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Effect of Green and White Tea Extract on Blood Lipids in Male Wistar Rats

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Abstract: The objective of this study was to investigate the effect of green and white tea extract on blood lipids in male Wistar rats. Experiment was carried out on 15 Wistar albino rats, divided into 3 groups. Group 1 was fed with a standard diet (20gm) and water (control group), group 2 was fed with a standard diet (20gm) and received 50 ml white tea extract and group 3 was fed with a standard diet (20gm) and received 50 ml green tea extract. Statistically insignificant difference was observed between control and experimental groups for growth rate, total food consumption , food intake or fluid consumption but difference was significant in change in weight at the end of study between control and white and between white and green tea extracts. It has been found in this study that although administration of white and green tea extracts has no significant effect on total cholesterol and HDL- cholesterol but white tea extract significantly reduces the triglyceride level.

Key words: Tea · Lipid Profile · Cholesterol · Growth Rate · Triglycerides

INTRODUCTION

Medicinal plants have been used for the treatment of the disease since time immemorial [1]. Consumption of food and beverages rich in antioxidant compounds such as tea, fruits, vegetables and wine seems to provide benefits and has been evaluated through a variety of biomarkers that characterize oxidative reactions, endothelial function and the post prandial levels of lipids and glucose [2-4]. Tea is the most commonly consumed beverage worldwide and has been used in traditional medicine for centuries [1]. Various types of tea such as black, white, green or red are produced from fresh tea leaf (*Camellia sinensis*). Teas are different in terms of production method and each type has its own characteristic flavor and pharmacological values [5, 6]. A number of studies suggest that consumption of green and white tea possess positive health effects [7-10]. Free radicals (that has one or more unpaired electron) derivatives of oxygen as well as non-radical derivatives and singlet oxygen are collectively known as reactive oxygen species (ROS) [11]. Reactive oxygen species are continuously produced in the body during in cellular pathways of aerobic metabolism, including electron transport chain in mitochondria and microsomes, oxidative phosphorylation, or immunological reactions [12] or even from external sources such as exposure to radiation, smoke pollutants [13].

Tea contains a wide range of phenolic compound such as flavanols, flavandiols, flavonoids and phenolic acids and other ingredients are alkaloids, amino acids, carbohydrates, proteins, chlorophyll, volatile compounds, minerals and trace elements [1]. The peculiar green color of green tea results from the inactivation of polyphenol oxidase by treating fresh tea leaves with hot steam and air [8]. Green tea is an excellent source of polyphenol antioxidants and predominant polyphenols in green tea are catechins such as (-)-epicatechin (EC), (-)-epicatechingallate (ECG), (-)-epigallocatechin (EGC) and (-)-epigallocatechingallate (EGCG) [14], but the concentrations of epigallocatechin-3-gallate (EGCG) cathenin, antioxidant activity and also methylxanthines (like caffeine) in white tea (WT) are more than Green or Black Tea [15, 16], because unlike green tea, white tea is

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an unfermented tea and is manufactured only from the first leaves i.e young shoot of *Camellia sinensis* that are dried with minimal processing and protected from sunlight to avoid the degradation of its polyphenols [17]. The catechins have been shown to possess strong antioxidant properties *in vitro* [18], inhibiting the peroxidation of phospholipids [19]and the copper ion and cell-mediated oxidation of LDL [20, 21].

Studies show that tea consumption has favorable effects on management of oxidative stress [22, 23] lead to improvement of response of inflammation biomarkers as C-reactive protein (CRP) and P-selectin [24], reverse of endothelial dysfunction [25].The objective of this work is to assess the effect of drinking white and green tea on lipid profile of healthy Wistar rats.

MATERIALS AND METHODS

Materials: The experiment was carried out on 15 healthy Wistar albino rats aged 8-16 weeks and weighing between 127-157 gm. Animals were obtained from Experimental Animal Care and Experimental Surgery Center at the Faculty of Medicine, King Saud University, Saudi Arabia. All animals were housed individually in stainless steel cages at 25 ± 2°C, given standard pellet diet , exposed to 12:12 h light and dark cycle at 50±5 % relative humidity in animal room. This study is in accordance with the Animal Ethics Committee of the College of Science, King Saud University.

Methods

Preparation of Extract: Five gram of different type of tea (each type was prepared alone) was added to 250 ml boiling water and allowed to boil further for 2-3 minutes and then cooled under room temperature.

Experimental Design: Rats were divided into 3 groups (5 in each group) according to their weight. Basal diet was obtained from the General Organization for Grain Silos and Flour Mills, Saudi Arabia. Group 1 was fed with a standard diet (20gm) and water (control group), group 2 was fed with a standard diet (20gm) and received 50 ml white tea extract and group 3 was fed with a standard diet (20gm) and received 50 ml green tea extract. Food and liquid intakes were monitored daily in all groups.

Assessment of Body Weight and Food Consumption

Growth: Body weight was recorded in the non-fed state at the beginning of study (initial weight) and at time before slaughter (final weight).

Weight gain = final body weight (g) - initial body weight (g)

Growth rate = total weight gain (g) /duration (days)

Food Consumption: Food consumption was analyzed daily in by calculating the difference between the diets provided (before consumption) and the diet consumed using a calibrated scale with 0.01mg precision. The calculation was performed as follows:

Food consumption per day (g) = diet provided (g) - diet consumed (g)

Food Efficiency: Food efficiency was calculated by the following formula:

Food efficiency: gain weight / total food consumption

Collection of Blood: At the 22nd day, animals were food deprived over-night and anaesthetized under chloroform and blood was collected from retro orbital plexus in heparinized tube and centrifuged at 3500 rpm for 15 minutes for plasma separation and stored at 5-7°C for further analysis [26].

Plasma Liver Function Test: The parameter measured includes total cholesterol, HDL cholesterol and triglycerides. Total cholesterol, HDL cholesterol and triglycerides were analyzed using kits following the instruction of manufacturer, provided by United Diagnostic Industry, Dammam, Saudi Arabia [27, 28, 29].

Statistical Analysis: Data were analyzed using SPSS statistical software package (version 22) and expressed as mean ± standard deviation. The differences among treatment groups were analyzed by ANOVA at a significance level of $p \leq 0.05$; if significant differences were found, Post-hoc analysis using Duncan's multiple range tests was performed [30].

RESULTS AND DISCUSSION

Effect of Green and White Tea on Growth Factors in Male Wistar Rats: Table 1 depicts the effect of green and white tea on growth factors in male Wistar rats. Body weight of animals increased progressively throughout the period of treatment. Controlled group showed weight gain of 84.6 gm after 22 days. However the weight gain of rats treated with white and green tea were 87.2 gm and

Table 1: Growth indicators of males Wister rats fed with white and green tea extract

Parameters	Control	White Tea	Green Tea
Initial weight (gm)	131.6±3.84[a]	137.8±0.836[a]	147.8±6.97[b]
Final weight (gm)	216.2±11.25	225±9.64	214.4±9.28
Change in weight(gm)	84.6±11.41[a]	87.2±9.311[a]	66.6±8.47[b]
Growth rate	3.85±0.52	3.96±0.42	3.02±0.38
TFC (gm)	432.06±7.45	419.264±10.52	427.21±9.42
Food intake (g/d)	19.64±0.339	19.06±0.48	19.419±0.428
FE	0.196±0.029[a]	0.207±0.017[a]	0.155±0.019[b]
Fluid consumption	44.64±1.51	45.50±0.81	45.64±0.53

Small alphabet letters in each row indicates significant difference among dietary treatment groups separately as indicated by ANOVA followed by Duncan's multiple range tests.

Table 2: Lipid profile of males Wister rats fed with white and green tea extract

Parameters	Control	White Tea	Green Tea
Total cholesterol	45.81±3.55	41.82±36.05	59.06±8.97
HDL -C	38.65±21.29	43.113±31.00	58.50±26.07
Triglycerides	201.09±87.75[b]	29.47±21.33[a]	125.71±51.93[ab]

Small alphabet letters in each row indicates significant difference among dietary treatment groups separately as indicated by ANOVA followed by Duncan's multiple range tests

66.6gm respectively. Although no significant difference was observed in weight gain between controlled and white tea group but it was highly significant between controlled and green tea group. It has been observed in this study that weight gain was least in green tea group. Some research has shown that the body weight of animals given green tea supplementation decreased significantly [31-33] but simultaneously Wu *et al*. [34] reported insignificant effect of tea consumption on weight loss. Teixeira *et al*. [9] also reported in their study that white tea supplementation was not able to reduce food intake, body weight or visceral adiposity. Green tea has been found valuable for reduction in weight gain and adiposity [35]. Various mechanisms are hypothesized to be responsible for weight reducing action of green or white tea. A researcher describes mechanism by which EGCG inhibits adipocytes differentiation and proliferation, reduces fat absorption and increases energy and fat utilization [36]. Another researcher hypothesized that the mechanism by which catechins reduce body fat may be related to the increase of energy expenditure [37]. The different results obtained in these studies might be due to the concentration of green tea used. Total food consumption was highest in controlled group but contrary to this fluid consumption was more in tea treated group but difference was not significant between groups. At the end of study no differences between the groups were seen in the amount of food and liquid intake. Similar finding was reported by Wu *et al*. [34].

Effect of Green and White Tea on Blood Lipids in Male Wistar Rats: Table 2 depicts the effect of green and white tea on blood lipids in male Wistar rats. The serum TG levels in the white tea group decreased significantly after 22 days of tea consumption. Total cholesterol levels also decreased in white tea group even though it increased in green tea group but the difference was not significant between controlled and treated group. Some researchers did not found any beneficial effect of white tea supplementation on cholesterol profile in mice [9, 38]. In contrast to this, some researchers reported reduction of cholesterol [39, 40]. Kushargina *et al*. [10] mentioned that white tea has higher effect in decreasing the lipids profile greater than green tea. It has been reported that tea polyphenols can inhibit the activity of acetyl-Co A carboxylase, thus inhibiting TG synthesis [41]. Epidemiological studies have showed that high intake of tea may reduce the coronary heart disease, although data are not consistent [42-44]. It has been suggested that the beneficial effect may result from inhibition of LDL oxidation [45] but simultaneously there are studies in which no change in plasma lipid was observed after consumption of green or black tea [46, 47]. Serki *et al*. [1] in their study on the effect of green and white tea against rifampicin induced chronic hepatotoxicity in rats mentioned that white tea supplementation improved lipid profile in treated rats in dose dependant manner more effectively than green tea. Some studies indicate that lipolytic activity of white tea might not bemediated by EGCG; but methylxanthines in white tea might have lipolysis activity [15].

CONCLUSION

In summary, the result of the present study indicates that white tea is more effective in reducing lipid associated parameters and green tea is effective in reducing weight in Wistar rats. Further studies are required to confirm the doses of green and white tea in terms of reducing hyperlipidemia.

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