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***REDUCING SUGAR CONTENT IN SIWALAN ROOMIE
(BORASSUS FLABELLIFER L) BEFORE COOKING AND LIQUID
BROWN SUGAR AFTER COOKING***

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Abstract

Sugar reduction is one of the essential macronutrients used as energy sources. High levels of sugar reduction in food can increase the sweet taste of these foodstuffs. However, the consumption of high sugar food can cause diabetes mellitus. The purpose of this study is to increase the economic value of liquid palm sugar (Borassus flabellifer L) and opportunities as a preservative in the food industry. This research used quantitative descriptive methods. The results showed that the level of sugar reduction in siwalan liquid brown sugar (Borassus flabellifer L) was 15.65%, the water content in the liquid palm sugar sample (Borassus flabellifer L) is 26.78%, and the temperature of the liquid brown sugar after cooking is 23°C. The effect of heat or temperature on cooking also causes physical changes in liquid brown sugar such as caramel formation, color and flavour.

Key Words: *Sugar, reducing sugar, palm Lotar, nira, cooking*

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INTRODUCTION

Palmyra palm (*Borassus flabellifer* L) is one of palm or Arecaceae types which grow widely in East Nusa Tenggara (ENT). ENT people understand that palmyra palm is one of multipurpose trees that can fulfill their daily needs. Parts of palmyra palm such as root, trunk, leaves and fruits can be used as materials for furniture, arts (Tambunan, 2010), as food and potentially as bioethanol (Budisetyowati *et al*, 2016). According to Kirana *et al* (2016), organ or parts of palmyra palm such as male flower cob may produce Nira for foodstuffs such as liquid palm sugar, ant sugar and plate sugar. Therefore, palmyra palm existence may fuel people's economic growth.

Nira is liquid tapped from mayang or male flower tree which can be consumed directly, but may also be processed into economic products such as soy sauce and *dodol* (Hanggara *et al* 2016). Siwalan roomie has sweet taste due to its sugar content or usually called carbohydrate.

Carbohydrate is polyhydroxy aldehyde or polyhydroxy ketone with empiric formula $(CH_2O)_n$. Many carbohydrate components found in vegetable ingredients in form of simple sugar. Carbohydrate has become the main source of calory for living things. Naturally, there are three important forms of carbohydrate: monosaccharide (glucose), oligosaccharide (consist of 2-10 unit of

monosaccharide) and polysaccharide (consist of more than 10 unit of monosaccharide) starch, amilum, cellulose and pectin. Monosaccharide and disaccharide class have reducing character that this class may be or usually called reducing sugar. Reducing sugar is sugar which have reducing ability. It is because the existence of aldehyde cluster, free ketone or free and reactive hydroxy cluster. Reducing sugar may undergo reaction affected by factors such as temperature and long storage. Types of sugar that included in reducing sugar are glucose, mannose, lactose, maltose, fructose, and galactose. On the other hand, nonreducing sugar is sugar which its carbonyl cluster bind with other monosaccharide compound such as sucrose (Mottram, *et al* 2017).

According to Pontoh (2013), Siwalan roomie contains sucrose, reducing sugar (glucose and fructose), polysaccharide and dextran. Fatkhul *et al* (2016), added that Siwalan roomie contains relatively high sugar, around 10 g/100mL. Reducing sugar is one of important macronutrients for body since it functions as the source of calory and calory supplier for body. According to Saputra *et al* (2014), reaction among sucrose, glucose and water as well as heat may result in Maillard reaction that affect reducing sugar composition.

Heating process increases sweetness in siwalan liquid palm sugar as a result of sucrose breaks down into glucose and fructose. Besides increasing the level of reducing sugar, heating process may also decrease water level that siwalan liquid palm sugar may be durable and not easily contaminated by mold. For this reason, ENT people choose siwalan liquid palm sugar as meat preservative. Based on above discussion, this research needs to be conducted in order to know the composition of reducing sugar in Siwalan roomie (*Borassus flabellifer* L) before cooking and in liquid palm sugar after cooking. This information is hoped to give understanding toward people about reducing sugar content in siwalan liquid palm sugar.

MATERIALS AND METHODS

This research conducted in Faculty of Science and Engineering laboratory, Nusa Cendana University, Kupang from October to November 2018. Method used in this research was descriptive quantitative. Analysis of reducing sugar level changes used Luff Schoorl method, while in determining water and ash level, thermogravimetri method was used (Wulandari 2017).

Tools used in this research were glass bottle, digital analitic scale (Mark), Erlenmeyer (pyrex) 500 mL, laboratory

flask 100 and 200 mL, volumetric pipette 10 ml, 25 ml and 50 mL, digital thermometer, Burette 50 mL, Stopwatch, and camera (Canon power ShotD30).

Ingredients used were 10 mL Siwalan liquid palm sugar, labels, kalium iodide (KI 20%) solution, Aquades, Al (OH)₂, sulfuric acid solution (H₂SO₄ 25%), sulfuric acid (inorganic), Natrium Thiosulfate solution (Na₂S₂O₃ 0,1 N), hydrochloric acid solution (HCL 25%), starch indicator 0,5%, and Luff Schoorl solution.

$$\text{Sugar before inversion (\%)} = \frac{W1 \times FP}{W} \times 100\%$$

$$\text{Sugar after inversion (\%)} = \frac{V2 \times FP}{W} \times 100\%$$

Information:

- W1 : Glucose (mg)
- V2 : Glucose (mg) register
- FP : dilution factor
- W : example weight (mg)

Research Procedure

Determining reducing sugar using Luff Schoorl method.

As sample, 10g of Siwalan liquid palm sugar put into 100 mL laboratory flask, 50 mL of Aquades added into 10 mL sample. Then, (OH)₂ is added until there is no effect formed in the solution. After that, the solution is homogenized and filtration is done. As much as 20 mL filtrate pipetted and put into boiling flask. Next, filtrate is added with 10 Luff Schoorl solution. The mixture of filtrate and Luff Schoorl

solution is heated for 10 minutes then set aside to cool. Furthermore, 10 mL KI 20%, 20 mL H₂SO₄ 25% are added. The solution is being titrated Na₂S₂O₃ 0,1 N using starch indicator 0,5 % until blue color is invisible. Titration is then repeated in blank solution (20 mL Aquades and Luff Schoorl solution). Reducing sugar content in 20 mL titrate is known based on the data in the table.

Measuring water content and temperature using thermogravimetry method.

As much as 2 g sample is put into an oven with 100-110°C temperature for 2 hours long. After that, the sample then set aside to cool in desiccator for 10 minutes, being weighed and then put into an oven minutes and reweighed. This process is continued until constant weight is

achieved.

$$\text{Water content} = \frac{\text{material weight (start-end)}}{\text{Initial material weight}} \times 100\%$$

In deciding sample ash content, 2 g of sample is put into evaporating dish which weight is known. In a furnace, sample is heated until becoming ash (white) in 500-600°C temperature for 5 hours long. Then, sample is set aside to cool in desiccator and being weighed.

$$\text{Ash content (\%)} = \frac{\text{ash weight (g)}}{\text{sample weight (g)}} \times 100\%$$

RESULTS AND DISCUSSION

Preparation of Siwalan roomie and siwalan liquid palm sugar to be examined on reducing sugar can be seen in below pictures.



Picture 1. (a) nira sample (white color) and palm sugar, (b). H₂SO₄ addition, (c). 10 minutes Luff heating, (d). Titration with Thiosulfate 0,1 N.

The result is after being cooked, sugar with changes in color, smell and Siwalan roomie becomes liquid palm texture. The data of reducing sugar

measurement can be seen in table 1 below:

Table 1. Data of Reducing Sugar Analysis Test using Luff Schoorl method

No	Sample	Na ₂ S ₂ O ₃			Reducing Sugar		
		I	II	Average	Blank	Before inversion	After inversion
1	Siwalan roomie	33,1	41	37,05	41,8	1,49	
2	Liquid palm sugar	34	34,8	34,4	53,2		15,65

Based on Table 1, result of reducing sugar analysis test using solution titration Luff Schoorl method is the average of reducing sugar content in siwalan roomie is 1,49 % and siwalan liquid palm sugar is 15,65 %. These results explained that after cooking, reducing sugar content increases compared with siwalan roomie before cooking. In other words, although both samples contain reducing sugar, in term of content there is 14,16% difference.

Reducing sugar experiences changes affected by heating factor. According to Wulandari (2017), the breakdown of glycosidic bond due to heating will cause non reducing sugar (sucrose) breakable into reducing sugar such as glucose and fructose. Related to this, Finallika *et al* (2015) explains that the result of heating process, a substance may experience changes in chemical property. Thus, based on above discussion, it can be argued that reducing sugar content increment after cooking process becoming liquid palm sugar is affected by the cooking process. Reducing sugar is formed not only

because of heating but also because of acid existence. Sucrose content is nonreductive because it does not have free reactive OH, however the existence of acid may cause sucrose hydrolyzed by the help of heat and becoming inverted sugar which are fructose and glucose, the reducing sugar. In this research, changes in physical are the liquid palm sugar red color becomes brown, the smell of sugar becomes more fragrant and liquid palm sugar texture becomes thicker or caramelized. These changes are caused by Maillard reaction in sugar molecules. Maillard reactions is reaction happens between reducing sugar with amine cluster. In this reaction melanoidin pigments (brown pigment) are produced. Cooking temperature affects caramelization reaction happens during palm sugar cooking. Caramelization reaction happens because sugar (glucose, fructose, sucrose) is heated until it reaches its melting point. Cooking process influences sample's physical characteristics. The higher cooking temperature, the higher sugar's color

intensity and caramel texture will be. In cooking process, complex sugar breaks down into simple sugar, including glucose and fructose. This invert sugar cannot be crystal in form since its solubility is immense, the higher the temperature, the higher the percentage of invert sugar that can be form will be (Ibrahim *et al*, 2015). Sugar with glucose or high inversion sugar

content is difficult to hardened and easily melted (Indahyanti *et al*, 2014).

Determining water level

The result of water level test using thermogravimetry method shows that nira lontar has higher water level compared with liquid palm sugar sample. Comparison of water level can be seen in below table no 2.

Table 2. Nira water level (before cooking) and liquid palm sugar (after cooking)

No	Sample Name	Amount(%)
1	Siwalan roomie	51,698
2	Liquid palm sugar	26,787

The data in table no 2 above show that siwalan roomie has more water level which is 51,698% compared with water level in cooked sugar which is 26,787%. Differences in water level in siwalan roomie and cooked liquid palm sugar is caused by cooking process (temperature). This means that through cooking process, cooked sugar has lower water level compared with siwalan roomie. Cooking process is very influential toward sample's water level because cooking uses heat or temperature that reduces water level amount in ingredient. According to

Dewi *et al* (2014), the longer the cooking process, the lower the water level will be as a result of many evaporation. Cooking process also determines sugar caramel level. During heating, water level reduction happens and so solid concentration increases (Nilasari *et al*, 2017).

Determining temperature

Laboratory analysis result with thermogravimetry method shows that siwalan roomie temperature is lower than liquid palm sugar temperature after cooking. Samples' temperature before and after cooking can be seen in below table no 3.

Table 3. Siwalan roomie and liquid palm sugar temperature

No	Sample Name	Temperature (°C)
1	Siwalan roomie	23
2	Liquid palm sugar	26

Based on table no 3, it can be explained that sample temperatures before (siwalan roomie) and after cooking (liquid palm sugar) are different. Differences in temperature before and after cooking are affected by water level. Note that sample's temperature is correlated with water level. Water level may hinder temperature rise. The amount of water level in a sample can help lower the temperature down. Moreover, temperature determine reducing sugar level. According to Nursafuan *et al* (2016), temperature affects reducing speed. Giving high temperature will influence reducing sugar increment process. Besides correlating with water level, temperature is also closely related with pH. The higher heating process is, the higher pH value is. High temperature may hinder invertase enzyme and microorganism activity, therefore sucrose does not experience many damages and pH value reduction (Winata *et al*, 2015). In addition, in high temperature, microorganism may experience lysis due to cell membrane liquidity increment so that it is destroyed or damaged. High temperature may kill microorganism pathogen, delay enzyme invertase, even kill all microorganism in ingredients. For this reason, people usually use palm

sugar as preservative in preserving foodstuffs (Winata *et al*, 2015).

CONCLUSION

Based on research results, it can be concluded that reducing sugar content in Siwalan roomie (*Borassus flabellifer* L) before cooking is 1,49% and in liquid palm sugar after cooking 15,65%. Besides differences in reducing sugar level before and after cooking, there are also differences in water and temperature level. Water level sample before cooking process is 51,69 % and 26,78 % after cooking, while sample temperature before cooking is 23°C and 23°C after cooking. In this research, physical changes happen in samples after cooking. The changes can be seen before and after cooking i.e. after cooking, sample is caramelized, brown in color and has palm sugar distinct aroma.

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