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Resources, Environment, And Marine In The Global Challenge

"The Role Of Science and Technology In The Basis Of Environment To Support Sustainable Resource Development"

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

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Abstract: Application of **siwalan** sugar **as** a **sweeteners** in [redacted]**ity 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.** One of the process ***engineering*** that can be done to reduce GI value is the **addition** of **tea extract.** 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** aims **to: (1) determine the** process **engineering to** reduce GI **value** of **siwalan sugar through the** process of adding **tea** extract, and (2) determine **tannins** content **and** GI **value** of siwalan **sugar process engineered Study design** is **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 used** siwalan **sugar** without **tea extract** addition. **Based** on the **study** revealed that the tannin content of siwalan **sugar** given **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** is 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),** and **crystal** sugar **(Wedowati & Puspitasari,** 2008; 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 of 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 the 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 **bas** 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 **processing** 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 palmae species plant in Indonesia were** not handled addressed optimally. Utilization of **siwalan** plant is still very **limited, views** of **parts** 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 both for **domestic needs** and for **export** Siwalan sap **potential as** a source of sweetener 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 siwalan 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 fhe 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 siwalan *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 consists 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 catechism, which is a derivative of condensed tannins, also known as polyphenol compounds. Polyphenol compounds is often referred to as tannin, Antigenic 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 siwalan 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. Rakhmawati, Rimbawan & Amalia (2011), bas 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. Arif, 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 amylopectin content, fat and protein content, digestibility of starch, and the way of processing.

Hypotheses

The addition of tea extracts on the processing of siwalan sugar can reduce the glycemic index value of siwalan *sugar*.
The higher the concentration of tea extract were added can produce siwalan 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 siwalan sugar products carried in the palm sugar artisans in the Sumur Gayam Village, Lamongan District.

Stages of research Engineering Process to Reduce Glycemic Index Value of Siwalan Sugar Through the Adding Tea Extracts Process are as follows: (1) Engineering processing of siwalan 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 I.

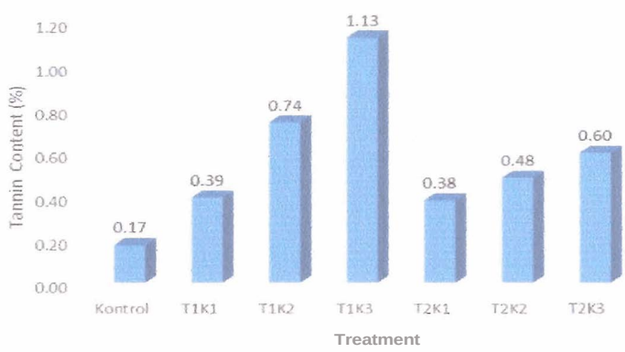

Figure 1. Tannin Content of Siwalan Sugar in Each Treatment

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 Mack tea The highest content of tannins 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 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 1. Average Content of Tannin (%)

Treatment	Tannin Content	Notation
Control	0.1733	e
T1K1	0.3933	d
T1K2	0.7367	b
T1K3	1.1267	a
T2K1	0.3800	d
T2K2	0.4833	cd
T2K3	0.5967	c

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.

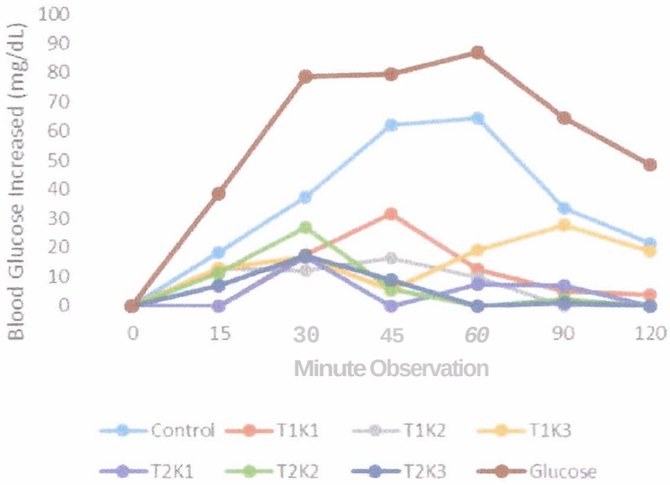

Figure 2. Blood Glucose Increased of Experimental Animal

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 of each treatment of sugar compared with the extent of the area under the curve for glucose as a standard. Glycemic Index d u e 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 2. Siwalan Sugar Curve Equations for Each Treatment

Treatment	Curve Equation
Control	$Y1 = -1{,}171 + 1{,}814\ X - 0{,}014\ X^2$
T1K1	$Y2 = -0{,}452 + 0{,}647\ X - 0{,}005\ X^2$
T1K2	$Y3 = 4{,}822 + 0{,}293\ X - 0{,}003\ X^2$
T1K3	$Y4 = 2{,}537 + 0{,}388\ X - 0{,}002\ X^2$
T2K1	$Y5 = 0{,}442 + 0{,}246\ X - 0{,}002\ X^2$
T2K2	$Y6 = 7{,}542 + 0{,}125\ X - 0{,}002\ X^2$
T2K3	$Y7 = 4{,}661 + 0{,}126\ X - 0{,}002\ X^2$
Glucose	$Y6 = 7{,}601 + 2{,}375\ X - 0{,}017\ X^2$

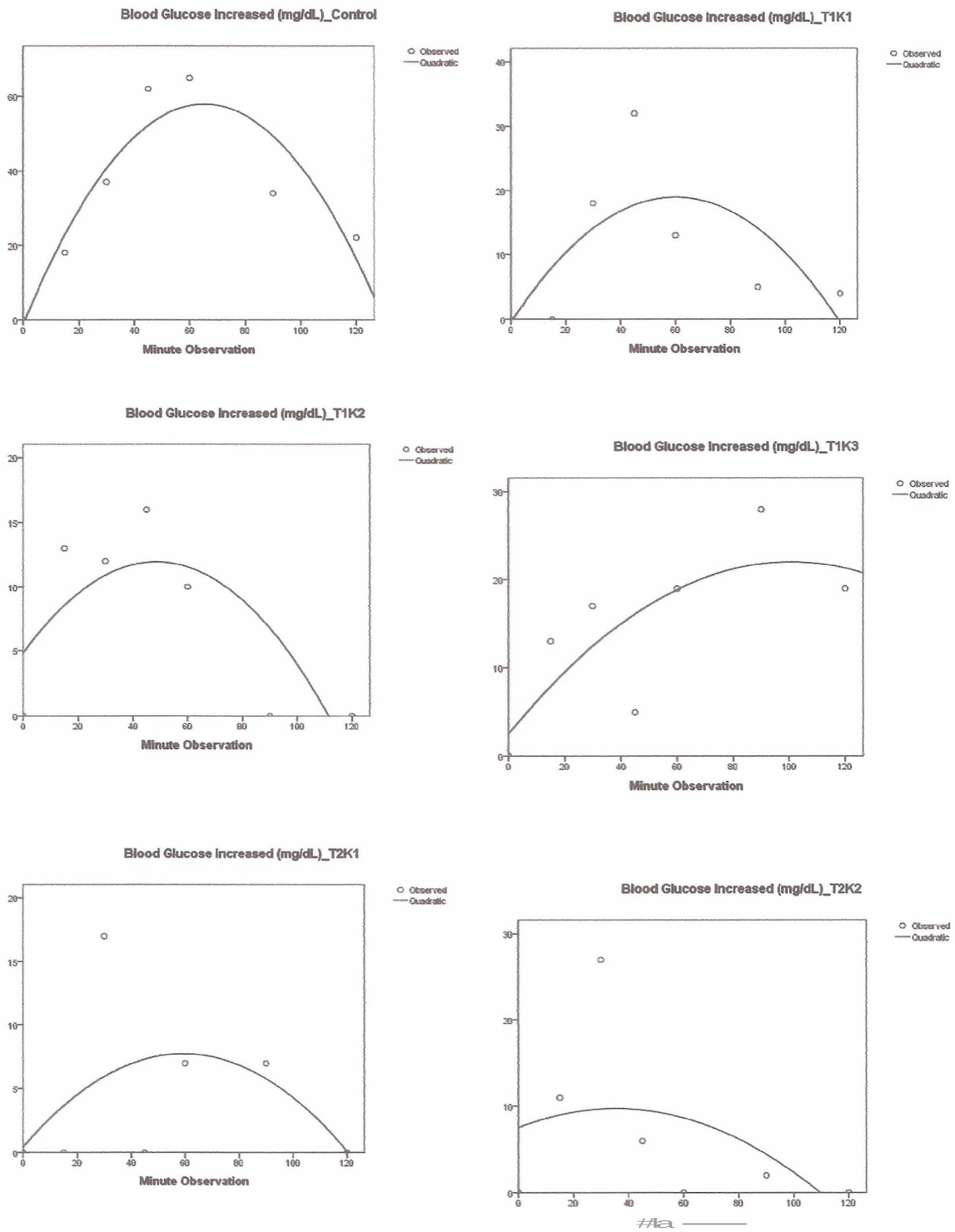

Figure 3. Blood Glucose Increased Curve in Each Treatment

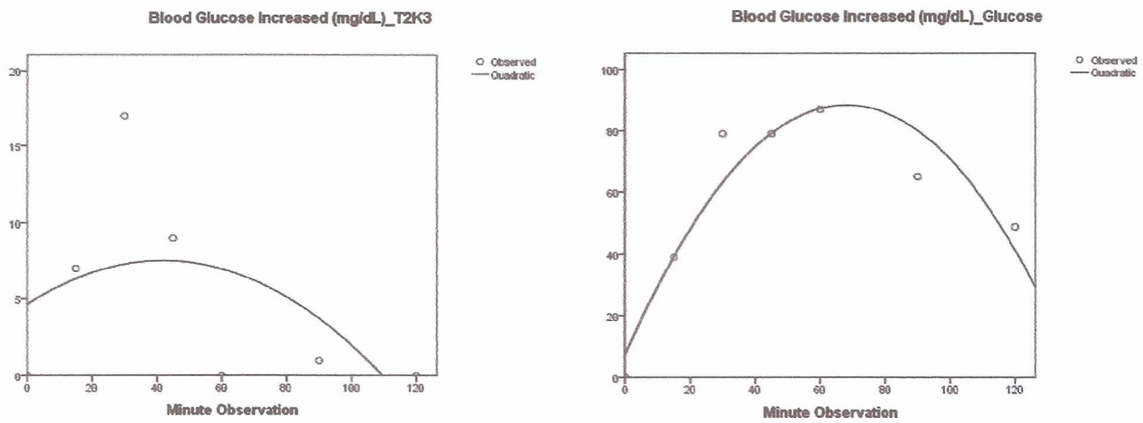

Figure 3. Blood Glucose Increased Curve in Each Treatment (Continued)

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

Table 3. Curves Area and Glycemic Index Value in Each Treatment

No.	Treatment	Curve Area	GI Value
1	Control	20984,28	75,47
2	T1K1	7484,16	26,92
3	T1K2	4416,24	15,88
4	T1K3	4250,04	15,29
5	T2K1	2976,24	10,70
6	T2K2	2957,04	10,64
7	T2K3	2690,52	9,68
8	Glucose	28617,24	100,00

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 of 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.

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