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The Potential of Green Coffee as Weight Loss Against Obesity

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Abstract: Obesity is a condition in which there is an excess amount of fat in the body. Green coffee contains chlorogenic acid and caffeine, which has many benefits, including antiobesity and antihyperlipidemic. This study aims to determine the potential of green coffee as a weight loss in obesity. This research was conducted by literature study using the narrative review method and data collection from some literature. The literature search is done online using several databases: Google scholar, PubMed, Elsevier, BioMed Central, and Science Direct. This study showed that significantly green coffee could lose weight in HFD-induced animals or in obese humans where the green coffee extract was tested using several dose variants, and then the case group was compared with the control group. The activity of green coffee in losing weight is caused by green coffee containing chlorogenic acid and caffeine compounds that have the benefits of increasing fat metabolism, improving insulin resistance, regulating energy expenditure, and thermogenic activity.

Keywords: Green Coffee, Weight Loss, Obesity.

INTRODUCTION

Obesity is a condition in which excess fat is in the body (Sofa, 2018), and is a dangerous, expensive, and complex disease (Harahap and Tanjung, 2020). Obesity risks experiencing health problems such as cardiovascular disease, chronic kidney disease, cancer, diabetes, and musculoskeletal disease (Australian Institute of Health and Welfare, 2017.). Obesity can also cause death, so it is the biggest killer of human health (Baijuan, 2021). In research conducted by Sikalat, *et al.*, (2017), cited in (Diana, *et al.*, 2013), the factors that can cause obesity are genetic factors, psychological factors, improper lifestyle, wrong eating habits, stress, and other triggers.

Obesity is one of the most dangerous and complex diseases in the world. In Indonesia, 13.5% of adults aged 18 years and over are overweight, and about 28.7% are obese (BMI) ≥ 25). Meanwhile, in children aged 5-12, 18.8% were overweight, and 10.8% were obese (Ministry of Health, 2018). Data obtained based on Riskesdas (2018), the obesity rate in Indonesia in 2018 and above was 21.8%, of which the highest rate was in North Sulawesi (30.2%), DKI Jakarta (29.8%), East Kalimantan and followed by other provinces. The Data from 2007 to 2018 tends to increase from 10.5% in 2007, 14.8% in 2013, and 21.8% in 2018.

Indonesia is known for a mega diversity of plants that can be used as medicinal ingredients. In research conducted by Yassir (2018), cited in Wasito (2008), more than 9,609 plant species in Indonesia have medicinal properties which have greatly benefited a healthy system. A plant that is known to have many benefits is coffee. Coffee has several types, including Arabica, Robusta,

Liberika, and Ekselsa (Rahardjo, 2012). The type of coffee that does not go through the frying or roasting process is called green coffee or green coffee because it does not change color to brown like other types of coffee (Doc, 2019). Green coffee contains chlorogenic acid and caffeine which have many benefits, including anti-obesity and anti-hyperlipidemia (Roshan, *et al.*, 2018).

One of the efforts to overcome obesity is using chemical drugs or herbal medicines that contain chlorogenic acid compounds, which can be obtained from coffee. There are several types of coffee, and coffee that does not go through the roasting or frying process is called green coffee. Chlorogenic acid is known to have the ability to lose weight. In addition, several studies have shown that the caffeine content in all types of coffee can increase metabolism by around 3 to 11 percent, and this increase can help you lose weight. Still, chlorogenic acid can lose weight faster than caffeine. Green coffee is known to have many advantages compared to coffee that has been roasted or fried, one of which is that the coffee roasting process can cause physical or chemical changes depending on the time and temperature used (Febrianti and Setyaningtyas, 2021) (Cho, *et al.*, 2019) so that compounds in roasted coffee such as chlorogenic acid will decompose into phenol derivatives and cause their contents to decrease (Febrianti and Setyaningtyas, 2021) in (Liang and Kitts, 2015) while green coffee does not go through this process. Hence, it is more effective in losing weight. In addition, consuming excess amounts of caffeine can increase blood pressure (Nuryati, 2021). Still, the caffeine content in green coffee is lower than in roasted coffee

because the roasting effect of coffee can cause the release of caffeine acid (Afliana, 2018). Chlorogenic acid reduces blood pressure in patients with mild high blood pressure if they consume around 2-3 cups of coffee daily (Hasbullah, *et al.*, 2021). Chlorogenic acid has the potential to reduce body weight by reducing insulin resistance and reducing plasma concentrations of blood glucose, while the caffeine contained in coffee plays a role in regulating energy balance by increasing energy expenditure and reducing energy intake so that it has the potential to regulate body weight (Hasbullah, *et al.*, 2021).

Research on coffee as a plant that is used as a medicinal ingredient has been carried out quite a lot. However, research on green coffee as a medicinal ingredient is still very small. Based on the description above, green coffee contains more compounds that are good for health than coffee that is already fried or baked. Therefore researchers are interested in collecting data and information about the effect of green coffee on weight loss using the method *narrative review*.

MATERIALS AND METHODS

The authors searched articles on several databases, namely, Google Scholar, *PubMed*, Elsevier, BioMed Central, and *Science direct*, using the keywords green coffee, weight loss, and obesity. *Review article* This study uses literature published in 2011-2021 which can be accessed in *full text* in pdf format. Articles were then collected and screened according to predetermined criteria and then reviewed.

RESULT

Table 1: Results of a Literature Study on the Potential of Green Coffee as Weight Loss Against Obesity in Experimental Animals

No.	Method	Results	Author and year of publication (Citation)
1	Green coffee bean extract with several dosage variants was tested experimentally <i>Live</i> in HFD-induced mice	Body weight in the HFD + GCBE group with doses of 100 and 200 mg/kg was stated to reduce body weight significantly.	(Choi, <i>et al.</i> , 2016)
2	Several dosage variants of green coffee bean extract were tested experimentally <i>Live</i> in rats induced by HFD	Administration of green coffee extract at doses of 200 mg/kg and 400 mg/kg in experimental rats showed the greatest weight loss.	(Aristina, <i>et al.</i> , 2018)
3	Green coffee bean extract with several dosage variants was tested experimentally <i>Live</i> in HFD-induced	Administration of GCE with several dose variations and the control group of GCE at a dose of 40 mg/kg showed the greatest	(Ilmiawati, <i>et al.</i> , 2020)

From literature searches on several databases, articles were selected based on inclusion and exclusion criteria to obtain 9 articles. The review of the nine articles in this study showed that significantly green coffee could reduce body weight in experimental animals induced by HFD or in humans who are obese. The activity of compounds in green coffee that can lose weight, namely chlorogenic acid, which plays a role in increasing fat metabolism and improving insulin resistance, while caffeine plays a role in regulating energy expenditure and thermogenic activity, which helps lose weight in HFD-induced experimental animals or humans who experience obesity.

Several of the nine articles combined green coffee with other materials or activities. In a study conducted by Zaben, Otaibi, and Bajaber, (2021), roasted coffee was also tested apart from testing the activity of green coffee. This is intended to compare the results of the two types of coffee. In addition, research conducted by Sarria, *et al.*, 2020 tested the activity of green coffee mixed with roasted coffee. The results showed significant weight loss and were not much different from studies that only gave green coffee extract.

However, when compared, studies that only provide green coffee extract show more significant results than combined studies. The research conducted by Haidari, *et al.*, 2017 also combines green coffee extract with energy restriction.

The results of a literature review regarding the potential of green coffee as a weight loss agent for obesity in experimental animals were found in 6 articles which can be seen in table 1.

	mice	weight loss.	
4	Green coffee bean extract at two different doses was tested experimentally <i>Live</i> in experimental rats. This study also tested roasted coffee bean extracts for comparison.	There was a significant difference in weight gain in the rat group with 1 ml GCE 0.5% and the rat group with 1 ml GCE 1% when compared to the negative group.	(Zaben, Otaibi and Bajaber, 2021)
5	Green coffee extract with several dosage variants was tested experimentally <i>Live</i> in HFD-induced mice.	The final body weight of the mice decreased in the 0.1% GCD and 0.3% GCD groups. The 0.3% group was expressed as the minimum effective dose of green coffee bean extract in reducing weight gain.	(Song, Choi and Park, 2014)
6	CGA and CGA/Cr obtained from green coffee bean extract were tested in vivo in HFD-induced mice	CGA/Cr and CGA supplementation prevented further weight gain and reduced it significantly in 2 weeks	(Ghadieh, et al., 2015)

Choi, *et al.*, reported their research that tested green coffee bean extract on 40 mice induced with HFD (60% Kcal from fat). HFD and green coffee extract were given simultaneously at 50, 100, and 200 mg/kg doses for 6 weeks. HFD administration caused mice to gain weight, but green coffee bean extract at doses of 100 and 200 mg/kg succeeded in reducing weight gain or preventing significant weight gain, which could be seen from changes in the initial and final body weight of the mice. This can happen because of the content of green coffee, namely chlorogenic acid, which plays a significant role in losing weight. Based on the data obtained, green coffee bean extract is stated to have an anti-obesity effect (Choi, *et al.*, 2016).

Another study by Alistina, *et al.*, tested green coffee bean extract on 30 experimental rats and divided them into five groups. Group 1 was a control, and the other group was induced by HFD, causing the rats to gain weight. Still, green coffee bean extract was given in the third week with several dose variants, namely 100, 200, and 400 mg/kg, showed significant weight loss on ANOVA test results, and at a dose of 400 mg/kg, showed the most significant weight loss. Chlorogenic acid compounds cause weight loss in green coffee, slowing fat absorption from food intake and activating fat metabolism. In addition, based on previous research, it was stated that green coffee bean extract at doses of 100, 200, and 400 mg/kg was proven to reduce body weight due to the effect of chlorogenic acid, which affects the absorption of sugar and synthesis of fat in the body (Alistina, *et al.*, 2018).

In addition, Ilmiwati, *et al.*, also explained in their research that green coffee bean extract was tested

on experimental rats induced by HFD causing weight gain. Administration of the green coffee extract at low doses of 10, 20, and 40 mg/kg caused weight loss in rats and the most significant weight loss at a dose of 40 mg/kg. The administration of HFD was carried out before the administration of green coffee bean extract. Weight loss occurs because the chlorogenic acid content in coffee has an anti-obesity effect. Chlorogenic acid increases fat metabolism in HFD-induced mice, reducing the amount of active fat and increasing insulin resistance. Therefore, this study states that low doses of green coffee extract affect body weight (Ilmiawati, *et al.*, 2020).

The activity of green coffee as a weight loss was also explained in research conducted by Zaben, *et al.*, green coffee bean extract was tested on rats induced by HFD, causing them to gain weight. HFD and green coffee extract were administered simultaneously. The green coffee bean extract concentration was 0.5% and 1%. In addition, this study also compared the effects of green coffee extract and roasted coffee extract. This study showed decreased body weight gain in rats given HFD and green coffee extract. The same thing happened to rats that were given roasted coffee extract, but when the two were compared, the decrease in weight gain in experimental animals with green coffee extract was more significant. This happened because of the chlorogenic acid in green coffee extract and coffee extract, which was already baked differently. Then when comparing green coffee extract with a concentration of 0.5% and 1%, there is also a difference in results where green coffee extract with a concentration of 1% is

more significant in reducing weight gain (Zaben, Otaibi, and Bajaber, 2021).

Song, *et al.*, also conducted the same study regarding the activity of green coffee bean extract as a weight loss in which green coffee bean extract at doses of 0.1%, 0.3%, and 0.9% was tested in HFD-induced mice. The results of this study indicate a decrease in weight gain. Among the three doses of green coffee bean extract used, the dose of 0.3% is stated as the minimum dose to prevent greater weight gain. Chlorogenic acid plays a role in this regard because it is known to protect tissues from oxidative stress, regulate glucose metabolism, and has an anti-obesity effect. This study also tested 5-CQA (CQD) supplements used to compare 5-CQA present in a dose of 0.9 GCD (the highest dose of GCD used). However, the results showed that 0.3 GCD had the same result as the CQD group. This could be due to the presence of other polyphenols in green coffee. Green coffee bean extract appears to achieve a maximum effect of 31% and 24% on decreased body weight gain and fasting plasma glucose in HFD-induced mice (Song, Choi, and Park, 2014).

This is also explained in the research conducted by Ghadieh, *et al.*, which used mice that HF and RD

induced for 7 weeks, and in the third week, mice that HFD induced were supplemented with CGA or CGA/Cr extracted from green coffee. CGA was supplemented with CRrIII because it is a strong hypoglycemic compound with anti-inflammatory activity, so it can help the effectiveness of CGA in regulating abnormal body metabolism in HFD-induced mice. HF-induced mice experienced weight gain, and supplementation with CGA and CGA/Cr prevented greater weight gain in mice and significantly reduced their weight. This can happen because the CGA/Cr supplement improves insulin tolerance. In addition, HF induction causes glucose intolerance, and CGA supplementation plays a role in this improving glucose tolerance. HF induction in experimental animals also causes hyperglycemia, but only CGA/Cr supplements can improve glucose intake in the body. CGA supplementation reduces body weight and glucose tolerance but does not improve insulin tolerance and glucose intake (Ghadieh, *et al.*, 2015)

The results of a literature review regarding the potential of green coffee as a weight loss agent for obesity in humans found 3 articles which can be seen in table 2:

Table 2: Results of a Literature Study on the Potential of Green Coffee as Weight Loss Against Obesity in Humans

No.	Methods	Results	Penulis dan tahun terbit (sitasi)
1	Quasy experiment with the approach of two treatment groups before and after treatment. The study population is obese women with BMI \geq 25 kg/m ²	Giving green coffee 200 mg managed to reduce the weight of obese women	(Harahap and Tanjung, 2020)
2	Intervention <i>randomized, controlled and cross-over</i> conducted on a group of people (women/men) aged 18-55 years and have a BMI of 20-25 kg/m ²	Body weight and BMI were significantly reduced after consuming a mixture of green coffee and roasted coffee (36/65, w/w) which contained 445 mg CGA.	(Sarria, <i>et al.</i> , 2020)
3	Clinic <i>testrandomised, double-blind, placebo-controlled</i> who tested the effect of green coffee extract 400 mg in obese women aged 20-45 years with FMI values \geq 8.7 kg/m ² for ages 25-34 and FMI \geq 9.9 kg/m ² for ages 35-45	BMI decreased significantly after 8 weeks of green coffee bean extract 400 mg and <i>didenergy-restriction</i>	(Haidari, <i>et al.</i> , 2017)

In research conducted by Harahap and Tanjung, the green coffee extract was tested on obese women. The results showed that giving green coffee extract can reduce body weight. This happens due to chlorogenic acid compounds in green coffee, which can increase the body's

metabolism. In addition, other studies also stated that the synergistic effect of chlorogenic acid and caffeine had been shown to reduce weight by reducing carbohydrate absorption. So, these results indicate that chlorogenic acid in green coffee can

reduce weight in obese women (Harahap and Tanjung, 2020).

Testing of green coffee bean extract on humans was also described in research conducted by Sarriá, *et al.*, green coffee extract combined with roasted coffee extract for weight loss. In this study, when testing the anti-obesity effect of coffee mixtures in hypercholesterolemia sufferers, their body weight decreased after consuming coffee. Weight loss is possible due to the two-component green and roasted coffee extract mixture. Chlorogenic acid plays a role in regulating appetite, while caffeine plays a role in increasing metabolic rate, energy expenditure, lipid oxidation, and the presence of lipolytic and thermogenic activity. In addition, the soluble fiber in the coffee mixture forms a viscous solution in the digestive tract which can delay transit time and inhibit the absorption of food nutrients and the reabsorption of bile salts (Sarriá, *et al.*, 2020).

Haidar, *et al.*, also conducted the same research, namely, green coffee extract as a weight loss but in combination with *energy restriction*. This study stated that chlorogenic acid plays an important role in fat metabolism. In previous studies, it has also been proven that chlorogenic acid inhibits glucose absorption in the small intestine by inhibiting glucose-6-phosphatase activity and glucose release, and this process causes weight loss. *Energy restriction* applied in this study played a role in *thermogenesis*. The results of this study indicate a decrease in body weight and BMI values in the group of respondents who are on a diet *energy restriction* and given green coffee bean extract (Haidari, *et al.*, 2017).

DISCUSSION

One effort that can be made to overcome obesity is to consume herbal medicines. One of the herbal plants that can be used is green coffee. Coffee comes from various countries depending on the type and variety, such as Arabica coffee of the Linie S variety originating from India and Arabica coffee of the Catara cultivars from Brazil. The origin of the liberica coffee type is the country of Liberia in western Africa. Before being used, green coffee is first processed using two methods, namely the dry processing method and the wet method where after processing, green coffee contains the most compounds, namely chlorogenic acid, and caffeine. Chlorogenic acid is a phenolic compound with antioxidant activity. It can regulate sugar and fat metabolism and increase insulin sensitivity, so it is believed to be able to overcome

obesity. Based on research conducted by Choi, *et al.* The total chlorogenic acid contained in green coffee bean extract is 50%. In addition, Ilmiwati, *et al* who tested green coffee bean extract using commercial products, stated that each capsule containing 500 mg of the green coffee extract contained 20.5 - 56.5 chlorogenic acids.

From a review of 9 articles, green coffee extract lost weight significantly. This is because the main ingredients of green coffee are chlorogenic acid and caffeine. The synergistic effect between chlorogenic acid and caffeine can suppress body weight by reducing the absorption of carbohydrates. In addition, chlorogenic acid can reduce leptin levels by inhibiting fatty acid acidification, 3-hydroxy3-methylglutaryl CoA reductase, and cholesterol acyl CoA acyl-transferase activity, which can cause fat loss and increase adiponectin concentrations. Leptin can prevent a reduction in energy expenditure associated with increased expression of uncoupling protein (UCP). UCP plays a role in encouraging the release of mitochondrial protons, increasing thermogenic activity (Harahap and Tanjung, 2020). Chlorogenic acid can also inhibit glucose absorption by inhibiting the activity of the glucose-6-phosphate enzyme and releasing glucose into the general circulation (Haidari, *et al.*, 2017). The article using humans as the proband found that the obesity rate in women was higher than in men. Differences in physical activity and energy intake between women and men caused this. In addition, the article reviewed using HFD to induce obesity in experimental animal probands. After that, the experimental animals were given green coffee extract to lose weight. The average human weight loss period of 8 weeks can lose about 7 kg. In general, losing weight quickly is dangerous, but losing around 0.9-1 kg per week is considered safe.

The research conducted by Zaben, *et al.*, who compared the activity of green coffee extract and roasted coffee, showed that weight loss only occurred in the experimental group that was given green coffee extract. This can happen because of differences in the content of the two as explained in the background of this research, namely the chlorogenic acid content in coffee that has been roasted is less because it has gone through the roasting process. In the research conducted by Haidari, *et al.*, 2017 which combines green coffee extract with *energy-restriction* showed the result that there was a more significant weight loss when compared to studies that only gave green coffee

extract without a combination of dual *energy-restriction* helps the work of green coffee extract in losing weight by playing a role in thermogenesis.

There are differences in the results of the articles using experimental animals, namely, some articles show the results of green coffee extract directly reducing weight, and some articles show the results of green coffee extract reducing weight gain or preventing greater weight gain. This can happen because of the difference in the administration time of HFD and green coffee extract, some articles give HFD and green coffee extract simultaneously. Hence, the results show that green coffee extract can prevent greater weight gain. Some articles first give HFD and then follow the administration of the extract of green coffee, so the results show that green coffee extract can lose weight.

CONCLUSION

From this literature review, it can be concluded that green coffee has weight loss activity in experimental animals or humans who are obese. This is because green coffee contains chlorogenic acid compounds and caffeine, which increase fat metabolism, improve insulin resistance, and regulate energy expenditure and thermogenic activity.

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