

## ANTI-DIABETIC ACTIVITY OF VIRGIN COCONUT OIL (VCO): REVIEW

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### ABSTRACT

*Diabetes mellitus is a metabolic disease characterized by increased blood glucose levels. Currently, the treatment of diabetes mellitus uses synthetic or chemical drugs and natural ingredients such as virgin coconut oil. Virgin coconut oil (VCO) is extracted with minimal heating and no chemical purification process. This study aims to obtain data on the impact of VCO as an antidiabetic obtained from several research journals. This literature study uses a narrative review method obtained from the Google Scholar, Pubmed, and Science Direct databases. The results of this study indicate that VCO can be used as an alternative to lowering blood glucose levels because it has antidiabetic activity. Medium-chain fatty acid (MCFA) lauric acid in VCO can stimulate insulin production in pancreatic beta cells. This study concludes that virgin coconut oil can potentially reduce blood sugar levels.*

**Keywords:** Diabetes Mellitus, medium chain fatty acids, VCO

### INTRODUCTION

Diabetes mellitus (DM) is a metabolic disease characterized by hyperglycemia. Diabetes is characterized by resistance to insulin action, insufficient insulin secretion, or both of them. It is classified into two big groups: diabetes type 1, caused by absolute insulin deficiency, and diabetes type 2, defined by the presence of insulin resistance with a compensatory increase in insulin secretion<sup>1</sup>.

Currently, the drugs used by DM sufferers are not only synthetic or chemical drugs, but many of them are medicines derived from plants that have functions and are efficacious as drugs or known as traditional medicines<sup>2</sup>. One type of medicinal plant that has the potential to be anti-diabetic is coconut. The fruit is the most important part of the coconut because it can be processed into various products like Virgin Coconut Oil (VCO)<sup>3</sup>. VCO is made from fresh old coconut. The processing process does not use chemicals and high heating. The VCO production process that does use low heat produces

high medium-chain fatty acids (MCFA), maintaining the presence of vitamin E and enzymes in coconut flesh<sup>4</sup>.

Virgin coconut oil has several benefits and advantages in pharmaceutical products, namely as a source of energy as a cure for viral diseases, overcoming various metabolic and degenerative disorders, and has benefits in the aspect of sexuality<sup>5</sup>. VCO components consist of saturated fatty acids and lauric acid, which have the potential as antioxidants<sup>6</sup>. In general, the VCO compound of MCFA in the form of lauric acid can stimulate insulin production. VCO can reduce blood glucose levels by stimulating insulin secretion, so that blood glucose levels remain stable<sup>7,8</sup>. Giving VCO can also reduce the development of diabetes by preventing the development of insulin resistance and hyperglycemia<sup>9</sup>. Medium-chain fatty acids contained in VCO act as an *insulinotropic*, which strongly stimulates insulin secretion by damaged pancreatic islets. In addition, MCFA can also stimulate insulin production in humans<sup>10</sup>.

## METHODS

This type of research uses the review method to collect data or information related to a particular topic from various sources. Data collection is carried out from several literature searches. All articles have results testing blood glucose, experimental in vivo, and write dose or concentration VCO are include criteria. Article did not complete method will exclude from database. This research was conducted in a narrative review of the literature related to activity of VCO. The articles search process is online using one of the search engines through google.com. Among them use Google scholar, Pubmed, and Science Direct database to obtain publication data for both national and international journals by entering the selected keywords, namely “diabetes mellitus”, “MCT”, and “VCO”. After that, screening was carried out again based on the established literature criteria. Literature that matches the criteria will be analyzed for results and then drawn a conclusion.

## RESULTS AND DISCUSSION

In this study, a literature study on the 125 article about anti-diabetic activity of VCO was conducted. From the results, 9 journals were discovered that the criteria of this study. The results showed that VCO has anti-diabetic activity because it can lower blood glucose levels. VCO has an important role in reducing blood glucose levels. As research conducted which was carried out for 3 weeks showed that the value of blood glucose levels always decreased in experimental animals. In this study, the results related to the anti-diabetic testing method from the literature used were in vivo, where the test animals were conditioned to experience hyperglycemia with different inducers<sup>11</sup>.

Inducers with alloxan which compound that can damage pancreatic beta cells, causing hyperglycemia. The streptozotocin method of test animals was induced with streptozotocin until blood sugar levels reached >200 mg/dL. The tolerance test is a test to see how the tolerance of a decrease in blood glucose levels in the administration of certain test drugs<sup>12</sup>.

**Table 1. Result review antidiabetic activities of VCO**

No.	Author, Year of Publication, and Country	Title	Antidiabetic Activity of VCO	Reff.
1.	Siddalingaswamy, Rayaorth, and Khanum (2011), India.	Anti-diabetic Effects of Cold and Hot Extracted Virgin Coconut Oil	<ul style="list-style-type: none"> <li>• VCO was given as much as 2 mL for 3 weeks using 32 rats.</li> <li>• Streptozotocin method.</li> <li>• Cold Extracted VCO, blood glucose levels decreased from 444 mg/dL to 273 mg/dL.</li> <li>• Hot Extracted VCO, blood glucose levels decreased from 485 mg/dL to 256 mg/dL.</li> </ul>	<sup>11</sup>
2.	Iranloye, Oludare and Olubiya (2013), Nigeria	Anti-diabetic and Antioxidant effects of Virgin Coconut Oil in Alloxan Induced Diabetic Male Sprague Dawley rats	<ul style="list-style-type: none"> <li>• The research was conducted for 4 weeks using 24 rats.</li> <li>• Alloxan method.</li> <li>• VCO group 7.5 mL/kg, blood glucose levels decreased from <math>\pm 300</math> mg/dL to <math>\pm 100</math> mg/dL.</li> <li>• VCO group 10 mL/kg, blood glucose levels decreased from <math>\pm 350</math> mg/dL to <math>\pm 100</math> mg/dL.</li> </ul>	<sup>13</sup>
3.	Narayanankutty <i>et al.</i> , (2016), India	Virgin Coconut Oil Redox Status and Improves Glycemic Conditions in High Fructose Fed Rats	<ul style="list-style-type: none"> <li>• The research was conducted for 4 weeks using 18 rats.</li> <li>• Glucose tolerance method.</li> <li>• VCO diet was given as much 10 g/100 g feed showed the blood glucose levels of rats reached a normal state (50-135 mg/dL) at the end of the experiment.</li> </ul>	<sup>9</sup>
4.	Nurpalah (2017), Indonesia	The Effect of Virgin Coconut Oil (VCO) Made Through Fermentation Techniques Using <i>Lactobacillus case</i> Bacteria Commercial Yakult Strain on Blood Glucose and Cholesterol Levels of Male Mice	<ul style="list-style-type: none"> <li>• The research was conducted for 7 days using 20 mice.</li> <li>• Alloxan method.</li> <li>• VCO group 1 = 0.1 mL/day with a percentage decrease in blood glucose levels of 11,88 %.</li> <li>• VCO group 2 = 0.3 mL/ day with a percentage decrease in blood glucose levels of 20,97 %.</li> <li>• VCO group 3 = 0.6 mL/day with the largest percentage in decreased blood glucose levels, which is 31.02 %.</li> </ul>	<sup>8</sup>
5.	Elshehy (2018), Egypt	Antidiabetic and Anti-hyperlipidemic Effects of Virgin Coconut Oil in Rats	<ul style="list-style-type: none"> <li>• The research was conducted 4 weeks using 40 rats.</li> <li>• Alloxan method.</li> <li>• VCO 10 mL/kgBW given every day.</li> <li>• The value of blood glucose levels after alloxan inducted reached 330 mg/dL decreased to 97.66 mg/dL.</li> </ul>	<sup>14</sup>
6.	Okpiabhele, Nw and Abu (2018), Nigeria	Therapeutic Potential of Virgin Coconut Oil in Ameliorating Diabetes Mellitus and Hepatotoxicity Using <i>Rattus Novergicus</i> as Case Study	<ul style="list-style-type: none"> <li>• The research was conducted 21 days using 24 rats.</li> <li>• Alloxan method.</li> <li>• The dose of VCO used was 1.42 mL/kg.</li> <li>• Blood glucose levels on day 1 with a value 321.50 mg/dL.</li> <li>• Day 7 decreased to 280.75 mg/dL.</li> <li>• Day 14 decreased to 241.75 mg/dL.</li> <li>• Day 21 decreased to 196.25 mg/dL.</li> </ul>	<sup>15</sup>

7.	Supriatna <i>et al.</i> , (2018), Indonesia	The Effect of VCO Processing Method on Blood Glucose, Cholesterol and Pancreatic Profile of Diabetic Mellitus Rats ( <i>Sprague dawley</i> )	<ul style="list-style-type: none"> <li>• The research using 24 rats.</li> <li>• Alloxan method.</li> <li>• The research was conducted for 28 days as much 0,81 mL + 1 tablespoon of VCO 3 times a day, equivalent 45 mL/day.</li> <li>• On day 8, the blood glucose levels of DM rats decreased from <math>\geq 500</math> mg/dL to 300 mg/dL.</li> </ul>	16
8.	Akinnuga, Bamidele and Adewumi (2019), Nigeria	Evaluation of Kidney Function Parameters in Diabetic Rats Following Virgin Coconut Oil Diet	<ul style="list-style-type: none"> <li>• The research was conducted for 12 weeks using 25 rats.</li> <li>• Blood glucose levels were checked at weeks 8 dan 12.</li> <li>• Streptozotocin method.</li> <li>• The 10% VCO group experienced a decrease in blood glucose levels from 320,76 mg/dL to 205 mg/dL.</li> <li>• The 20% VCO group experienced a decrease in blood glucose levels from 316,26 mg/dL to 206,82 mg/dL.</li> </ul>	17
9.	Rahmawati <i>et al.</i> , (2020), Indonesia	Antidiabetic Effect of The Virgin Coconut Oil and The Virgin Coconut Oil Emulsions	<ul style="list-style-type: none"> <li>• The research was conducted for 8 weeks using 42 male rats.</li> <li>• VCO group 0,8 ml/200g/day.</li> <li>• Alloxan method.</li> <li>• Blood glucose levels decreased from 346,57 mg/dL and after VCO treatment the blood glucose level obtained were 129 mg/dL.</li> </ul>	12

The results showed that all treatment groups had initial blood glucose levels  $>200$  mg/dL, after alloxan induction all treatment groups has an increase in blood glucose levels. But after the therapeutic treatment, treatment groups become decrease in blood glucose levels<sup>18</sup>. The chemical content found in VCO can reduce blood glucose levels is MCFA or medium chain fatty acid in the form of lauric acid<sup>8</sup>. Antioxidants in VCO can inhibit oxidative stress on cells and increase cell metabolism, including pancreatic beta cells for insulin production<sup>7</sup>. The first effect of VCO in helping prevent complications of DM is helps release the hormone insulin in diabetics. Under any conditions, VCO is easily absorbed. After entering the body, VCO containing lauric acid has the effect of stimulating insulin secretion by langerhan's pancreatic cells<sup>8</sup>.

The dominant lauric acid content in VCO plays a role in stimulating GLP-1 (Glucagon like peptide-1)<sup>19</sup>. GLP-1 binds to the G protein receptor on the beta cell membrane. This binding activates adenylyl cyclase and increases intracellular cAMP. This increase will close the  $K^+$  channel followed by an increase in intracellular calcium levels thereby stimulating insulin secretion<sup>20</sup>. GLP-1 can increase proliferative activity and decrease beta cell apoptosis, so that GLP-1 also has the ability to repair pancreatic beta cells<sup>21</sup>. Lauric acid has strong antihyperglycemic potential to streptozotocin-induced beta cell regeneration. Lauric acid can lower blood glucose levels by acting directly on the liver, activating insulin signaling in the liver which then causes a decrease in gluconeogenesis or the

formation of new glucose and increases glycogenesis or the process of glycogen breakdown through the action of insulin in the liver<sup>22</sup>.

In addition, there is also the possibility of VCO lowering blood glucose levels due to its antioxidant properties. The beta cell response to oxidative stress may have been enhanced to allow it to carry out its insulin-producing function. This increase in insulin production will cause a decrease in blood glucose<sup>13</sup>.

The content of MCFA in VCO has a big role in lowering blood glucose levels. Lauric acid can increase insulin secretion. Increased insulin secretion causes the search for glucose alternatives to be reduced and free radical by-products are produced less so that pancreatic beta cell damage can be inhibited<sup>15</sup>.

## CONCLUSION

Virgin Coconut Oil with dose around 1 ml/kgBW can lower blood glucose levels because it contains MCFA or medium chain fatty acids in the form of lauric acid which is insulinotropic.

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