose.

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STATEMENT OF AUTHORSHIP

The first author conducted the laboratory work, undertook the writing of the manuscript, and reviewed the paper. The second author assisted in the preparation & analysis of the data,and conducted the literature study.

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