

Antidiabetic effect of the virgin coconut oil and the virgin coconut oil emulsions

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ABSTRACT

Lifestyle is the primary prevention of diabetes, especially type-2 diabetes (T2D). Supplement intake has been associated with the prevention and management of many chronic diseases including T2D. Virgin Coconut Oil was supplement which bioactive compounds such as unsaturated fatty acids, and biophenols. Emulsion was preferred for consumer than oil form. The research aims to compare the effectivity of anti-diabetes VCO and VCO emulsion with varied sweetener to reduced blood glucose levels on Rattus norvegicus diabetes induced alloxan. The assay used 42 male rats divided into six groups: group I (negative control) was given emulsion without sweetener; group II (positive control) was administered with Glibenklamide; group III was added with Virgin Coconut oil and following by Virgin Coconut oil emulsion with additional different sweetener of each glucose, sorbitol, and Honey was put into group IV, V and VI respectively. The blood glucose levels measured on the day 14th. The results showed that the administration of VCO and VCO emulsion with various sweeteners could reduce the blood glucose levels on Rattus norvegicus diabetes. Both VCO emulsion, with honey and sorbitol as sweetener resulted the same ability to reduce blood glucose levels to VCO

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INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic diseases characterized by hyperglycemia due to impaired insulin secretion, insulin action, or both. Chronic hyperglycemia from diabetes is associated with long-term damage, dysfunction and failure of various organs, especially the eyes, kidneys, nerves, heart and blood vessels (Dipiro *et al.*, 2015). Diabetes mellitus has been categorized as a global disease whose prevalence continues to increase from year to year (Whiting *et al.*, 2011). WHO predicts a large enough increase in the number of people with diabetes for the coming years. For Indonesia, WHO predicts an increase in the number of patients from 8.4 million in 2000 to around 21.3 million in 2030 (WHO, 2015).

Diabetes tend to have high cholesterol levels, therefore it is advisable to limit saturated fat in their diet (Maulana, 2008). Diabetics need to limit total and saturated fat intake to achieve normalization of blood glucose and lipid levels. There is one type of fat that can be consumed by DM patients, this fat is coconut oil, especially those produced through a cold process or what is known as Virgin Coconut Oil (VCO). Virgin Coconut Oil (VCO) produced from coconut oil extracted from fresh, ripe coconut, processed through fermentation without using chemicals or enzymatically without heating, resulting in medium chain fatty acids (MCFA), high levels of vitamin E, antioxidants, and enzymes in coconuts. VCO is proven to be able to overcome and cure various diseases such as diabetes mellitus (DM), high blood pressure, hepatitis, and even coronary heart disease (Teo *et al.*, 2013). Various health roles of VCO have been widely reported, among others, VCO contains medium chain triacylglycerols (MCT), especially laurine which is

digested faster than other types of fat. The major phenolic acids were ferulic acid and p-coumaric acid (Marina, 2009). VCO and its emulsion have antioxidant effect (Wiyani *et al.*, 2020). The chemical components of fatty acids contained in VCO are medium and short-chain saturated fatty acids. Empirically consuming VCO every day is believed to increase immunity, prevent diseases caused by bacterial, fungal and viral infections, help overcome obesity, prevent heart disease, atherosclerosis, overcome cholesterol, diabetes and cancer. Coconut oil intake has also been shown to increase the absorption of Ca and Mg minerals if there is a deficiency of these two minerals in the body, a condition that is often encountered in people with Diabetes mellitus. In addition, VCO supplementation can also increase antioxidant status. Compounds that are strongly thought to play a role are polyphenols contained in VCO, especially from the flavanone and dihydroflavanol groups. The total polyphenol content in VCO is around 84 milligrams / 100 grams, this is higher than the total polyphenol content in copra oil (coconut oil with heating process) which is only 64.4 milligrams / 100 grams (Subroto, 2006).

Along with the development of studies that discuss VCO and its benefits for health, more and more people are interested in trying to consume VCO both as medicine and as a supplement to maintain body resistance. The oily taste of VCO is one of the obstacles for people to consume VCO.

Organoleptic test research showed a taste that consumers don't like because of the oily impression on the mouth. Even though it is nutritious, people are still reluctant to consume VCO directly. One alternative to reduce oiliness is to formulate VCO in the form of an emulsion. Wiyani *et al.*, (2016^a) have studied various VCO

emulsion formulations with Tween 80 and Span 80 emulsifiers to VCO emulsion preparations with the addition of orange carrot juice (Wiyani *et al.*, (2017) with various sweeteners, exsample sucrose Wiyani *et al.*, (2018) and honey (Wiyani *et al.*, (2020), as an alternative in overcoming the unpleasant taste problem of VCO when consumed in oil form.

MATERIALS AND METHODS

Materials

The materials used in this study were alloxan, aluminum foil, glucometer, blood glucose test strips, glibenclamide, VCO , VCO emulsion with varied sweetener, glucose, honey and sorbitol, and xanthan gum.

Preparation of VCO emulsion

The emulsion consist of VCO, orange juice and sweetener (honey, sorbitol, and glucose) in a ratio of 10 : 86 : 4 and 0.75 ml xanthan gum as emulgator. The emulsion was made with a homogenizer at 15,000 rpm for 4 minutes (Wiyani *et al.*, 2016^{ab}; 2017 and 2018)

Selection and Provision of Test Animals

This research used 42 of test animals weighing 150-200 grams, which were divided into 6 groups. Before being treated, the experimental animal were adapted of the Pharmacology Laboratory of the Faculty of Pharmacy, Universitas Muslim Indonesia.

Induction of hyperglycemia

Hyperglycemia was induced by applying 130 mg/kg alloxan monohydrate. After 72 hours, a blood test confirmed hyperglycemia (> 200 mg/dL) , then VCO and VCO emulsion was orally administered.

Experimental design

Forty-two healthy male Sprague Dawley rats with an average body weight of 150–200 gram was used in a special cage with water ad libitum and 12 hours light/dark cycle in a room temperature controlled at 25 °C. The animals were distributed into 6 groups: group I (negative control) was given emulsion without sweetener; group II (positive control) was administered Glibenklamid; group III was added with Virgin Coconut oil and following by Virgin Coconut oil emulsion with additional different sweetener of each glucose, sorbitol, and Honey was put into group IV, V and VI respectively. The administered dose of VCO and emulsion VCO was 0.8 ml/200g/day (Supriatna *et al.*, 2008), and the glibenclamide dose was 600 µ/kg/day. Both were administered orally for 8 weeks using a cannula needle at the laboratory

RESULT AND DISCUSSION

The formula was obtained from research to find the stabil formula of VCO with orange juice as flavoring agent. And another researcher was the type of emulgator that produces a stable emulsion. Then the stable emulsion, further research was carried out on the addition of various types of sweeteners. Selected as a sweetener,

namely sorbitol, glucose and honey. This sweetener is chosen by considering the sweetener sources, namely natural and synthetic ingredients

Blood glucose levels were measured on days 14th to determine the decrease of blood glucose levels in experimental animals. Blood glucose levels were measured by a glucometer, which in principle works using the glucoseoxidase biosensor method. Glucose in the capillary blood test will react with the glucose-oxidase enzyme in the test strip. This enzymatic reaction produces electrons which will be captured by the electrodes on the glucometer. The number of electrons captured is proportional to the glucose level in the test material (Sacks, 2006). The data obtained were then analyzed statistically to see the comparison of initial, induction and therapy blood glucose levels. Figure 1. Shows the results of measurements of rat blood glucose levels, where all treatment groups had initial blood glucose levels <200 mg / dL, and an increase blood glucose level after alloxan induction. Figure 1 also shows that group 2 (glibenclamide) has the greatest percentage reduction compared to other test groups. Glibenclamide was chosen as a positive control because the mechanism of action of glibenclamide is in accordance with the diabetes mellitus model made in experimental animals, namely by inducing alloxan, resulting in decreased insulin secretion due to damage to pancreatic β cells. According to Suherman (2007), this decrease in blood glucose levels is due to the pharmacodynamic properties of glibenclamide which stimulate pancreatic beta cells to secrete insulin even though pancreatic beta cells have been damaged by giving alloxan, but the nature of the destruction of the pancreas is partial so that there are pancreatic beta cells that can secrete insulin and maintaining glycemia levels. In the VCO group, ingredients that can lower blood glucose levels are MCFA (Medium Chain Fatty Acid) or medium chain fatty acids. MCFA (Medium Chain Fatty Acid) is easily absorbed into cells and then into the mitochondria, so that metabolism increases. With the increase in metabolism, cells work more efficiently to form new cells and replace damaged cells more quickly (Inggita *et al.*, 2006).

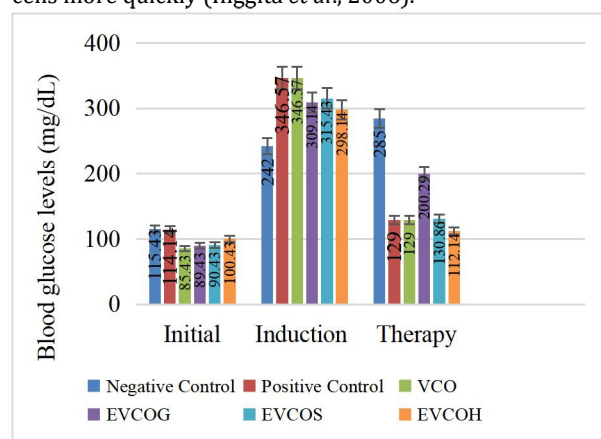


Figure 1. Results of measurement of blood glucose levels; control negative (xanthan gum); control positive (glibenclamide); VCO (virgin coconut oil); EVCOG (VCO emulsion with

glucose); EVCOS (VCO emulsion with sorbitol); EVCOH (VCO emulsion with honey)

The VCO emulsion used in this study uses 3 variations of sweeteners, namely glucose, sorbitol and honey, these three types of sugar are the main sweeteners that are often used in various industries. The addition of sweeteners to the VCO emulsion is expected to improve the organoleptic quality, especially the characteristics be more palatable and the taste of the VCO emulsion was more convenient for patient or consumer.

Sorbitol with the chemical formula $C_6H_{14}O_6$ is a polyol monosaccharide (1,2,3,4,5,6-hexanahexol). Sorbitol is a compound in the form of granules or white crystals with a melting point ranging from 89^o-101^oC, and has a sweet taste. Sorbitol has a relative sweetness level of 0.5 to 0.7 times the sweetness of sucrose with a calorific value of 2.6 kcal / g or equivalent to 10.87 kJ / g. Sorbitol is included in the GRASS (Generally Recognized as Safe) category, meaning that this substance has no toxic effect so it is safe for human consumption (Cahyadi 2008).

There were not significant value between the glibenclamide group with VCO, glibenclamide with VCO emulsion added with sorbitol, and Glibenclamide with VCO emulsion added with honey. This is related to the content of compounds contained in VCO, namely MCFA and sorbitol absorption by the body is slower, and tends to be imperfect so that it can be consumed by diabetics. The effect of giving honey on diabetics is to improve glycemic control in diabetes mellitus, stimulate glucose uptake in peripheral tissues, regulate activity and expression of enzymes involved in carbohydrate metabolic pathways and act like insulin (Amalia 2015). Meanwhile, there is a significant difference between glibenclamide and VCO emulsion with glucose sweetener. Emulsion with various sweeteners, both glucose, sorbitol and honey showed a greater percentage reduction than Xanthan Gum (negative control). Blood glucose levels continued to increase in negative controls, this is because xanthan gum does not have the effect of lowering blood glucose or is neutral.

CONCLUSION

The results of this study show that administration of VCO and VCO emulsion with various sweeteners except glucose were able to reduced the blood glucose levels as shown in its ability to reduce blood glucose level of alloxan induced diabetic rats.

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