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RESEARCH ARTICLE

ANTIHYPERGLYCEMIC EFFECT OF TANNIC ACID IN STREPTOZOTOCIN INDUCED DIABETIC RATS

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ABSTRACT

Tannic acids are a naturally abundant plant phenolic compound in the human diet and are known to have drug property for some diseases. In the present study the antidiabetic efficacy of tannic acid was investigated experimentally. The diabetes was induced by intraperitoneal injection single dose of streptozotocin (50mg/kg b.w). After three days (72hr) of induction of diabetes. The diabetes animals were treated with tannic acid (200mg/kg b.w) and glibenclamide (600µg /kg b.w). Blood glucose estimation was performed every week of the study The tannic acid treated diabetic rats significantly decreased the level of body weight, blood glucose as well as increased level of insulin, glycogen and lowering level of creatine levels. These finding demonstrated that tannic acid possess anti hyperglycemic activity against STZ induced diabetic rats. The antidiabetic effects of tannic acid was compared with standard anti diabetic drug glibenclamide.

INTRODUCTION

Diabetes is a group of metabolic diseases characterized by hyperglycemic resulting from defects in insulin secretion, insulin action or both. It is a universal problem affecting human societies at all stages of development. Diabetes has become health problem of epidemic proportion in the wide world particularly in developed countries (Anthony and Chen, 2009). Use of tannic acid in food application is far more widespread and significant amounts are used as process aids in beer clarification, aroma compound in soft drinks and juices. Tannic acid is applied directly to treat sore throat and tonsils, spongy or receding gums, cold sores and fever blister (Cox and Cox, 2009). Tannic acid can medicate bleeding, chronic diarrhea, dysentery, bloody urine, painful joints, persistent coughs, and cancer. Vaginally, tannic acid can be used as a douche for white or yellowish discharge, i.e, leukorrhea. (Covington, 1996). A systemic review by Chung *et al*. (1998) found that tannins have also been reported to exert many physiological effects, such as to accelerate blood clotting, reduce blood pressure, decrease the serum lipid level, produce liver necrosis. Several studies have been pointed that polyphenols can be considered as a toxins, as some tannins have toxic effects such as reducing the absorption of proteins, binding to proteins, leading to some metabolic disorders (Bravo, 1998; Despande *et al*., 1984). Yet, polyphenols including tannins have been recognized as functionally active molecules, possessing antioxidant, anticancer antimutagenic properties, hypoglycemic agents, as well as exerting protective effects against cardiovascular and other diseases (Zhu and Filippich,1992). The aim of, the present study is to investigate the antihyperglycemic activity of tannic acid on control STZ induced diabetic rats.

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MATERIALS AND METHODS

Chemical

Tannic acid (purity 97%) was purchased from Aldrich chemical (Milwaukee, Wi). Streptozotocin was purchased from sigma chemical (St, Louis, U.S.A). All other chemical used for this study are of analytical grade.

Animals

Normal healthy male Wister albino Rats (150-200 g) were used for present investigation. Rats were maintained on standard pellet diet and tap water ad libitum. They were kept in polycarbonate cages in an animal room with 12hr light/dark cycle and room temperature 25±2°C. This study was conducted according to the guidelines approved by the Institutional animal Ethical committee (IAEC, 889/2013).

Induction of Experimental Diabetes

Diabetes was induced by injection of a single intra-peritoneal dose of Streptozotocin solution. Streptozotocin (50mg/kg b.w) was dissolved in ice cold citrate buffer immediately before use. Diabetes was confirmed by glucose estimation. Animal with blood glucose value above 200 mg/dl were selected for the experimental study.

Experimental Design

The animals were divided in to four groups with six animals for each group.

Group1: Control rats
Group2: STZ induced diabetic rats
Group3: Diabetic rats treated with Tannic acid (200mg/kg b.w).
Group4: Diabetic rats treated with glibenclamide (600 µg/kg b.w).

Experimental procedure

Fasting blood glucose levels was determined in all experimental rats initially to determine the diabetic status. During 45 days experimental period blood was obtained by orbital sinus puncture and blood glucose levels were determined using standard glucometer. At the end of the treatment (45days) the animal were sacrificed by cervical dislocation. The antidiabetic effects of tannic acid in normal and diabetic rats were determined by assessing the plasma glucose, plasma insulin, liver glycogen, glycosylated hemoglobin, initial and final changes in body weight were determined.

Body weight

Body weight was determined by observing the initial (0 day) and final body weight (45^{th}) day of each group were observed.

Estimation of blood glucose

The blood glucose level was estimated using standard blood glucometer.

Estimation of plasma insulin

The plasma insulin was estimated using Human Insulin ELISA (Enzyme linked Immunosorbant Assay) (Abcam kit) (Karuppusamy *et al*., 2013).

Estimation of glycosylated hemoglobin

Glycosylated hemoglobin was estimated by the method of Nayak and Pattabiraman, (1981).

Estimation of liver glycogen

Liver glycogen was estimated by the method of (Shirwaikar *et al*., 2005).

Estimation of creatinine

Creatinine was estimated by the method of Folin and Wu, (1919).

Statistical analysis

The experimental results were expressed as the mean ± SEM data were assessed by the method of analysis of ANOVA followed by student t-test $P<0.05$ were considered as statistically significant.

RESULTS

Tannic acid treated diabetic rat's exerted prominent antidiabetic effect.

Body weight

In the present study streptozotocin induced diabetic rats show decrease in body weight throughout the experimental period. Oral treatment with tannic acid significantly improved the body weight in diabetic rats as compared to control (Table.1).

Blood glucose and plasma insulin

There was a significant elevation in blood glucose level and decrease in plasma insulin levels in diabetic rats, compared with control rats (Table.2). The tannic acid (200mg/kg b.w) and glibenclamide (600mg/kg b.w) treated diabetic rats reverted the glucose and insulin level to normal range.

Glycosylated hemoglobin & creatinine level.

Significant increase in level of glycosylated hemoglobin and creatinine level in diabetic rats was observed. Tannic acid reverted the normal physiology in regulating the above parameters to significant level (Table 2).

Table 1. Effect of Tannic acid on body weight in streptozotocin induced diabetic rats

Groups	Initial Body weight (grams)	Final Body weight (grams)
Control	179.16 ± 6.75	184.33 ± 6.26
Diabetic	168.50 ± 6.18	127.50 ± 4.48a
D + T.acid (200mg/kg)	176.66 ± 9.27	151.33 ± 11.66
D + Glibenclamide	174.66 ± 5.72	170.16 ± 5.81

Values are mean ± SEM of 6 animals in each group

Table 2. Effect of Tannic acid on biochemical parameters in streptozotocin induced diabetic rats

Groups	Glucose (mg/dl)	Insulin (µU/ml)	Liver Glycogen (g/100 gm)	Glycosylated Hemoglobin (%)	Creatinine (mg/dl)
Control	88.67±1.15	16.09±1.11	26.39±1.36	4.14±2.35	0.56±1.04
Diabetic	212.14±1.31	10.19±0.22	10.67±1.38	7.04±0.57	2.28±0.18
D + T.acid (200mg/kg)	107.67±1.14	14.16±1.02	17.52±0.79	5.23±0.42	1.27±0.07
D + Glibenclamide	92.20± 0.97	15.1±1.51	21.37±1.62	4.55±0.42	0.71±0.06

Values are mean ± SEM of 6 animals in each group

Glycogen level

The liver glycogen in control and experimental groups of rats were significantly decreased There was a significant restoration of these parameters to near normal after administration of the tannic acid and also by glibenclamide.

DISCUSSION

Despite the presence of known antidiabetic prescription medicines, herbal drugs and preparations are of considerable interest for the ethno-botanical community and are considered to be less toxic and free from adverse effects than synthetic agents (Pari and Umamaheswari, 2000; Atmakuri and Dathi, 2010). STZ is an antibiotic produced by *Streptomyces achromogenes.* In experimental animals it causes irreversible destruction of pancreatic beta cells, and is mostly used to induce diabetes mellitus in experimental animals through its toxic effects (Kim *et al*., 2003; Matteucci andGiampietro, 2008). In the present study the chronic treatment with tannic acid reduces the blood glucose level in the diabetic rats, indicating its anti hyperglycemic activity. The tannic acid enhances glucose utilization. So the blood glucose level was significantly decreased in tannic treated rats. In diabetes, the excess of glucose is present in the blood which reacts with hemoglobin and form glycosylated hemoglobin. We observed increased glycosylated hemoglobin and creatinine levels in diabetic rats. Tannic acid treated diabetic rats indicate the decreased glycosylated hemoglobin and creatine levels. The glycogen content is decreased in liver muscle of diabetic rats and the tannic acid treatment exerts the restoration level. Previous studies demonstrated that tannic acid induces glucose transport through activation of the insulin-mediated signaling pathway in adipocytes, antidiabetic in human diabetic patients (Gin *et al*., 1999). Study of (Xueqing Liu *et al*., 2005) had been showed that tannic acid may have the potential to become the lead compound in the development of new types of antidiabetic pharmaceuticals that are able to reduce blood glucose levels without increasing adiposity. The study also suggested the mechanism by which tannic acid mediates this activity.

Conclusion

The present experimental findings proved that tannic acid is a perfect antidiabetic agent in lowering blood glucose and its assisted parameters. Also we can conclude, from this study, that the tannic acid should still be investigated thoroughly for its molecular mechanism in diabetic physiology

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