Effect of coffee and nescafe on blood glucose and lipid profile of diabetic male rats

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Abstract:
The present study aimed to investigate the effect of coffee and nescafe on blood glucose level and lipid profile of diabetic male rats.

Methods: 200 mg/kg from coffee and nescafe were used, and the animals were treatment for 30 days.

Results: the results showed a significant increase in blood glucose, cholesterol, triglycerides, Low density lipoprotein (LDL), Very low density lipoprotein (VLDL), whereas it explained a significant decrease in high density lipoprotein (HDL) of the diabetic male rats when compared with control group. The results showed that the consumption of coffee and nescafe showed an adverse effect on various biological markers of the lipid profile of diabetic male rats.

Key words: coffee, nescafe, alloxan, diabetic, male rats.
1. Introduction:

Diabetes mellitus (DM) is considered to be a syndrome associated with disorders in the metabolism of carbohydrates, lipids, and proteins caused by the absolute or relative lack of insulin (American Diabetes Association, 2010). Coffee is the most widely consumed beverage in the world and heavy coffee consumption has been associated with a lower risk of diabetes, but little is known about the mechanisms responsible for this association. Caffeine is one of the active biological components in coffee and is the principal source of the suggested benefits of coffee consumption. The effect of caffeine on glucose tolerance is still controversial, however (Urza et al., 2012). Caffeine had been reported to somewhat reduce the risk of type 2 diabetes (Van Dam, 2008). A growing body of research suggests that caffeine disrupts glucose metabolism and may contribute not only to the development of but also the control of type 2 diabetes, a major public health problem (Lane, 2011). It has also been reported that caffeine may increase the effectiveness of some medications (Gilmore and Michael, 2011). Coffee beans are the seeds of coffee trees that are widely cultivated in the tropics and these beans have to be roasted and ground before the infusion is made. About 100mg of caffeine and 200mg of tannin in a cup of coffee made by infusing 60g of coffee in a pint (450ml) of water. Analyses of cups of coffee showed that to days Londoners may get from 58 to 168mg of caffeine in a cup of coffee and 43 to 92mg in a cup of tea. Coffee is commonly consumed with a coffee creamer or lightener to soften the acidic taste (Pordy, 1994). Coffee made at home was slightly weaker than that served in cafés (averages 92 and 99mg/cup, respectively), but homemade tea was stronger (Passmore and Eastwood, 1998). The drink that revives hundreds of millions of us (about one-third of the world's population) and especially the Finns who drink an average of five cups each a day, is made from the evergreen shrub now grown in some fifty different countries (Lewington, 1990). Coffee rapidly loses some of its flavor after grinding; the best coffee is made from beans ground in the home. Preparations of dried ground coffee are convenient but lack bouquet. Instant coffee beans are spray-dried and the powder sold in airtight containers in the home, it is conveniently made into a drink by simply adding warm water. Instant coffees have overtaken traditional ground beans in popularity in many industrial countries. They contain 20 to 40mg of caffeine per gram of powder (Passmore and Eastwood, 1998). The coffee cream consists of vegetable fat, sodium caseinate, stabilizers, sweetener, emulsifiers, flavor and color (Ellinger, 1972).

The aim of this study is to determine the effects of coffee and nescafe on blood glucose and lipid profile in alloxan-induced diabetic Wister male rats.

2. Materials and Methods:

2.1 Induction of diabetes mellitus:

The animals were fasted for 12 hr and diabetes was induced by a single intraperitoneal (IP) injection of alloxan monohydrated (BDH, England) dissolved in D.W at a dose of 125 mg/kg body weight in a volume of 0.5 ml. The diabetic state was confirmed 7 day after alloxan injection by the blood serum. Sugar value was greater than 200 mg/dl (hyperglycemia). Survived rats with a fasting blood glucose level higher than 200 ml /dl were included in the study (Alarcon et al., 2002).

2.2 Experimental design:

The study was carried out on twenty four mature male rats (Rattus norvegicus), aged as 10-12 weeks and weighing between 180 - 200 gm were procured from Department of Biology, College of Science, University of Thi Qar, Iraq. The animals were housed in a well ventilated 12 hrs light and 12 hrs dark cycles. The animals were divided into four equal groups, each group consists of (6) rats:

1- The first group (control group) was treated with drinking water with for 30 days.
2- The second group was injected with (0.5ml/animal/day) of alloxan (125mg/kg).
3- The third group was injected with (0.5ml / animal/day) of alloxan (125mg/kg) ,after week, this group was treated with (200mg/kg) of coffee with drinking water for 30 days.
4- The fourth group was injected with (0.5ml / anima/day l) of alloxan (125mg/kg), after week, this group was treated with (200mg/kg) of M. nescafe with drinking water for 30 days.

2.3 Blood collection:

After 30 days of treatment, the animals were sacrificed. Blood samples were collected by cardiac puncture, 5mL of blood were drawn from each animal of experimental groups, and put in tubes without EDTA, centrifuged at 3000 rpm for 15 minutes, and then serum was separated and kept in the refrigerator at -20°C until the time of assay.
2.4 Measurement of serum lipid profile:
The used reagents were supplied by Biolabo (France), and serum total cholesterol was measured according to Allan and Dawson, (1979), and Serum TG was measured according to (Tietz et al., 1994). While serum HDL was measured according to Lopes-Virella, (1977), and measurement of LDL and VLDL according to Friedwald et al., (1972), LDL and VLDL concentration was measured as follows : 
LDL = total cholesterol – (HDL + VLDL)
VLDL = serum TG /5

2.5 Statistical analysis:
Statistical analyses were done utilizing the computer data processing (SPSS, version 14). A probability value (P<0.05) was considered to be statistically significant and used to calculate least significant difference (LSD) values for the comparison of means following.

3. Results:
The results of the present study showed a significant increase (p<0.05) in the glucose level of the diabetic male rats when compared with control group (table 1), while the rats treated with coffee and nescafe at dose 200 mg/kg showed a significant increase (p<0.05) in the level of glucose of the diabetic male rats when compared with diabetic rats and control group (table 1). The results showed a significant increase (p<0.05) in the level of cholesterol and TG of the diabetic male rats when compared with control group (table 1), while the rats treated with coffee and nescafe at dose 200 mg/kg showed a significant increase (p<0.05) in the level of cholesterol and TG of the diabetic male rats when compared with diabetic rats and control group (table 1), the results showed a significant decrease (p<0.05) in the serum level of HDL of the diabetic male rats when compared with control group(table 1), while the rats treated with coffee and nescafe at dose 200 mg/kg showed a significant decrease (p<0.05) in the serum level of HDL of the diabetic male rats when compared with diabetic rats and control group (table 1).

The results indicated a significant increase (p<0.05) in plasma LDL, VLDL of the diabetic male rats when compared with control group (table1), while the rats treated with coffee and nescafe at dose 200 mg/kg showed a significant increase (p<0.05) in plasma LDL, VLDL of the diabetic male rats when compared with diabetic rats and control group (table 1).

4. Discussion:
The present study showed that the blood glucose level in alloxane diabetic rats was significantly elevated (hyperglycemia). This result is in agreement with (Ene et al., 2006; Vinuthan et al., 2007). They observed that alloxane induced diabetes and hyperglycemia because this chemical induced necrosis to β-cells islets (Inawati and Winarno, 2008), or may be alloxane impaired insulin secretion by oxidative damage which resulted from free radicals formation secondary to glucose-autooxidation and the increase of free radicals might lead to liver cell damage (Kim et al., 2006). The results indicated that coffee and nescafe given at a dose of 200 mg/kg significantly increased the blood glucose levels in diabetic rats with the control. This finding was consistent with that of Lane et al. (2011) who reported that acute administration of caffeine impaired postprandial glucose metabolism in diabetic patients. They concluded that daily consumption of caffeinated beverages with meals could produce higher average glucose levels that increase the risk of diabetes complications. Gerben et al., (2002) explained that caffeine can decrease insulin sensitivity in healthy humans, possibly as a result of elevated plasma epinephrine levels. Caffeine can directly antagonize adenosine receptors in many tissues including tissues in the central nervous and cardiovascular systems and skeletal muscle and adipose tissue. This could result in a multitude of responses including adrenaline secretion, altered blood flow and lipolysis (Terry et al., 2000).

The present data recorded that rats consumed instant coffee beverage revealed a significant increase in the serum levels of cholesterol, TG, LDL, and VLDL-c, Table 1: Effect of coffee and nescafe on lipid profile levels of diabetic male rats.
while caused a significant decrease in HDL. The elevations of lipid fractions could be attributed to the lipid component of coffee, cafestol and kahweol, which classified as diterpenes. Nawrot et al. (2003) suggested that caffeine in not coffee that is responsible for the hypercholesterolemic but to the two diterpenoid alcohols (cafestol and kahweol). The increase level of cholesterol and triglyceride seen in this study is consistent with the finding of Sadeek et al. (2010) found that caffeine produced a significant increase in serum total cholesterol as well as triglyceride in diabetic rats compared to normal control. Mahmoud et al., (2013) found that coffee consumption reduced total cholesterol and LDL-cholesterol in non-diabetic rats.

The obtained results are in agreement with many other authors. Rezq and Fathy (2010) revealed that administration of boiled and Turkish coffee induced a significant increase in atherogenic index represented as increase in total lipids, TG, TC, LDL-c and VLDL-c. Also, Abd El-Fatta (2008) showed a significant elevation of serum total cholesterol, TC, TG, LDL-c, while a significant decrease of HDL-c in rats fed on diet supplemented with low or high dose of coffee. Similarly, Onuegbu et al. (2001) found a significant increase in the mean total serum cholesterol concentration and LDL-c cholesterol concentration were observed in healthy human subjects after regular administration of caffeine. On the contrary, coffee consumption has been consistently revealed a reduction in LDL-cholesterol in rats and in humans alike (Grzegorzewska et al., 2009; Mahmoud et al., 2013). Also, Onuegbu et al., (2001) found a significant increase in the mean total serum cholesterol concentration and LDL-c cholesterol concentration in healthy human subjects. On the contrary, previous study by Sadeek et al., (2010) indicated a significant decrease in serum HDL-Cholesterol in diabetic rats compared to normal control. Onuegbu et al., (2001) on the other hand, in another study, reported non significant difference the mean HDL cholesterol concentration when healthy humans were administered caffeine over a period of time. Grzegorzewska et al. (2009) reported that plasma concentration of HDL cholesterol was significantly higher in patients who were drinkers of caffeinated coffee compared to those who were nondrinkers. Again, these reductions were found not to be significant. This finding is similar and consistent with that of Mourão-Júnior et al., (2006). The significant increase of serum levels of cholesterol,TG, LDL-C, VLDL-C and LDL-c/ HDL-c ratio in rats consumed nescafe, could be attributed to

the fact that the nescafe contains hydrogenated palm kernel oil, the major source of trans fats, and corn syrup. Ibegbulum and Chikezie (2012) proved that palm kernel oil is one atherogenic factor because it contains more short chain saturated fatty acids and few antioxidant phytochemicals. Increase the serum of LDL-c and LDL-c/ HDL-c ratio are indicative to promote the synthesis of cholesterol rather than phospholipids, whereas, HDL-c contains phospholipids more than cholesterol (Nelson and Cox, 2000; Glew, 2006).

References:


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