Nira acidity and antioxidant activity of Palm sugar in Sumowono Village

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Abstract. The palm sugar not only has potential as natural sweetener but also has antioxidant. The purpose of this study was to analyze antioxidant and pH of the nira in palm sugar. The sample in this study was palm sugar from 6 different production sites. Test of antioxidant activity used DPPH method (1.1-diphenyl-2-picrylhydrazyl) with a wavelength of 517 nm. The value of absorbance solution was measured using spectrophotometry and the value of effective concentration (IC50) was counted. The pH test was measured using a pH meter. Pearson's correlation test revealed r=0.045 with significant value 0.932 (>0.005). There was no correlation between pH value and antioxidant activity of palm sugar. IC50 value of palm sugar in Sumowono village revealed that it had a strong antioxidant activity (50 μg/ml - 100 μg/ml) that is 74.73 μg/ml; 83.94 μg/ml; 82.31 μg/ml; 83.94 μg/ml; 86.10 μg/ml; 82.13 μg/ml; 89.71 μg/ml; 89.71 μg/ml; and 84.84 μg/ml. Lower IC50 values indicate higher antioxidant activity. Palm sugar with the best antioxidant activity came from the production sites which had IC50 values of 74.73 μg/ml. Potential antioxidants can be optimized by making improvements to the processing system.

Keywords: DPPH, IC50, palm sugar, pH, antioxidant

1. Introduction

Palm sugar is one of the natural sweeteners derived from the nira of aren tree as the main ingredient. Nira is a sweet liquid obtained from stems or sap of plant flower bunches such as sugar cane, beetroot, sorghum, maple, siwalan, dahlia flower or palm family such as palm, coconut, nipah, sago, and dates [1]. In Sumuwono village, aren tree grows wildly and utilized by the community as it has economic value by processing the physical parts of the tree. Processing of palm juice into sugar is still traditional. Sugar palm used as commodities rapidly changes into acid because the fermentation process has been started when the nira was taken out of palm tree bunches for the first time. It is also supported by the condition of the nira container which is not clean and inhabited by microbes so that the fermentation process takes place quickly. The degree of acidity (pH) of the nira when it first comes out of the bunch is about 7, but it will decrease as the fermentation process occurs [2]. Nira's
pH is associated with antioxidant activity. High pH levels will lead to increased antioxidants [3]. Antioxidants are beneficial to health, especially against degenerative diseases. The degenerative disease is the cause of death of 55 µg/ml of 14.5 million deaths in Southeast Asia which will increase by 21 µg/ml in 2008 based on WHO 2011 [4]. Antioxidants become one of the important compounds that should be present in daily diet due to the development of degenerative diseases. Antioxidants are important compounds in maintaining the health of the body because it serves as a catcher of many free radicals formed in the body. Free radicals are molecules or compounds that are free and have one or more unpaired free electrons. At a reasonable amount, free radicals may trigger insulin sensitivity in humans [5]. Electrons from unpaired free radicals very easily attract electrons from other molecules so that free radicals become more stable. As a result, free radicals are very easy to attack healthy cells in the body [6]. The body can produce antioxidants endogenously, but not sufficiently to fight off disease-causing free radicals and thus require additional exogenous intake [7]. Palm sugar is one source of natural antioxidants. Sia et al. studied the antioxidant activity on cane sugar and palm sugar from Southeast Asia and found that palm sugar contains the highest antioxidant activity compared to sugar from sugarcane. The study also found that unrefined palm sugar, commonly called sugar anau, contains antioxidant number one compared to sugar derived from sugarcane [8].

Antioxidant stability can be affected by several factors, one of which is the degree of acidity (pH). In a study analyzing the effect of pH on antioxidant activity of the extract of mania showed that pH could influence antioxidant activity where the best IC50 value is at pH 4 [9]. This article discusses the relationship of nira’s pH with the antioxidant activity of palm sugar in Sumuwono village.

2. Materials and Methods
2.1. Material
Nira of palm trees and palm sugar were sampled from six different production sites in Sumuwono village. The collection of palm sugar was done in the morning. Antioxidant activity was measured in the afternoon on the same day.

2.2. Method
2.2.1. Measurement of nira’s pH. Nira of the palm sugar that had been collected from the production site was measured using a pH meter. Measurement of sample solution pH used pH meter that had been calibrated with buffer solution pH 4, pH 7 and pH 10. The electrode was removed from the sample solution and then washed with water [10].

2.2.2. Measurement of antioxidant activity. The antioxidant activity of palm sugar was measured using the free radical method of DPPH (2,2-diphenyl-1-picrylhydrazyl). The principle of this method is that the antioxidant in the studied material captures hydrogen free radicals. DPPH is a free radical that will be reacted with a sample containing antioxidants [11]. DPPH electrons have strong absorption capability at 517 nm wavelength (UV-vis spectrophotometer) in purple color. Antioxidants cause the purple color changes into yellow due to DPPH changes to DPPH-H [12]. The DPPH binding activity is indicated by the percentage decrease in the purple color intensity of the DPPH [11].

2.2.3. Data analysis. Data analysis used normality test and Pearson's correlation test using SPSS.

3. Results
Results of pH measurement on palm nira and antioxidant activity of palm sugar can be seen in Table 1.
Table 1. pH value of palm nira and antioxidant activity of palm sugar

| Owner | pH value | Antioxidant activities (μg/ml) |
|-------|----------|-------------------------------|
| A     | 4.25     | 74.73                         |
| B     | 4.32     | 82.31                         |
| C     | 4.15     | 83.94                         |
| D     | 4.18     | 86.10                         |
| E     | 4.05     | 82.13                         |
| F     | 4.26     | 89.17                         |

The antioxidant of the six nira had an effective concentration value (IC50) below 100 µg/ml. The lower value of IC50, the higher the antioxidant activity. Antioxidants are said to be very strong if the IC50 value is less than 50 µg/ml, strong for IC50 of 50-100 µg/ml, moderate if the IC50 value is 100-150 µg/ml and weak if the IC50 value is 151-200 µg/ml [13]. In Table 1 the most potent antioxidant activity value is nira A.

4. Discussion
The result of pH nira analysis showed that the pH was below 5. According to a study conducted by Nur Aimi (2013), the use of fresh nira had a pH of 5.5 to 6.0, a sweet taste and greenish brown color. Many factors that can affect the quality of the nira itself may depend on the type of sugar palm, the level of maturity, processing and storage, and geothermal conditions where the palm grows. The condition of the nira water used as this raw material may affect the composition and quality of the palm sugar [14].

Natural fermented of fresh nira sap may cause changes in aroma and taste. This is because the sap of nira is very evenly distributed. Generally, fresh nira sap has a sweet and fruity odor, does not contain higher alcohols and acetic acid. The fermented nira sap contains a large amount of ethanol, alcohol, esters, diacetyl, and higher acetate.

Before the correlation test, the result of nira's pH and the antioxidant activity of palm sugar was subjected to Shapiro-Wilk normality test. The results obtained showed normally distributed data (p = 0.664). The data normality test is intended to show that the sample data comes from normally distributed data. The result of analysis using Pearson's correlation test obtained significance value with p = 0.932 (p> 0.05) which means there was no significant correlation between nira pH with the antioxidant activity of palm sugar. This was because, at the time of production of the nira, there was uniformity of time. Decreased pH may occur during storage before antioxidant testing. Nira allowed to stand at room temperature >4 hours may have decreased pH. This process occurs due to fermentation by yeasts (Irawan, Ginting, & Karo-Karo, 2015). When the sap was stored at a cold temperature (5°C), the pH drop was very small. Unstable pH conditions affect the measurement of antioxidant activity [15].

5. Conclusion
In Sumuwono village, the pH of palm sugar ranged from 4.05 to 4.32 with strong antioxidant activity values, ranging from 74.73 µg/ml - 89.17 µg/ml. Based on Pearson's correlation test, there was no significant correlation between nira's pH and antioxidant activity of palm sugar from Sumuwono village.

6. Recommendation
Recommendations for next research is to analyze the content of microbiology and water content in palm sugar with the physical condition of nira in palm sugar.
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References
[1] Baharuddin, M. M, and B. H. 2007. Pemanfaatan Nira Aren (Arenga pinnata Merr) Sebagai Bahan Pembuatan Gula Putih Kristal. *J Perenn*. 3(2). 40-3.
[2] Gafar and Heryani. 2012. The Development of Aren Sap Drink Processing Technology by Using Ultrafiltration and Deodorization Techniques. *J Has Penelit Ind.* 25(1). 1-10.
[3] Karseno, et al.2017. Effect of pH and temperature on browning intensity of coconut sugar and its antioxidant activity. *Food Research*.1-7.
[4] Tristanti, et al.2016. *Pengujian Aktivitas Antioksidan Menggunakan Metode DPPH pada Daun Tanjung (Minusops elerngi L)*, in *Universitas Indonesia*.
[5] Kravitz. 2010. *Is Exercise the Best Antioxidant Supplement*, University of New Mexico: Albuquerque.
[6] Pelealu, Julius, and Edi. 2011. *The effect of heating on antioxidant activity during the brown sugar processing*. Universitas Sam Ratulangi.
[7] Halliwell, B.1992. Reactive oxygen species and the central nervous system. *J Neurochem.* 59: p. 1609-23.
[8] Sia, J., et al.,2010. *Cyclic Voltammetric Analysis of Antioxidant Activity in Cane Sugars and Palm Sugars from Southeast Asia*. *Food Chem Sci Direct*. 118: p. 840-6.
[9] Giuliana, F., M. Ardana, and R. Rusli. 2016. *Pengaruh pH Terhadap Aktivitas Antioksidan Ekstrak Daun Miana (Colesus atropurpurheus L. Benth)*. Universitas Mulawarman.
[10] Saputra, K., S. Julius, and M.Lidyga. 2015. Analisis Kandungan Asam Organik pada beberapa Sampel Gula Aren. *Jurnal Unsrat*. 4(1): p. 69-74.
[11] Prakash, A. 2001. *Antioxidant activity*. Minnesota: Medallion Laboratories Analytical Progress: .
[12] Xu, J. and Q. Hu. 2004. Effect of foliar application of selenium on the antioxidant activity of aqueous and ethanolic extracts of selenium-enriched rice. *Journal of Agricultural and Food Chemistry*. 52: p. 1759-1763.
[13] Zuhra, C.F., J.B. Tarigan, and H. Sihotang. 2008. Aktivitas Antioksidan Senyawa Flavonoid dari Daun Katuk. *Jurnal Biologi Sumatera*. 3(1): p. 7-10.
[14] Aimi, N., F. Abu Bakar, and M.H. Dzulkifly. 2013. Determination of volatile compounds in fresh and fermented Nipa sap (Nypa fruticans) using static headspace gas chromatography-mass spectrometry (GC-MS). *International Food Research Journal*. 20(1): p. 369-376.
[15] Irawan, S.A., S. Ginting, and T. Karo-Karo. 2015. Pengaruh Perlakuan Fisik dan Lama Penyimpanan Terhadap Mutu Minuman Ringan Nira Tebu. *J.Rekayasa Pangan dan Pert.* 3(3): p. 343-353.