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Original Article

ANTIOBESITY EFFECT OF ETHANOL EXTRACT OF *ANREDERA CORDIFOLIA* (TEN) STEENIS LEAVES ON OBESE MALE WISTAR RATS INDUCED BY HIGH-CARBOHYDRATE DIET

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ABSTRACT

Objective: Overweight or obesity is one of the health problems that can promote cardiovascular risk diseases such as hypertension, hyperlipidemia, atherosclerosis, and diabetes mellitus. *Anredera cordifolia* (Ten.) Steen is leaves have been used traditionally to reduce body weight. In this study, the anti obesity effect of ethanol extract of *A. cordifolia* leaves was tested on obese rats induced by high-carbohydrate diet.

Methods: Animal were divided into five groups consisted of the negative control group, positive control group, an ethanol extract of *A. cordifolia* leaves at doses of 50 and 100 mg/kg bw group, and Orlistat group at a dose of 21.6 mg/kg bw. High-carbohydrate diet was given *ad libitum* for 30 d to all mice in groups, except to the negative control group. Then the rats were treated based on their groups for 14 d, and the high-carbohydrate diet was still given during the treatment. The parameters observed were the increment of body weight, food index, and feces index.

Results: The results showed that ethanol extract of *A. cordifolia* leaves at a dose of 100 mg/kg bw had the lowest increment of body weight (59.97±5.63) among other groups, and it was significantly different compared to the positive control group (76.11±8.50). The percentage of the food index and feces index did not differ significantly among all test groups.

Conclusion: Ethanol extract of *A. cordifolia* leaves at a dose of 100 mg/kg bw has a potency of the antiobesity agent by inhibiting the increment of the body weight of obese rats induced by high-carbohydrate diet, without affecting their appetite and bowel movement.

Keywords: Obesity, High-carbohydrate diet, Antiobesity, *Anredera cordifolia* (Ten.) Steenis

INTRODUCTION

According to World Health Organization (WHO) data, more than 1.4 billion and more than half a billion adults in 2008 were overweight and obese, respectively. Moreover, 42 million preschool children were overweight in 2013 globally [1]. Each year, it is estimated that at least 2.8 million people die as a result of being overweight or obese [1].

Overweight and obesity is an excess amount of fat in adipose tissue due to an excess intake of calories [2, 3]. It is believed that overweight and obesity can lead to disease development. 44% of diabetes, 23% of ischaemic heart disease and 7–41% of certain cancers are attributable to overweight and obesity [1].

Both fats and carbohydrates are the major energy sources for our body that contribute in fat deposition. Some developed countries tend to consume high fat foods while others consume high carbohydrates as the main meal. In Indonesia, the majority of the population consumes carbohydrate as the main energy intake [4]. Therefore, this study focuses on the obesity caused by high-carbohydrate diet.

Obesity can be treated by managing the food intake, exercise and consuming a drug. Certain plant medicine also has been used traditionally to reduce the body weight. One of the plants that can be used to overcome the overweight is *Anredera cordifolia* (Ten.) Steenis. *A. cordifolia* (Ten.) Steenis is known as multipurpose medicinal plants because almost all parts of the plant, starting from the root to the leaf, are beneficial to humans. It has been reported that *A. cordifolia* has an activity as diuretics and antioxidant [5, 6]. The previous study also showed that *A. cordifolia* leaves an effect for renal repair [7, 8]. Moreover, *A. cordifolia* has also has been reported to have activity as anti-obesity in high-fat-diet-induced obese rats [9]. None study has been reported regarding its anti-obesity activity in high-carbohydrate diet, where this condition is the main cause of obesity in Asian countries, especially in Indonesia. Therefore, in this study, the effect of *A. cordifolia* leaves as an anti obesity agent on obese rats induced by high-carbohydrate diet was studied.

MATERIALS AND METHODS

Materials

Powder of dried plant of *A. cordifolia* leaves, 70% ethanol, aqua dest, sodium-CMC, orlistat, normal chow, high-carbohydrate chow, drinking water, amyl alcohol, ether, magnesium powder, hydrochloric acid, chloroform, Dragendorff reactant, hydrochloric acid, iron (III) chloride, sodium hydroxide, a quads, chloroform, ammonia solution, 25% gelatin, Steasny reagents, sodium acetate, acetic acid anhydride and concentrated sulfuric acid.

Collection of plant material

Anredera cordifolia (Ten.) Steenis leaves were obtained from Manoko Plantations, Lembang, Bandung, Indonesia. Identification of plants was performed in the Herbarium Bandungense, School of Life Sciences and Technology, Bandung Institute of Technology. The leaves were then dried in an oven at a temperature about 40 °C. Once dried, the leaves were ground to fine powder.

Extraction and phytochemicals screening of the dried plant and extract

The ethanol extract was prepared by using reflux method. The filtrate obtained was evaporated using rotary evaporator. The extract was then stored in the refrigerator at 2-8 °C for further used. Phytochemicals screening was done by determining alkaloid, flavonoid, quinine, tannin, saponin, steroid/triterpenoid), total ash, loss on drying, water and ethanol extractable matter, and density [10].

Animal

Healthy adult male Wistar rats (100-160 g) were obtained from animal husbandry D'wistar, Gatot Subroto, Bandung. Rats were maintained on normal rat chow and tap water *ad libitum* before

obesity induction starting. This study was conducted in accordance to research ethics and the Guide for the Care and Use of Laboratory Animals, Institute for Laboratory Animal Research [11].

Anti-obesity assay *in vivo*

The test animals were grouped randomly into five groups, namely the negative control group, positive control group, an ethanol extract of *A. cordifolia* leaves at doses of 50 and 100 mg/kg bw group, and Orlistat group at a dose of 21.6 mg/kg bw. Each group consisted of 5 rats. High-carbohydrate diet was given *ad libitum* for 30 d to all mice in groups, except to the negative control group. The composition of the high-carbohydrate diet can be seen in table 1 [12].

Table 1: Composition of normal chow and high-carbohydrate chow for rat

Components	Normal chow (kg)	High-carbohydrate chow (kg)
Wheat flour	1.7	1.7
Rice flour	0	3
Cornmeal	1.25	1.25
Fishmeal	0.8	0.8
Mung bean flour	0.7	0.7
Cow fat	0.5	0.5

After 30 d, the rats were treated based on their groups for 14 d, and the high-carbohydrate diet was still given during the treatment. The parameters observed were the increment of weight gain, food index, and feces index. Rat body weight was measured daily while the food index and feces index were determined at the end of treatment.

Measuring the food and feces index

Each animal was put into a metabolic cage individually and fed with 20 g of high-carbohydrate chow. After 24 h, the leftover chow and the stool was collected and weighted. The food index was calculated by dividing the weight of food consumed to the total weight of food given. The feces index was calculated by dividing the weight of the feces to the weight of the rat.

Statistical analysis

Data were statistically evaluated using one-way ANOVA by using SPSS version 16.0 software. The values were considered significant when $p<0.05$.

RESULTS

Screening of phytochemicals of the dried plants and the ethanol extract of *A. cordifolia*

The results of the phytochemicals screening of the dried plants and ethanol extract of *A. cordifolia* can be seen in table 2. The results showed that a phytochemicals component of dried plant and ethanol extract of *A. cordifolia* leaves were similar. Both samples contained flavonoid, saponin, phenol, steroid and triterpenoid. In another study, it was reported that *A. cordifolia* contained not only saponins and flavonoid but also alkaloids [13]. Saponin was predicted to play a role in lowering the total cholesterol and body weight through preventing the reabsorption of cholesterol by binding the cholesterol and bile acids in the gut [14].

Table 2: Phytochemicals screening of dried plant and ethanol extract of *A. cordifolia* leaves

Phytochemical screening	Results	
	Dried plant	Extract
Alkaloid	-	-
Flavonoid	+	+
Quinon	-	-
Saponin	+	+
Phenol	+	+
Tannin	-	-
Steroid/triterpenoid	+	+

Note: += detected,-= not detected

Ethanol extract of *A. cardifolia* leaves inhibit the increase of body weight of obese rat induced by high-carbohydrate diet

All groups studied were fed with high-carbohydrate diet for 30 d before treatment, except for the negative control group. The weight of the animals can be seen in fig. 1. There was a significant increment of body weight after 30 d of high-carbohydrate diet administration (fig. 1). This data suggested that high-carbohydrate diet could increase the body weight in a month of induction. Excess of carbohydrate can increase the formation of fatty acids. Fatty acids then will be converted into triglycerides as energy reserves, leading to increasing of body weight [15].

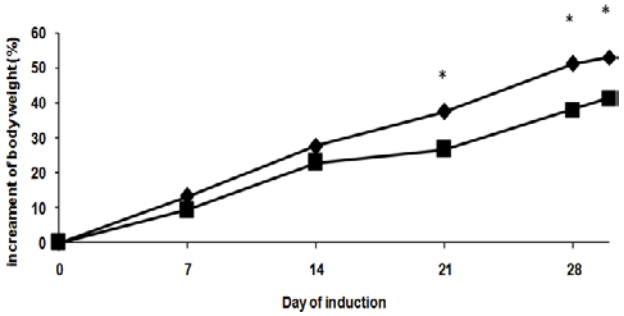

Fig. 1: Percentage of body weight increment after 30 d of obesity induction with a high-carbohydrate diet. Rats were fed with high-carbohydrate diet for 30 d. The body weight was measured every week. Graph shows mean of the body weight. * Means statistical difference compared to negative control group, $p<0.05$. (■) body weight of negative control group, n = 6 (♦) body weight of positive control group, ethanol extract of *A. cordifolia* leaves at dose of 50 and 100 mg/kg bw group, and Orlistat group at dose of 21.6 mg/kg bw, n = 24

After 30 d of high-carbohydrate administration, the rats were then treated based on their group for 14 d. The effect of each treatment on rat body weight can be seen in table 3. The data showed that in the positive control group, the percentage of body weight increment was the highest among other groups. Upon treatment with *A. cordofolia* at a dose of 100 mg/kg bw and orlistat at a dose of 21.6 mg/kg bw, the increment of body weight could be attenuated. *A. cordofolia* at a dose of 100 mg/kg bw showed the best effect in inhibiting the increment of body weight which was significantly different compared to positive control.

Table 3: Percentage of body weight increment compared to baseline during treatment

Group	Percentage of body weight increment at day of treatment			
	3	7	10	14
Negative control	47.78±6.26	55.23±7.34	58.85±7.89	67.56±8.21
Positive control	56.31±5.29	64.40±6.73	69.44±7.26	76.11±8.50
A. cordifolia 50 mg/kg bw	54.53±4.92	60.86±4.99	65.73±4.02	72.76±5.16
A. cordifolia 100 mg/kg bw	49.88±6.83	56.50±4.67	58.06±5.78*	59.97±5.63*
Orlistat 21.6 mg/kg bw	52.57±9.93	61.37±10.89	64.88±11.51	65.46±12.80*

Note: * means significant difference compared to positive control group, $p<0.05$

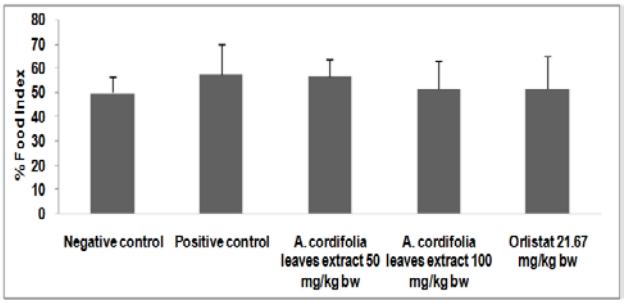

Fig. 2: Food index at day 14 after treatment Rats were fed with high-carbohydrate diet for 30 d, the rats then were treated based on their group for 14 d. The food index was measured at day 14 after treatment. Bar shows the mean±standard deviation of food index, n = 6 per group.

Orlistat partially inhibits hydrolysis of triglycerides when administered with fat-containing foods, thus reducing the subsequent absorption of monoglycerides and free fatty acids [16, 17]. In this study, the obese rat was induced by administering high-carbohydrate diet, which led to less role of orlistat in inhibiting the triglyceride accumulation in our body. This may explain the delay effect of orlistat in inhibiting the increment of body weight.

Ethanol extract of A. *cordifolia* leaves does not affect food index and feces index

Several strategies for treating obese patients are by suppressing appetite and increase the intestinal motility. Therefore, in this study, the food and feces index was calculated by considering the food intake and feces weight upon treatment. In fig. 2, it shows that there was no significant difference in all group studied compared to positive control. This data suggested that ethanol extracts of *A. cordifolia* leaves at doses of 50 mg/kg and 100 mg/kg bw did not inhibit the appetite of the animal.

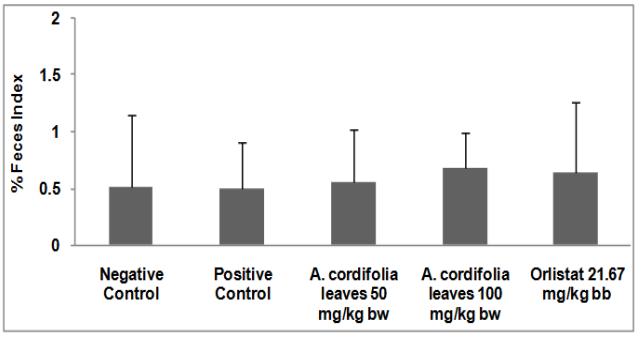

Fig. 3: Feces index at day 14 after treatment Rats were fed with high-carbohydrate diet for 30 d; then the rats were treated based on their group for 14 d. The feces index was measured at day 14 after treatment. The bar shows the mean±standard deviation of feces index, n = 6 per group.

Similar to the result on food index, there was no influence of extract studied in weight of the feces (fig. 3). Although the *A. cordifolia* extract group at doses of 50 and 100 mg/kg showed slightly higher feces index compared to the positive control group, but there was no significant activity observed. This data suggested that the extract studied also did not affect the bowel movement.

The limitation of this study is no cholesterol absorption inhibitory assay of ethanol extract of *A. cordifolia* leaves. This assay might answer the possible mechanism of the extract in reducing the body weight without affecting their appetite and bowel movement.

CONCLUSION

Ethanol extract of *A. cordifolia* leaves at a dose of 100 mg/kg bw has a potency of the antiobesity agent by inhibiting the increment of the body weight of obese rats induced by high-carbohydrate diet, without affecting their appetite and bowel movement. Therefore, these results suggest that the extract could be useful for prevention or treatment of obesity.

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CONFLICT OF INTERESTS

Declare none

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