Short Communication

Black And Green Tea Extracts Activate Glucose Catabolism in The Liver in vitro

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In this study, the effects of aqueous extracts of black and green teas on hepatic glucose metabolism in vitro, were investigated. Fresh bovine liver was used in the assays. After adding glucose into the liver homogenate, they were incubated with tea extracts for two hours at three different concentrations. Then, glucose concentrations were assayed in each case. Aqueous black and green tea extracts accelerate glucose catabolism in liver. Both green and black teas might play beneficial roles in the catabolism of glucose in the hepatic tissue.

Keywords: Black tea, green tea, glucose, liver, Diabetes.

INTRODUCTION

Recent epidemiologic research shows a positive correlation between the consumption of fruits, vegetables, grains, and legumes and the prevention of chronic illnesses. Phytochemicals, naturally occurring plant biochemicals may improve or prevent a number of chronic diseases because of their anti-inflammatory, antithrombotic, antioxidant, and anticarcinogenic activity (Craig, 1999). The polyphenols, which include more than 4000 identified flavonoids, comprise one of the largest groups of active phytochemicals (Hollman, 1997). Plants containing flavonoids are used to treat diabetes in Folk medicine. Tea, a beverage commonly consumed worldwide is a significant source of a type of flavonoids called catechins. Tea is argued to have glucose-lowering effects in animal models. The green tea catechins include (−)-epigallocatechin gallate (EGCG), (−)-epigallocatechin, (−)-epicatechin gallate, and (−)-epicatechin (Fig. 1) (Guo et al., 1999). In a recent report, injection of EGCG into lean and obese Zucker rats significantly lowered blood glucose and insulin levels, and green tea extract increased glucose metabolism in adipocytes (Kao et al. 2000; Broadhurst et al., 2000).

In a study, it has been shown that the regulation of hepatic glucose production is decreased by a tea constituent, EGCG (Waltner-Law et al., 2002). In another study, it has been suggested that green tea promoted glucose metabolism in healthy human volunteers as well. They presented evidence indicating that green tea has an antidiabetic effect (Tsuneki et al., 2004).

In a study carried out previously no significant effect was observed in this regard. They performed a double-blind, placebo-controlled, randomized multiple-dose (0, 375, or 750 mg per day for 3 months) study in adults with type 2 diabetes mellitus not taking insulin. They found no changes between pre and post values of the patients with regard to HbA1C values in type 2 diabetes mellitus group. (MacKenzie et al., 2007).

In the present study, an in vitro study was performed in order to obtain further information on the possible effect of tea drink in the glucose metabolism in the body.

MATERIALS AND METHODS

Tea extracts were prepared by soaking plants (10 %, w/v) into the distilled water and waiting for 24 h at room temperature by continuously rotating. After the debris was removed, extracts were centrifuged at 10,000 rpm for 20 min and upper clear part was taken as extract and
used in the assays. Bovine liver was obtained from animals after sacrificing at slaughterhouse. After homogenisation in physiological saline solution (5 %, w/v), liver tissue homogenate was centrifuged at 5000 rpm to obtain supernatant fraction. Assays were performed in this fraction. After the addition of glucose solution into the supernatant (Final glucose concentration was 17.2 ± 1.9 mg/dl), supernatant fractions were incubated with changing concentrations (5, 10, 15 %, w/v) of green and black tea extracts for 2 hours. Glucose concentrations were measured at the beginning and after 2 h incubation period. Control assays without extracts were also performed. Glucose measurement was performed using classical Folin-Wu method (Folin et al., 1920).

RESULTS

Results are given in the tables 1 and 2. As seen from the tables, both tea solutions causes significant reductions in hepatic glucose concentrations after 2 h of incubations. Moreover, green tea extract causes more reductions in glucose concentrations compared with that of black tea. As seen from the tables, both green and black teas accelerate glucose utilisation between 0 and 2nd h rates (first period) in the liver. The effects are however more prominent in the green tea treatment. The rates were lowered between 2nd h and 4th h (second period) as compared to first period. Green tea treatment were again more effective than black tea in the second period.

DISCUSSION

Results indicate that constituents of both tea solutions increase glucose consumption in which several mechanisms like activation of enzymes participating in glucose catabolism may play part. Catechin derivatives in the tea are the most possible factors in this event. Indeed, in several studies, it has been found that some tea constituents like EGCG are proposed to increase tyrosine phosphorylation of the insulin receptor and insulin receptor substrate-1 (IRS-1), and reduce phosphoenolpyruvate carboxykinase gene expression in a phosphoinositide 3-kinase-dependent manner. EGCG also mimics insulin by increasing phosphoinositide 3-kinase, mitogen-activated protein kinase, and p70s6k activity. (Kao et al., 2000; Ahmad et al., 1989; Hii et al., 1984). EGCG differs from insulin, however, in that it affects several insulin-activated kinases with slower kinetics. Furthermore, EGCG regulates genes that encode gluconeogenic enzymes and protein-tyrosine phosphorylation by modulating the redox state of the cell (Waltner-Law et al., 2002).
In another study, green tea has been shown to have an antidiabetic effect. They expressed that although they could not find simple reversed effect of green tea on the diabetes-induced modifications of the levels of several serum proteins, they found that the 4211 (4212) Da protein level that was decreased in the diabetic state was further decreased after green tea administration. They pointed that it was the first report demonstrating that a certain serum protein might be involved in the antihyperglycemic effect of green tea (Tsuneki et al., 2004).

Regarding the subject, several studies were performed. Among them, Sabu MC et al reported anti-diabetic activity of green tea polyphenols and their role in reducing oxidative stress in experimental diabetes (Sabu et al., 2002). They proposed that their results demonstrated that changes in the redox state might have beneficial effects for the treatment of diabetes and suggested a potential role for EGCG, or derivatives, as an antidiabetic agent.

Kobayashi Y et al proposed that green tea polyphenols inhibited the sodium-dependent glucose transporter of intestinal epithelial cells by a competitive mechanism, thereby producing antidiabetic effect (Kobayashi et al., 2000).

Another study showed that green tea supplementation ameliorated insulin resistance and increased glucose transporter IV content in a fructose-fed rat model (Wu et al., 2004).

However, in a double-blind randomized study carried out by Todd MacKenzie et al no significant effect was observed regarding any positive effect of tea consumption on glucose metabolism (MacKenzie et al., 2007).

Our result show that both green and black tea extracts accelerate glucose catabolism in liver homogenate, which occurs by a concentration- dependent manner. In this event, it seems possible that catechin derivatives in black tea like EGCG play significant part through phosphorylation of the insulin receptor. Additionally, the fact that EGCG gallate can mimic insulin by increasing phosphoinositide 3-kinase might be also responsible of this result (Kao et al., 2000; Ahmad et al., 1989; Hii et al., 1984). In the effect of the green tea extract, possibly similar mechanisms might be responsible. However, subject needs further studies to obtain exact information in this regard.

CONCLUSIONS

It has been concluded in the present study that both green and black teas might play beneficial roles in the catabolism of glucose in the hepatic tissue, and therefore they are good choices as drink for the diabetics to regulate their glucose metabolisms.

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REFERENCES


