"The Role Of Science and Technology In The Basis Of Environment To Support Sustainable Resource Development"
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"The Role Of Science and Technology In The Basis Of Environment To Support Sustainable Resource Development"
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1,2,3 Universitas Wijaya Kusuma Surabaya, Indonesia
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1 Universitas Wijaya Kusuma Surabaya, Indonesia
t_rahayu66@yahoo.co.id

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2,3 Intelligent Network Expertise Multimedia Department of Electrical Engineering, Faculty of Industrial Technology, Sepuluh November Institute of Technology Surabaya, Indonesia
anang65@anang65.web.id, anang65@Mahm.ac.id, lti@tjarsi3y@gmail.com, ekomujianto@ee.it.ac.id

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SIWALAN SUGAR PROCESSING WITH TEA EXTRACT ADDITION TO REDUCE GLYCEMIC INDEX VALUE

Endang Reño Wedowati, Diana Puspitasari, Fauzki Sri Rejeki, Akmarawita Kadir
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Abstract: The application of siwalan sugar as a sweetener is necessary requires testing in terms of health. It is necessary for the testing of siwalan sugar glycemic index value. Glycemic index (GI) value of siwalan sugar is lower than cane sugar but higher than diet sugar. However, GI value of siwalan sugar is still relatively high. This study aims to (1) determine the process engineering to reduce GI value of siwalan sugar. Therefore, it is necessary to process engineering of siwalan sugar processing with the addition of tea extract to reduce GI value of siwalan sugar. This study uses Randomized Block Design with two factors, namely: First Factor is tea type, with 2 levels are Green Tea and Black Tea, as well as the Second Factor is concentration of tea extract with three levels are 1%, 2%, and 3%. For comparison, additional siwalan sugar without tea extract addition. Based on the study revealed that the tannin content of siwalan sugar green tea extract higher when compared with black tea extract. The tannin content is expected to affect the GI value of siwalan sugar. Glycemic Index measurement used glucose as a standard with GI value of 100. The measurement result showed that the higher tannin content affect GI value tends to lower.

Keywords: Siwalan Sugar, Tea Extract, Tannin, Glycemic Index

1. Introduction

Siwalan sap have potential as a source of sweetener other than cane, because it has a relatively high sugar content of around 10-15% (Lutony, 1993), which can be either liquid sugar (Wedowati, Rejeki, & Puspitasari, 2012), solid sugar (Rejeki, Wedowati, & Puspitasari, 2010), or crystal sugar (Wedowati & Rahayuningsih, 2006). The use of siwalan sugar as a sweetener in society requires a test in terms of health. It is necessary for testing on glycemic index of siwalan sugar.

Glycemic Index (GI) is one of the parameters in the food sector which is closely related to the metabolism of carbohydrates. Glycemic index of food is a food index according to their effect on blood glucose level. Determining food glycemic index using the glycemic index of pure glucose as the comparison, which glycemic index of pure glucose is 100 (Rimbawan & Siagian, 2004).

Glycemic index value of siwalan sugar are generally still lower than sugar cane but above diet sugar glycemic index. Among three types of siwalan sugar, solid siwalan sugar has a lowest glycemic index value. However, the three types of siwalan sugar glycemic index value is still relatively high (Wedowati, Puspitasari, & Kadir, 2014). It is based on the classification of GI values: foods with low GI (GI<55), moderate GI (GI: 55-70), and high GI (GI>70). It is necessary for efforts to reduce the siwalan sugar glycemic index value in order to become a sweetener which has low GI. One of the engineering process that can be done to reduce GI value is by adding tea extracts. Therefore, it is necessary to process engineering of siwalan sugar with the addition of tea extract to reduce the GI value.

This research aims to: (1) Determine the engineering process to reduce siwalan sugar glycemic index value through a process of adding tea extracts, (2) Determine the tannin content of siwalan sugar process engineered, and (3) Determine the glycemic index value of siwalan sugar process engineered.

2. Literature Review

Theoretical Review

Siwalan plant (Borassus flabellifer Linn) is a palms species plant in Indonesia were not handled addressed optimally. Utilization of siwalan plant is still very limited, views of part of the plant used, the type of product produced, and the technology applied. Various studies indicate that there is still quite a lot of possibilities to develop the parts of the plant palm as industrial raw materials for domestic needs and for export. Siwalan sap potential as a source other than cane, because it has a relatively high sugar content is about 10-15% (Lutony, 1993). The use of siwalan sugar
as a sweetener in society requires a test in terms of health. It is necessary for testing on the siwaliul sugar glycemic index.

Glycemic index is first developed in 1981 by Dr. David Jenkins (Professor of Nutrition at Toronto University, Canada) to help determine the best food for diabetics. This concept assumes that all carbohydrates food with the same quantity will yield the same influence on blood glucose levels (Rimbawan & Siagian, 2004).

Based on glycemic index response, foods are classified into three groups, namely foods with low GI (GI < 55), moderate GI (GI: 55-70), and high GI (GI > 70). The foods that have high GI when consumed will increased blood glucose levels quickly and high. Conversely, people who consume low GI food then an increase in blood glucose levels has been slow and glucose content peak is low.

Food with a low GI are digested and changed gradually and slowly, so that blood glucose levels peak will also be low, so fluctuations in sugar levels will also be low. It is very important for diabetes to control blood glucose levels. Conversely, athletes who want to compete require a high GI food that food consumed immediately converted into energy (Anonymous, 2014).

Information about IG various types of siwaliul sugar can help people with the disease Diabetes Mellitus (DM) in choosing a sweetener that does not increase blood glucose levels dramatically, so that blood glucose levels can be controlled at a safe level. Food with a low GI helping people to control hunger, appetite and blood glucose levels, then food with low GI can help reduce excess weight.

One treatment to reduce the GI value is with the addition of tea extract. Leaves of tea plant contains flavonoids which is polyphenol compounds. The type of tea consist of black tea (perfect fermented tea), green tea (unfermented tea) and oolong (semi-fermented tea). But in general there are two types of tea based on the presence or absence of fermentation in the processing process, namely black tea and green tea (Wijaya, Wardani, Meutia, Hermawan, & Begum, 2012).

The main compounds contained in tea are catechin, which is a derivative of condensed tannins, also known as polyphenol compounds. Polyphenol compounds is often referred to as tannin. Antigentic substances can reduce the protein and starch digestibility so that the glycemic response is decreases. Therefore, in this study will be used tea leaf extract to reduce the GI value of siwaliul sugar.

Several studies have linked GI has been done, including the Glycemic Index of rice with high and low amylose (Widowati, Santosa, & Budiyanto, 2007), where the results can be used as a reference for determining the appropriate rice varieties for diabetics and obese. Glycemic Index value of some types of sweet corn processing has also been reviewed by Amalia, Rimbawan & Dewi (2011), the research concluded that the roasted sweet corn has a medium GI value, while the boiled sweet corn that has a low GI value. Rakhamwati, Rimbwan & Amal (2011), has conducted a study on the GI value of variety of processed breadfruit and concluded that of the various refined breadfruit (fried, steamed, boiled) have high GI value. Ari, Budiyanto, & Hoerudin (2013) has conducted research on the factors that influence the glycemic index of food products. Research results states that factors that affect the GI value include the fiber content of food, amylose and amylpectin content, fat and protein content, digestibility of starch, and the way of processing.

Hypotheses

The addition of tea extracts on the processing of siwaliul sugar can reduce the glycemic index value of siwaliul sugar. The higher the concentration of tea extract were added can produce siwaliul sugar with GI value that is lower.

3. Research Method

This research was conducted in the laboratory of Analysis Product Industry, Department of Agriculture Industrial Technology, Faculty of Engineering UWKS and Laboratory of Hewan Coba, Faculty of Medical, UWKS. Manufacture of siwaliul sugar products carried in the palm sugar artisans in the Samur Gayam Village, Lamongan District.

Stages of research Engineering Process to Reduce Glycemic Index Values of Siwaliul Sugar Through the Adding Tea Extracts Process are as follows: (1) Engineering processing of siwaliul sugar with the addition of tea extract, (2)

Determination of tannin content of siwalan sugar process engineered, and (3) Measurement glycemic index of siwalan sugar process engineered in experimental animals (mice).

Engineering processing of siwalan sugar with the addition of tea extracts using a randomized block design with two (2) factors, namely: Factor 1 (Type of Tea), with 2 levels are Green Tea (T1) and Black Tea (T2), while Factor 2 (Concentration of Tea Extract), with 3 levels are 1% (K1), 2% (K2), and 3% (K3). Thus there are six combinations of treatments, where each treatment was repeated 3 times, so there are 18 attempts. For comparison is used siwalan sugar without the addition tea extract.

Data processing was performed by descriptive analysis and analysis of variance, if there is a difference followed Duncan test with 95% confidence level.

4. Discussion

Tannin Content

Based on the results of the chemical tests for parameters tannin content in the product of siwalan sugar process engineered, average results of tannin content obtained for each treatment is shown in Figure 1.

![Figure 1. Tannin Content of Siwalan Sugar in Each Treatment](image)

Based on Figure 1 can be seen that the higher the concentration of the tea extract is added to the processing of siwalan sugar, the tannin content of sugar products also be higher as well. Tannin content of siwalan sugar with the addition of green tea extract tends to be higher when compared with black tea. The highest content of tannin found in siwalan sugar products with T1K3 treatment, i.e. at 1.13%.

Based on the results of analysis of variance is known that there is interaction between the factor treatment of siwalan sugar tannin content, is based on the value of \( F = 17.898 > F \text{table} = 3.885 \) with sig = 0.00 < \( a = 0.05 \). Therefore, continued with Duncan test and the results are as shown in Table 1. The tannin content of siwalan sugar with the addition of green tea extract higher when compared with black tea at a concentration of 2% and 3% (tannin content T1K2 > T2K2; and T1K3 > T2K3). However, the addition of tea extract at a concentration of 1%, siwalan sugar tannin content not different significantly. This shows that the addition of green tea extract would produce siwalan sugar products with higher tannin content when compared to black tea.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Tannin Content (%)</th>
<th>Notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.1733</td>
<td>e</td>
</tr>
<tr>
<td>T1K1</td>
<td>0.3933</td>
<td>d</td>
</tr>
<tr>
<td>T1K2</td>
<td>0.7367</td>
<td>b</td>
</tr>
<tr>
<td>T1K3</td>
<td>1.1267</td>
<td>a</td>
</tr>
<tr>
<td>T2K1</td>
<td>0.3800</td>
<td>d</td>
</tr>
<tr>
<td>T2K2</td>
<td>0.4833</td>
<td>cd</td>
</tr>
<tr>
<td>T2K3</td>
<td>0.5967</td>
<td>c</td>
</tr>
</tbody>
</table>
Glycemic Index Value

Calculation of the glycemic index (GI) value is based on an increase in blood glucose of experimental animals for observation. Observation of blood glucose content is done in minutes 0, 15, 30, 45, 60, 90, and 120 after the product samples given at experimental animals. The observation of an increase in blood glucose for each treatment of sugar is shown in Figure 2.

![Figure 2. Blood Glucose Increased of Experimental Animal](image)

Based on the observations of an increase in the blood glucose content in minutes 0, 15, 30, 45, 60, 90, and 120 made quadratic regression curve. Quadratic regression equation is then made integral to explore the extent of the area under the curve. To calculate the value of the GI, the extent of area under the curve for each treatment of sugar compared with the extent of the area under the curve for glucose as a standard. Glycemic Index due of glucose is 100. The curve equations for each treatment of sugar is shown in Table 2. The curves for each treatment of sugar shown in Figure 3.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Curve Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>$y_1 = -1.171 + 1.814x - 0.014x^2$</td>
</tr>
<tr>
<td>T1K1</td>
<td>$y_2 = -0.452 + 0.647x - 0.005x^2$</td>
</tr>
<tr>
<td>T1K2</td>
<td>$y_3 = 4.822 + 0.293x - 0.003x^2$</td>
</tr>
<tr>
<td>T1K3</td>
<td>$y_4 = 2.537 + 0.388x - 0.002x^2$</td>
</tr>
<tr>
<td>T2K1</td>
<td>$y_5 = 0.442 + 0.246x - 0.002x^2$</td>
</tr>
<tr>
<td>T2K2</td>
<td>$y_6 = 7.542 + 0.125x - 0.002x^2$</td>
</tr>
<tr>
<td>T2K3</td>
<td>$y_7 = 4.661 + 0.126x - 0.002x^2$</td>
</tr>
<tr>
<td>Glucose</td>
<td>$y_8 = 7.501 + 3.375x - 0.017x^2$</td>
</tr>
</tbody>
</table>
Figure 3. Blood Glucose Increased Curve in Each Treatment
Figure 3. Blood Glucose Increased Curve in Each Treatment (Continued)

Calculation results of area under the curve and glycemic index values for each treatment of sugar can be seen in Table

<table>
<thead>
<tr>
<th>No.</th>
<th>Treatment</th>
<th>Curve Area</th>
<th>GI Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control</td>
<td>20984.28</td>
<td>75.47</td>
</tr>
<tr>
<td>2</td>
<td>T1K1</td>
<td>7484.16</td>
<td>26.92</td>
</tr>
<tr>
<td>3</td>
<td>T1K2</td>
<td>4416.24</td>
<td>15.88</td>
</tr>
<tr>
<td>4</td>
<td>T1K3</td>
<td>4250.04</td>
<td>15.29</td>
</tr>
<tr>
<td>5</td>
<td>T2K1</td>
<td>2976.24</td>
<td>10.70</td>
</tr>
<tr>
<td>6</td>
<td>T2K2</td>
<td>2957.04</td>
<td>10.64</td>
</tr>
<tr>
<td>7</td>
<td>T2K3</td>
<td>2690.52</td>
<td>9.68</td>
</tr>
<tr>
<td>8</td>
<td>Glucose</td>
<td>28617.24</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Based on the calculation results of the glycemic index (GI) value, then the GI value of siwalan sugar process engineered is included in the low GI group (IG < 55). Between the various treatments available, treatment produce siwalan sugar with the lowest IG is T2K3 treatment with IG value is 9.68. The use of black tea extract is able to lower the siwalan sugar GI value than green tea extract. And the higher the concentration of tea extract were added, then the resulting siwalan sugar has a GI value that the lower too. Therefore it can be concluded that the use of tea extracts on the processing of siwalan sugar can decrease the GI value of siwalan sugar products.

5. Conclusion

Based on the results of this study concluded that:

- The tannin content of siwalan sugar with the addition of green tea extract tends to be higher when compared with black tea.
- There was an interaction between treatment factors for siwalan sugar tannin content.
- The siwalan sugar glycemic index (GI) value with the addition of black tea extract is lower when compared with green tea.
- The lowest siwalan sugar GI value obtained at T2K3 treatment with GI value is 9.68.

Suggestions
Further research is needed to determine the GI value with human respondent, so that siwalan sugar can be used as a natural sweetener and healthy.

6 References