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*Original Artical***Effects of Green Tea Consumption on Serum Lipid Pattern in Women.**Tabassum S^{1*}, Akhter QS², Khan S³, Quddus GMR⁴, Rahman F⁵, Nazmin S⁶, Mou US⁷

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Corresponding Author*Abstract**

Background: Dyslipidaemia is an important risk factor for Coronary artery diseases (CAD) and stroke. The National Cholesterol Education Program-Adult Treatment Panel (ATP-III) suggested lifestyle intervention including diet, exercise and judicious use of pharmacologic agent for management of CAD. Green tea became very much popular due to various pharmacological effect and nutritional profile. **Objective:** In this study our main goal is to evaluate the beneficial effects of green tea on lipid profile in women. **Materials and Methods:** This interventional study was conducted in the Department of Physiology of Dhaka Medical College from January 2016 to December 2016. After fulfilling the ethical aspect, a total number of 42 women with age ranging from 40 to 50 years were selected and randomly assigned in study group (22 women) and control group (20 women). Study group consumed green tea for 12 weeks and the control group did not consume green tea. The study variables were serum lipid profile levels. Variables of both groups were estimated 2 times (at baseline and after 12 weeks). Data were analyzed by paired Student's 't' test and unpaired Student's 't' test. **Results:** After intervention, significantly lower values were found in following variables [TC ($p < 0.001$), LDL ($p < 0.001$), TG ($p < 0.05$)] in study group in comparison to their baseline values. Moreover, significant reduction in LDL ($p < 0.001$), TC and TG ($p < 0.05$) was observed in study group comparison to that control group after 12 weeks. No significant change was observed in HDL level in both group after green tea consumption. **Conclusions:** The study concluded that, regular consumption of green tea may improve lipid profile.

Introduction

Dyslipidemia plays a crucial role in development of cardiovascular diseases, which has become the leading cause of death in most developed countries as well as developing countries including Bangladesh.^{1,2} According to WHO, 17.7 million people died from CVD in 2015, representing 31% of global death. 80% of these deaths occur in the population from lower and middle income countries like Bangladesh.^{3,4}

Green tea, one of the healthiest drinks is rich in caffeine, antioxidant polyphenol and other beneficial nutrients like protein, carbohydrate, vitamins and minerals. The polyphenols are rich in catechins and the EGCG is the strongest bioactive polyphenol. From

centuries it was used in traditional Indian and Chinese medicine for various diseases. A number of studies showed its anti-microbial, anti-inflammatory, anti-allergic, neuroprotective and hepatoprotective properties. It also decreases platelets aggregation, stimulates the immune system and modulates detoxification of enzymes. It also has potential benefit on Alzheimer's diseases, heart diseases, stroke and inflammatory skin diseases.^{5,6} Some study showed that it can reduce malondialdehyde (MDA) thereby lower the incidence of chronic disease that may occur due to the consequences of increased oxidative stress.⁷ An epidemiological survey exhibited that regular green tea

drinking population like Japanese have low risk of type 2 DM and cardiovascular disease (CVD). Daily intake of more than two cups per day can lower the plasma cholesterol level and reduce the risk of death from CVD by 22-33%.⁸ It also stimulates hepatic beta-oxidation and has hypolipidemic activity.⁹

Materials and Methods

This prospective interventional study was conducted in the Department of Physiology, Dhaka Medical College, Dhaka from January 2016 to December 2016 after obtaining ethical clearance from concerned Departments, Research review committee and Ethical review committee of Dhaka Medical College. At the beginning of the study 48 female subject were selected on the basis of inclusion and exclusion criteria from outpatient department of Endocrinology, Dhaka Medical College Hospital and by personal contact from different areas of Dhaka city. The nature, purpose and benefit of the study was explained to each subject in details. Informed written consent was taken from the participants. Detailed history of food habit, drug, daily physical activity and medical history were taken. Data were collected in pre-designed structured questionnaire form by the researcher herself. For statistical analysis, paired Student's 't' test and unpaired Student's 't' test were done. Anthropometric measurement (Height, weight and waist circumference) of the subjects was done and BMI was calculated. Blood pressure was measured. All the information's were recorded in a prefixed questionnaire. Fasting serum total cholesterol (TC), triglycerides (TG), low-density lipoprotein, high-density lipoprotein (HDL) were estimated two times in the department of clinical pathology of Dhaka Medical College, Dhaka. The subjects were asked to maintain former food habit, physical activities and type and doses of medicine (oral hypoglycemic drugs, antihypertensive or lipid lowering agent) during the course of study. Regular telephonic contact and periodic visit had made them to supply green tea and to ensure compliance with intervention. The participants were instructed to prepare a cup of green tea by

dipping one tea bag of green tea in 150 ml of hot water and allowed to infuse for 3 minutes.¹⁰ At the end of the study, 4 subject from study group and 2 from control group leave the experiment for different causes. So, finally, 22 subject from study group and 20 subject from control group had completed the study. For statistical analysis, paired students t test and unpaired student t test were performed as by using SPSS version 22.0.

- **Grouping of the subjects:**
- the sample size was divided into two groups
- Group A (control group): consisted of 20 women who did not consume green tea
- Group B (Study group): consisted of 22 women who consumed green tea for 12 weeks
- Both groups are studied two times and designated as-
 - A₁: Baseline study
 - A₂: After 12 weeks of study period
 - B₁: Before consumption of green tea
 - B₂: After 12 weeks of consumption of green tea

Results

At the beginning of the study, the baseline characteristics of all subjects (n=42) from both study group (B₁) and control group (A₁) were studied and there was no significant difference between study and control group (Table I). The baseline values of mean TC, TG, LDL & HDL of both groups (A₁ vs B₁) showed no statistically significant difference (Table II). Again, in control groups, mean TC, TG, LDL & HDL values showed no significant difference at baseline and after 12 weeks (A₁ vs A₂). But in study group, after consumption of green tea, the TC (P<0.001), TG (P=0.001), LDL (p<0.001) were significantly decreased in comparison to their baseline values (B₁ vs B₂). Furthermore, TC (P=0.035), TG (P=0.047), LDL (P<0.001) were found significantly lower in B₂ group, in comparison to A₂ group whereas HDL remain nonsignificant (A₂ vs B₂).

Table I- General characteristics of the subjects in both groups (n=42)

Parameters	Groups		p value
	Control group (n=20)	Study group(n=22)	
Age (year)	47.80 ± 4.33	48.81± 4.76	0.475 ^t
BMI	31.62 ± 1.80	32.22 ± 2.14	0.629 ^t
Systolic BP (mm of Hg)	128.40 ± 14.87	122.72 ± 6.85	0.115 ^t
Diastolic BP (mm of Hg)	79.75 ± 6.97	83.86 ± 6.53	0.055 ^t

Data were expressed as mean ± SD. Unpaired student's 't' test was performed for comparison. p value < 0.05 was accepted as level of significance. N = Total number of subjects, n = number of subjects in each group, t = nonsignificant,

Table II- Lipid profile in different groups (n=42)

Parameters	Groups			
	A ₁ (n=20)	A ₂ (n=20)	B ₁ (n=22)	B ₂ (n=22)
TC (mg/dl)	198.75 ± 59.00	190.75 ± 53.12	213.18 ± 48.08	161.36 ± 32.63
TG (mg/dl)	197.85 ± 76.89	187.04 ± 89.50	194.85 ± 76.89	156.68 ± 56.52
LDL (mg/dl)	168.35 ± 48.07	164.50 ± 50.02	146.81 ± 37.02	111.31 ± 26.60
HDL (mg/dl)	29.65 ± 4.45	30.05 ± 3.94	28.22 ± 4.75	29.36 ± 4.11

Statistical analysis

Groups	P value			
	TC	TG	LDL	HDL
A ₁ vs A ₂	0.090 ^t	0.539 ^t	0.667 ^t	0.418 ^t
A ₁ vs B ₁	0.388 ^t	0.679 ^t	0.110 ^t	0.324 ^t
B ₁ vs B ₂	<0.001 ^{***}	0.001 ^{**}	<0.001 ^{***}	0.399 ^t
A ₂ vs B ₂	0.035 [*]	0.047 [*]	<0.001 ^{***}	0.585 ^t

Results are expressed as mean ± SD. Paired t test was performed for comparison within groups and unpaired t test was performed to compare between groups. The test of significance was calculated & p value < 0.05 was accepted as level of significance.

n = number of subjects,

t = non significant

*/**/** = significant

A₁: Control group at baseline

A₂: Control group after 12 weeks

B₁: Study group at base line

B₂: Study group after 12 weeks of consumption of green tea

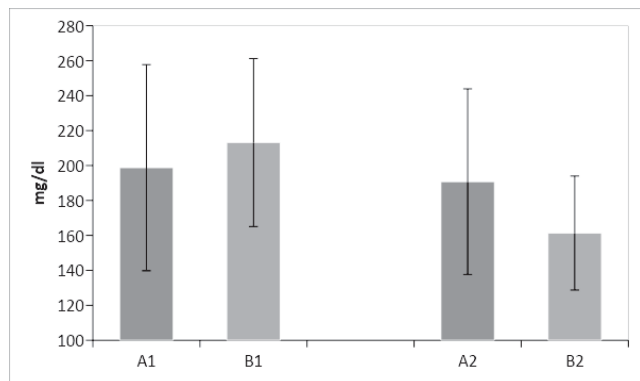


Figure- 1: Mean total cholesterol (TC) level in different groups (n=42)

A1: Control group at baseline

A2: Control group after 12 weeks

B1: Study group at baseline

B2: Study group after 12 weeks of consumption of green tea

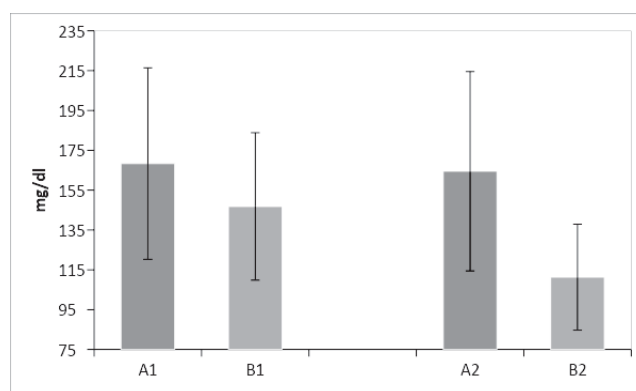


Figure -3: Mean low-density lipoprotein (LDL) level in different groups (n=42)

A1: Control group at baseline

A2: Control group after 12 weeks

B1: Study group at baseline

B2: Study group after 12 weeks of consumption of green tea

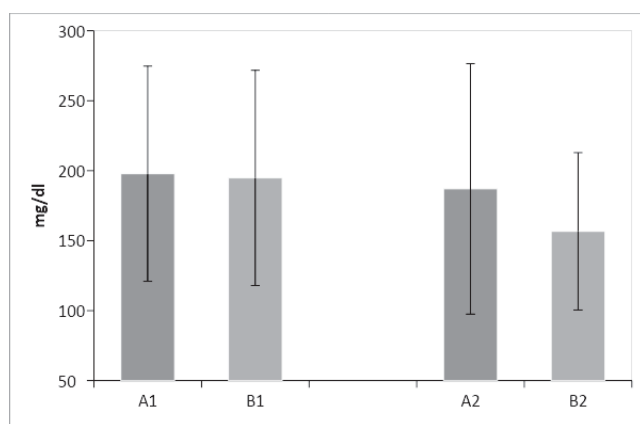


Figure-2: Mean triglyceride (TG) level in different groups (n=42)

A1: Control group at baseline

A2: Control group after 12 weeks

B1: Study group at baseline

B2: Study group after 12 weeks of consumption of green tea

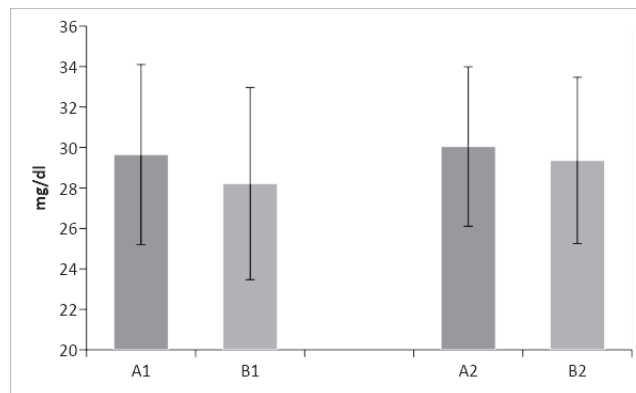


Figure -4: Mean high density lipoprotein (HDL) level in different groups (n=42)

A1: Control group at baseline

A2: Control group after 12 weeks

B1: Study group at baseline

B2: Study group after 12 weeks of consumption of green tea

Discussion

At the beginning (baseline) of the study TC, TG, LDL, HDL levels were almost similar and no statistically significant differences were found. After 12 weeks, the mean TC, LDL and TG were found significantly lower in study group in comparison to their base line value and to the control group. Moreover, HDL was found significantly higher in study group but remain nonsignificant in control group. The findings are supported by several studies.^{10, 11, 12} Almost similar types of study were done by others that had shown varying result.^{13, 14, 15} A cross sectional study on 1306 Japanese male had found that serum cholesterol level is inversely related with consumption of green tea while no association was noted with serum TG and HDL level.¹⁶

Several studies suggested that green tea catechins can decrease the blood lipids by interfering with its digestion and absorption process. It impedes the emulsification and micelle formation which are the essential steps of lipids digestion and absorption. The gallate esters present in catechins forms an insoluble co-precipitate of cholesterol, thus prevents the absorption of bile acid and cholesterol and increases their fecal excretion as much as 24%.¹⁷

This increased excretion of bile acid and cholesterol activates cholesterol 7 α -hydroxylase enzyme in liver and enhances conversion of cholesterol to bile acid to restock the loss. Decreased hepatic cholesterol content stimulates low density lipoprotein (LDL) receptor expression and increases LDL uptake from circulation and thereby decreases serum LDL level. Catechins also can reduce serum LDL level through inhibition of cholesterol synthesis. According to Hu et al. (2014), three enzymes (Mevalonate Kinase, mevalonate diphosphate decarboxylase and farnesyl pyrophosphate synthase) of mevalonate pathway of cholesterol biosynthesis can be simultaneously inhibited by green tea polyphenols. Moreover, 3-hydroxy-3-methylglutaryl, the rate controlling coenzyme of cholesterol synthesis is also inhibited by green tea. It decreases the blood triglyceride level by inhibiting activity of the enzyme pancreatic lipase and

thereby slowdown its absorption. Moreover, Liver triglycerides synthesis depends on the expression of gene stearoyl-CoA desaturase (SCD 1). Green tea may suppress the expression of that gene and decrease serum triglycerides level. It also reduces the activity of acetyl-Co A which also responsible for decreased triglyceride synthesis.^{5, 11, 18, 19, 20, 21}

Conclusion

After analyzing the results of the study, it can be concluded that, regular consumption of green tea may improve the lipid pattern in women.

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