ORIGINAL ARTICLE

Impact of Gallic Acid on Oxidative Stress in Diabetes

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ABSTRACT

Background: Free radicals play important role in the metabolism of our body, free radicals transfer their free electrons, which result in the oxidation of cellular organization of human body. This oxidation process has detrimental effect on our body process, likewise in diabetes..

Aim: To observe the result of Gallic acid on oxidative stress in diabetes. For that purpose the study was organized to understand the effect of Gallic on oxidative stress in alloxan induced diabetic rats and its effect on the control of diabetes.

Methods: Fifteen adult male Wistar rats were selected and housed in steel cages in the animal farm at Rawalpindi Medical University, Rawalpindi during the period from 10.05.2016 to 20.05.2017. The rats were kept in the suitable environmental condition with the room temperature of 24 ± 5 ℃, under a 12 hour light cycle: 12 hour dark cycle and were allowed free to have access to water and food (standard rats chow) (Amin et al. 2011). The rats were arranged into 3 different groups.

Results: Determination of blood level of glucose showed that positive control group has significantly higher glucose level as compared to group treated with gallic acid. Determination of cholesterol concentration revealed no significant difference in cholesterol concentration was observed. Determination of serum triglycerides showed no significant difference. No remarkable changes were found in the case of HDL, LDL, and VLDL concentration.

Conclusion: In the present study, it has been concluded that the GA has an ant diabetic potential. While their other properties like anti-lipidemic, antioxidants and anti-lipid peroxidation were not conformed during this research trial. Firstly, this is just because of that the potential dose of alloxan that was used in this dose is actually safe which showed no deterioration in major blood biochemistry instead of hyperglycemia.

Keywords: Gallic acid, diabetes, alloxan, plasma lipid profile, catalase, rats.

INTRODUCTION

Diabetes is a disorder which is characterized by the disturbed metabolism and absorption of carbohydrates, lipids and proteins which ultimately result in increased the blood sugar level in the body. The metabolism and absorption of carbohydrate depends upon the level of insulin and the sensitivity of insulin receptors in the body, alteration of these processes will lead to mal-absorption of carbohydrates. There are two major types of diabetes i.e. adult onset diabetes and juvenile diabetes. It is the one of the major health problems in the world that affects different systems of our body directly or indirectly. Micro-vascular problems include retinopathy, neuropathy and nephropathy. The macro-vascular complications include the heart diseases, stroke and peripheral vascular disease. Moreover, the diabetes mellitus is leading cause of limbs amputation in patients because it slows down the healing mechanism and fastens the spread of infection.

Diabetes is regarded as oxidative stress disorder which is caused by imbalance between the oxidant and anti-oxidant agents in the body. The increased in amount of anti-oxidants have protective role is term of different complications caused by diabetes mellitus (Gulcin et al. 2003). The antioxidants include the vitamins, supplements and the components of plants and fresh fruit. Moreover, some drugs used in the treatment of this disorder also have antioxidant activity.

Different studies on Gallic acid (GA; 3, 4, 5-trihydroxybenzoic acid) showed that it has antioxidant property and GA has maximum ability of absorption by the system (Konishi et al. 2006). It has multiple pharmacological effects like anti-inflammatory, antimicrobial, and effective antioxidant effects (Kim et al. 2007). The GA in alloxan-induced diabetic rats showed beneficial effects on diabetes by lowering oxidative stress-related complications (Ramkumar et al. 2013). So it was hypothesized that GA has an anti-diabetic and antioxidant effects on alloxan induced oxidative stressed diabetic rats and in science, rats are a well-used model of diabetes.

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MATERIALS AND METHODS

Fifteen adult male Wistar rats were selected and housed in the stainless steel cages in the animal shed at Rawalpindi medical university, Rawalpindi. The rats were kept in the environmentally feasible condition where the room temperature is 24 ± 5 ℃, with alternating light and dark cycle of 12 hours each(standard rats chow) (Amin et al. 2011). The rats were classified into following three groups (5 rats in each group);

Group I: This group was labeled as non-diabetic or negative control.

Group II: This group was marked as diabetic or positive control.

Group III: This group was labeled as diabetic and treated with GA.

After overnight fasting, Alloxan (150mg/kg body weight) was injected as a diabetogenic compound to the rats of groups II and III. The rats of group I, were given the equal volume of 0.9% saline. After 4-6 days, blood samples were taken for analysis.

Blood sampling: At the end of the experiment (14 days), samples were collected via cardiac puncture for the analysis of fasting glucose level. The sample were taken in try centrifuge tubes and then allowed to coagulate at room temperature, ad after the coagulation process it was shifted to centrifuged chamber at the speed of 3000rpm for 15 minutes. The clear, non-hemolysed serum was collected by using dry plastic syringes and then stored at -20°C for analysis of blood sugar levels (Kumar 2012).

Biochemical analysis: The biochemical analysis of, lipid profile (triglycerides, Total cholesterol), serum glucose, lipoproteins (HDL, LDL, VLDL), anti-oxidant status (MDA catalase) was done via available kits (Randox, UK).

Statistical Analysis: Result was analyzed by SPSS version 13

RESULTS

Blood glucose concentration: Showed that positive control group has significantly higher glucose level as compared to group treated with gallic acid. The result is shown in the table 1.

Cholesterol concentration: No significant difference in cholesterol concentration was observed in three treatment groups. The result is shown in the table 2.

Serum triglycerides: No significant difference was observed in triglycerides concentration in three treatment groups.

HDL, LDL and VLDL-Cholesterol concentration: No significant difference was observed in HDL, LDL and VLDL-Cholesterol concentration in three treatment groups.

Catalase and MDA concentration: No significant change has been observed in catalase and MDA concentration between these treatment groups.

Table 1: Serum glucose concentration in rats of three treatment groups.

Groups	**Glucose (mg/dl)**
NC	1.054 ± 2.89^{a}
PC	2.112 ± 6.72^{c}
GA	1.320 ± 9.61^{b}
Groups	**Total Cholesterol (mg/dl)**
NC	1.642 ± 4.92
PC	1.703 ± 4.18
GA	1.686 ± 2.68

[a–c]Within the same column, means with multiple superscripts are quite different (*P*<0.05). Results are reported as mean±SEM.

NC= Negative control called group I; PC= Positive control treated with alloxan called group II; GA= Gallic acid treatment group called group III. Results are reported as mean±SEM.

NC= Negative control called group I; PC= Positive control treated with alloxan called group II; GA= Gallic acid treatment group called group III.

DISCUSSION

Diabetes Mellitus is a current major issue of the world. Its incidences in increasing day by day and a lot of researches have been carried out to discover the possible cause of this illness as well as to achieve the best treatment plan to reduce the risk of complications. Mounting clues suggested that oxidative stress plays an important part in the pathogenesis of diabetes mellitus (Ceriello et al. 2000). In diabetic patient, the antioxidant quantity present may not be enough to level the excess ROS produced. Thus, the exogenous source of antioxidant should be present in the body to neutralize the effect of free radicals. Antioxidants are important agents that decrease the possibility of oxidative harm as well as stop the progression of various diseases (Gulcin et al. 2003).

Many plants contained phenolic compounds which showed effective antioxidant properties. In these categories aromatic plants have been especially are reported that have high phenolic content and have been widely used for the treatment of many chronic diseases (Ramkumar et al., 2009). According to Kusirisin et al. (2009) phenolic compounds had free radical scavenging properties that is being used for reducing the diabetes oxidative stress.

In these plant phenolic compounds, Gallic acid (GA; 3, 4, 5- trihydroxybenzoic acid), which is a plant phenol and widely seen in wine, berries catalase,

fruits, and tea. It has been reported that GA showed highest absorption by the body (Konishi et al. 2006)

CONCLUSION

Present study showed significantly higher blood glucose level in positive control as compared to group that was treated with Gallic acid and negative control. Gallic acid showed decrease in glucose concentration which was increased due to alloxan treatment. Alloxan is considered the perfect and traditional agent for diabetes induction in animals (Lenzen 2008). Our results are accordance to the results of Ramkumar et al. (2013) in which they reported about the anti-hyperglycemic activity by decreasing the glucose level of blood with GA in alloxan-induced diabetic rats. Similar results have been reported by Raid & Al-Salih (2010) in which showed decrease in blood glucose level after one, two and three weeks of treatment with Gallic acid. According to Huang et al. (2005) Gallic acid action regarding antidiabetic is just because of enhancement of insulin receptor sensitivity. Present finding regarding the beneficial results of Gallic acid on diabetes is being useful in decreasing oxidative stress-related diabetic complications.

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