



Efficacy of *Garcinia Cambogia* as Adjuvant in the Treatment of Obesity and Associated Diseases

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Abstract

Introduction: Obesity has been considered a public health problem because its prevalence has been increasing and collaborating with the emergence of several chronic diseases related to overweight. Dietary reeducation associated with the practice of physical activity has been stimulated to promote the reduction of body weight. Parallel to this, herbal treatment has emerged as an adjuvant in the fight against obesity.

Objective: This review aims to discuss *Garcinia Cambogia's* mechanism of action and its adjuvant role in weight loss and in the treatment of type 2 diabetes, dyslipidemia and hypertension.

Methods: We selected 33 original articles from experimental, clinical and epidemiological studies, using search terms in the electronic databases (Pubmed, Scielo, Bireme and Google Scholar) with *Garcinia Cambogia*, Obesity, Hydroxycitric acid, Diabetes, Hypertension, Dyslipidemia, from 2002 to 2018.

Results: The articles were arranged in chronological order in two tables containing information from experiments on animal and human.

Conclusion: It was concluded that *Garcinia Cambogia* is an effective herbal medicine in the fight against obesity and that its adjuvant role in the control of the associated diseases is related to its effectiveness in weight control, more experiments are necessary to verify its toxicity.

Keywords: Diabetes; Dyslipidemia; *GarciniaCambogia*; Hydroxycitricacid; Hypertension; Obesity

Introduction

Obesity has been considered a public health problem in recent years, as its prevalence has been increasing and is associated with the emergence of several chronic diseases related to the increase in body adiposity, such as: dyslipidemia, type 2 diabetes, arterial hypertension, cancer, among others [1, 2].

Dietary re-education associated with the practice of regular physical activity has been encouraged in order to promote a reduction in body weight and a consequent decrease in adipose mass, thus stimulating an improvement in the markers for diseases associated with obesity [3]. Parallel to this, adjuvant treatments based on plants have appeared, aiming to help control body weight and fight obesity, as is the case of

supplementation with the herbal medicine *Garcinia Cambogia* [4].

Currently, *Garcinia Cambogia* has shown to be an effective herbal treatment to aid weight loss, as it has properties that promote appetite reduction, block fatty acid synthesis, alter the metabolic flow of carbohydrates, hypocholesterolemic action and action on triglycerides, these mechanisms being induced by its active component hydroxycitric acid (HCA) [5, 6]. However, some studies have shown cases in which the consumption of *Garcinia Cambogia* can induce liver damage [7].

The present review aims to discuss the mechanisms of action of *Garcinia Cambogia* and its role as an adjuvant in the

Results

process of loss of body fat, and its effectiveness in the treatment of obesity and associated diseases such as: type 2 diabetes, dyslipidemia and hypertension.

Methodology

For this bibliographic review, 32 articles were used in the period from 2002 to 2018, being selected 20 original articles from experimental and clinical trials carried out in humans and animals to compose the analysis of the results. The research was carried out with the words: *Garcinia Cambogia*, Obesity, Hydroxycitric acid, Diabetes, Hypertension, Dyslipidemia, through the collection of data in the electronic bases: Pubmed, Scieloe Bireme and Google Scholar.

Author/year	Title	Methodology	Results	Conclusion
OHIA et al., 2002 [8]	Safety and mechanism of appetite suppression by a novel hydroxycitric acid extract (HCA-SX)	Cerebral cortex sections of rats exposed to HCA and serotonin, fluoxetine and clomipramine reuptake inhibitors.	The LD50 of HCA is greater than 5,000 mg / kg / day. No toxicological findings were found.	They have shown that HCA is a safe supplement beneficial in controlling appetite and in other serotonin deficient conditions.
HAYAMIZU et al., 2003[5]	Effect of <i>Garcinia Cambogia</i> extract on serum leptin and insulin in mice	Mice supplemented with <i>Garcinia Cambogia</i> at 3.3% in 10% sucrose for 4 weeks.	It showed no effect on body weight, fat mass or blood glucose. Serum insulin and leptin levels were lower in treated subjects.	<i>Garcinia Cambogia</i> extract has been shown to improve glucose metabolism.
TALPUR et al., 2003[9]	Effects of niacin-bound chromium, Maitake mushroom fraction SX and (-)-hydroxycitric acid on the metabolic syndrome in aged diabetic Zucker fatty rats	8 obese and diabetic elderly rats were supplemented with 200 mg / day of HCA for 3 weeks and then with a double dose of week 4-6.	They had significantly lower body weight loss and blood pressure.	They demonstrated that HCA supplementation in obese diabetic elderly people can benefit in several metabolic parameters associated with aging.
LEONHARDDT et al., 2004 [10]	Effect of hydroxycitrate on respiratory quotient, energy expenditure, and glucose tolerance in male rats after a period of restrictive feeding	24 male rats were supplemented with a hyperglycemic diet, at 3% HCA for six days, after being fed strictly for 10 days.	HCA decreased the respiratory coefficient and the energy expenditure	They indicate that HCA suppresses lipogenesis and improves glucose tolerance.

Table 1: Results of the search for studies in animals, related to *Garcinia Cambogia* and associated diseases: Hypertension, Type Diabetes and Dyslipidemia.

WIELINGA et al., 2004 [11]	Hydroxycitric acid delays intestinal glucose absorption in rats	310 mg / kg of HCA was administered to rats after an intraduodenal or intragastric glucose load.	Delayed intestinal glucose absorption in the small intestine. It attenuated the levels of glucose post prandial intragastric and intraduodenal.	It has shown that HCA is a supplement with function capable of reducing postprandial blood glucose.
SAITO et al., 2005 [12]	High dose of <i>Garcinia cambogia</i> is effective in suppressing fat accumulation in	Obese rats at 6 weeks of age were fed different doses of HCA (0.10, 51, 102 and 154 mmol / kg of feed) for 92 to	102 mmol HCA / kg or greater caused testicular atrophy and toxicity, while 51	They considered that supplementation of 51 mmol HCA / kg (350 mg HCA / kg body weight /

	developing male Zucker obese rats, but highly toxic to the testis	93 days.	mmol HCA / kg or less showed no toxicity.	day) is safe and does not cause an adverse effect.
ASGHAR et al., 2007 [13]	inflammation, insulin resistance, and body weight in developing obese Zucker rats	Developing obese male rats were supplemented with 500 mg / kg / day of HCA for 2 weeks and then the doses were increased to 1500 mg / kg / day for another 5 weeks.	It reduced food intake, body weight gain, and attenuated the increase in inflammation, oxidative stress and insulin.	They suggest that HCA can be used as an intervention related to obesity, inflammation, oxidative stress and insulin resistance.
KIM et al., 2008 [14]	<i>Garcinia Cambogia</i> extract ameliorates visceral adiposity in C57BL/6J mice fed on a high-fat diet	36 obese male rats of 7 weeks of age divided into 3 groups where 1 group consumed a high calorie diet with extract of <i>Garcinia Cambogia</i> for 12 weeks.	It decreased weight gain, blood and liver lipid concentrations, as well as insulin and leptin levels.	They suggest that <i>Garcinia Cambogia</i> extract alleviates obesity induced by a high-fat diet through the modulation of multiple genes associated with obesity.

Table 1 (cont.): Results of the search for animal studies, related to *Garcinia Cambogia* and associated diseases: Hypertension, Type 2 diabetes and Dyslipidemia.

Author/year	Title	Methodology	Results	Conclusion
LIM et al., 2003 [21]	(-)-Hydroxycitric acid ingestion increases fat utilization during exercise in untrained women	6 women supplemented with 250 mg of HCA for 5 days and after that period submitted to exercise on a cycle ergometer.	HCA tended to decrease the ratio of respiratory exchange and carbohydrate oxidation.	They suggest that HCA increases fat metabolism by decreasing the use of glycogen during exercise, improving performance.
TOMIKA, et al., 2003 [22]	(-)-hydroxycitrate ingestion increases fat oxidation during moderate intensity exercise in untrained men	6 untrained men were supplemented with 500 mg of HCA for 5 days associated with moderate intensity endurance exercise.	Free fatty acid concentrations were increased in the blood and the rate of respiratory exchange was decreased.	They suggest that short-term HCA supplementation increases fat oxidation in untrained men.
PREUSS et al., 2004 [23]	Effects of a natural extract of (-)-hydroxycitric acid (HCA-SX) and a combination of HCA-SX plus niacin-bound chromium and <i>Gymnema sylvestre</i> extract on weight loss	60 obese people supplemented with 4667mg of HCA associated with physical activity (walking) for 8 weeks	There was a 5-6% decrease in body weight. LDL, total cholesterol, triglycerides and serum leptins were reduced.	They have shown that HCA is effective for weight loss and for promoting healthy blood lipid levels.
PREUSS et al., 2005 [6]	Efficacy of a novel calcium/potassium salt of (-)-hydroxycitric acid in weight control	82 obese individuals were divided into 3 groups where 1 group was supplemented with 2800 mg / day with HCA and a 2000 kcal diet associated with a 30 min / day walking program, 5 days a week for 8 weeks.	There was a decrease in body weight, BMI, LDL, triglycerides and leptin. There was an increase in HDL, serotonin and urinary excretion of fat metabolites.	They concluded that when administered correctly, HCA is an effective adjunct to healthy weight control.

Table2: Results for studies in humans, related to *Garcinia Cambogia* and associated diseases: Hypertension, Type Diabetes and Dyslipidemia.

Author/year	Title	Methodology	Results	Conclusion
GATTA et al., 2009 [24]	Acute effects of pharmacological modifications of fatty acid metabolism on human satiety	8 eutrophic men received 2g of HCA after lunch to check their satiety.	HCA decreased hunger and promoted satiety after lunch.	They concluded that in healthy eutrophic men, acute supplementation with HCA increases the intensity and duration of satiety, possibly by increasing the elimination of free fatty acids for oxidation.
THAZHATH et al., 2016 [25]	Effects of intraduodenal hydroxycitrate on glucose absorption, incretin release, and glycemia in response to intraduodenal glucose infusion in health and type 2 diabetes: A randomised controlled Trial	12 healthy individuals and 8 type 2 diabetics received intraduodenal infusion of HCA (2800 mg in water) for 60 min., Then received an infusion of 60 g of glucose for 120 min.	In healthy individuals, blood glucose was lower both before and during glucose infusion. In patients with type 2 diabetes, there was no differentiation, but the plasma glucagon was higher in the presence of HCA, during the glucose infusion.	In healthy individuals, HCA promoted a modest reduction in glycemia and stimulation of plasma glucose and glucagon-dependent insulinotropic polypeptide, but did not show an effect on glycemia in patients with type 2 diabetes.

Table 2 (cont.): Results for studies in humans related to *Garcinia Cambogia* and associated diseases: Hypertension, Type Diabetes and Dyslipidemia.

Discussion

Mechanism of action

Garcinia Cambogia is a plant originally from Asia that has hydroxycitric acid component in its composition, which has been attributed to weight reduction and combats obesity, by acting on the metabolism of fatty acids, carbohydrates and also as an appetite suppressant [23].

The consumption of *Garcinia Cambogia* extract promotes fat oxidation, inhibiting ATP citrate lyase, thus increasing the inhibition of lipogenesis in the body and consequently reducing leptin levels, inhibiting appetite, in obese and non-obese individuals [24]. It was also found that when administered together with high fat diets, hydroxycitric acid acts as an anti-obesity agent, attenuating the harmful effect of the diet [19].

Significant results have been shown when supplementation is associated with physical activity, resulting in an even greater increase in fat oxidation in trained and untrained individuals [21, 22].

The treatment with hydroxycitric acid from *Garcinia Cambogia* has also indicated, to reduce body weight gain by inducing energy expenditure by regulating thyroid hormone levels that promote protein synthesis with alteration of the metabolic direction of amino acids [18].

Regarding carbohydrate metabolism, they aim to help reduce postprandial glycemia, delaying glucose absorption time, and thus improving glucose tolerance [10].

In the cerebral cortex, hydroxycitric acid has been identified as a potentiating agent of serotonin levels, thus helping to regulate eating behavior and promoting improvement in appetite control [8, 28].

Treatment of diseases: Type 2 diabetes, Hypertension, Dyslipidemia

Garcinia Cambogia has been identified as a herbal medicine capable of helping in the treatment of obesity, reducing abdominal fat and body weight, improving the lipid profile, blood glucose levels, insulin resistance, blood pressure, oxidative stress and inflammation [13].

Adipose tissue represents an important source of reactive oxygen species and can contribute to the emergence of insulin resistance associated with type 2 diabetes (MATSUDA; SHIMOMURA, 2013). Central obesity and oxidative stress represent one of the factors that contribute to the emergence of insulin resistance and type 2 diabetes, also resulting in elevated blood pressure [27, 28].

Treatment with *Garcinia Cambogia* has been shown to be effective for inhibiting weight gain, and improving serum lipid profile markers for total cholesterol, triglycerides, and LDL, when tested on an animal submitted to a high-fat diet [14, 15].

A study carried out in a rat with 400 mg / kg / day of *Garcinia Cambogia* extract together with a high-fat diet for 10 weeks, found its effectiveness in decreasing body weight, glucose intolerance, plasma leptin levels and inflammation markers (SRIPRADHA; MAGADI, 2015). However, a test performed with an intra duodenal infusion of 2800mg of hydroxycitric acid in water, showed no direct effect on blood glucose in patients with type 2 diabetes [25].

In addition, a study carried out with elderly diabetic rats found that supplementation of 220 mg / day with hydroxycitric acid significantly decreases blood pressure levels [9].

Toxicity

An animal study showed that *Garcinia Cambogia* attenuates diet-induced adiposity, but exacerbates the accumulation of liver collagen and inflammation [16]. It also showed that treatment with hydroxycitric acid, while reducing hyperlipidemic manifestations, promotes an increase in lipid accumulation in the liver [20].

However, case studies in humans indicate that the increase in hepatotoxicity can be caused when there is pre-existence or genetic pre-disposition for liver diseases, considered that the consumption of hydroxycitric acid up to 4667 mg / day would be safe [29, 30].

Testicular atrophy has also been one of the problems seen with the consumption of *Garcinia Cambogia* extract, however a test carried out on rats showed that 389 mg / kg / day of hydroxycitric acid is a safe amount, not promoting an adverse effect in relation to toxicity and atrophy testicular [12, 31, 32].

Conclusion

The treatment with *Garcinia Cambogia*, as well as its hydroxycitric acid component, proved to be an effective herbal medicine to combat obesity, as it promotes reduced glucose absorption, decreased appetite, and improved lipid profile. Significant results have been shown when associated with the practice of physical activity. The adjuvant role of *Garcinia Cambogia* in fighting type 2 diabetes, hypertension and dyslipidemia has been shown to be associated with its effectiveness in controlling body weight, which consequently promotes improvement in the markers of the lipid, glycemic and blood pressure profiles. Regarding the opposite effects, further studies are needed to prove toxicity, because in safe doses no adverse effect has been identified.

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