Consumption of "Cracker Biscuit" from Sutchi Catfish as *Healthy Diabetic Cookies* to Reduce Blood Glucose Level on Normal Human Blood

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Abstract

People nowadays are identified to have negative consumption habits, due to their preference to consume high-leveled calorie fast food and unhealthy snacks. This habit results in an increase of metabolic risk factors that affect general health. In response to the case, the innovation of healthy snacks is sought after to remedy the situation. This study proposes the production of healthy snacks in the form of glucose friendly biscuits. The study utilizes sutchi catfish (Pangasius hypophthalmus) cracker biscuit which contains EPA and DHA as a healthy snack alternative in order to reduce the glucose level and increase the insulin sensitivity. The study aims to determine human blood glucose levels after consuming sutchi catfish (Pangasius hypophthalmus) cracker biscuits. The methods were included in phase 1 clinical trials where 30 people were divided into 3 treatments: negative control (placebo was given), positive control (white bread was given) and sutchi catfish cracker biscuits as test foods with 10 times replications. The result shows a tangible result in terms of reducing the level of glucose level within human blood, 2 hours after the consumption of sutchi catfish filrate-based cracker biscuits. The percentage reduction in the treatment of sutchi catfish cracker biscuits was 22.64% within the normal range of general blood glucose levels. In accordance with the results, it can be concluded that sutchi catfish filtrate-based biscuit crackers can be considered as nutraceutical or healthy diabetic cookies. It is healthy and safe (glucose friendly biscuits) to be consumed by most people, particularly those who suffer from diabetes mellitus

Keywords: *biscuits, glucose, sutchi catfish, human*

I. INTRODUCTION

Communities in developing countries, one of them is Indonesia, has a significant negative impact on lifestyle and consumption patterns. This negative impact refers to changes in people's consumption patterns because they really like *fast food* that has very high levels of calories, fat and carbohydrates and there is a shift in people's lifestyle in carrying out various activities that do not really need or release energy. It increases the possibility of an increase in metabolic risk factors and diseases that affect human health.

Consuming snacks in the leisure time and eating heavy foods is a habit that is often done by all levels of Indonesian society. The results of the study *'Snacking Habit Report* in Indonesia' showed that from three Indonesian people, one person can consume more than 3 kinds of snacks per day. As for snacks that are consumed vary, from food that tastes traditional to modern food that is presented in modern way of plastic packaging.

There is twenty percent of Indonesian people trying to find healthy foods with high vitamin and mineral content to consume every day. Each type of food contains carbohydrates, proteins, vitamins and other substances that have some physical properties so that each type of food consumed can affect blood glucose levels. Thus, each type of food will have different effects on glucose levels depending on the amount of carbohydrates and other substances contained in the food we consume (Wilson, 2015). Based on this

explanation, it is needed innovation in making snacks in the form of cracker biscuits that are safe and healthy and will not increase the response of blood sugar levels which is assumed important and it is an effort to improve the overall health of the Indonesian people. Biscuits that are made must meet important components such as animal and vegetable food ingredients, in order to meet the animal components, one way is to use fish filtrate extract as a mixture of biscuit. In a study conducted by Rahmi (2018), addition animal food ingredient used in making biscuits was sutchi catfish filtrate.

Sutchi catfish is a type of freshwater fish that lives in Indonesia, especially in South Kalimantan in the Banjar district. The recent data on sutchi catfish production in South Kalimantan Province in 2014 was 25.5 thousand tons. This volume is same with 6.3% of national sutchi catfish production which reaches 403 thousand tons. The target of national sutchi catfish production in 2015 was 604.7 thousand tons with a production contribution target from South Kalimantan was 48.6 thousand tons. In one day, the Banjar District Minapolitan area is capable of producing 35 - 40 tons of sutchi catfish.

Sutchi catfish contains vitamins, nutrients, minerals and omega-3 fatty acids that is good for health. According to Hidayaturrahmah research, (2016) sutchi catfish oil contains Omega-3 fatty acids consisting of eikosa pentaenoic acid (EPA) of 0.21-2.48% and docosa hexanoic acid (DHA) of 0.95-9.96%. EPA here serves to increase insulin sensitivity so that it can normalize glucose levels in the blood. The function of insulin is to regulate the level of normal blood glucose. High blood sugar level is a cause of diabetes mellitus.

Previous research conducted by Rahmi (2018) stated that the giving of sutchi catfish crackers biscuits containing omega-3 by 1.39% in rat that had been given alloxan injection could provide hypoglycemic activity on rat blood glucose level. The treatment of sutchi catfish cracker biscuits which had the most significant effect on the reduction in rat blood glucose level was 80.20% within 15 days of treatment. From that result, this study of sutchi catfish biscuit is passed to human as the main subject because it is believed that sutchi catfish biscuits will have the same effect of hypoglycemic activity toward humans.

Research on Normal Human Blood Glucose Level after the Administration of sutchi catfish crackers biscuits *(Pangasius hypophthalmus)*"aims to determine the effect of sutchi catfish biscuits giving on normal blood glucose level in young and adult men by looking at their glucose level after being treated in the form of sutchi catfish biscuits, so it can provide benefits to the people of Indonesia in developing healthy consumption patterns and controlling blood sugar levels.

II. LITERATURE REVIEW

2. 1 Functional Food in the form of Crackers Biscuits

Functional compounds in fish are widely used in functional food in the form of food and drinks. Functional food is food that is beneficial to health beside basic nutrition or it is beneficial to health outside the available nutrients. The definition of functional food according to Health Canada is a product that resembles traditional food but is beneficial for health. Functional food is enriched with vitamins, fiber, and fatty acids or foods that are designed to be low in Na and fat, it can be utilized by consumers to improve their nutritional status (Susanto & Fahmi, 2012).

Biscuits are food products made from flour that are roasted to have a water content of less than 5%. The fat and oil contained in the biscuits has function to soften the biscuit dough and makes the biscuit crispier. Biscuits contain a lot of carbohydrates and fats, so it is necessary to innovate additional ingredients so that biscuits conform to SNI standards and are safe and healthy when consumed by human.

2.2 Mechanism of fatty acid content of sutchi catfish on blood glucose level

Fish is an important source of fatty acids, especially unsaturated fatty acids with many double bonds (PUFA) n-3 or it is better known as omega-3 namely eikosa pentaenoic acid (EPA) and docosa hexanoic acid (DHA) which are essential fatty acids for humans because these fatty acids cannot be produced by the human body itself. The presence of omega-3 in fish oil can reduce cholesterol level in the blood and can prevent also can overcome several types of diseases including coronary heart disease, hypertension, cancer, inflammation, hypotrigliceridemic effects and diabetes. In addition, omega-3 fatty acid is also very important to help the brain function, especially for the process of brain growth and development (Raharja et al., 2011).

Diabetes mellitus is a clinical syndrome characterized by hyperglycemia because insulin deficiency is both absolute and relative. This situation is caused by a decrease in insulin production due to pancreatic beta cell damage. These disorders include the target tissue resistance to insulin disorders or deficiency. Hyperglycemia that occurs results in high blood glucose levels accompanied by excretion of sugar in the urine. The situation is aggravated by the body's inability to convert and hoard sugar into glycogen in tissues. Hyperglycemia causes a buildup of glucose levels in certain cells and tissues and can transport glucose without the need for insulin (Velayutham et al, 2008).

Sutchi catfish extract contains omega-3 which can reduce blood glucose level in diabetic rat because of the role of EPA and DHA in insulin sensitivity (Farsi et al., 2014). EPA and DHA affect the pancreas in insulin sensitivity so that it can regulate blood glucose level. The direct effect of omega-3s on tissue metabolism is highly dependent on the accumulation of the fatty acids in cell membrane phospholipids and the modulation of oxylipin metabolism (Flasch et al., 2014).

III. METHODOLOGY

3.1 RESEARCH METHOD

The research method that was done is Phase 1 clinical trial research using *blind, random, matching* to avoid significant effects which were divided into 3 treatments with 10 replications. The treatment patterns in this study can be seen in Table 1:

Table 1. Research treatment patterns

NO	Treatment	Information
1.	Negative Control	The treatment was given a placebo biscuits (biscuits with the same formulation as the test biscuits but do not us sutchi catfish filtrate
2.	Positive Control	The Treatment was given white bread
3.	Test Biscuits	The treatment was given sutchi catfish biscuits

3.2 WORKING PROCEDURES

3.2.1 PROBANDUS SELECTION

Probandus used in this study were normal adult men (not person with diabetes) in a healthy condition, not smoking, the blood sugar level was not too low, and included in the normal category of BMI and also had no history of the disease. The total probandus used in this study were 20 people for biscuits test and 10 people for white bread, it was adjusting to clinical testing in phase 1. The selected probandus also had to fill out a form that stated willingness to be the subject of research in the form of informed consent in appendix 1. Statement in this informed consent was the result of the Session in the Ethics Committee of the Medicine Faculty of the Lambung Mangkurat University in order to obtain Ethical Clearance approval and it had passed the number of 57/KEP-FK UNLAM/EC/II/2019.

3.2.2 MEASUREMENT OF BLOOD GLUCOSE LEVEL

Probandus that had been selected would come to the location of the research, after that they would be given an informed consent sheet and signed by probandus. In this study the measurement of blood

glucose level was carried out by using a glucometer and a strip measuring blood glucose level because it can show results quickly. The process of blood taking was done by the finger prick method and it was dropped on the glucometer strip until the indicator was full and allowed to stand for 10 seconds until the number was appeared in the glucometer of the instrument.

3.2.3 **Calculation of Decreased Blood Glucose Level Percentage**

The calculation of the percentage of the decrease in the blood glucose level was measured with the following formula: (Astuti, 2012). % Decrease = $\frac{\text{Level of initial glucose – Level of final glucose}}{\text{Initial glucose level}} \times 100\%$

Data Analysis from the measurement of blood glucose level was then tested for normality of data distribution and homogeneity of data variance using the Kolmogorov-Smirnov test and Levene test. If normal and homogeneous data were obtained, an ANOVA (Analysis of Variance) test would be performed. Duncan test was then performed to obtain conclusion and research result.

IV. RESULT AND DISCUSSION

4.1 Normal Human Blood Glucose Levels

This study indicates that the provision of sutchi catfish biscuits showed a significant effect on the value of normal blood glucose level of human. The treatment by giving sutchi catfish biscuit in lowering level of blood glucose in the normal human was better on the T 90, and T120. The value of blood glucose level in the sutchi catfish biscuit treatment was still in the normal range. The average value of blood glucose level (mg/dL) on the observation time from 0 to 120 minutes can be seen in Table 2:

Table 2. Average value of blood glucose level (mg / dL) on Normal Human after Consumption of "Cracker Biscuit" from Sutchi Catfish (*Pangasius hypopthalmus)* Filtrate

TR	Sampling Time (T)					
	TP	T0	T30	T60	T90	T120
A	99,80± 14,75^{a}	121,90±12,2^{a}	125,20±11,90^{b}	120,30±18,75^{b}	113,00±17,91^{b}	102,90±6,85^{b}
B	96,50±22,57^{a}	125,3±18,34^{a}	100,00±23,61^{a}	117,6b ± 10,69^{ab}	108,40±10,01^{b}	106,60±13,34^{b}
C	88,10±21,30^{a}	110,4±29,73^{a}	93,20±19,76^{a}	101,10±23,23^{a}	91,00±19,68^{a}	85,40±17,35^{a}

Information:

TR : Treatment, T : Sampling Time (minutes), A: White bread, B :Placebo biscuits, C : Test biscuits

1. Numbers which are followed by the same letters in the same column show no significant difference (P> 0.05), while numbers with different letters in the same column show significantly different value (P> 0.05).
2. TP (fasting blood glucose level); T0 (measurement time right after treatment was given); T30 (measurement time after the first 30 minutes of test food consumption); T60 (measurement time after the first 60 minutes of test food consumption); T90 (measurement time after the first 90 minutes of test food consumption); T120 (measurement time after the first 120 minutes of test food consumption).

Changes in probandus blood glucose level in all treatments from T0 to the time of T120 (minuetes) by giving biscuits are presented in graphical form (Figure 1). The graph of average blood glucose level (mg/dL) in all treatments can be seen in Figure 1.

Figure 1 shows a decrease in blood glucose level. The administration of placebo biscuits to the treatment subjects showed a decrease in blood glucose level that approached the positive control of white bread. The greatest decrease in blood glucose level occurred in the treatment with sutchi catfish biscuits compared with the value of blood glucose level in normal control treatment (placebo). This shows that sutchi catfish biscuits can reduce the value of blood glucose level in normal human

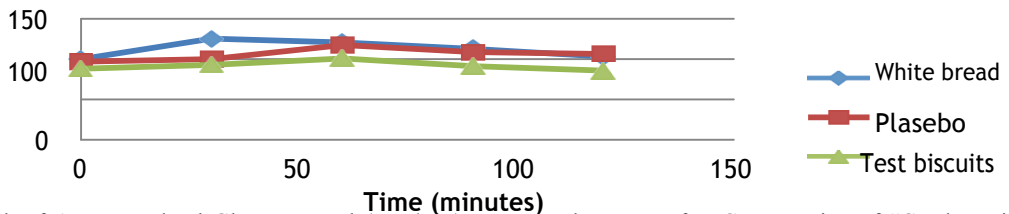

Figure 1. Graph of Average Blood Glucose Level (mg / dL) on Normal Human after Consumption of "Cracker Biscuit" from Sutchi Catfish (*Pangasius hypopthalmus)* Filtrate

The result of normal human blood glucose level obtained at negative control which was given a placebo showed the blood glucose level was still in normal condition and there was no significant decrease in blood glucose level when compared to the decrease that occurred when it was given sutchi catfish biscuit. It is because in the placebo, the omega-3 content was only found in small amounts which derived from egg yolk and other ingredients as mixture in the material of making biscuits. According to Amrullah (2003) egg is one of the foods that contains high nutrition and is a source of animal protein that is needed by the human body, egg also contains omega-3 which is an essential fatty acid for the body that cannot be produced from the body.

The positive control treatment was given white bread with the result of a decrease in normal human blood glucose level that was higher than the decrease produced by placebo (Figure 1 & Table 2). The use of white bread as a positive control is because white bread included as one of the standard foods in a study. In the treatment group which was given fish biscuits, it showed a significant decrease in blood glucose level (Table 2), the maximum reduction was found after 2 hours of consumption of the test food. This study showed that the administration/provision of sutchi catfish biscuits showed a significant effect on the value of blood glucose level. It means that giving sutchi catfish biscuit influences on level of blood glucose in normal human. The treatment by administering sutchi catfish biscuit gave larger effect on lowering the blood glucose level to normal human with similar effect to the positive control treatment. This is due to the omega-3 content in the form of DHA which is contained in sutchi catfish biscuit by 0.12 %, SFA by 39.34%, MUFA by 42.42% and PUFA by 17.22% (Nopriliyanti, 2019). Overall, the fatty acid content of sutchi catfish biscuit is greater than placebo biscuit.

Sutchi catfish biscuit which is being processed contains unsaturated fatty acid which has omega-3 which content that plays a role in reducing blood glucose level. Omega-3 fatty acid has essential fatty acids in the form of EPA and DHA. Insulin is formed from proinsulin with the help of zinc. Zinc will then be stimulated by EPA and DHA into the cell membrane to enhance the process of insulin synthesis (Soltan, 2012).

4.2 PERCENTAGE OF HUMAN BLOOD GLUCOSE LEVEL DECREASE

Calculation of the reduction percentage in blood glucose level aims to determine the ability of test food in reducing normal human blood glucose level that has been tested for 120 minutes and to find out what percentage of reduction in the three treatments that have been tested. The biggest percentage of treatment was in sutchi catfish biscuits. The results of the calculation of the decrease percentage can be seen in Table 3:

Table 3. Percentage of Blood Glucose Level Decrease on Normal Human after Consumption of "Cracker Biscuit" from Sutchi Catfish (*Pangasius hypopthalmus)* Filtrate

Treatment	Percentage of Decrease
Control	14,92%
Positive	15,58%
Sutchi Catfish Biscuits	22,64%

Decreased blood glucose level is thought to be due to sutchi catfish biscuit which contains EPA, where precursor in the formation of the eicosanoid hormone is EPA. Cell membrane is influenced by eicosanoid hormone which influences the movement of calcium that comes into and out of cells (Balasubramanian, 2013). The inhibition of the release of K+ ion from the cell occurs due to the process of closing the K channel on the cell membrane which causes the depolarization stage, which is also followed by the opening stage of Ca channel. This situation that occurs is what allows the entry of Ca2+ ion into cells and makes insulin secretion occurs.

Insulin secretion by pancreatic β cell depends on 3 main factors, namely: blood glucose level, *ATP-sensitive K channel* and *Ca channel*. In the fasting state when the blood glucose level decreases, ATP-

sensitive K channels in the ß cell membrane will open, so that the potassium ions will leave the ß cell, therefore, it keeps the membrane potential in a hyperpolar state so that the Ca-Channel is closed, consequently it makes the calcium cannot enter the ß cell. Thus, the stimulation of ß cell to secrete insulin decreases. In contrast to the situation after eating, increased blood glucose level will be captured by ß cell through *glucose transporter* 2 (GLUT 2) and brought into the cell (Ganong, 2002). Insulin released into the blood will reduce blood glucose concentration by stimulating the use of glucose in muscle and fat tissue, and suppressing glucose production by the liver (Soewolo, 2000).

V. CONCLUSION

The results showed that the biscuits sutchi catfish gave a real response in lowering blood glucose level of normal human at 2 hours after the consumption of the biscuit filtrate sutchi catfish. The reduction percentage in sutchi catfish biscuit filtrate treatment was 22.64% within the normal range of general blood glucose level. Based on this case, it can be concluded that the biscuit from the sutchi catfish filtrate is healthy biscuits/cookies for diabetic which is safe and healthy for people to be consume, especially for diabetics mellitus patient.

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