Scholars LITERATURE

La Prensa Medica Argentina

Research Article

DOI: https://doi.org/10.47275/0032-745X-218
Volume 106 Issue 4

Effect of Green Tea Extract on Body Weight and Serum Lipid Profile in Obese Subjects

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Abstract

Objective: The present study aims to investigate the anti-obesity effects of green tea extract (GTE) which contains a very low dose of polyphenols and Epigallocatechin gallate, (EGCG) in obese young adult males.

Methods: A total of 50 young healthy obese male (BMI ≥ 30) within the age range 24-35 years were included in the study and were randomly assigned to either of one group placebo (1 gram gluten-free corn flex) or GTE group (349 mg of polyphenols and 136 mg of EGCG; 4 capsules/day) for 12 weeks. Bodyweight, BMI, lipid profile (total cholesterol, LDL, triglycerides, HDL) were measured in the study subjects at the start of the study and after 12 weeks of supplementation. Appropriate statistical analysis was applied to analyse the data.

Results: Remarkable decrease in body weight (weight, 89.2±6.2 kg *vs.*75.4±6.3 kg, $p<0.001$) and BMI (31.6±1.5 kg/m^2 *vs.* 26.6±1.4 kg/m^2, $p<0.001$) were observed in only GTE group after 12 weeks but not in placebo group (weight: 88.6±6.9 kg *vs.* 88.0±6.6 kg; BMI: 31.2±1.1 kg/m^2 *vs.* 30.9±0.9 kg/m^2). Serum lipids total cholesterol (282.2±14.8 *vs.* 188.0±7.2), LDL (187.8±5.6 *vs.* 122.7±4.5 mmoles/L), triglycerides (281.2±10.8 *vs.* 168.9±7.6 mmoles/L) were reduced and HDL (28.5±2.7 *vs.* 37.5±3.1 mmoles/L) was increased only in GTE ingesting group after 12 weeks. No significant difference in total cholesterol, LDL, triglycerides and HDL was seen in placebo group after 12 weeks. No side effects or adverse events was noted in any study subjects.

Conclusion: This study establishes that low doses of green tea extract for 12 weeks are effective in reducing the body weight, BMI, total cholesterol, LDL and triglycerides as well as increasing the HDL in young obese males. Our results confirm the beneficial effect of green tea extract.

Keywords: Green tea extract; Polyphenols; Epigallocatechin gallate; Obesity; Body weight; Lipids

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Citation: Ahmad DA (2020) Effect of Green Tea Extract on Body Weight and Serum Lipid Profile in Obese Subjects. Prensa Med Argent, Volume 106:4. 218. DOI: https://doi.org/10.47275/0032-745X-218.

Received: February 23, 2020; **Accepted:** March 06, 2020; **Published:** March 11, 2020

Introduction

Overweight and obesity is a preventable common health problem increasingly seen in young populations globally. According to WHO, in 2016, more than 1.9 billion adults aged >18 years were overweight of which 650 million were obese [1]. According to the Global Burden of Disease study in 2013, middle eastern countries have the highest incidences of overweight and obesity in both the genders [2]. Obesity alone is known to affect the serum lipid profile. It increases total cholesterol, LDL, triglycerides and reduces HDL [3,4]. Altered serum lipid profile forms a gateway to numerous adverse health conditions such as diabetes mellitus, hyperlipidaemia and cardiovascular diseases [5,6]. Hence, treating overweight and obesity could normalize the deranged lipid profile thus reducing the risk of these deadly diseases.

Current treatment regime for obesity includes pharmacological interventions for Class I (BMI 30-34 kg/m^2) and Class II (BMI 35-40 Kg/m^2) obesity while for Class III (BMI>40 kg/m^2) obesity bariatric surgery is recommended [7]. Among pharmacological drugs, statins (HMG Co-A reductase inhibitor) are widely used as lipid lowering agents [8]. Although they are efficient in reducing total cholesterol, LDL, and triglycerides as well as increasing HDL; consistent use of statins is associated with incidences of hepatotoxicity and myalgia as evident from human studies and animal experiments [9-11]. Hence, presently natural alternatives rather than synthetic drugs are most sought after as they are known to have fewer side effects.

Green tea (*Camellia sinensis*, GT) is increasingly becoming a healthy beverage worldwide due to its numerous beneficial effects on human health. GT is an abundant source of polyphenols called catechins (epiogallocatechin-3-gallate (EGCG), epigallocatechin (EGC), epicatechin gallate (ECG), and epicatechin (EC). Among them EGCG is the most pharmacologically active component [12]. In recent years, a plethora of studies have been conducted on examining the anti-obesity effect of GT. Nonetheless, the result from these studies are not consistent. Huang et al., reported that GTE treatment for 6 weeks reduced weight and LDL in obese women but had no effect on BMI, total cholesterol, triglyceride and HDL [13]. In another study, GTE consumption for 8 weeks considerably decreased body weight and BMI but only mildly affected LDL and no effect on total cholesterol, triglyceride and HDL [14]. Hsu CH, et al. (2018) observed that in obese women who received GTE for 12 weeks had no difference in

body weight, BMI and total cholesterol compared to placebo but had remarkably lowered LDL, triglyceride and increased HDL [15]. Yet, in another study, GTE supplementation for 3 months decreased BMI, total cholesterol, LDL, triglyceride and increased HDL [16].

Hence, more human data from different ethnic background is required to bring a conclusive view on beneficial effects of GTE on body weight, BMI, and lipid profile. In this study we aimed to examine the effect of GTE treatment on lipid profile and weight of young obese Saudi men.

Methods

Study patients

The study was conducted from January 2018 till January 2019 in Kirkuk city /Iraq.

A total of 50 men were recruited in the study who fulfilled the inclusion and exclusion criteria. Inclusion criteria: age between 20-35 years, BMI≥30 kg/m^2, and stable body weight (>3 kg of self-reported change in last 3 months). Exclusion criteria: taking any medications, suffering from any chronic diseases, smokers, taking alcohol and non-consenting individuals.

Written informed consent was obtained from all the study subjects prior to initiation of the study. The study protocol was approved by Human Ethics Committee of our hospital.

Study Design

The study is a prospective, randomised, and double-blinded in design. Randomization was done by a computer. Both the patients and researchers were blinded to the randomization.

All the study subjects were randomly assigned to either of the two groups: GTE group and placebo group. GTE group received green tea extract (Whitworths Ltd, Wellingborough, United Kingdom) in capsular form with 4 capsules/day for 12 weeks. Four capsules of green tea extract consisted a total of 340 mg of polyphenols and 136 mg of Epigallocatechin gallate (EGCG). Placebo group received 1 g of gluten free corn flex for 12 weeks.

Body weight and BMI measurements

Anthropometric measurements were done using standardized methods, with light clothing's and without shoes at the beginning of the study and after 12 weeks of treatment. Weight was measured to the nearest 0.1 kg and height was measured to the nearest 0.1-0.5 cm. BMI was calculated as weight/(height)^2 kg/m^2. Patients were classified as obese if BMI was ≥30kg/m^2.

Biochemical measurements

Venous blood was collected from study patients after overnight fast in serum separation tubes. Coagulated blood was kept at room temperature for 30 min and then centrifuges at 2000 rpm for 15 min at 4℃. Serum thus separated was stored at -80℃ until used.

Serum total cholesterol, LDL, triglycerides and HDL were measured at baseline and after 12 weeks of treatment. The above biochemical parameters were determined using absorption photometry (Cobas 6000C, Roche Applied Sciences).

Statistical analysis

All the data were statistically analysed using the Statistical Package for Social Sciences, version 21.0 (SPSS, Chicago, Ill). Data was presented as mean and standard deviation. Variables at baseline and at 12 weeks between groups were analysed using independent *t* test. Paired *t* test was used to measure the difference within groups at baseline and at 12 weeks. A p value ≤0.05 was considered statistically significant.

Results

Baseline characteristics

A total of 50 healthy males (mean age 26.9±2.6 years) who were compliant with inclusion and exclusion criteria were recruited for the study. The baseline demographic and biochemical characteristics of the control and treated groups is shown in table (Table 1). Age, body weight, BMI and total cholesterol levels were comparable between placebo and GTE groups at baseline. However, LDL, triglyceride, HDL, total cholesterol/HDL ratio and LDL/HDL ratio levels were considerably different at baseline between the groups.

Following 12 weeks of intervention, statistically significant reduction in body weight (p<0.001), BMI (p<0.001), cholesterol (p<0.001), LDL (p<0.001), triglyceride (p<0.001), total cholesterol/HDL (p<0.001) and LDL/HDL ratio (p<0.001) was observed in GTE group compared to placebo group. On the other hand, HDL levels (p<0.001) were increased in GTE group as compared to placebo (Table 2).

Twelve weeks of treatment with GTE caused significant reduction in body weight (<0.001), BMI (<0.001), cholesterol (<0.001), LDL (<0.001), triglycerides (<0.001), total cholesterol/HDL (p<0.001) and LDL/HDL (p<0.001) as well as considerable increase in HDL (<0.001). In placebo group, after 12 weeks, all the parameters studied were not statistically significant except HDL which was slightly reduced (p<0.05) and was statistically significant (Table 3).

Discussion

Although numerous studies have investigated the beneficial effect

Table 1: Baseline characteristics of both groups.

Variables	Placebo (n=25) (Mean ± SD)	GTE (n=25) (Mean ± SD)	P value
Age	27.2±2.3	26.6±2.9	0.376 (ns)
Body weight	88.6±6.9	89.2±6.2	0.733 (ns)
BMI	31.2±1.1	31.6±1.5	0.210 (ns)
Total cholesterol	281.4±16.0	282.2±14.8	0.856 (ns)
LDL	167.4±8.7	187.8±5.6	<0.001
Triglyceride	308.2±20.9	281.2±10.8	<0.001
HDL	32.2±1.4	28.5±2.7	<0.001
Total cholesterol/HDL ratio	8.7±0.7	10.0±1.2	<0.001
LDL/HDL ratio	5.2±0.4	6.6±0.6	<0.001

Assessment between groups at 12 weeks

Table 2: Between group comparison of variables after 12 weeks.

Variables	Placebo (n=25) (Mean ± SD)	GTE (n=25) (Mean ± SD)	P value
Age	88.0±6.6	75.4±6.3	<0.001
Body weight	30.9±0.9	26.6±1.4	<0.001
BMI	280.2±13.6	188.0±7.2	<0.001
Total cholesterol	166.8±9.0	122.7±4.5	<0.001
LDL	310.1±21.8	168.9±7.6	<0.001
Triglyceride	31.4±1.8	37.5±3.1	<0.001
HDL	8.9±0.7	5.0±0.6	<0.001
Total cholesterol/HDL ratio	5.3±0.4	3.2±0.3	<0.001
LDL/HDL ratio	5.2±0.4	6.6±0.6	<0.001

Assessment between groups at 12 weeks

Table 3: Comparison of various parameters within group at baseline and after 12 weeks of treatment.

Variable	Placebo (n=25) (mean±SD)			GTE (n=25) (mean±SD)		
	Baseline (A)	12weeks (B)	P value	Baseline (A)	12weeks (B)	P value
Body weight	88.6±6.9	88.0±6.6	0.479	89.2±6.2	75.4±6.3	<0.001
BMI	31.2±1.1	30.9±0.9	0.244	31.6±1.5	26.6±1.4	<0.001
Cholesterol	281.4±16.0	280.2±13.6	0.407	282.2±14.8	188.0±7.2	<0.001
LDL	167.4±8.7	166.8±9.0	0.422	187.8±5.6	122.7±4.5	<0.001
Triglyceride	308.2±20.9	310.1±21.8	0.175	281.2±10.8	168.9±7.6	<0.001
HDL	32.2±1.4	31.4±1.8	0.036	28.5±2.7	37.5±3.1	<0.001
Total cholesterol/HDL ratio	8.7±0.7	8.9±0.7	0.079	10.0±1.2	5.0±0.6	<0.001
LDL/HDL ratio	5.2±0.4	5.3±0.4	0.119	6.6±0.6	3.2±0.3	<0.001

of GTE on body weight, BMI and deranged lipid levels, the outcome from these studies are not consistent. We report that ingestion of GTE containing polyphenols and low dose of EGCG for 12 weeks reduces weight, BMI, total cholesterol, LDL, triglycerides, and increases HDL in obese males.

Green tea extract enriched with polyphenols and catechins especially EGCG has great potential in reducing obesity mainly by altering lipid levels. EGCG interferes with the cholesterol solubilization by affecting micellar formation and hence lowers cholesterol absorption [17]. EGCG dose ranging from >350 mg to ≤1000 mg was found to be safe and effective in reducing weight, BMI and atherogenic lipid levels although the outcome was not consistent [13-16]. Huang LH, et al. (2018), observed that daily consumption of 856.8 mg of GTE for 6 weeks reduced weight and LDL in obese women without affecting BMI, total cholesterol, triglyceride and HDL [13]. A report by Basu A, et al. (2010) found that approximately 440- 460 mg of GTE intake daily for 8 weeks considerably decreased body weight and BMI but only mildly affected LDL and had no effect on total cholesterol, triglyceride and HDL [14]. Hsu CH, et al. (2008) observed that in obese women who received 400 mg of GTE every day for 12 weeks had no difference in body weight, BMI and total cholesterol compared to placebo but had remarkably lowered LDL, triglyceride and increased HDL [15]. Yet, in another study, 379 mg of GTE supplementation containing 208 mg of EGCG every day for 3 months decreased BMI, total cholesterol, LDL, triglyceride and increased HDL [16,17]. On the contrary, high single dose of EGCG (1500 mg/kg) or 750 mg/kg of EGCG twice daily was found to be hepatotoxic in experimental model of obesity [18]. In another study, EGCG from GTE has been shown to induce acute cytotoxicity in liver cells [19]. In accordance with Sulibursk J, et al. (2012) we found that, in young male adults consuming a very low dose of EGCG (136 mg/day) along with 340 mg/day of polyphenols was very effective in reducing the body weight, BMI, total cholesterol, LDL, triglycerides as well as increasing HDL [16]. Together it indicates that beneficial effects of GTE and EGCG on obesity as well as deranged lipid levels is evident at a very low dose as compared to high dose.

Chen et al., in their study had shown that the baseline characteristics of placebo and GTE group were similar. After 12 weeks, only total cholesterol and LDL were decreased in GTE group, but no difference was evident after 12 weeks in placebo group [20]. Other studies have also noted the similar trend [13-16]. In our study, although the basal level of LDL, triglycerides and HDL were different between GTE group and placebo, after 12 weeks treatment, decrease in LDL, and triglycerides was seen only in GTE group. No statistically significant difference was observed in placebo group indicating that irrespective of the initial difference between groups, actual reduction is seen in only in GTE group.

The present study has several limitations. The bioavailability of low dose EGCG was not investigated in our study. Chow HH, et al. (2003), reported that a high daily dose of EGCG (≥800 mg once) elevates EGCG by >60% in plasma [21]. On the contrary, the daily EGCG intake was much lower to that reported in the above study and it was spread over 2 or 4 doses per day, and the bioavailability in this case of very low doses needs to be investigated. Furthermore, the effect of low dose of EGCG spread throughout a day on liver enzymes also needs to be investigated, although we assume to have no toxic or negligible effect.

Conclusion

The current study demonstrates that low doses of EGCG coupled with polyphenols in green tea extract, when taken intermittently (4 capsules/day) for 12 weeks is effective enough in reducing body weight, BMI, high total cholesterol, LDL, and triglycerides as well as increasing the HDL in young obese males. Although, our study confirms the beneficial effect of GTE, further studies on larger population from different ethnicities is needed to support our data.

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