Acta Scientiarum
http://periodicos.uem.br/ojs/acta
ISSN on-line: 1807-8648
Doi: 10.4025/actascihealthsci.v47i1.67620

Influence of *Garcinia cambogia* extract on metabolic profile, weight loss, and eating behavior of humans

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ABSTRACT. The objective of this study was to evaluate the effectiveness of *Garcinia cambogia* extract to cause changes in body composition, biochemical parameters, and eating behavior in overweight and obese individuals. Thirty-four female volunteers between 20 and 61 years of age, BMI ⩾ 25 Kg/m^2 were divided into two groups: control and treatment. Both groups received a diet plan and the treatment group received 500 mg of *G. cambogia* extract three times a day for a period of 4 weeks. Weight loss and body composition were assessed by anthropometry and bioimpedance data; the biochemical parameters analyzed were: total cholesterol and fractions, triglycerides, fasting glucose, urea, creatinine, creatinine clearance, and transaminases. The eating behavior was assessed using the *Three Factor Eating Questionnaire*. The treatment group showed a significant difference ($p<0.05$) in creatinine values, creatinine clearance, waist circumference, basal metabolism rate, and cognitive restraint eating behavior when compared to the control group. Other parameters evaluated, essentially body weight and body mass index, suffered significant changes resulting from experimental intervention in both control and treatment groups. *G. cambogia* extract showed an assistant action to the dietary plan. It resulted in improvements in morphological and biochemical parameters such as decrease in waist circumference, an increase in basal metabolism rate, a decrease in creatinine value, improvement in creatinine clearance, and an increased cognitive restraint on eating behavior. Therefore, *G. cambogia* extract represents a complementary alternative for overweight and obese individuals.

Keywords: Obesity; herbal medicines; hydroxycitric acid.

Received on March 24, 2023.
Accepted on February 07, 2024.

Introduction

Obesity is considered a major health care problem worldwide. Recent data show that obesity rates have almost tripled over the last 40 years. 39% of adults aged 18 or above are overweight and 13% are obese (World Health Organization [WHO], 2021). For 2025 there are estimations that 2.3 billion adults will be overweight, and more than 700 million will be obese. In Brazil, some studies show that more than 50% of the Brazilian population are overweight or obese (Fideles et al., 2022). The complex physiopathology of obesity involves a metabolic imbalance associated to increased insulin resistance, type II diabetes, high blood pressure, dyslipidemias, chronic obstructive pulmonary disease, cardiovascular diseases, and certain types of cancer (Chartrand et al., 2022, Palma et al., 2022; Tian et al., 2022; Ruze et al., 2023).

Due to the severity of complications, the treatment for obesity and overweight, and the maintenance of normal morphophysiological parameters are complex and multidisciplinary. In general, medication is an auxiliary treatment in therapies focused on changing life habits related to nutrition and exercising (Silveira et al., 2023), in many cases added to psychotherapy and surgery (Associação brasileira para o estudo da obesidade e da síndrome metabólica [ABESO], 2016). Studies suggest that a loss of 3-5% of body weight can considerably reduce glucose and cholesterol levels and risks related to cardiovascular alterations (Haber et al.,2018). Pharmaceutical treatment of obesity may involve anorectics and psychostimulants with central nervous system (CNS) action, which can induce side effects (Abes, 2016). Agents such as orlistat, loriciferan, liraglutide, phentermine/topiramate, and naltrexone/bupropion are used nowadays for weight control in obesity treatment (Golden, 2017). These drugs may present considerable side effects, such as anxiety, changes

in cardiovascular parameters, stomachache, paresthesia, vomiting, insomnia, constipation, headache, and nausea. Still, most of these drugs cannot be prescribed to patients with cardiovascular diseases or with a high risk of developing them (Shin & Gadde, 2013; Che et al., 2019).

Under these circumstances, natural products such as *Garcinia cambogia* have become alternatives to traditional medication or adjuvants in obesity treatment. The *G. cambogia* fruit (Guttiferae famioy) presents flavonoids, alkaloids, saponins, phenolic compounds, and tannins as secondary metabolites (Espirito Santo et al., 2020). The main component in *G. cambogia* is hydroxycitric acid (HCA), its biologic activity is attributed to its inhibitory action on the ATP citrate-lyase enzyme, also inhibiting lipogenesis and acting on hunger suppression and decreasing body weight (Golzarand et al., 2020; Andueza et al., 2021; Fenget al., 2021; Han et al., 2021).

Researchers observed weight loss and a reduction of body fat when they evaluated the use of *G. cambogia* in association with *Camelia sinensis* (Chong et al., 2014). Fassina et al. (2015) also reported a positive relation between *G. cambogia* and weight loss, appetite reduction, and decrease in fat percentage, lipogenesis, cholesterol, and glycemia. However, there are few clinical trials described using pure *G. cambogia* extract and there is a variety of doses, treatment time, and sample size in those that use pure *G. cambogia* extract (Chong et al., 2014; Fassina et al., 2015; Rosa & Machado, 2016). Hence, the objective of this study was to evaluate the effectiveness of *G. cambogia* extract to cause changes in body composition, biochemical parameters, and eating behavior in overweight and obese individuals.

Materials and methods

Sample

The clinical trial was conducted with obese and overweight female volunteers, aged between 20 and 61, with body mass index (BMI) ⩾ 25 kg/m^2, attended by the Family Health Team (FHT) in the city of Itumirim (MG), which were divided into two homogenized groups.

Participation of the volunteers only began after understanding and signing the Informed Consent Form (ICF). Research protocols were previously approved by COEP of the Federal University of Lavras, and the project is registered under the number CAAE: 89196918.0.0000.5148.

Initial volunteer recruitment began with 62 people, however, due to safety-related exclusion criteria, only 34 volunteers remained. Exclusion criteria were: pregnancy, severe health condition, undergoing treatment for dyslipidemia, diabetes, cognitive deficiency, depression, clinical or biochemical evidence of acute or chronic infection, hepatic and/or renal disfunction, chronic alcohol use, any major surgery or reason for hospitalization in the last 6 months, use of medication that interferes in lipid metabolism or hunger/satiety and use of any weight control method. Due to a lack of evidence of reproductive toxicity such as testicular atrophy and spermatogenesis, all selected individuals were women.

The volunteers were informed that they could be part of the Control Group (1) – treated only with a diet plan (n=15) or of the Treatment Group (2) – treated with a diet plan and *G. cambogia* (n=19), and were aware and agreeing to participate in the group to which were allocated. Groups were defined in a homogenized form, considering parameters obtained from each volunteer at the beginning of the experimental intervention.

Interventions

Capsules of *G. cambogia* were prepared at a manipulation pharmacy, using a standardized dry extract (Florien) with 50% of hydroxycitric acid. Besides hydroxycitric acid, the extract has its isomers I, II, III and IV and anthocyanosides B1 and B2; resin, composed by benzophenones and yellow and red xanthones, and mucilage. The dosage was defined according to previous studies which showed morphological, physiological, and/or biochemical changes in humans (Onakpoya et al., 2011).

The Treatment Group consumed 3 capsules of *G. cambogia* per day, before the main meals, equivalent to 750 mg of hydroxycitric acid per day, in addition to an individualized diet plan. The Control Group received only the diet plan. The intervention lasted for a period of 4 weeks for both groups.

The following procedures took place before the beginning of the clinical trial and right after its end:application of the *Three Factor Eating Questionnaire* – TFEQ, analysis of body composition, and blood sampling for biochemical parameter analysis.

Analyzed parameters

The effect of *G. cambogia* on the organism of the volunteers was evaluated through weight in Kg, body fat percentage, waist circumference, BMI calculated by Weight/Height^2,plasmatic levels of total cholesterol (TC), low-density lipoprotein (LDL-c), high-density lipoprotein (HDL-c), fasting triglycerides (TG), fasting glycemia, in addition to quantification of the activity of oxalacetic transaminase (TGO) and pyruvic transaminase (TGp), quantification of blood urea and creatinine and creatinine clearance.

Anthropometric measurements

Height was measured using a stadiometer with a mobile rod with a precision of 0.1 cm. Weight was measured using an electronic micro digital scale with a weighing capacity of up to 150 kg and 50 g precision. Both were from Welmy. Body Mass Index was defined as the ratio between weight in Kg and squared height in meters.Volunteers were classified as overweight, or obese degrees I, II, and III according to World Health Organization (Who, 2008) parameters.

Waist circumference was measured at the midpoint between the lower costal margin and the iliac crest, using the cut-off point of 88 cm for women, according to the National Cholesterol Education Program (NCEP) - Adult Treatment Panel III (ATP-III) (I Diretriz Brasileira de Diagnóstico e Tratamento da Síndrome Metabólica, 2005).

Body composition

Body composition was determined using the electric bioimpedance measuring InBody R20. This body analysis uses a system of 4-point tactile electrode which measures total and segmental impedance and the phase angle of the alternating current in 8-12 different frequencies. Through the software, the device calculates body composition based on the tetrapolar bioelectrical impedance. The daily reproducibility of the bioelectric impedance body composition monitors to determine the percentage of body fat is of 3.5-5%.

Evaluations included body fat percentage and fat-free mass, total body mass, height, weight, body mass index (BMI), and waist-hip ratio (WHR).

Biochemical parameters

Blood samples from the volunteers were collected at the municipal laboratory, using specific and standardized methodologies, equipment, and reagent kits (Labtest) for biochemical analysis. Fasting glycemia, lipid profile (LDL-c, HDL-c, and triglycerides), urea and creatinine, glomerular filtration, and activity of the oxalacetic transaminase (TGO) and pyruvic transaminase (TGP) enzymes. Volunteers were asked to fast for 12 hours before blood sampling.

Eating behavior

Eating behavior was evaluated using the *Three Factor Eating Questionnaire* (TFEQ), which estimates eating behavior in three dimensions: cognitive restraint, bingeing, and emotional eating.

Nutrition and physical activity

All participants were oriented to maintain the same physical activity routine they had before the study. The diet plan followed the recommendations of the National Policy of Food and Nutrition (Brasil, 2013). For both groups basal metabolic rate (BMR) was calculated through bioimpedance measuring and considered an activity factor of 1.3. The basal metabolic rate (BMR) is the amount of energy necessary to maintain the vital functions of the organism, and is measured under standardized conditions of fasting, physical and mental rest, calm environment with controlled temperature and lighting, and noiseless (Wahrlich & Anjos, 2001).

The diet plan was developed using the Nuto 1.0 software calculating 50-65% of carbohydrates, 25% of lipids, and 10-15% of protein (normocaloric, normolipidic, and normoproteic) for each individual.

Statistical analysis

The data were treated as means, standard deviation, and p-value. Comparative analyses were made between the means of the data obtained before and after the experiment, within each group (control and treatment), and between the groups. The software Prism, software R (R Core Team, 2019), and the tidy verse package were used for the analysis.

Results

Only eight volunteers (53.33%) from the control group (15 volunteers) and 14 (73%) of the treatment group (19 volunteers) completed the experiment of 4 weeks. The volunteers that dropped out of the experiment did not report their reasons for doing so.

Anthropometric measures

Weight loss in each group, when comparing the weight measured before the experiment to the weight measured after the experiment, showed statistical significance (Control p = 0.0034, treatment p = 0.0002) (Table 1). However, a comparison between the weight loss means from the control group and the treatment group did not show significance.

BMI showed statistical difference both in the control group (p = 0.0034) and in the treatment group (p = 0.0002) (Table 1). However, when comparing both groups, such difference was not observed (p = 0.9217).

Waist circumference did not show a statistically significant change in the control group (p = 0.1007) but presented a significant change in the treatment group (p = 0.0033) (Table 1). Still, comparison between the means of both groups did not show a statistically significant difference (p = 0.6449).

Table 1. Anthropometric results analyzed before and after 30-day experimental intervention in the control and treatment groups.

Control group/Age	Weight (Kg)		BMI (Kgm^{-2})		Waist circumference (cm)	
	Before	After	Before	After	Before	After
31	149.2	148.9	54.8	54.6	150.0	146.0
37	81.1	79.9	34.4	34.0	100.0	95.0
41	86.4	87.1	30.9	31.2	98.0	98.0
27	85.7	85.6	30.0	29.9	94.0	94.0
36	100.1	97.4	41.1	40.0	113.0	116.0
30	96.5	92.0	32.6	31.0	99.0	98.0
36	92.4	89.2	37.0	35.7	102.0	98.0
30	77.3	75.6	28.0	27.4	87.0	78.0
Mean	88.7	88.2	35.0	32.6	103.5	98.0
P-value	0.0034*		0.0034*		0.1007*	
Treatment group/Age	Weight (Kg)		BMI (Kgm^{-2})		Waist circumference (cm)	
	Before	After	Before	After	Before	After
22	79.1	77.4	30.0	29.4	97.0	90.0
45	112.4	109.1	42.8	41.5	133.0	128.0
55	89.6	87.8	36.3	35.6	113.5	112.0
56	74.3	73.2	31.7	31.2	110.0	97.0
58	88.6	86.9	36.8	36.1	103.0	101.0
61	76.1	75.7	29.7	29.5	112.0	106.0
44	92.1	89.1	37.8	36.6	112.0	104.0
47	69.0	69.4	28.3	28.5	93.0	93.0
32	80.9	78.9	33.6	32.8	105.0	109.0
37	97.4	97.4	40.5	40.5	120.5	120.0
31	106.4	103.6	40.5	39.4	120.0	115.0
49	94.7	93.8	41.5	41.1	121.0	120.0
34	88.7	87.9	32.5	32.2	99.0	94.0
33	93.0	91.6	38.2	37.6	110.0	103.0
Mean	89.2	87.9	36.5	35.9	111.0	105.0
P-value	0.0002*		0.0002*		0.0033*	

Control group: diet plan. Treatment group: diet plan + *G. cambogia* 500 mg, 3 times a day. BMI = weight/height^2. Reference value for obesity ⩾ 30Kgm^{-2}. Waist circumference (WC) in cm. Reference value for women = 88cm.

Body composition and basal metabolic rate (BMR)

The values obtained for body fat percentage, muscle mass percentage, basal metabolism rate, and body composition, before and after the experiment, did not show a statistically significant difference in both study groups. The treatment group presented a significant increase in basal metabolism rate when compared to the control group.

Biochemical parameters

The means obtained for glycemia, TC, LDL-c, HDL, TG, TGO, and TGP, from the treatment and control groups, after the experimental intervention, did not show a statistically significant difference in relation to

the results obtained before the intervention (Table 2). Only the control group showed significant differences, after the intervention, for urea values (p = 0.043) (data not shown). Both groups showed significant differences after the intervention for creatinine values (p = 0.0115; p = 0.0072) and creatinine clearance (p = 0.0153; p = 0.0057), respectively (Figure 1).

The triglycerides parameter showed a p value of 0.0538 when both groups were compared. The remaining biochemical parameters did not show statistically significant differences in this analysis (Table 2).

When the means of the creatinine and creatinine clearance from the control group and the treatment group were compared, they presented statistical significance (p < 0.05).

Table 2. Results of the biochemical parameters evaluated in the control and treatment groups, before and after the experimental intervention.

Control group	Total Cholesterol		LDL		HDL		Triglycerides		Glucose	
	Before	After	Before	After	Before	After	Before	After	Before	After
1	180.0	176.0	124.0	119.6	43.1	42.9	64.0	65.0	93.0	95.0
2	180.0	176.0	94.7	107.6	56.9	40.2	142.0	140.0	78.0	73.0
3	225.0	190.0	143.0	107.8	45.0	48.0	220.0	173.0	178.0	147.0
4	173.0	183.0	111.0	114.3	39.4	43.5	110.0	128.0	70.0	78.0
5	198.0	173.0	117.2	99.7	62.0	49.7	94.0	116.0	69.0	81.0
6	127.0	99.0	57.3	37.8	51.7	43.9	90.0	87.0	71.0	83.0
7	180.0	193.0	108.3	126.1	51.9	53.7	99.0	64.0	86.0	84.0
8	194.0	204.0	139.7	140.5	40.4	45.7	69.0	87.0	67.0	73.0
Means	181.5	179.5	112.6	111.0	45.3	44.8	120.0	101.5	83.0	82.0
P value	0.3185		0.4902		0.3742		0.7016		> 0.9999	
Treatment group	Total Cholesterol		LDL		HDL		Triglycerides		Glucose	
	Before	After	Before	After	Before	After	Before	After	Before	After
1	140.0	154.0	95.8	101.6	36.2	39.8	39.0	65.0	84.0	78.0
2	161.0	166.0	91.5	89.2	47.1	47.6	112.0	144.0	85.0	88.0
3	216.0	219.0	152.5	136.9	42.4	57.7	107.0	124.0	91.0	86.0
4	171.0	157.0	83.6	59.5	57.4	47.9	150.0	248.0	108.0	98.0
5	177.0	198.0	99.3	127.6	38.7	42.2	196.0	141.0	134.0	139.0
6	269.0	260.0	191.0	181.2	55.0	56.0	116.0	114.0	83.0	85.0
7	183.0	177.0	115.5	110.8	45.5	39.2	110.0	133.0	80.0	81.0
8	214.0	206.0	130.6	130.8	66.5	53.4	85.0	111.0	82.0	78.0
9	138.0	130.0	55.5	48.0	33.4	33.8	245.0	242.0	88.0	97.0
10	211.0	215.0	125.9	120.9	54.9	48.9	150.0	226.0	93.0	104.0
11	164.0	233.0	73.0	141.9	44.2	41.4	234.0	247.0	86.0	86.0
12	213.0	238.0	135.8	161.0	48.4	43.4	144.0	166.0	61.0	77.0
13	122.0	124.0	72.6	62.7	39.2	48.0	49.0	65.0	79.0	75.0
14	199.0	215.0	133.0	160.0	40.0	35.0	130.0	98.0	73.0	80.0
Means	180.0	198.0	107.4	120.0	44.9	43.4	123.0	141.0	84.7	86.0
P value	0.1380		0.3543		0.5851		0.0913		0.4181	

Reference values: Total cholesterol: optimal < 200 mg dL^{-1}, borderline 200-239 mg dL^{-1} and high > 240 mg dL^{-1}.HDL-c: desirable > 60 mg dL^{-1} and low < 40 mg dL^{-1}. LDL-c: optimal < 100 mg dL^{-1}, desirable 100-129 mg dL^{-1}, borderline 130-159 mg dL^{-1}, high 160-189 mg dL^{-1} and very high > 190 mg dL^{-1}. Triglycerides: desirable < 150 mg dL^{-1}, borderline 150-200 mg dL^{-1}, high 200-499 mg dL^{-1} and very high > 500 mg dL^{-1}. Glycemia: normal 60-99 mg dL^{-1}.

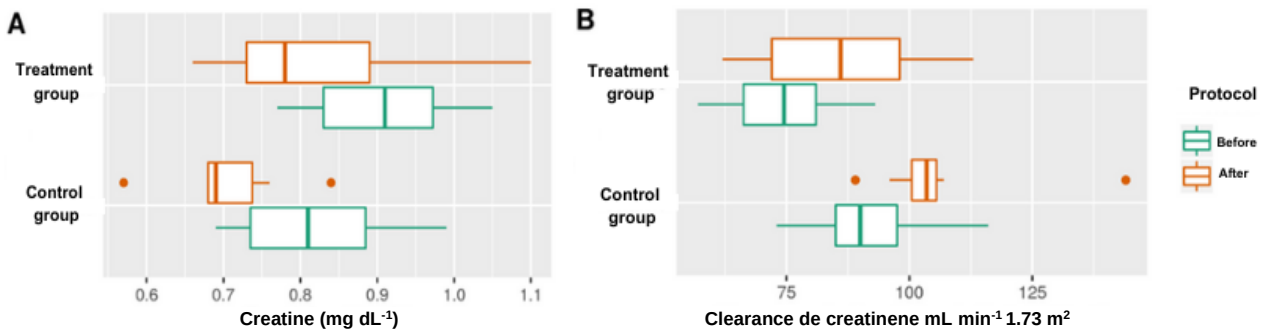

Figure 1. Renal function biochemical parameters analyzed before and after the 30-day experimental intervention in the control and treatment groups. The data are shown as means and standard deviation of the values obtained in each group, before and after the experimental intervention. (A): Blood creatinine results from control and treatment groups before and after the intervention. (B): Creatinine clearance results from control and treatment groups before and after the intervention. Reference Values: Creatinine (0.60 - 1.30 mg dL^{-1}; creatinine clearance: normal > 60 mL min^{-1} 1.73 m^2).

Eating behavior

In relation to eating behavior, the control group did not show statistically significant differences in the analyzed variables. The treatment group showed a significant increase in the cognitive restraint score (p = 0.0051) (Figure 2).

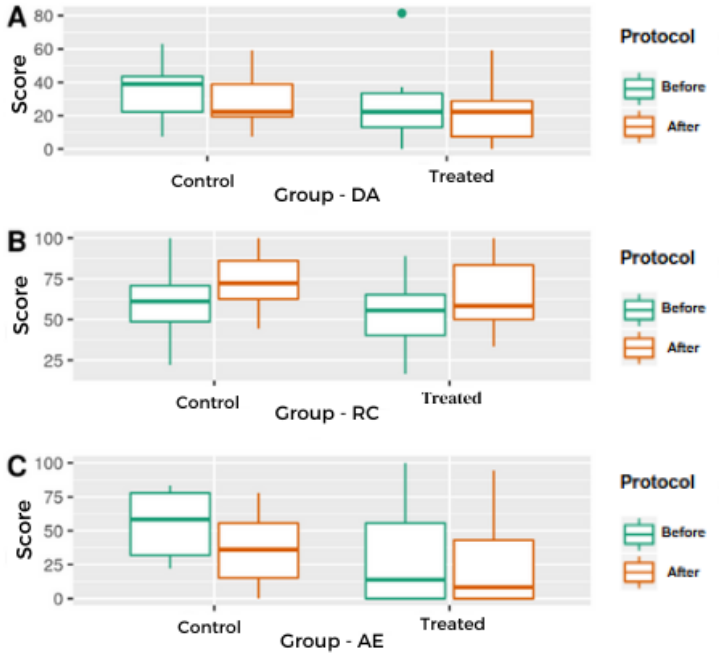

Figure 2. Eating behavior analyzed using data from the Three *Factor Eating Questionnaire*, applied before and after the 30-day experimental intervention in the control and treatment groups.(A) shows results of bingeing in the control and treatment groups before and after experimental intervention. (B) shows results of cognitive restraint in the control and treatment groups before and after experimental intervention. (C) shows results of emotional eating in the control and treatment groups before and after experimental intervention. B = Bingeing.CR= Cognitive restraint. EE= Emotional eating.

Discussion

Obesity has become the subject of many studies due to the increasing number of overweight and obese individuals and to the cost of health care worldwide. The search for immediate results can put in risk the health of people that use commercial products without medical follow up.

Studies with human subjects are important to evaluate the benefits and hazards of many therapies for human health. Many studies showed that *G. cambogia* is effective in promoting weight loss (Sripradha & Magadi, 2015; Golzarand et al., 2020; Mena-García et al., 2022; Feng et al., 2023). However, studies in humans did not show significant changes in the anthropometric variables (Vasques et al., 2014; Ríos-Hoyo & Gutiérrez-Salmeán, 2016; Haber et al., 2018). This is possibly due to limitations inherent to each study, such as a reduced sample number, insufficient intervention time, or statistical methodology models which are inadequate to evaluate biological parameters.

Maia-Landim et al. (2018) were able to show the effectiveness of *G. cambogia* for reducing weight in humans in a long-term treatment (6 months). Our study showed the effectiveness of a normocaloric, normoproteic, and normolipidic diet plan for reducing weight and BMI in the control and treatment groups, during a 4-week intervention period. Beneficial changes in other parameters evaluated were observed in both groups. However, the treatment group showed values that were more significant, especially for: decrease in waist circumference, increase in basil metabolic rate, decrease in creatinine value, improve in creatinine clearance and increase in eating behavior cognitive restraint.

The studies using animals described in literature used a predominance of' a hypercaloric and hyper lipidic diet, however, in most human studies a calorie restriction is used in addition to the use of herbal medicine (Onakpoya et al., 2011). Eating patterns may significantly alter the results once a great part of the action of *G. cambogia* is related to its mechanism of inhibition of ATP citrate-lyase, through HCA, showing a direct action on the lipidic metabolism.

The waist circumference measure reflects subjectively the deposition of abdominal fat and is related to cardiovascular risk (I Diretriz Brasileira de Diagnóstico e Tratamento da Síndrome Metabólica, 2005). This study showed that individuals that used *G. cambogia* at the dosage of 1500 mgday^{-1} showed a significant reduction in waist circumference.

Hayamizu et al. (2003) showed in a 12-week study with humans a reduction in visceral fat, subcutaneous fat, and total fat, analyzed through computerized tomography, after a daily intake of 1667.25 mg of *G. cambogia*. Al-Kuraishy and Al-Gareeb (2016) showed that the association of *G. cambogia* and orlistat was superior to the isolated use of orlistat when analyzing the cardio-metabolic effect and decrease in visceral fat.

It has been proven that a decrease in waist circumference leads to an expressive decrease in visceral fat, improves significantly sensitivity to insulin, decreases plasmatic levels of glucose, which can prevent type 2 diabetes (I Diretriz Brasileira de Diagnóstico e Tratamento da Síndrome Metabólica, 2005), which enhances the relevance of the data from the present study. Although our study did not show the decrease in fat as reported in the literature, it is possible to suggest that fat loss occurred in many volunteers, considering the weight loss and waist circumference data.

The laboratory parameters showed the effectiveness of weight loss for improving renal function in both groups, control, and treatment. When comparing both groups, we could observe a greater increase in glomerular filtration rate and a decrease in creatine values, for the treatment group. Mathew et al., (2011) linked the use of *G. cambogia* to a dose-dependent diuretic action in rats, which could explain the data observed in our study. Up to the moment there are no studies in humans showing this action of *G. cambogia*, which renders our data unprecedented.

We were not able to show statistically significant changes in the TC, LDL-c, HDL-c, TG, and glycemia values, although individual changes were observed. Hence, we consider that a larger intervention time would increase the chances of obtaining significant changes in the evaluated parameters in the groups, hence each organism reacts at different metabolic speeds. According to our study, the treatment group changed its eating habits significantly to a restrained eating habit. The individual which presents a cognitive restraint pattern uses behavioral and cognitive strategies to maintain or lose weight. This type of behavior is related to overweight, and frequently these individuals may show a paradoxical phenomenon described as bingeing (Natacci & Junior, 2011).

In relation to the safety of using *G. cambogia*, we can mention the ANVISA´s regulation, which considers the amount of 1500 mg safe for daily consume, which contains 750 mg day^{-1} of the active principal to which the therapeutic actions are attributed (hydroxycitric acid-HCA). Hepatic alterations described in literature were attributed to the consume of Hydroxicut®, however this formula may present an association of up to 20 ingredients besides *G. cambogia* (Semwal et al., 2015). Kim et al. (2013) did not observe adverse effects in individuals that used supplements of *G. cambogia*, supporting the study by Anton et al. (2013) which also reported “No Observed Adverse Effect Level” (NOAEL), after an assessment of doses over 4000 mgday^{-1}. In review studies by Chuah et al. (2012), the authors reported "No Observed Adverse Effect Level" (NOAEL), for doses of GC/HCA of up to 2800 mgday^{-1}, suggesting that it is safe for use. Hence, scientific reports describe the therapeutic effectiveness of GC/HCA, and an absence of toxicity (Chuah et al., 2012; Calaquian & Yau, 2022).

Our study showed, during the period that was studied, in relation to liver function, that the use of *G. cambogia* in the dosage of 1500 mg day^{-1} is safe, and changes in the TGO and TGPn exams or any type of symptoms were not observed or reported by the patients. Still, we point out that herbal medicines commonly used by the population should be used with caution, preferably with medical recommendation and follow up.

Conclusion

The *G. cambogia* extract presented an auxiliar action to the diet plan, promoting improvements in some morphological and biochemical parameters, such as: decrease in waist circumference, increase in metabolic basal rate, decrease in creatinine values, improvement in creatinine clearance and increase in cognitive restraint in relation to eating habits, demonstrating to be a complementary alternative in the treatment of overweight and obese individuals. This study reinforces the safety of this herbal medicine, under the tested conditions, due to the absence of liver alterations. The authors reinforce that, in face of the complexity of the mechanisms involved in the process of obesity, that changes in lifestyle such as healthy eating habits and physical activity should be associated to a pharmaceutical and/or herbal medicine treatment.

Acknowledgments

The authors would like to thank the Health Sciences Graduate Program (PPGDSA), of the National Council for Scientific and Technological Development (CNPq), the Coordination for the Improvement of Higher Education Personnel (CAPES) and the Research Support Foundation of Minas Gerais (FAPEMIG) and the Federal University of Lavras (UFLA), Brazil.

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