EFFECT OF GREEN TEA INGESTION ON POSTPRANDIAL TRIGLYCERIDE LEVELS IN YOUNG WOMEN

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Abstract— **Introduction:** High blood triglyceride (TG) level is a risk factor for cardiovascular disease. Green tea, as a beverage, may reduce postprandial blood TG level through inhibition of fat absorption in the intestinal lumen. The aim of this study was to assess the difference of postprandial blood TG level changes between treatment group (high-fat meal and green tea beverage containing 738 mg of catechins) and control group (high-fat meal and plain water containing 0 mg of catechins).

Methods: The study was a randomized, single-blind, parallel-group clinical trial including 40 healthy young women. Blood was collected immediately before the meal and then at 2 and 4 h thereafter of each group. Method of TG measurement: GPO-PAP, using Beckman CX 5-CE machine and Good's buffer reagent.

Results: Postprandial blood TG level at 4 h in the treatment group was significantly lower compared to the control group (1.00 ± 0.27 vs. 1.22 ± 0.34 mmol/L, $p = 0.03$). The change in blood TG level from baseline to 4 h postprandial was also significantly lower in the treatment group compared to the control group (0.21 ± 0.14 vs. 0.37 ± 0.26 mmol/L, $p = 0.02$).

Conclusion: It was concluded that green tea ingestion during high fat meal suppressed postprandial elevation of TG 4 hour after meal.

Keywords: *green tea, triglyceride, postprandial, catechin, high fat meal*

INTRODUCTION

Cardiovascular diseases are major causes of death in the world. It was estimated that in 2015 the number of deaths caused by cardiovascular diseases would reach 20 million. One of the main risk factors for cardiovascular disease is dyslipidemia.

Dyslipidemia is a lipid metabolism disorder signed by either increased or decreased blood lipids.[3] The main type signs of lipid disorder are increased of total cholesterol level, low density lipoprotein cholesterol (LDL-C), and triglyceride (TG), as well as decreased of high density lipoprotein cholesterol (HDL-C). The causes of dyslipidemia include imbalanced diet, high-fat meals, inadequate dietary fiber intake, and inadequate physical activity.[4,5]

Tea is a popular beverage in Asia and the second most consumed beverage worldwide after water. Among all types of tea, green tea has become well-known due to its beneficial health effects. Green tea contains catechins, which has antioxidant, antiinflammatory, anticarcinogenesis, antihypertension, antiobesity, antidiabetic, antiplatelet, vasodilation, and hypocholesterolemic effects.

Human and animal studies have shown that green tea catechins may lower blood cholesterol and TG level by inhibiting the synthesis of pancreatic lipase, which plays a role in digestion and absorption of fat, therefore fat absorption is inhibited and cholesterol is excreted through feces.[15,16] Green tea catechins disturb fat emulsification process, causing bigger size of fat droplets, therefore inhibiting fat digestion.

METHODS

Green tea beverage

Five bags of green tea were brewed using 300 mL of hot water at 90°C for 3 minutes. The catechins content was analyzed at laboratory. The catechins content was 3691.45 ppm = 369.145 mg/100 mL = 738.29 mg/200 mL. This study used 200 mL of the green tea beverage containing 738 mg of green tea catechins to be compared to plain water (0 mg of catechins) as the control.

Subjects

After obtaining ethic approval from the Research Ethics Committee of Faculty of Medicine, Universitas Indonesia, recruitment for the study subjects was announced to all female undergraduate students aged of 19−24 years undergoing clinical education at Tangerang Regency General Hospital in Banten. Forty subjects were recruited for the study; each had a normal BMI according to the BMI cut-offs in Asian and Pacific populations (18.5−22.9 kg/m^2),[22] had normal blood pressure (<120/80 mm Hg),[23] had fasting blood TG level of <1.70 mmol/L,[24] and gave written consent to participate in the study. Exclusion criteria included smoking, alcohol consumption, pregnant or lactating, history of cardiovascular disease, diabetes mellitus, kidney disease, or liver disease, consumption of any supplement or food containing catechins, consumption of any drug that may affect lipid metabolism, i.e. fibrates, statins, progestins, steroids, and a history of gastritis after ingesting tea.

Study design and experimental protocol

This study was a randomized, single-blind, parallel-group clinical trial to compare the change of blood TG level between groups of 2 and 4 h after the ingestion of 200 mL of green tea beverage containing 738 mg of green tea catechins, and control group of 200 mL of water ingestion. The subjects were divided into two groups (treatment and control groups) through block randomization, resulting in 20 subjects in each group.

In the morning after 12 h fasting overnight, blood samples were collected from the subjects. The subjects were then given 200 mL of green tea beverage or 200 mL of hot water. No sugar or artificial sweetener was added to either beverage. The two beverages both were served with a high-fat meal (>35% of total energy from fat), which consist of margarine and granulated sugar smeared on sliced white bread (consisted of 46 g of carbohydrate, 23.5 g of fat, and 7 g of protein for a total energy of 1.77 MJ (or 422 kcal)). The meal and the beverage were consumsed and finished within 10 minutes. Blood samples were collected at 2 and 4 h after the meal. All blood samples were sent to the laboratory for TG level assessment.

Statistical analysis

Result data were analyzed using the Statistical Package for Social Science (SPSS) 11.5.

Shapiro-Wilk test was used to assess the distribution of the data. All data are normally distributed; therefore all results are presented as mean ± SD. Unpaired t-test was used to compare the data between the two groups. Significant difference was determined if p <0.05.

RESULTS

Subject characteristics

All 40 subjects were included in this study. There was no significant difference in age or BMI between control and treated groups (Table 1).

Every subject ingested ≥95% of the whole meal and beverage served. The meal and the beverage were well-tolerated by the subjects.

Triglyceride

There was no difference in fasting blood TG level between control and treatment groups, showing that the two groups were similar at baseline. Triglyceride level at 2 h postprandial showed no significant difference between treated and control groups. However, at 4 h postprandial, there was a significant differences in blood TG level and blood TG level change between treated and control groups (Table 2).

DISCUSSION

This study aimed to explore the effect of ingesting 200 mL of green tea beverage containing 738 mg of green tea catechins compared to plain water on postprandial blood TG levels in young women. This study was conducted as an effort to find out a way to prevent cardiovascular diseases in the scope of nutrition studies.

The study used young subjects to ensure normal body metabolism and normal *lipoprotein lipase* activity.[6] Only female subjects were recruited because elevation of postprandial blood TG level may be influenced by sex, i.e. elevation of postprandial TG level in men would be higher than in women.[6,27] In addition, subjects with normal BMI were chosen because it was found that in overweight and obese subjects blood TG level was still high even after 10–12 h postprandial.[27]

Blood samples for the TG level assessment were collected after the subjects fasted for 12 h in order to obtain endogenous blood TG levels (not influenced by the previous meal).[24] The postprandial blood TG levels were assessed twice (at 2 h and 4 h postprandial) to adequately predict the peak of the postprandial TG level. After 2 h postprandial, triglyceride-rich chylomicrons are already in the circulation.[28,29] Whereas, the time to reach the peak of blood TG level varies between 2 and 7 h postprandial.[26,27]

In individuals ingesting 15−30 g of fat, 450−900 mg of green tea catechins are needed to suppress postprandial hypertriglyceridemia.[19] According to a meta-analysis by Zheng et al.[31], the dose of catechins used in the present study is still safe and does not cause adverse effects.

In this study, there were no significant differences in the blood TG level and the change in blood TG level at 2 h postprandial between the control and treatment groups. This is in accordance with the study by Koutelidakis et al.[32] that reported a significant difference at 3 h postprandial. It is probably because at 2 h postprandial the catechins has not reached the intestine.

At 4 h postprandial, the blood TG level and the change in blood TG level in the treatment group were significantly lower than those in the control group. This corresponds with the results of previous studies.[30,32,33] Green tea catechins are assumed to be able to affect the size of fat droplets, resulting in inefficient fat emulsification process.[33] In addition, green tea catechins may inhibit the synthesis of pancreatic lipase, which plays a part in fat digestion and absorption.[15,16]

Table 1. Subject characteristics

	Control (n = 20)†	Treatment (n = 20)‡	*p*
Age (year)	20.6 ± 1.7	20.5 ± 1.8	0.938
BMI (kg/m^2)	20.8 ± 1.3	20.8 ± 1.3	0.921

†, ‡ results are presented as mean ± SD

Table 2. Fasting and postprandial blood triglyceride levels (mmol/L)

	Control (n = 20)§	Treatment (n = 20)¶	*p*
Fasting	0.85 ± 0.24	0.80 ± 0.26	0.572
2 h postprandial	1.03 ± 0.29	0.99 ± 0.35	0.668
4 h postprandial	1.22 ± 0.34	1.00 ± 0.27	0.033
Change at 2 h postprandial	0.18 ± 0.15	0.19 ± 0.22	0.906
Change at 4 h postprandial	0.37 ± 0.26	0.20 ± 0.14	0.019

§, ¶ results are presented as mean ± SD.

In conclusion, the results of the this study suggest that green tea ingestion can lower the elevation of blood TG level after a high-fat meal in young women, and the effect was reached at 4 h postprandial. Further studies are needed to characterize the effect of green tea ingestion on postprandial blood TG level in male subjects and also in subjects with dyslipidemia.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding publication of this paper.

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