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The Effect of Green Coffee Bean Extract Supplementation on Anthropometric indices, Lipid Profile and High-sensitivity C-reactive Protein in adult men with Dyslipidemia

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Abstract

Background: Dyslipidemia is the first modifiable risk factor for cardiovascular disease. Chlorogenic acid which is abundantly found in Green Coffee Bean has a significant anti-oxidant and anti-inflammatory properties. Objectives: The aim of this study was investigating the effects of Green Coffee Bean Extract (GCBE) on some biomarkers of dyslipidemic patients. Methods: This study is a randomized, placebo-controlled, clinical trial. 70 subjects were assigned to use 800 mg/day GCBE supplements or placebo for 8 weeks, to examine Anthropometric indices, Lipid Profile and High-sensitivity C-reactive Protein. Results: GCBE supplementation significantly decreased weight, visceral fat and hs-CRP and significantly increased HDL-C level in intervention group ($p<0.05$). Conclusion: GCBE supplement may improve weight, visceral fat, hs-CRP and HDL-C but there were no positive effects on triglyceride, total cholesterol and LDL-C.

Keywords: Green Coffee Bean Extract, Dyslipidemia, Lipid Profile, Anthropometric Indices.

Introduction

Cardiovascular diseases account for 80% of the total deaths from non-communicable diseases in the world (Pappachan, 2011). Regardless of smoking, dyslipidemia is the first modifiable risk factor for cardiovascular disease (Hendrani and et al., 2016). Dyslipidemia include increased plasma level of total cholesterol, triglyceride and low-density lipoprotein (LDL) and decreased level of high-density lipoprotein (HDL) (National Library of Medicine, 2006). Several evidences show the main role of dyslipidemia in the progression of atherosclerosis and the development of cardiovascular disease (Hendrani and et al., 2016). Dyslipidemia can damage the endothelium and trigger stages of atherogenesis (Hurtubise and et al., 2016). One of the main approaches of reducing the mortality rate of cardiovascular disease is to prevent and reduce the incidence of Dyslipidemia (Pereira and et al., 2015). Two main methods of control and treatment of dyslipidemia are lifestyle interventions and drug therapy and the latest American Heart Association guidelines for preventing cardiovascular disease are healthy diet patterns, maintaining weight, blood pressure and lipid profiles in the normal range (Gotto 2002).

Antioxidants decelerate the process of vascular atherosclerosis and progression of cardiovascular disease (Zhang and et al., 2014). Chlorogenic acid is a polyphenol with antioxidant properties which is found abundantly in green coffee beans that is an ester of cynnamic acids such as caffeic acid, ferulic acid and p-coumaric acid with quinic acid (Budryn and et ak., 2017; Ayelign & Sabally, 2013). Evidence suggests that this antioxidant compound is likely to have hypoglycemic and hypolipidemic effects through mechanisms such as decreasing the activity of fatty acid synthesis enzymes in the cytosol of the liver cells, and a significant increase in the activity of

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fatty acid oxidative enzymes in the mitochondria of the liver cells (Tanaka and et al., 2009; Budryn and et al., 2017). The anti-

inflammatory effects of this compound have also been reported in some studies. These features, along with the anti-bacterial, anti-oxidant and anti-carcinogenic properties of chlorogenic acid, have suggested its effectiveness in the treatment or prevention of certain chronic diseases such as cancers, cardiovascular disease, aging and neurodegenerative disease (Budryn and et ak., 2017; Ayelign & Sabally, 2013; Li and et al., 2012; Song and eta l., 2014).

Considering that the biological effects of green coffee bean extract has not been investigated in patients with dyslipidemia, it seems necessary to perform such studies to find solutions for the treatment of dyslipidemia and prevention of cardiovascular disease. The aim of this study was to evaluate the effect of green coffee bean extract supplementation on anthropometric indices, lipid profiles, high sensitivity C-reactive protein in men with dyslipidemia.

Material and Methods

Study design and participants

This randomized, double-blind, placebo-control clinical trial evaluated the effect of 800 mg GCBE supplementation on anthropometric indices, lipid profile and hs-CRP in adult men with dyslipidemia. 75 dislipidemic male employees aged 30 to 55 years from a Petrochemical company in Southwest of Iran who have inclusion criteria were enrolled for this 8-week intervention study. According to previous studies, this period is suitable for the effect of polyphenols on body composition and alteration of inflammatory factors and adipocytokines (Wedick and et al., 2014; Dellalibera and et al., 2006).

Inclusion criterias were having dyslipidemia (abnormalities of at least one of the blood lipids and lipoproteins, total cholesterol >200mg/dl, triglyceride>150mg/dl, LDL-C>130mg/dl, HDL-C<50 in women and <40 in men (Tabatabaei-Malazy and et al., 2014)). diagnosed by blood lipid profile test, aged 30-55 years and desire to participate in the study.

Exclusion criterias were taking lipid lowering drugs, history of heart disease, kidney, liver and endocrine disorders, weight loss or weight gain in the last 6 month, adhering to weight loss or weight gain or vegetarian diet in the last 6 month, consumtion of any anti-oxidant supplement in the last 6 month, coffee intolerance and coffee addiction.

This study was approved by the ethics committee of Ahvaz Jundishapur University of Medical Sciences (No. IR.AJUMS.REC.1396.899).

After obtaining written consent from the participants, the required data were collected using questionnaires (demographic data, 3-day food recall and physical activity), blood tests and anthropometric examinations. Subjects were randomly assigned to two groups of GCBE and placebo using blocked randomization method, size of 4.

The capsules which were coded with A and B, were given to participants. They were asked to take two capsules daily, one capsule before lunch and another one before dinner. each GCBE supplement contains 400mg decaffeinated GCBE with 50% chlorogenic acid, each placebo capsule contains 400 mg starch. The supplement and placebo capsules manufactured by Sabzdaru company, Isfahan, IRAN.

Physical activity, dietary intake assessment

The participants were advised not to change their usual physical activity and dietary intake during study. Dietary intake which was obtained at the beginning and the end of study include total energy, macronutrients, fiber, cholesterol, poly unsaturated fatty acid (PUFA), mono unsaturated fatty acid (MUFA) and saturated fatty acid (SFA) was assessed by using 3-day food recall and analyzed using NUTRITIONIST IV software. Physical activity of subjects was assessed by using the International Physical Activity Questionnaire (IPAQ) at baseline and the end of study. Data from the IPAQ were converted to metabolic equivalent (MET) minutes/week using the guidelines (Wolin and et al., 2008).

anthropometric and biochemical assessments

Weight, height, waist circumference, total body fat and visceral fat percentage (using OMRON-BF-511 body composition analyzer) were measured according to existing standard protocol at the beginning and the end of the study.

10 cc blood sample were collected from the participants in 10-12 hours overnight fasting state at before and after study. The lipid profile including total cholesterol, triglyceride, HDL-C and LDL-C were measured by enzymatic method (Pars Azmoon Co, Tehran, Iran). Enzyme-linked immunosorbent assay (ELISA) kit were used to assay Hs-CRP (Zellbio Co, Germany).

Statistical Analysis

To determine the distribution normality of data, Kolmogorov-Smirnov test was used. According to the normal or abnormal distribution of the data, a T-test or Mann-Whitney test was used for comparison between the two groups and T-test or Wilcoxon test was used to compare the results before and after each group. Data were analyzed by SPSS software version 22 with a significant level of 0.05.

Results

Five samples (two in the intervention group and three in the placebo group) from the 75 subjects because of travel and mission, were excluded.

As shown in Table 1, there was no significant difference between the intervention group (n = 36) and the control group (n = 34) in age, weight and other anthropometric indices.

In the intervention group, weight, BMI and visceral fat percentage decreased significantly. In this group, the mean weight (kg) decreased from 92.46 ± 15.2 to 91.82 ± 15.1 , p=0.009, mean Body Mass Index (kg/m) decreased from 26.40 ± 4.3 to 26.21 ± 4.3 , p=0.009 and mean visceral fat (%) reduced from 13.3 ± 4.4 to 12.53 ± 4.2 , p=0.018. However, there were no significant changes in these variables in the placebo groups.

Table 1: The mean age and anthropometric indices at the beginning and the end of the study in two groups

Variable		Intervention Group M±SD	Placebo group M±SD	P^1	P^2
age (year)		6.2±39/5 1	5.8±38.42	0.62	_____
weight (kg)	Week 0	92.46±15.2	91.39±12.2	0.86	0.51
	Week 8	91.82±15.1	91.00±12.2	0.91	
	P^3	0.01	0.28	-	
BMI	Week 0	26.39±4.3	26.12±3.1	0.76	0.51
	Week 8	26.21±4.3	26.01±3.1	0.82	
	P^3	0.009	0.20	-	
Waist circumference	Week 0	104.81±10.5	105.68±8.4	0.26	0.63
	Week 8	104.60±10.7	105.25±9.0	0.41	
	P^3	0.47	0.20	-	
BF	Week 0	29.69±5.2	29.69±3.9	0.99	0.94
	Week 8	29.31±4.9	29.35±3.8	0.97	
	P^3	0.32	0.32		
LBM	Week 0	32.85±2.8	32.93±4.4	0.93	0.36
	Week 8	33.24±2.8	33.75±2.4	0.41	
	P^3	0.1	0.27		
Visceral fat	Week 0	13.03±4.4	12.79±3.01	0.80	0.61
	Week 8	12.53±4.2	12.53±2.7	0.99	
	P^3	0.018	0.22		

P^1 : result from independent t-test or mann-withney test
P^2: result of the comparison of mean changes in both groups (independent t-test or mann-withney test)
P^3 : result from Paired t-test or Wilcoxon

Table 2 shows dietary and calori intake of subjects in two groups. As can be seen, there was no significant difference in these variables between two groups at baseline and the end of study.

Table 2: The mean energy and nutritional intake at the beginning and the end of study in two groups

Variable		Intervention group M±SD	Placebo group M±SD	P^1	P^2
TEE	Week 0	3279±679	3242±520	0.8	0.30
	Week 8	3181±659	3177±476	0.98	
	P^3	0.0001	0.004		
Energy (kcal)	Week 0	3266±675	3181±703	0.61	0.85
	Week 8	3251±610	3157±603	0.52	
	P^3	0.50	0.38		
Protein (g)	Week 0	121.9±26.5	121.2±27.4	0.91	0.96
	Week 8	121.1±25.6	120.4±24.5	0.90	
	P^3	0.49	0.47		
Carbohydrate (g)	Week 0	485.5±100.5	468.3±114.6	0.51	0.75
	Week 8	482.4±94.5	465.4±106.9	0.49	
	P^3	0.097	0.28		
Fat (g)	Week 0	101.3±33.9	98.9±34.6	0.77	0.59
	Week 8	100.4±32.0	97.1±31.2	0.66	
	P^3	0.42	0.16		
SFA (g)	Week 0	35.0±11.7	34.7±12.8	0.91	0.85
	Week 8	34.5±11.3	34.0±11.8	0.86	
	P^3	0.39	0.29		
Cholesterol (g)	Week 0	239.3±76.1	234.4±81.9	0.48	0.75
	Week 8	237.9±73.6	236.3±80.2	0.44	
	P^3	0.53	0.69		
PUFA (g)	Week 0	45.7±15.3	43.1±15.0	0.80	0.51
	Week 8	45.5±14.9	42.8±14.2	0.93	
	P^3	0.67	0.40		
Fiber (g)	Week 0	24.5±5.4	23.5±6.0	0.48	0.90
	Week 8	24.2±5.0	23.2±5.3	0.43	
	P^3	0.14	0.24		

P^1 : result from independent t-test or mann-withney test
P^2: result of the comparison of mean changes in both groups (independent t-test or mann-withney test)
P^3 : result from Paired t-test or wilcoxon

As shown in Table 3, there was no significant difference in lipid profile (triglyceride, total cholesterol, LDL-C, HDL-C) and hs-Crp between the two groups at baseline. At the end of the study, the mean level of triglyceride decreased in the intervention group and increased in the placebo group, but these changes were not significant. There were no significant increase in total cholesterol and LDL-C in two groups. The increase in HDL-C was also observed in both groups, which was significant in the intervention group. After 8 weeks, hs-Crp level was significantly decreased in the intervention group, however the reduction in the control group was not significant.

Table 3: The mean lipid profile and hs-Crp at the beginning and the end of study in two group

variable		Intervention Group M±SD	Placebo group M±SD	P^1	P^2
TG	Week 0	193.14±54.6	197.26±78.3	0.80	0.52
	Week 8	191.69±60.5	205.06±85.1	0.45	
	P^3	0.89	0.48		
TC	Week 0	200.69±34.0	210.79±38.1	0.25	0.88
	Week 8	208.22±31.6	216.91±50.3	0.39	

	P [3]	0.07	0.50		
HDL	Week 0	44.17±9.5	45.32±9.2	0.61	0.12
	Week 8	48.64±7.4	47.18±8.2	0.43	
	P [3]	0.00001	0.13		
LDL	Week 0	116.78±27.9	124.26±32.0	0.30	0.35
	Week 8	117.00±27.8	132.76±41.6	0.065	
	P [3]	00.96	0.26		
HsCrp	Week 0	4.49±3.0	3.73±1.7	0.20	>0.0001
	Week 8	2.81±2.0	4.17±1.6	0.003	
	P [3]	0.001	0.11		-

P[1] : result from independent t-test or mann-withney test
P[2]: result of the comparison of mean changes in both groups (independent t-test)
P[3] : result from Paired t-test or wilcoxon

Discussion

This study is the first randomized clinical trial that investigated the effects of 800mg/day GCBE supplementation on anthropometric indices, lipid profile and hs-CRP in adult men with dyslipidemia. The results of this study showed that 8 weeks of GCBE supplementation caused a significant increase in HDL-C and reduction in hs-CRP, BMI and visceral fat in adult men with dyslipidemia, however these changes were not significant in the control group.

Given that lipogenesis suppression and lipolysis amplification are the most important metabolic effects of chlorogenic acid, it can be attributed to the effects of this supplement on increasing HDL-C and reducing weight, visceral fat and hs-CRP (Tanaka and et al., 2009). The most significant difference between the two groups was the reduction in hs-CRP. Hs-CRP increased in the control group but decreased significantly in the intervention group and the mean changes were also significant between the two groups. Therefore, the anti-inflammatory effects of this compound are likely to have the most important role in changes in HDL-C, weight and visceral fat of the subjects.

Green Coffee Bean Extract contains a significant amount of chlorogenic acid, which lowers LDL-C and total cholesterol and triglyceride levels in the serum and liver (Tanaka and et al., 2009). The mechanism of chlorogenic acid effect on lowering blood lipids is associated with inhibiting the intestinal absorption, transfer and liver biosynthesis of lipids and cholesterol (Li and et al., 2012).

Samadi et al., in a review article of effects of GCBE on weight loss have concluded that the the weight loss properties of green coffee extract are related to its chlorogenic acid content (Samadi and et al., 2015). In 2008, Tanaka et al., conducted a study to investigate the anti-obesity and hypo-triglyceridemic properties of raw coffee bean extract in SD male rats. Weight gain and adipose tissue in rats fed with raw coffee bean extract significantly decreased compared to control group. In the intervention group, the activity of the fatty acid synthesis enzymes in cytosol of liver cells significantly decreased and the fatty acid oxidative enzymes activity increased significantly in mitochondria of liver cells and suggested that the raw CBE has anti-Obesity properties and may reduce triglyceride levels in the blood and liver and these effects are likely due to lipogenesis suppression and lipolysis amplification (Tanaka and et al., 2009). Galvez et al., In a review article on the role of chlorogenic acid on metabolic syndrome, posed their positive effects on dyslipidemia (Santana-Gálvez and eta l., 2017). Cho et al., observed that chlorogenic acid and caffeic acid supplementation in rats caused a significant reduction in serum free fatty acid, total cholesterol, triglyceride and a significant increase in HDL-C (cho and et al., 2010). Wan et al., studied the effect of chlorogenic acid on lipid profile of hypercholesterolemic rats and have found a significant decrease in LDL-C and a significant increase in HDL-C (Wan and et al., 2013). Chlorogenic acid significantly increases the level of mRNA of the PPAR-α gene expression in the liver, and the hypoplipidemic effects of chlorogenic acid are related with PPAR-α effects on simplification of lipid metabolism in the liver (Li and et al., 2012). In the present study, there was a significant increase in HDL-C and decrease in triglyceride level in the intervention group but was not significant. Total cholesterol and LDL-C increased, but these changes were not significant. Contradictory results may be justified by the different doses, the type of GCBE supplement and the length of study.

The results of this study also showed a significant reduction in hs-CRP. ShahMohammadi et al., investigated the effect of GCBE on patients with fatty liver and reported a significant decrease in hs-CRP in the intervention group (Shahmohammadi and et al., 2017).

Song et al., studied the effect of GCBE on serum leptin and adiponectin levels in rats fed with high fat diet and observed lower levels of leptin and higher adiponectin in intervention group compared to control group. The researchers concluded that these changes in plasma biomarkers of inflammation are due to the effects of chlorogenic acid content of decaffeinated GCBE (Song and et al., 2014).

Recent findings have shown effectiveness of green coffee in reducing the accumulation of adipose tissue and inflammation. The results of the studies suggest that a wide range benefits of chlorogenic acid can provide a non-invasive and non-pharmacological approach to the treatment or prevention of some chronic diseases (Li and et al., 2012; Song and et al., 2014; cho and et al., 2010). Overall, the results of this clinical trial showed that the supplementation of GCBE in adult men with dyslipidemia had positive effects on weight, BMI, visceral fat and HDL cholesterol. Recommendation for the use of Green Coffee to patients with dyslipidemia can be useful due to its antioxidant and anti-inflammatory properties, but for improvements in lipid profiles more extensive human studies are needed.

Conclusion

GCBE supplement may improve weight, visceral fat, hs-CRP and HDL-C but there were no positive effects on triglyceride, total cholesterol and LDL-C. Future studies should focus on mechanism of GCBE supplement effects on inflammatory and lipids factors.

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