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Green Tea Effects on the Levels of Serum Glucose and Lipid Profiles

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Abstract Green tea (GT) is one of the most popular beverages in the world, which contains numerous polyphenols known as catechins. Because of the high rate of GT consumption in worldwide populations, even small effects on an individual basis could have a large public health impact. Therefore, more and more researches focus on the effects for GT on human health. To date, GT is identified as an important modifier for diabetes, lipid metabolism, and even for some haematological indices. Based on the previous reports, this study tries to investigate the effects of green tea (GT) on the partial haematological and serological indices of the peripheral blood of the healthy people. As a result, GT really affects the level haematological and serological indices of the male and female populations with the habit of long-term GT intake.

Keywords: *green tea, haematological indices, serological indices, the male, the female*

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1. Introduction

Green tea (GT) is one of the most popular beverages in the world, which contains numerous polyphenols known as catechins, particularly epigallocatechin gallate (EGCG), epicatechin gallate (ECG), and gallocatechin gallate (GCG). Because of the high rate of GT consumption in worldwide populations, even small effects on an individual basis could have a large public health impact [1]. Thus there are many reports which focus on the biological function of GT currently. As already reported, GT and its components have shown various biological and pharmacological effects like antibacterial [2], anti-inflammatory [3], anti-hypertension [4] anti-cardiovascular disease [5] and anti-carcinogenic activities [6].

In some studies, GT is identified as an important modifier of diabetes [7], and its effects on diabetes have received increasing attention in view of the accumulated encouraging findings from experimental research [8]. GT is also functions as a regulating factor for lipid metabolism. Some scholars reported that EGCG could decrease lipid digestion and absorption, where the mechanism responsible could be the function of increasing fecal excretion of lipids [9,10,11]. Besides, GT can affect the level of serum iron, and this mechanism probably works through a negative effect on iron absorption in GT consuming population [12]. However, there are other authors suggesting the controversial arguments related to the effects of some haematological and serological effects [13,14]. Therefore, it is necessary to further promote research in this field in order to understand the effects of the activities of GT on human health.

In this study, the male and female populations with GT-consumption and non-consumption were recruited; some biochemical indices were assayed and analyzed, respectively. Through such a study, we hoped to evaluate the effects of GT on human health.

2. Material and Methods

2.1. Subjects

According to the age stages of 26-35, 36-45 and 46-55, 300 males and 300 females with the habits of GT-intake were respectively recruited and divided into experiment-1 (E-1), experiment-2 (E-2) and experiment-3 (E-3) groups in turn. There were 200 people in each group. Referring such a condition, 300 people without the habit of GT consumption were also enrolled and divided into control-1 (C-1), control-2 (C-2) and control-3 (C-3) groups in turn. The person in the GT-intake population were office stuff who averagely had at least two cups of tea every day. All those subjects were excluded from the study, when they had apparent symptoms of infectious, tumor, immune diseases and erythrocytosis. Participants were also excluded when had habits of drinking alcohol and coffee. In the past six months, no one had any medicine or had undergone any other therapy. Besides, the women who were pregnant, or had undergone abortion or were having high menstruation indication were ruled out as well. Written informed consents were obtained from all the participants. The study was approved by the ethics committee of Affiliated Hospital of Jining Medical University.

2.2. Methods

1.8 ml venous blood was collected from each of the subjects, who had fasted overnight, and centrifuged at 3000 rpm for 10 min. The serum was used to assay biochemical indices with Hitachi 7600 automatic biochemistry analyzer (Hitachi High-Tech Corp., Japan). The biochemical indices included fasting blood glucose (FBG), cholesterol (CH), triglyceride (TG), high and low density lipoprotein (HDL & LDL).

2.3. Statistical Analysis

The data were analyzed with the SPSS statistical software version 13.0 (SPSS, Inc., Chicago, IL, USA). The paired Quantitative figures and percentage data were respectively compared by t-test and $\chi 2$ test. There was a significant difference if $P<0.05$.

3. Results

In the male participants, all the indices of E-1 group were similar to those of C-1 group. HDL of E-2 and E-3 group was significant higher than that of C-2 and C-3 group ($P<0.05$); Besides the four indices, the other indices of the two experimental group were significantly lower than those of the two control groups (all $P<0.05$) (Table 1).

Table 1. The hematological and serological indices of the different age stages in male population

Indexes (mmol/L)	Consumption population			Un-consumption population		
	E-1 group	E-2 group	E-3 group	E-1 group	E-2 group	E-3 group
FBG	4.93±0.75	5.12±1.04*	5.27±1.12*	5.01±0.69	5.44±1.26	5.59±1.42
CH	4.53±0.88	4.54±0.90*	4.61±1.07*	4.57±0.91	4.83±1.07	5.21±1.19
TG	1.32±0.59	1.27±0.72*	1.32±0.77*	1.44±0.85	1.53±1.12	1.62±1.27
HDL	1.74±0.66	1.66±0.83*	1.57±0.92*	1.44±0.59	1.39±0.66	1.21±0.87
LDL	2.58±0.81	2.54±0.75*	2.39±0.96*	2.71±0.0.89	2.80±0.85	2.94±0.99

FBG: fasting blood glucose; CH: cholesterol; TG: triacylglycerol; HDL, high density lipoprotein; LDL, low density lipoprotein. *comparing with the according indices in non-consumption population, $P<0.05$.

In the female attendee, In the female attendee, all the indices of E-1 group were also similar to those of C-1 group. HDL of E-2 and E-3 group was significant higher than that of C-2 and C-3 group ($P<0.05$); Besides these three indices, the other indices of the two experimental group were significantly lower than those of the two control groups (all $P<0.05$) (Table 2).

Table 2. The hematological and serological indices of the different age stages in female population

Indexes (mmol/L)	Consumption population			Un-consumption population		
	E-1 group	E-2 group	E-3 group	E-1 group	E-2 group	E-3 group
FBG	4.82±0.68	4.91±0.76*	5.24±0.95*	4.99±0.57	5.31±0.68	4.82±0.68
CH	4.47±0.79	4.49±0.87*	4.99±1.16*	4.52±0.82	4.79±0.90	4.47±0.79
TG	1.14±0.45	1.19±0.52*	1.34±0.69*	1.16±0.78	1.38±0.69	1.14±0.45
HDL	1.62±0.69	1.77±0.71*	1.69±0.86*	1.57±0.57	1.52±0.69	1.62±0.69
LDL	2.52±0.74	2.59±0.71*	2.64±0.85*	2.58±0.70	2.70±0.70	2.52±0.74

FBG: fasting blood glucose; CH: cholesterol; TG: triacylglycerol; HDL, high density lipoprotein; LDL, low density lipoprotein. * comparing with the according indices in un-consumption population, $P<0.05$.

4. Discussion

In recent years, some researchers found that GT has the potential benefits on the prevention and control of diabetes [8,15,16,17]. In a animal experiment, Young (7 week-old) db/db mice were randomized and assigned to receive diets supplemented with or without EGCG for 10 weeks. As a result, in db/db mice, EGCG improves glucose tolerance and increases glucose-stimulated insulin secretion. EGCG supplementation reduces the number of pathologically changed islets of Langerhans, increases the number and the size of islets, and heightens pancreatic endocrine area [18]. Snoussi et al. [19] gave the acute (30 min) or chronic (6 weeks) oral administration of green tea decoction (GTD), and investigated the changes of blood glucose through glucose tolerance tests. In the results, glucose tolerance was observed significantly improved in the rats with acute and chronic administration of GTD. In a human test, Suliburska et al. [20] treated the obese patients with capsule containing 379 mg green tea extract (GTE) and 208 mg EGCG, and after three months, they found the concentration of serum glucose decreased from 5.64±0.44 mmol/L to 5.48±0.31 mmol/L, while this significant change was not detected in the control group with placebo intake. Such a result was also observed in another report recently [21]. In this study, except for 26-35 yr stage, not only in males but also in females, the FBG concentrations of the subjects of 36-45 and 46-55 yr with GT consumption were lower than those with non-intake one. These results showed that GT could decrease the level of serum glucose, which should base on the condition of adequate long time for GT consumption. Although the mechanism of GT of controlling glucose still remain unclear, there seem to be indications that the basic mechanism is associated with insulin metabolism [22,23].

In some reports of animal expriments [24,25], after an intervention with GTE, the concentration of TC, TG and LDL of the mice were significantly lower than those of the placebo group, while the level of HDL obviously increased. In the review and meta-analysis of randomized clinical trials, Onakpoya et al [26] found that GT intake results in significant reductions in total cholesterol, and LDL cholesterol. Such a finding was consistent with the

reports by other researchers [19,27,28]. With contradictory results, several authors [29,30] found that GT or GTE could not decrease but increase the level of plasma glycerol, and the production of HDL neither be improved. In this study, the beneficial effects of GT on the indices related to lipid metabolism were observed. In spite of males and females with GT consumption, compared to the control subjects without GT consumption, TC, TG and LDL significantly decreased, while HDL increased. As the results show, only the two age groups of 36-45 and 46-55 years showed the corresponding significant changes. Notably, these differences are associated with the time of GT intake. As to the mechanism of this function, in Frejnagel's opinion, it was caused by the decreased absorption of cholesterol from the diet in the presence of the polyphenols from GTE in the small intestine, especially if the supplement is taken by subjects during meals (31). In the newest report, Ge et al (32) found that three enzymes (Mevalonate kinase, mevalonate diphosphate decarboxylase and farnesyl pyrophosphate synthase) in the mevalonate pathway (MVP) of cholesterol biosynthesis can be simultaneously inhibited by GT polyphenols. However, to date, the studies of GT's effects on lipid metabolism are only focused on TC, TG, HDL, LDL and similar factors; and the exact mechanisms related to the functions still remain unclear. Therefore, there is further need of research work necessary to understand the different mechanisms involved.

In conclusion, GT could decrease the concentrations of FBG, TG, CH, and LDL, increase of the level of HDL, which could be of benefit for prevention and/or modulation of diabetes, high hyperglycemia and hypercholesterolemia; meantime, long-term intake of GT could disorder the iron metabolism and raise the occurrence of anemia and iron-deficiency anemia. Therefore, the maintenance of the quantity of GT intake in order to achieve the best beneficial effects to human health still needs further complementary studies especially with regard to understanding the molecular.

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