EFFECT OF *GARCINIA CAMBOGIA* EXTRACT ON HEART OF RATS FED HIGH LIPID DIET

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ABSTRACT

Many plants had been used as raw materials in drug development. One of them is a tropical plant native to Southeast Asia, named *Garcinia cambogia.* The extract obtained from *Garcinia cambogia* fruits presents hypolipidemic properties, which arise from its high flavonoid content. The aim of the study was to validate the ability of HCA-containing *Garcinia cambogia* extract and flavonoids on cardiac lipid and protein metabolism in old and obese rats fed high lipid diet. Thirty female, one-year-old Sprague-Dawley rats were used and separated into three equal groups. Group 1 (control group) was fed basal diet, while the diets of both group 2 and 3 contained vegetable oil and cholesterol (3%). 4.5 % *Garcinia cambogia* extract was added to the diet of group 3 from day 45. At the end of 75 days trial period, heart samples of all animals were promptly excised and homogenized. Cardiac total protein, triglyceride and cholesterol concentrations were determined in post-mitochondrial fractions of the samples. The administration of diets containing vegetable oil (10%) and cholesterol (1.5%) in high levels in group 2 caused an insignificant increase in triglyceride and cholesterol levels of heart compared with control group. Also feeding with 4.5% *Garcinia cambogia* extract added to the diet and starting on day 45 caused an insignificant decrease in triglyceride and cholesterol levels in group 3 compared with group 2. Levels of cardiac total protein showed no significances between groups. All these findings suggest that there is a suppressive effect of HCA-containing *Garcinia cambogia* extract on cardiac lipid and protein metabolism in rats fed high lipid diet. According to these results, *Garcinia cambogia* can be recommended as a therapeutic agent against coronary heart disease by reducing cardiac triglyceride and cholesterol levels.

KEYWORDS: *Garcinia cambogia*, high lipid diet, total protein, triglyceride, cholesterol

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1. INTRODUCTION

Garcinia cambogia, known as Malabar tamarind, is a plant that belongs to the genus *Garcinia* of the family *Clusiaceae (Guttiferae)* [1]. The extract, obtained from *Garcinia cambogia* fruits, has been suggested to have antifungal, anticancer, antihistamine, antiulcerogenic, antimicrobial and antiviral pharmacological properties [2]. Additionally, the extract presents hypolipidemic properties, which arise from its high flavonoid content [3], and also antiadipogenic and appetite suppressor effects in experimental animals [4].

The fruit rind of *Garcinia cambogia* contains (-)-hydroxycitric acid (HCA) which inhibits ATP-citrate-lyase enzyme that catalyzes the cleavage of citrate to oxaloacetate and acetyl coenzyme A. This action reduces the acetyl-coA pool and limits the availability of 2-carbon groups required for fatty acid and cholesterol biosynthesis [5]. This had led to suggestions that HCA administration could inhibit lipogenesis which was confirmed by several studies, resulting in *in vivo* an *in vitro* inhibition rates of lipogenesis in tissues known to convert carbohydrates into fatty acids (liver, adipose tissue and small intestine) after HCA administration [6].

Cholesterol is a major risk factor for coronary artery disease. Consumption of diets including high-saturated fat and cholesterol are associated with increased risk of coronary artery disease [7]. A number of epidemiological studies suggested that dietary flavonoids have a protective role against coronary heart disease [8], and it was also reported that flavonoid intake is inversely correlated with mortality due to coronary heart disease [3, 9]. This study was designed to validate the ability of HCA-containing *Garcinia cambogia* extract and flavonoids on cardiac lipid and protein metabolism in old and obese rats fed high lipid diet.

2. MATERIALS AND METHODS

2.1. Treatments of animals and dietary

This research project was conducted from 01.05.2007 to 01.11.2009. Thirty, 1-year-old female Sprague-Dawley rats, weighing 229 g on average, were housed individually

in standard cages (33x23x12 cm) under controlled conditions of temperature, lighting and humidity. Rats were randomly assigned to 3 experimental groups of 10 animals each. Diets and tap water were given *ad libitum*. *Garcinia cambogia* rind fruit extract was provided by General Nutrition Products, Inc., SC, USA. After 1-week adaptation to housing conditions, group 1 (control group) was fed basal diet (2% liquid vegetable oil, 0% cholesterol), while the diets of group 2 and 3 contained vegetable oil (2% liquid- and 5% hydrogenated-vegetable oil) and cholesterol (3%). Also, 4.5% (w/w) *Garcinia cambogia* extract containing 65% HCA was added to the diet of group 3, from day 45 of experiments. Composition and calculation of nutrients in diets are indicated in Table 1. The trial period was 75 days.

At the end of the trial period, all animals were euthanasied by diethyl ether overdose, sacrificed, and heart samples were promptly excised, weighed and homogenized (3 g of each heart sample). Post-mitochondrial fractions (PMF) were obtained as described by Adaramoye et al. [10] and Galobart et al. [11], and were stored at -4 ^{o}C until analysis.

2.2. Assay procedures

Cardiac total protein, triglyceride and cholesterol concentrations were determined using an autoanalyzer (Tokyo Boeki Medical System TMS1024) and commercial kits (Reactivos Spinreact, S.A., Girona, Spain) in PMF samples.

2.3. Statistical analysis

The statistical comparisons of PMF total protein, triglyceride and cholesterol between groups were evaluated with one-way ANOVA. A statistical significance was considered at $P \leq 0.05$. SPSS statistical software package (version 10.0) was used for statistical analysis. All results were displayed as means ± SE.

3. RESULTS

The administration of diets containing vegetable oil (10%) and cholesterol (1.5%) in high levels in group 2 caused an insignificant increase in triglyceride and cholesterol levels of heart compared with control group. Also feeding with 4.5% *Garcinia cambogia* extract, added to the diet and starting on day 45, caused an insignificant decrease in triglyceride and cholesterol levels in group 3 compared with group 2. Total protein levels of group 3 were found to be higher than control and group 2.

No statistically significant changes were observed in weights of heart tissues, and in the activities of cardiac total protein, triglyceride and cholesterol concentrations between groups (Table 2).

TABLE 1 - Composition and calculation of nutrients in diets.

Composition of nutrients (%)	Group 1	Group 2	Group 3
Cracked barley	23	11	5.5
Cracked wheat	42.5	42.5	52.5
Rasmol	15	15	5
Soybean meal	14.5	17.5	17.5
Fish meal	2	3	4
Liquid vegetable oil	2	2	2
Vitamin-mineral mixture	1	1	1
Cholesterol	-	3	3
Hydrogenated vegetable oil	-	5	5
Garcinia cambogia extract	-	-	4.5
Calculation of nutrients			
Metabolisable energy (MJ/kg)	12.5	13.7	13.7
Crude Protein (%)	19.5	19.5	19.5

Vitamin-mineral mixture, kg: Vitamin A 12.000 IU, Vitamin D_3 1.500 IU, Vitamin E 104 IU, Vitamin K 15 mg, Vitamin B_1 14 mg, Vitamin B_2 11 mg, Vitamin B_6 14 mg, Vitamin B_{12} 20 mg, Folic acid 2.5 mg, Nicotinic acid 78 mg, Pantothenic acid 26 mg, Biotin 334 mg, Choline chloride 1635 mg, Selenium 0.36 mg, Cobalt 0.46 mg, Iodine 1.41 mg, Zinc 95 mg, Manganese 68 mg, Copper 20 mg, Iron 104 mg

TABLE 2 - Effect of *Garcinia cambogia* extract on cardiac total protein, triglyceride and cholesterol of rats fed high lipid diet.

	Total Protein (g/100 g)	Triglycerides (mg/100 g)	Cholesterol (mg/100 g)
Group 1	2,56 ± 0,43	281,43 ± 75,17	62,29 ± 9,52
Group 2	2,47 ± 0,74	314,90 ± 90,29	66,10 ± 20,15
Group 3	2,46 ± 0,87	280,75 ± 66,70	64,08 ± 20,28

Group 1: Control group; Group 2: High lipid diet-fed group; Group 3: High lipid diet-fed group and *Garcinia cambogia* extract-supplemented (after day 45) group. Results are the means ± SD (n=10). P< 0.05 compared with control.

4. DISCUSSION

Garcinia cambogia, also known as Malabar tamarind, is popularly used as an ingredient of dietary supplements for weight loss in developed countries. (-)-Hydroxycitric acid (HCA), the primary acid in the fruit rinds of *Garcinia cambogia* [12], has been shown to be active in suppressing appetite and body fat accumulation in experimental animals [13, 14]. Obesity, particularly with visceral fat accumulation, is a serious risk factor for so-called lifestyle-related diseases, such as cardiovascular disease. Therefore, antiobesity foods and food ingredients may avert obesity, possibly leading to prevention of lifestyle-related diseases, if they are effective in reducing body fat accumulation [15].

HCA is a potent competitive inhibitor of ATP-citrate-lyase enzyme which is an extramitochondrial enzyme catalyzing citrate to oxaloacetate and acetyl coenzyme A [16]. By this inhibitory action, HCA reduces acetyl-CoA pool, thus limiting the availability of 2-carbon groups required for fatty acid and cholesterol biosynthesis. In this respect, HCA might promote weight maintenance by inhibiting or limiting *de novo* lipogenesis capacity [17].

Dietary cholesterol has been reported to promote the elevation of plasma cholesterol. It has been reported that the presence of high cholesterol in the diet exhibited to elevate serum and aortic tissue cholesterol and aortic atherosclerosis. Previous studies indicated that there is a linear correlation between dietary cholesterol intake and mortality from heart diseases [10].

Hertog et al. [9] reported an irreversible correlation between dietary flavonoid intake and the incidence of coronary artery disease in elderly men. In a study of Keli et al. [18], it was suggested that certain flavonoids may be stored in blood vessels and there exert antiatherogenic effects.

Koshy and Vijayalakshmi [3] studied the impact of certain flavonoids on lipid profiles. They reported that administration of flavonoids from *Garcinia cambogia* produced a significant reduction in the concentrations of cholesterol and triglycerides in the hearts of Sprague-Dawley male rats. Percentage of reduction from *Garcinia cambogia* in the heart was 29% in case of cholesterol but 22% in case of triglycerides. They also reported that very high doses are ineffective. In another study, it was observed that *Garcinia cambogia* flavonoids made effective reductions in cholesterol and triglyceride levels in the hearts of normal and hypercholesterolemic Sprague-Dawley male rats [19]. In the present study, feeding of *Garcinia cambogia* extract added to atherogenic diet caused an insignificant decrease in heart triglyceride and cholesterol levels of rats. These data show similarity to the studies of Koshy et al. [19] and Koshy and Vijayalakshmi [3]. The reasons of this reduction may be due to the hypolipidemic activity of HCA, found in *Garcinia cambogia* extract in terms of inhibition of cholesterol synthesis and suppression of body fat accumulation.

In a study of Uko et al. [21], it was reported that high levels (20 mg/100 g body weight) of *Garcinia kola*-treated Wistar albino rats showed an insignificant decrease ($P<0.05$) in serum total protein. Similarly, the data of Adaramoye [20] in male to strain mice treated with a high dose of kolaviron (200 mg/kg body weight), showed an insignificant decrease ($P<0.05$) in levels of serum protein. On the contrary, Saito et al [16] stated that in Zucker obese rats fed (30.2 g HCA/kg diet) *Garcinia cambogia*-containing diet leads to an insignificant increase in serum total protein levels. In this study, addition of 4.5% *Garcinia cambogia* extract to diet caused an insignificant slightly decrease in cardiac PMF total protein. This data was contrary to that of Saito et al. [16] but showed parallelism to the data of Adaramoye [20] and Uko et al. [21].

In conclusion, all these findings suggest that there is a suppressive effect of HCA-containing *Garcinia cambogia* extract on cardiac lipid and protein metabolism in rats fed high lipid diet. According to these results, *Garcinia cambogia* can be recommended as therapeutic agent against coronary heart disease by reducing cardiac triglyceride and cholesterol levels.

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