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The Effect of Green Coffee Bean Extract on The Weight Rats with High Fat Diet

Arie Dwi Alristina[1(CA)], Annis Catur Adi[2], Rita Ismawati[3]

[1(CA)]Faculty Public Health, Airlangga University, Indonesia; dwial83@gmail.com (Corresponding Author)

[2]Faculty Public Health, Airlangga University, Indonesia; annis_catur@yahoo.com

[2]Faculty Public Health, Airlangga University, Indonesia

ABSTRACT

WHO declares that obesity is a global epidemic. In 2014, 39% of adults >18 years old were overweight and 13% had obesity. This research aims to determine the effect of green coffee extract on the weight rats fed high-fat diet. Method: This research is true experimental pre-post test with control group design. The animals were grouped into 5 groups, i.e., group1 (negative control), group2 (positive controls fed high-fat diet), group3 (high-fat diet and GCBE dose of 100 mg/kg BW), group4 (high-fat diet and GCBE with dose of 200 mg/Kg BW), group5 (high-fat diet and GCBE dose of 400 mg/Kg BW). The obtained data were tested with one-way ANOVA followed by LSD analysis with α=0.05. Results: This research proves that green coffee bean extract with a dose of 100, 200 and 400 mg/kg BW can lower weight of rats with higt fat diet. Discussion: Green coffee extract contains active compound of chlorogenic acid that can increase AMPK activity so it has positive impact that can direct the result of metabolite substance, which is useful in decreasing fat synthesis. The high fat oxidation process results in decreased fat synthesis characterized by burning fat into energy thereby decreasing fat cells in adipose tissue.

Keywords: Obesity, Body weight, Chlorogenic acid, Green coffee

INTRODUCTION

Background

Obesity is still a worldwide public health issue. World Health Organization (WHO) declares that obesity is a global epidemic. According to WHO, in 2014, 39% of adults over 18 years old were overweight (39% male and 40% female) and 13% had obesity (11% male and 15% female). Therefore, nearly 2 billion adults across the world were overweight and over half a billion were obese(1).

Overweight and obesity in childhood and adolescence affect obesity in adulthood(2). Overweight and obesity in adolescence also affect the occurrence of several degenerative diseases in adulthood. Study on overweight students shows that 58% has risk factors of cardiovascular diseases(3).

Until now, black coffee is also used for slimming combined with ephedrine. However, safety level of this combined compound is uncertain(4). Therefore, there should be an alternative in the processing, which is making green coffee which is coffee bean which isn't fried, roasted, or grilled so that the caffeine content is low. One of them active compounds of green coffee, chlorogenic acid, is able to increase metabolism(5) and increase fatty acid oxidation(6).

Green coffee is coffee beans that are not fried, roasted or baked first in processing so that the caffeine content is low, but still high in terms of chlorogenic acid content in it. The effect of coffee roasting is to increase the bitterness of coffee due to the release of caffeine acid and the formation of lactones and other phenol derivatives that are responsible for flavor and aroma. Many researches have reported that by the process of roasting, chlorogenic acid can decompose into phenol derivatives and can cause the value of its content to be reduced in the beans(7).

Purpose

Researches on green coffee in Indonesia are still rarely studied, especially regarding the given effective dose. Previous researches on the effects of orlistat, green coffee extract and its combination of adiponectin levels and animal lipid profiles of the experiments are conducted. The results prove that giving green coffee ethanol extract 400 mg/Kg BW is efficient in lowering LDL cholesterol, increasing HDL cholesterol, lowering triglycerides and lowering total cholesterol levels of white rats(8). However, the research uses a single dose and not analyzed body weight of rats so that the effect of green coffee bean extract on the body weight of rats has not known yet.

METHODS

Animals for experiment were (*Rattus norvegicus*) Sprague dawley male strain white rats whose age was 2-3 months old, weight was 100-150 grams and the number was 30 in normal and healthy conditions obtained from Laboratory Faculty of Medicine at Airlangga University of Surabaya. Animals for experiment were kept in cages according to standard.

High-fat diet was duck egg yolk which was standardized by FKH (Faculty of Veterinary Medicine) Unair (Airlangga University). Standard feed ingredients were given during the 7-day acclimation period on ad libitum. An additional high-fat diet of egg yolks was given starting the second week for 7 consecutive days. Feeding was in the form of pellets. Green coffee bean extract was given in the third week for 14 days by way of sonde (food pipes) per oral.

Measurement of body weight was conducted 3 times, that was after acclimation, after feeding high-fat diet and after giving green coffee bean extract.

The green coffee bean extract was obtained by the ethanol extraction process made at the pharmaceutical laboratory of Unair.

This research is true experimental posttest only with control group design with complete randomized design. Animals for experiment are grouped into 5 groups:

1. Group 1, fed standard food only
2. Group 2, fed additional high-fat diet
3. Group 3, fed additional high-fat diet and EBKH dose of 100 mg/Kg BW
4. Group 4, fed additional high-fat diet and EBKH dose of 200 mg/Kg BW
5. Group 5, fed additional high-fat diet and EBKH dose of 400 mg/Kg BW

The variables observed in this research were: body weight of rats before and after administered by green cofee bean extract (GCBE).

Before the hypothesis, statistical normality of data with kolmogorov-smirnov and data variance with levene test was tested. If it qualified both, ANOVA would be tested one way followed by Post Hoc Least Significant Difference (LSD) analysis.

Before performing anova test, data normality test and data variance homogeneity test were performed. Normality test of initial weight (BW1) in this study used Kolmogorov-Smirnov's test with a sample of 30 rats. It results in p value > 0.05, meaning the data was normally distributed. Then, Levene test was performed with p value > 0.05, meaning the data was homogenous. Afterward, anova test could be performed. Anova test showed p value = 0.01, meaning there was significant difference between groups. In post hoc LSD test, it was found that there was difference in the weight between the group not administered with green coffee bean extract and the groups administered with green coffee bean extract. The weight difference was also significant between administered with different dosages of the extract.

RESULTS

There was a tendency of average increase and standard deviation of rat body weight in all groups. The average weight gain occurred in measurements after a high-fat diet, whereas weight loss occurred at the end of the research after giving green coffee seed extract in the K3, K4 and K5 groups.

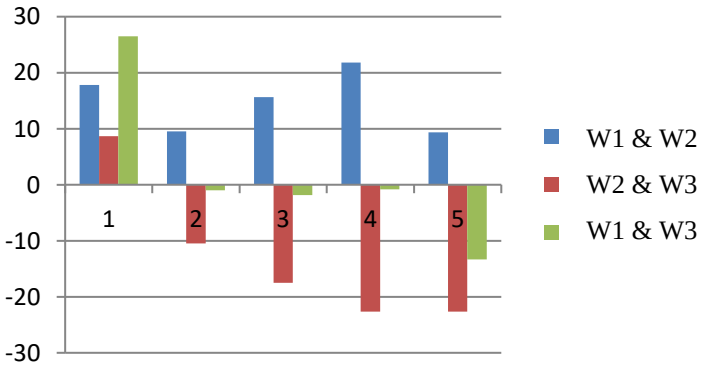

Figure 1. Weight change in animals for experiment

The figure above shows that weight gain occurs in measurements after a high-fat diet occurs in all groups. While all the groups that get GCBE are on average lose weight. The largest weight loss occurs in the group given GCBE with a dose of 200 mg/Kg BW and 400 mg/Kg BW. The result of post hoc LSD test is known to be the value of BW ratio before treatment with BW after feeding high-fat diet and after significantly different GCBE (p

< 0.05). However, the body weight measurement before treatment and after the end of the research is p > 0.05 and thus, it is concluded that there is no significant difference.

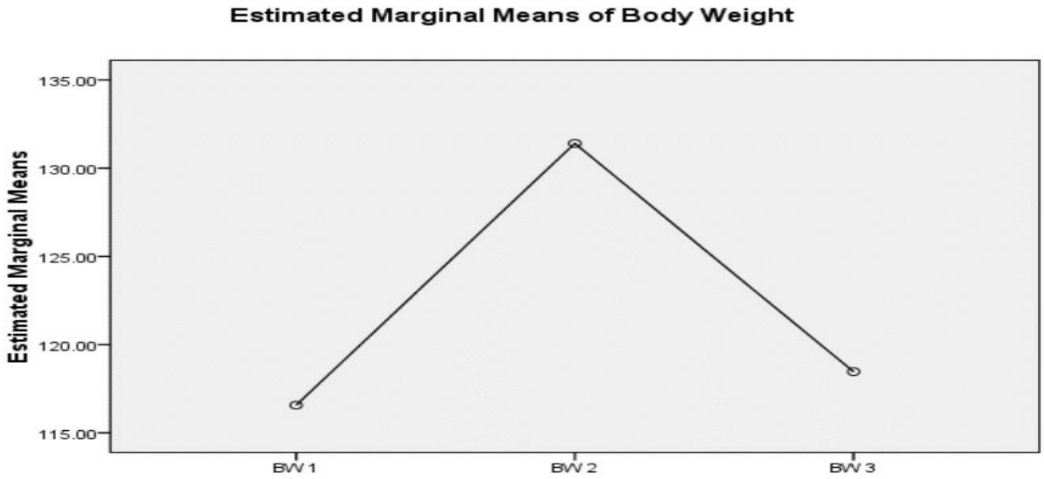

Figure 2 Plots of Estimated Marginal Means of Body Weight

Figure 2 showed Anova test result in the plot. Where there was a significant difference between body weight before treatment (BW1) and body weight after being fed a high-fat diet. Weight increases after supplemental high-fat feeding. Anova testing also proved that there was a difference in body weight after rats were given green coffee extract. Shown in figure 2, there is weight loss after 2 weeks given green coffee bean extract. Thus it has been proven that green coffee bean extract has an effect on body weight.

The average weight gain of each group showed significant result with different treatment. The average weight of the mouse group administered with standard feed had stable increase. In the groups which received high fat diet, i.e. groups K2, K3, K4 and K5, there were significant weight gains. Anova test showed significant difference between the weights of the group not administered with high fat diet and the groups administered with high fat diet.

DISCUSSION

There was weight loss in weight measurement after administering green coffee bean extract (BW3) compared with the weight before green coffee bean extract (BW2) administration. Weight loss happened to groups K3, K4, and K5. This was also shown by the result of Anova test which showed significant difference between BW2 (after high fat diet) and BW3 (after green coffee bean extract administration). However, the weight of rats which were administered with standard feed wasn't different from the weight of rats after green coffee bean extract provision. The average weight of rats at the end of the study lowered to the initial weight before treatment. The biggest weight loss happened to the group which was administered with 400 mg/kg weight of green coffee bean extract. Green coffee can be a source of anti-obesity effects[8]. Various researches have shown that chlorogenic acid slows the absorption of fats from food intake and also activates fat metabolism.

Green coffee bean extract was administered at 400 mg/kg weight. The dosage is potentially anti-obesity[9]. Based on the present study, it was evident that 100 mg/kg weight, 200 mg/kg weight and 400 mg/kg weight could lower the weight of the rats significantly. Possible factors behind the weight loss were the effect of chlorogenic acid on sugar absorption from starch and fat synthesis in the body. A study published in 2007 in"The Journal of International Medical Research" states that subjects who consume instant coffee enriched with chlorogenic acid can lower their weight due to reduced glucose absorption[10].

There are some way the body utilizes glucose: (1) The body burns glucose for energy. If not required for energy, glucose will be transformed into glycogen in liver or muscle. If the body has excess glucose, the excess glucose will be transformed into fat by the liver and stored as adipose tissue, or better known as "body fat". It happens after glycogen capacity is full. So, essentially, when the body metabolizes glucose, the body will store the remaining glucose as glycogen, then transforms the rest into adipose tissue or "body fat". (2) The liver regulates fat metabolism as the heart pumps excess fat from the body through bile and into small intestine. What most people don't realize is liver is a tool to control weight. The liver serves as "fat burning" and "fat pumping" organ[11]. Therefore, there are two important factors in weight gain, i.e. excessive glucose and fat metabolism in the liver.

AMP activated protein kinase (AMPK) is a master sensor and regulator of cellular energy balance. It is activated by various pharmacological, pathological, and metabolic stressors such as metformin, thiazolidinediones, hypoxia and exercise. Activation of AMPK leads to translocation of GLUT4 from intracellular membranes to plasma membranes, thus increasing glucose transport[12].

Chlorogenic acid stimulated glucose transport in myotubes via increasing expression of GLUT4 and PPAR-γ transcript. Subsequently, previous research investigated the role of Chlorogenic acid in the regulation of glucose transport in skeletal muscle isolated from rats and L6 skeletal muscle cells. The results showed that Chlorogenic acid stimulated glucose transport in L6 myotubes in a dose- and time-dependent manner. In addition, it was demonstrated for the first time that Chlorogenic acid stimulates glucose transport in skeletal muscle via the activation of AMPK[13]. In the following year, Ong et al. further investigated the effects of Chlorogenic acid on glucose tolerance, insulin sensitivity, hepatic gluconeogenesis, lipid metabolism, and skeletal muscle glucose uptake in rats. It was found that in rats, acute treatment with Chlorogenic acid lowered AUC glucose in an OGTT. Chronic administration of Chlorogenic acid inhibited hepatic G-6-Pase expression and activity, attenuated hepatic steatosis, and improved lipid profiles and skeletal muscle glucose uptake, which in turn improved fasting glucose level, glucose tolerance, insulin sensitivity, and dyslipidemia in rats. Furthermore the results of this study showed that Chlorogenic acid activated AMPK, leading to subsequent beneficial metabolic effects, such as suppression of hepatic glucose production and fatty acid synthesis. Inhibition and knockdown of AMPK abrogated these metabolic alterations. It suggested that Chlorogenic acid can improve glucose and lipid metabolism via the activation of AMPK.

Green coffee extract which contains chlorogenic acid inhibits glucose release in the body. It stops the body from storing fat. Glucose is stored as fat is glucogen pocket is hinted to be full. Chlorogenic acid also increases metabolism in the liver. By increasing liver metabolism, green coffee effectively helps keep weight under control by burning fat and pumping fat out[13].

CONCLUSION

Provision of green coffee extract with a dose of 100 mg/Kg BW, 200 mg/Kg BW and 400 mg/kg body weight is effective in lowering body weight of male wistar rats fed a high-fat diet. However, further researches need to be done to research the side effects and the impact of green coffee bean extract on the stomach and intestines. In addition, it is also necessary to examine the comparison of the effectiveness of the chlorogenic acid effect in robusta green beans between powder preparations, ethanol extract, and chlorogenic acid purification extract.

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