

## A COMPARISON BETWEEN THE EFFECT OF BLACK TEA AND KOMBUCHA TEA ON BLOOD GLUCOSE LEVEL IN DIABETIC RAT

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*SUMMARY: Diabetes mellitus is a metabolic disorder characterized by insufficient insulin secretion and/or insensitive target tissues to metabolic actions of insulin. Despite progressive efforts in production of synthetic drugs for treating diabetic patients there is a widespread propensity of patients to herbal medicine. Among these herbal remedies consumption of Kombucha tea (a solution of Kombucha mushroom cultivated in sweetened black tea) is relatively popular in some societies as an antidiabetic drink. On the other hand black tea (camellia sinensis) is a normal drink approximately in all societies. A case-control clinical trial study was conducted to evaluate the effect of black tea and Kombucha tea on blood glucose level in diabetic rats. In this study Wistar male rats with a free access to normal diet and light-dark cycle were used in room temperature of 22-25°C. Diabetes mellitus was induced on 15 rats by intraperitoneal injection of 60 mg/kg BW Streptozotocin. The diabetic animals (with blood glucose level equal or more than 300 mg/dl) divided equally into two groups. The animals in group 1 consumed black tea and in group 2 Kombucha tea instead of fresh water while animals in group 3 consumed fresh water. The blood samples were obtained from each animal in 3, 7 and 15 days after diabetic induction and blood glucose level in these stages relative to that in the onset of diabetes induction and were compared with each other. Our data showed that blood sugar level of both the black tea and Kombucha tea consuming diabetic rats declined significantly ( $p < 0.01$ ). The blood sugar of the control group however remained at normal levels ( $p < 0.107$ ). There was no significant differences between black tea and Kombucha tea groups ( $p < 0.273$ ). Therefore, if there is any antidiabetic effect in Kombucha tea, it seems to be due to some components of black tea which is the basic element in production of Kombucha tea.*

*Key Words: Diabetes mellitus, black tea, Kombucha tea.*

### INTRODUCTION

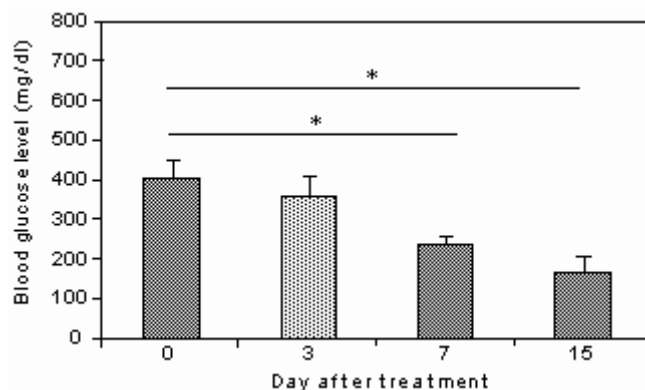
Hippocrates claimed that the herb vitex was useful in assisting with the passing of afterbirth. Confucius never ate a meal that did not include ginger. Cohorts of explorer Captain James Cook dubbed kava kava the intoxicating pepper because of its calming effects. Nevertheless, the

fact remains that herbal therapies are widely popular: Americans are expected to spend an estimated \$2 billion to \$5 billion per year on herbal remedies and each year this expenditure rises (1). In 1998, Eisenberg and colleagues (2) evaluated trends in alternative medicine use in the United States and showed that an estimated 15 million adults were at risk for potential drug-herb interactions. And in 2000, Bennett and Brown, in a study

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Figure 1: The effect of black tea on the blood glucose level in diabetic rats.



\*The data indicate a significant differences between the blood glucose level in day 0 (before consuming black tea) and that of 7 and 15 days after the consumption of the drink ( $p=0.013$ ,  $p=0.000$  respectively, students' t-test).

of herb use among patients enrolled in a health maintenance organization, found that 40% of patients took herbs, usually as a preventive measure, and that most used the products without the knowledge of their physicians or pharmacists (3).

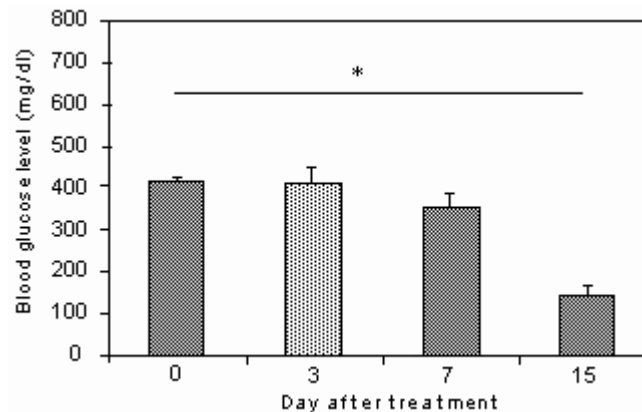
Several explanations for the upsurge in the use of herbs have been postulated: a focus on prevention in health care has renewed public interest, and the rising costs of health care, along with a dissatisfaction with managed care, may also be contributing to the more use of herbs (4). Although, some of them have been considered previously as needless, useless, or even toxic dietary compounds. There is little doubt that the preventive effects of plant products are intrinsically related to the presence of phytochemicals (5). In part, the protective role of vegetables, fruits, and tea is thus to provide antioxidant vitamins and specific phytochemicals that display a powerful inhibition in oxidative reactions. Epidemiological studies as well as laboratory experimentation have yielded sound data and evidence in support of the fact that vegetables, fruits, tea and specific antioxidants, are responsible for this inhibition (6). The major phytochemicals are phenolic compounds like flavonoids and phenolic acids (7). Flavonoids are ubiquitous in plants; almost all plant tissues are able to synthesize flavonoids.

The number of flavonoids may be close to 5.000. The most important flavonoids are quercetin, kaempferol, myricetin, and chrysin, these are found in most fruits and vegetables (8). The content of flavonoids in various beverages like tea and wine is very high (9).

Black tea infusions prepared with tea bags (4.0 or 5.0 g) contain 17-25 mg/l quercetin, 13-17 mg/l kaempferol, and approximately 3 mg/l myricetin (10). The contents of catechins ranges 3-10% (wt/wt solids) (11). Edible plant material also contains numerous weakly estrogenic diphenolic compounds termed phytoestrogens which are lignans, isoflavones, coumestans, and resorcylic acid lactones. The precursors of these compounds are to be found in fiber-rich unrefined grain products, various seeds, cereals, legumes and tea (12-13).

*Diabetes mellitus* is a complex disease whose prevalence is very high. The international diabetic federation estimates the prevalence of diabetes is probably between 2 to 4% in United State (14). In Iran more than 2 million people suffer from diabetes (15). On the other hand a large and increasing number of patients use medicinal herbs or seek the advise of their physicians regarding their use one of these herbal medications which is quite popular in diabetic patients as is Kombucha

Figure 2: The effect of Kombucha tea on the blood glucose level in diabetic rats.



\*The data indicate a significant difference between the blood glucose level in day 0 (before consuming Kombucha tea) and 15 days after the consumption of the drink ( $p=0.000$ , students' t-test).

tea. Since the principle element of this beverage is black tea which contains myricetin that mimics insulin in stimulating lipogenesis and glucose transport in rat adipocytes *in vitro* (16), we conducted the experiments reported here to compare the effect of black tea and Kombucha tea on blood glucose level on diabetic rats.

#### MATERIALS AND METHODS

In this study Male Wistar Rats weighing 180-220 g were used in all experiments. 15 rats were housed in groups of 5 in a controlled environment with free access to food and water and were maintained on a 12:12 hour light-dark cycle with a temperature of 22-25°C. *Diabetes mellitus* was induced in all rats by intraperi-

toneal injection of 60 mg/kg BW Streptozotocin (the Upjohn company Kalamazoo, MI 49001, USA). The diabetic animals (with blood glucose level equal or above 300 mg/dl) were divided equally into three groups. The animals in group 1 consumed black tea, group 2 Kombucha tea and group 3 fresh water. The blood samples were obtained from each animal in 3, 7 and 15 days after diabetic induction and blood glucose levels were measured using an Autoanalyzer (Auto Technicon-RA-1000). Data were expressed as mean  $\pm$  SEM for blood glucose level in these stages as well as in the onset of diabetes induction (day 0). Data were compared in these groups by using the SPSS software and the statistical significance was assessed by students' t-test.  $p<0.05$  was chosen as the level of significance.

Table 1: Blood glucose level (BG) in different days (0, 3, 7 and 15) from the onset of treatment in diabetic rats treated with black and Kombucha teas and drinking fresh water (n=5).

Days	0	3	7	15	P value
	Mean $\pm$ SEM	Mean $\pm$ SEM	Mean $\pm$ SEM	Mean $\pm$ SEM	
B. G. Groups					
Black tea	406 $\pm$ 64.5	361 $\pm$ 67	236 $\pm$ 26	166 $\pm$ 51	0.00014
Kombucha tea	417 $\pm$ 15	413 $\pm$ 34	352 $\pm$ 30	145 $\pm$ 26	0.000
Fresh water	432 $\pm$ 86	390 $\pm$ 80	346 $\pm$ 89	341 $\pm$ 49	0.107

\*p values are indicated for the differences between the blood glucose level in day before consuming the drinks (day 0) and 15 days after that (day 15) using students' t-test.

## RESULTS

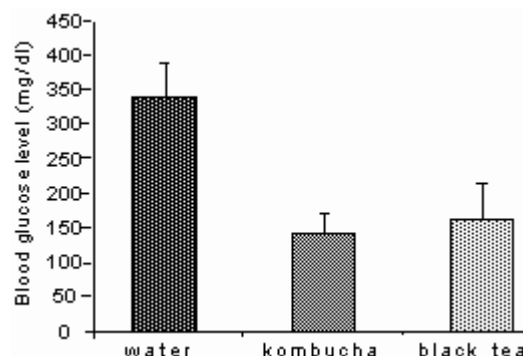
Our results showed that blood glucose level declines successively in all three stages after treatment in both test groups but not in control group (Table 1). In the black tea consuming animals the blood glucose level declined significantly 7th and 15th days after the onset of treatment ( $p=0.013$ ,  $p=0.000$  respectively) (Figure 1) while in the case of Kombucha tea consuming group, only the difference between the blood glucose level in 15th days following treatment relative to that of the onset of treatment (day 0) was significant ( $p=0.000$ ) (Figure 2). Although there was a significant decline in blood glucose levels due to black tea and Kombucha tea 15 days following consumption as compared to that of control group ( $p=0.006$  and  $p=0.002$  respectively), no significant difference between the blood glucose level in two test groups was observed ( $p=0.273$ ) (Figure 3).

## DISCUSSION

*Diabetes Mellitus* is a metabolic disorder characterized by insufficient insulin secretion and/or insensitive target tissues to metabolic actions of insulin (17). Despite the progressive efforts to produce synthetic drugs for treating diabetic patients, there is a widespread propensity of patients to herbal medicine. Among these herbal remedies consumption of Kombucha tea is relatively popular in some societies as an antidiabetic drink (18). On the other hand black tea (*camellia sinensis*) is a normal drink approximately in all societies.

Several epidemiological studies suggest that black tea consumption is associated with a reduced risk of degenerative diseases such as cardiovascular diseases (19-20), cancers (21) and *diabetes mellitus* (22). The most effective agents in tea that prevent and/or treat the diseases are flavonoids, content of which is very high in tea (23). One of these polyphenolic agents is myricetin (8) which mimics insulin in stimulating lipogenesis and glucose transport in rat adipocytes *in vitro*. Myricetin-stimulated glucose uptake is possibly due to a change in the intrinsic activity of the glucose transporter, caused by alterations in membrane fluidity or transporter-lipid

Figure 3: Comparison between the blood glucose level in diabetic rats 15 days after consuming black tea, Kombucha tea and fresh water (n=5).



\*The data indicate that although there is significant decline in blood glucose levels in both black tea and Kombucha tea consuming groups as compared with the control group ( $p=0.006$  and  $p=0.002$  respectively), there was no significant difference between the black tea and Kombucha tea, consuming groups ( $p=0.273$ , Students' t-test).

interactions, as a result of the insertion of myricetin into the membrane bilayer. Thus, myricetin may have a therapeutic potential in management of non-insulin-dependent diabetes mellitus by stimulating glucose uptake, without the presence of fully functional insulin receptors (16).

Our results also indicate the effectiveness of black tea in treating streptozotocin induced *diabetes mellitus* in rats. On the other hand there was a similar effect for Kombucha tea which is a beverage made by cultivating a mushroom in black tea cultivating fields. Also the component of Kombucha tea is quite different from that of black tea, antidiabetic effect of which may be due to polyphenolic residues from the black tea as the basic element of Kombucha tea. This needs further investigations.

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