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RESEARCH ARTICLE

DOSE-DEPENDENT EFFECTS OF HABITUAL COFFEE AND TEA CONSUMPTION ON SOME RISK FACTORS OF TYPE 2 DIABETES MELLITUS IN LIBYA

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Abstract

Patient's Lifestyle such as habitual consumption of certain meals and beverages plays major role in the development of diabetes. There is strong positive association between overall obesity as measured by Body Mass Index (BMI), blood cholesterol, blood pressure and diabetes. Black and green tea and coffee are traditional beverages that are daily consumed by many Libyans. In this study, we studied the relationship between the average daily consumed amount of coffee, green tea, or black tea and fasting blood glucose, cholesterol, blood pressure or Body Mass Index (BMI) as an indicator for obesity in type 2 diabetic patient. Our study included 396 Libyan diabetic patients (292 females and 104 males) with mean age of 49±17 years from Tripoli center of diabetes. This study performed during a period of 2 years. We also included control patients who were coffee or tea non consumer type2 diabetics. The results of this study showed that as the amount of daily consumed coffee, green tea, and black tea increases there is a marked decrease in fasting blood glucose of type 2 diabetics. In addition, a habitual green tea consumption strongly reduces blood cholesterol, blood pressure and BMI while black tea has weaker effect. In contrast, coffee consumption significantly increases blood cholesterol, BMI and blood pressure of diabetics at higher doses.

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Introduction:-

Black tea and green tea are made from the leaves of the plant Camellia Sinesis[1]. Black tea beverage differs in composition from green tea in that most of the flavanols and the other phenolic materials are converted to the oxidized forms known as theaflavins and thearubigins [2]. Flavanols and catechins are a group of polyphenols called flavonoids. It has been shown that tea's protective benefits are linked to the antioxidant property of this group of compounds. Epigallocatechingallate (EGCG) is found in the highest concentration in green tea and it is well researched catechins[3]. In addition, caffeine, aluminium and manganese have been reported to be present at small

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concentrations in both types of tea. The remaining compounds consist of partially soluble proteins, polysaccharids, lignin and sugars[1].

Many ingredients in Arabic coffee have been intensively studied and correlated to the health benefits of coffee drinking such as chlorogenic acid and caffeine[4].

Type 2 diabetes mellitus is the most common endocrine disorder worldwide characterized by hyperglycemia[5]. It is chronic condition in which cells fail to use insulin properly, sometimes combined with insulin resistance. AWHO criterion for the diagnosis of diabetes is fasting blood glucose of more than 126 mg/dl or random blood glucose of more than 200 mg/dl[6]. Obesity and type 2 diabetes are tightly associated diseases because obesity can lead to insulin resistance[7]. The proportions of people with these two health problems have recently reaching epidemic levels in Asia[8]. There is strong positive association between overall obesity as measured by Body Mass Index (BMI), blood cholesterol, blood pressure and diabetes[9]. The prevalence of diabetes in Libya is very high[10]. Patient's Lifestyle such as habitual consumption of certain meals and beverages plays major role in the development of diabetes[11]. Since black and green tea and coffee are traditional beverages that are daily consumed by many Libyans and some studies suggest that these beverages can modulate many biochemical parameters in the blood such as cholesterol level and blood glucose[12,13], we investigated here the effects of habitual intake of certain amounts of these beverages over a period of more than 2 years among Libyan diabetics. Libyans are generally conduct similar method in their preparation of these beverages. In Libya, there are a special well known cups usually used for tea drinking which can hold till 20 ml of tea either black or green. Arabic coffee traditionally served in a special cup holding about 30 ml. Preparation of either green or black tea and coffee is done according to traditional Libyan method.

Materials and Methods:-

Study design:

A random population sample of 396 diabetic patients included 292 women and 104 men mean age was 49 ± 14 years, took part in a screening study performed at the Tripoli center of Diabetes. We included only cases that habited to daily consume only one of the beverages since 2 years ago or more. Additional control sample of 100 diabetic patients was considered in our study, they were coffee and tea non- consumer diabetics. Type 1 diabetics are not included in this study. We have also investigated 100 normal subjects who were non-diabetics in the same age range and do not usually consume coffee or tea as non-diabetic control sample.

Measurement of BMI:

We recorded the weight (kg) and length (m^2) to calculate BMI using the formula $(BMI) = \text{Weight (kg)} / \text{height}(m^2)$. WHO criterion for diagnosis of obesity is BMI of more than $29 \text{ kg}/m^2$ [9].

Measurement of fasting serum glucose:

Fasting serum glucose (FBG) was analyzed with a standard glucokinase method using commercial reagent kits from Analyticon® Biotechnologies AG[14]. Glucokinase catalyzes the oxidation of glucose to gluconic acid with formation of hydrogen peroxide which detected using phenol-aminophenazone in the presence of peroxidase. The assay procedures performed according to kit instructions. Normal fasting serum glucose is 70-110 mg/dl [15].

Measurement of blood cholesterol:

Fasting blood cholesterol was determined after enzymatic hydrolysis and oxidation according to the kit instructions from Randox Labs® UK at 500nm. Patients were asked to don't eat or drink anything other than water for 9 to 12 hours before the blood sample is taken[16].

Measurement of blood pressure:

Blood pressure was measured twice on the left arm while the participants were in a supine position. The mean of the two blood pressure measurements was used in the analysis. The systolic and diastolic blood pressures were measured using a Boso Oscillomat (Bosch & Sohn, Jungingen, Germany).

Statistical analysis:

The data was represented as mean $\pm$ SD. To test the significance differences, we compare the mean of each group of data with that of the mean obtained for the corresponding control sample of coffee or tea non-consumer diabetic patients. The data was analyzed statistically using paired student t test by Sigma Plot 2 Programm [17]. (* indicates

a statistically significant difference where $P < 0.05$, ** indicates a statistically significant difference where $P < 0.001$. (ns) means no significant difference is observed.

Results:-

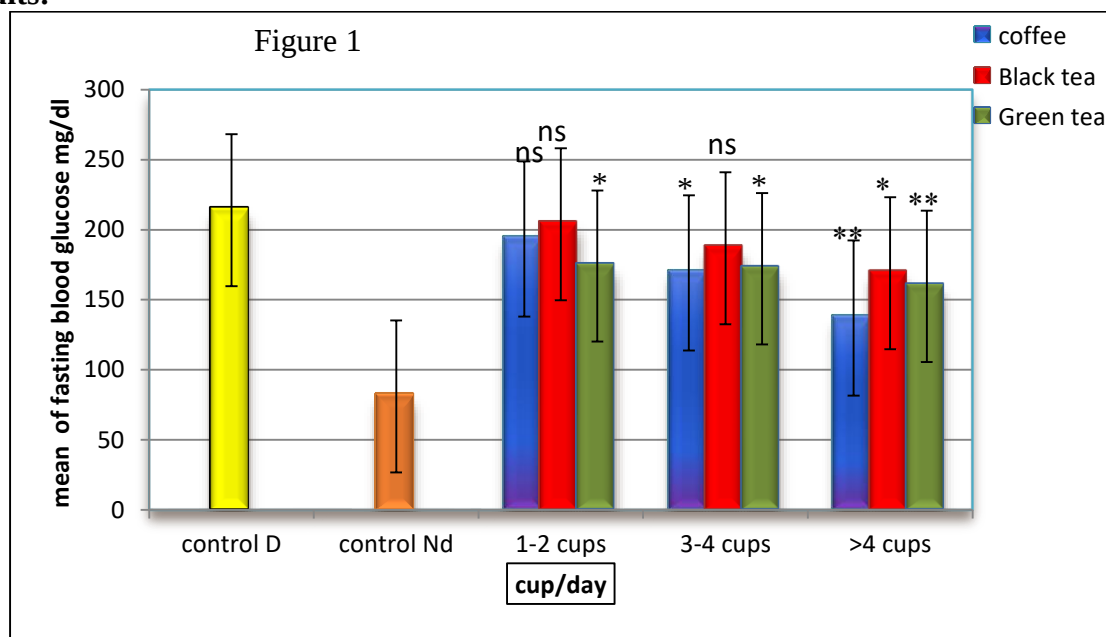


Figure 1:-The effects of different amounts of coffee or tea habitually consumed on fasting blood glucose of diabetics

Mean of FBG of control diabetic patients who do not habitually consume tea or coffee is represented by yellow column. The orange column represents the mean FBG of control sample for non-diabetics who usually do not consume tea or coffee. The violet column represents the mean of FBG for diabetics who habitually consume only coffee. The red column represents the mean FBG of diabetics who habitually consume only black tea. The green column represents the mean FBG of diabetics who habitually consume only green tea.

Figure 1 shows the levels of mean fasting blood glucose (FBG) in diabetic patients with relation to number of cups that are habitually consumed per day since at least two years ago of coffee, black, or green tea and we included a result of FBG for non-diabetic control sample who do not habitually drink these drinks (control Nd) as well as control sample represent mean of FBG in diabetics who are not habituated to drink these drinks regularly. As expected, we observed a marked difference between FBG of diabetics who were coffee or tea non consumers (control) and diabetics who were heavy coffee or tea consumers (drink more than 4 cups per day). The mean FBG of type 2 diabetics is lower in those persons who consumed 4 cups per day than who consumed one or two cups only. We also observed that FBG in type 2 diabetics is reduced by consuming increased amount of tea in a dose dependent manner.

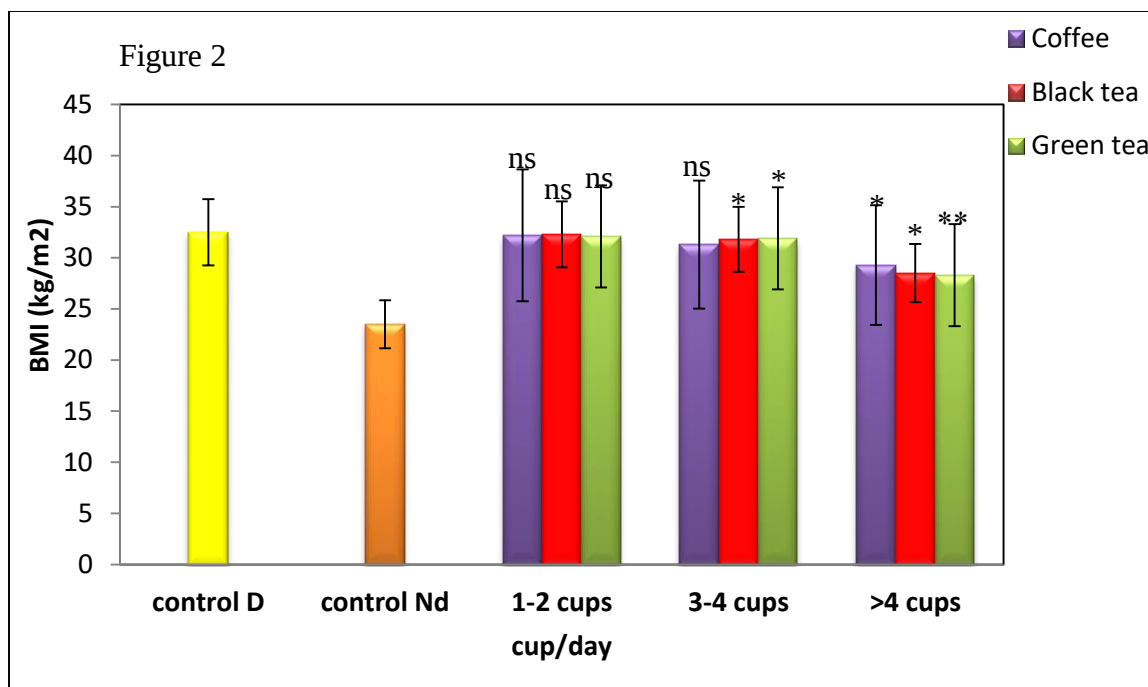


Figure 2:-The effects of different amounts of coffee or tea of daily intake on BMI

Mean of body mass index (BMI) of control diabetic patients who do not habitually consume tea or coffee is represented by yellow column. The orange column represents the mean BMI of control sample for non-diabetics (Nd) who habitually do not consume tea or coffee. The violet column represents the mean of BMI for diabetics who habitually consume only coffee. The red column represents the mean BMI of diabetics who habitually consume only black tea. The green column represents the mean BMI of diabetics who habitually consume only green tea.

Figure 2 shows that mean of BMI is markedly reduced in diabetics who usually consume 4 cups of tea per day in comparison to those diabetics who do not drink tea in a regular manner, the effect of coffee drinking on BMI is seemingly weaker. We observed that diabetics who are consuming coffee have a less significant lower BMI than those consuming green tea. Increased daily green tea intake rather than black tea was associated with more significant lower BMI of diabetics.

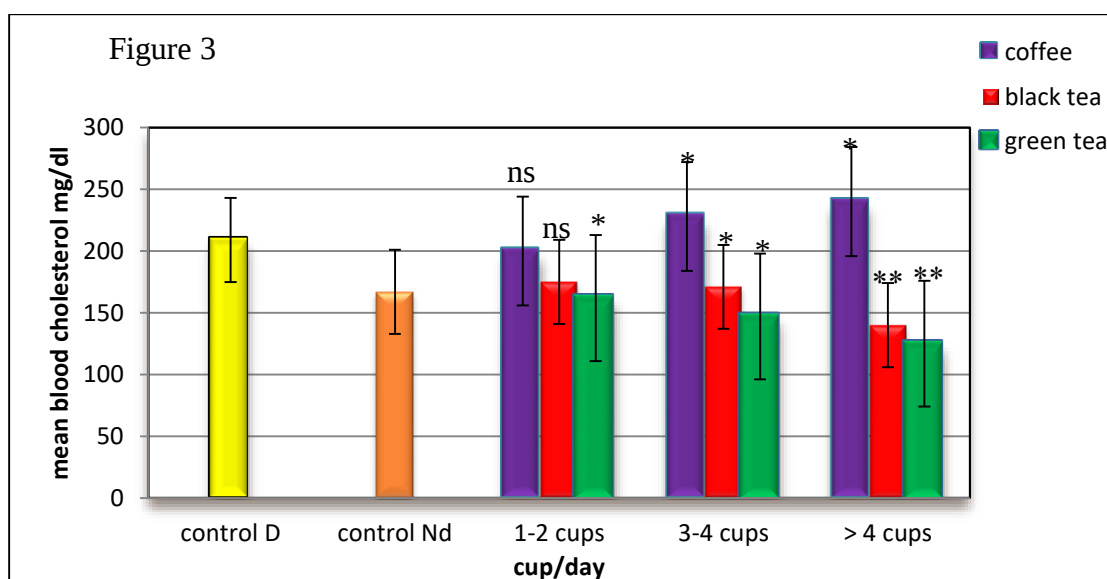


Figure 3:-The effects of different amounts of coffee or tea daily intake on blood cholesterol.

Mean of blood cholesterol of control diabetic patients who do not habitually consume tea or coffee is represented by yellow column. The orange column represents the mean blood cholesterol of control sample for non-diabetics (Nd) who habitually do not consume tea or coffee. The violet column represents the mean of blood cholesterol for diabetics who habitually consume only coffee. The red column represents the mean blood cholesterol of diabetics who habitually consume only black tea. The green column represents the mean blood cholesterol of diabetics who habitually consume only green tea.

Figure 3 shows that mean of blood cholesterol is markedly decreased in diabetics who consume more than 3 cups of green tea or black tea daily whereas coffee lead to increased cholesterol level markedly as compared to those diabetics who do not usually consume coffee or tea.

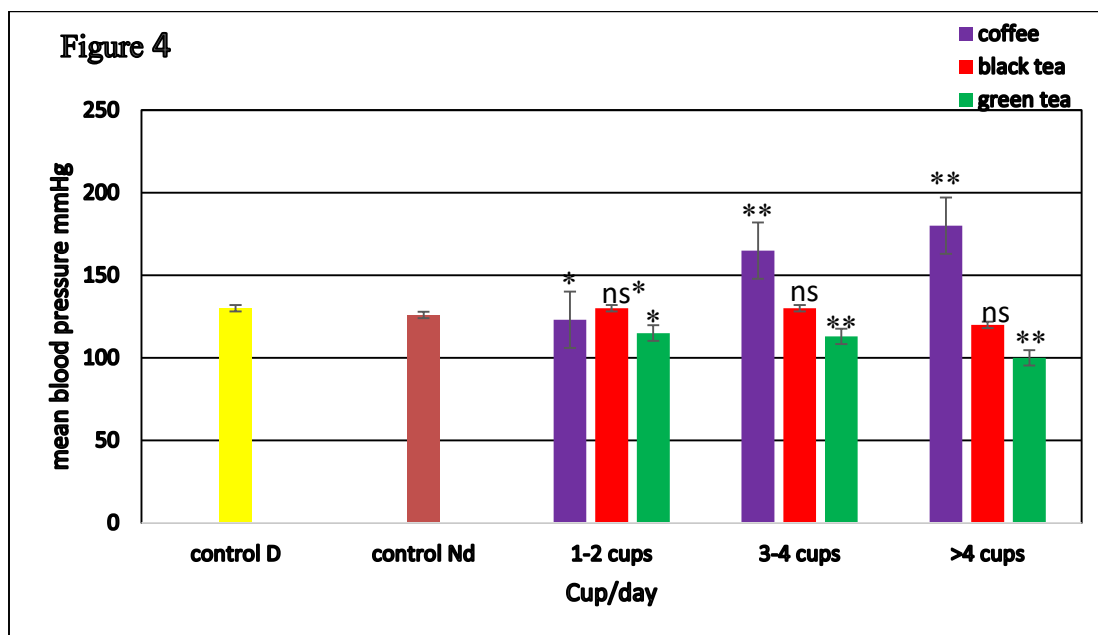


Figure 4:- Systolic blood pressure of diabetics according to the habitual daily intake of coffee or tea.

Mean of systolic blood pressure of control diabetic patients who do not habitually consume tea or coffee is represented by yellow column. The orange column represents the mean systolic blood pressure of control sample for non-diabetics (Nd) who habitually do not consume tea or coffee. The violet column represents the mean of systolic blood pressure for diabetics who habitually consume only coffee. The red column represents the mean systolic blood pressure of diabetics who habitually consume only black tea. The green column represents the mean systolic blood pressure of diabetics who habitually consume only green tea.

We observed a significant dose-dependent increase of coffee on systolic blood pressure in those patients consuming coffee and not tea daily (figure 4). We noticed powerful lowering effect of green tea at a dose of more than 4 cups daily on systolic blood pressure, whereas coffee intake at increasing amounts significantly increases systolic blood pressure of diabetics. Drinking similar amounts of black tea daily led to weaker change in blood pressure.

Discussion:-

Both coffee and tea are good source of caffeine which may affect glucose tolerance [18]. It has been found that habitual drink of coffee or tea is associated with decline of blood glucose level in diabetics [19]. The blood glucose lowering effect of coffee seen in type 2 diabetics might be due to the fact that chlorogenic acid in coffee reduces glucose absorption, and inhibits hydrolysis of glucose-6-phosphate and thus reduce glucose output in the liver [20]. Moreover, coffee is rich in magnesium, which improves insulin sensitivity and secretion [21]. The effects of green tea and black tea on blood glucose level are not clear. Black tea and green tea extracts have found to produce no effects on blood glucose in type 2 obese diabetics [22]. Our observation (figure 1) is in line with that study in Japan which showed that high consumption of green tea (six or more cups per day) lowered the risk of developing type 2 diabetes by 33% [23]. Obesity and type 2 diabetes are closely linked metabolic diseases. We have shown previously

that the majority of Libyan diabetic females suffer from obesity and the majority of male patients belong to the category overweight as measured by BMI according to WHO classification of body weight[24]. It's known that elevated blood lipids enhance insulin resistance in obese patients[25]. It has been found that cholesterol raising effects of unfiltered coffee (as used in this study) could be due to the diterpenes cafestol and kahweol which lead to increased LDL and triglycerides also [26,27]. In consistence with our results, green tea catechins could inhibit key enzymes involved in lipid biosynthesis resulting in the reduction of body weight [28]. In addition, theaflavin-3-gallate, a theaflavin derivative found in tea has been shown to reduce cholesterol absorption [29,30]. Consistently, our results show that diabetic patients who habitually drink green tea have lower BMI and blood cholesterol as compared to those who habitually drink coffee (**figure 2 and figure 3**). Moreover, we observed a marked increase in the systolic blood pressure in those patient consuming coffee daily (**figure 4**). Elevated blood pressure may predate type 2 diabetes [30,31]. The increase in blood pressure due to coffee consumption might be due to its high content of caffeine which has been found to increase blood pressure and heart rate[32,33]. In contrast, we observed a significant decrease in systolic blood pressure in a dose-dependent manner in diabetics who consume green tea daily. However, drinking black tea has no significant effects on blood pressure.

Conclusion:-

From these results we can conclude that increased daily consumption of green tea rather than coffee or black tea may be helpful for diabetics. Although, increased daily intake of coffee significantly reduces fasting blood glucose of diabetics it leads to increased blood cholesterol as well as BMI and systolic blood pressure. Black tea intake by diabetics has weaker effects on these biochemical parameters than green tea.

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