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Ameliorative potential of aqueous leaves extract of *Sapindus saponaria* associated metabolic alterations in STZ induced diabetic rats

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ABSTRACT

In the present study oral administration of aqueous extract of Sapindus saponaria (SS) to streptozotocin (STZ) induced diabetic rats secluded the rats from the changes induced in carbohydrate and lipid metabolism. The increase in the glycosalated hemoglobin is a sign of succession in diabetes. In addition during diabetes there is an enhancement in the cholesterol and triglyceride contents. The Supplementation of Sapindus saponaria leaves aqueous extract (100mg/kg bw) brought the levels of glucose (98±8.4) and lipids (LDL: 32.14±2.71 b and VLDL: 25.71±1.86 b) to almost normal by demonstrating anti-hypoglycemic and anti-lipidemic properties. The reduction in HDL cholesterol in diabetic rats can be used as a marker in the evaluating the severity of diabetes.

Key words: *Sapindus saponaria*, Hemoglobin, Glucose levels, Sugar, Lipid profile

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INTRODUCTION

Diabetes mellitus (DM) which is an inter-metabolic disorder which is found globally and fast increasing worldwide. This disorder is quite alarming in most of the developing countries like India. India has more than 40 million diabetic individuals which represents nearly 20 % of total diabetes population worldwide. DM affects approximately 4% of the population worldwide and is expected to increase by 5.4% in 2025 [1]. A number of currently existing antidiabetic agents have number of unfavorable effects on the body [2]. Therefore, regulation of diabetes without any side effects is still a difficult task for health care researchers [3]. Consequently, the exploration for more successful and safer hypoglycemic agents with lesser side effects has unremitting to be a momentous area of study. Many diabetes related metabolic alterations are reported [4-5]. Still though antidiabetic action of crude extracts and purified bio- active components of many plants are identified, investigated related to the curative activity of medicinal plants with reference to the diabetes linked altered metabolic functions are very scanty. Therefore in this investigation *Sapindus saponaria* leaves has been chosen to study the crude extract effect in the renovation of enzyme activities which are involved in the carbohydrate metabolism in STZ induced alterations in diabetic albino rats.

MATERIALS AND METHODS

2.1 Animals

Male albino rats (Wistar strain, weighing 180-200g) were purchased and housed under standard husbandry conditions (30ºC ± 2ºC, 60-70 % relative humidity and 12hr day night cycle) and allowed standard pelleted rat feed and water ad libitum.

2.2 Plant material and extraction preparation

The *Sapindus saponaria* leaves were harvested and shade dried for 20 days. Then grinded mechanically and 100g of coarse powder was extracted by using water in soxhlet apparatus. Extract was concentrated to semi-solid water free material and final extract yield was 9.5%.

2.3 Induction of diabetes mellitus in rats

Diabetes was induced in male Wistar albino rats aged 2–3 months (180–200 g body weight) by intraperitoneal administration of STZ (single dose of 50 mg/kg b.w.) dissolved in freshly prepared 0.01M citrate buffer, pH 4.5 [6][Gupta et al., 2004]. After 72 h rats with marked hyperglycemia (FBG ≥250 mg/dl) were selected and used for the study.

2.4 Experimental design

Animals were divided in to six groups of six animals each. Group I served as a control: group II had normal + SS(60 mg/ kg bw) rats; group III had normal + SS (100 mg/kg bw) and Group IV acts as diabetic control, V as diabetic + SS (60 mg/ kg bw) and VI comprised the diabetic + SS (100 mg/kg bw) rats treated with *Sapindus saponaria* aqueous roots extract 60 and 100 mg/Kg bw/day respectively for 6 weeks, by oral incubation method. Rats were sacrificed at the end of 6 weeks and the blood samples were collected to analyze the effect of SS leaves extract on biochemical parameters. Collection and processing of blood for estimation of glucose and other biochemical parameters. Total hemoglobin was estimated by the cynomethaemoglobin method [7] and glycosylated hemoglobin (HbA1C) was estimated by the method [8-9]. Serum total cholesterol, triglycerides and serum HDL-cholesterol were using commercial kits (Dialab, Austria).

2.5 Toxicity studies

The aqueous extract was administered orally to different groups of rats (n=6) in doses ranging from 100 mg-1g/kg of bw/day to 2-5g/kg of bw/day. The rats were observed for any lethal effects.

2.6 Statistical analysis

Statistical analysis was performed using the SPSS software package, version 9.05. The values were analyzed by one way analysis of variance (ANOVA) followed by Duncan's multiple range test (DMART). All the results were expressed as mean ± SD for six rats in each group and $p<0.05$ was considered as significant.

RESULTS

The yield of aqueous roots extract of SS was found to be 9.5 % (w/v). The SS leaves aqueous extract treated rats appeared as normal. No toxic effect was reported with the effective dose of aqueous extract and there were no death in all the groups. The application of aqueous roots extract of *Sapindus saponaria* on the change of body weight, plasma glucose, hemoglobin and glycosylated hemoglobin is mentioned in Table 1 and Table 2.

Tables 1: Effect of *Sapindus saponaria* (SS) leaves extract (60 and 100 mg/kg bw) on glucose and changes of body weight in control and STZ-induced diabetic rats

Group	Glucose mg/dl	Change in Body weight, g
Control	72±7.8	+24.1±5.3
Normal + SS (60 mg/kg bw)	84±7.9	+24.1±4.4
Normal + SS (100 mg/kg bw)	77±7.2	+26.2±5.5
Diabetic control	211±13.2	-25.0±8.2
Diabetic + SS (60 mg/kg bw)	96±8.2	-11.5±7.5
Diabetic + SS (100 mg/kg bw)	98±8.4	-8.±7.3

Each value is mean ±SD for 6 rats in each group.
a: p<0.05 by comparison with normal rats.
b: p<0.05 by comparison with STZ diabetic rats.
- : No significance.

In diabetic rats there are significant decrease in the levels of glycogen and glycosylated hemoglobin was observed when compared to the untreated normal rats Oral administration of aqueous leaves extract of SS significantly increased the levels of glycogen and restored the normal levels of glycosylated hemoglobin in diabetic treated rats. In Table 3 and 4 serum lipids of normal and diabetic rats were mentioned. Total cholesterol, triglycerides and LDL cholesterol levels were significantly increased in diabetic rats with significant decrease of HDL cholesterol levels in comparison with untreated control rats. Oral administration of aqueous leaves extract of SS showed significant effect in the restoration of the normal levels of above mentioned lipids. Thus SS aqueous leaves extract is able to protect the system from diabetic induced damage by altering both carbohydrate and lipid metabolism.

Table 2: Effect of *Sapindus saponaria* (SS) leaves extract on Hemoglobin (Hb), Glycosylated hemoglobin (HbA1C), and Hepatic glycogen levels in control and STZ-induced diabetic rats

Groups	Hb (mg/dl)	HbA1C (mg/g of Hb)	Hepatic Glycogen (gm/100g wet tissue)
Normal	15.1±1.11	0.62±0.06	4.18±0.30
Normal + SS (60 mg/kg bw)	13.9±1.05b	0.51±0.02 b	4.02±0.31 b
Normal + SS (100 mg/kg bw)	13.7±1.06 b	0.48±0.03 b	4.19±0.33 b
Diabetic control	6.0±0.51a	1.22±0.08 b	1.32±0.09 b
Diabetic + SS (60 mg/kg bw)	14.2±1.04 b	0.56±0.05 b	3.82±0.31 b
Diabetic + SS (100 mg/kg bw)	13.9±1.06 b	0.62±0.03Ab	3.56±0.34b

Each value is mean ±SD for 6 rats in each group.
a: p<0.05 by comparison with normal rats.
b: p<0.05 by comparison with STZ diabetic rats.
- : No significance.

Table 3: Effect of *Sapindus saponaria*(SS)leaves extract on tissue total cholesterol levels in control and STZ-induced diabetic rats

Groups	Total cholesterol (mg/g wet tissue)	
	Liver cholesterol	Ttriglycerides
Normal	7.12±0.61	6.12±0.54
Normal + SS (60 mg/kg bw)	6.75±0.56 b	6.01±0.52 b
Normal + SS (100 mg/kg bw)	6.17±0.61 b	6.22±0.49 b
Diabetic control	15.12±1.07 a	13.78±1.01 a
Diabetic + SS (60 mg/kg bw)	8.13±0.61 b	8.12±0.69 b
Diabetic + SS (100 mg/kg bw)	7.84±0.57 b	7.88±0.58 b

Each value is mean ±SD for 6 rats in each group.
a: p<0.05 by comparison with normal rats.
b: p<0.05 by comparison with STZ diabetic rats.
- : No significance.

Table 4: Effect of *Sapindus saponaria* (SS) leaves extract on serum HDL, LDL and VLDL levels in control and STZ-induced diabetic rats

Groups	HDL-cholesterol (mg/dl)	LDL-cholesterol (mg/dl)	VLDL-cholesterol (mg/dl)
Normal	45.16±3.61	23.67±1.67	19.72±1.21
Normal + SS (40 mg/kg bw)	48.27±3.91 b	22.61±1.45 b	20.12±1.68 b
Normal + SS (80 mg/kg bw)	52.12±4.12 b	24.72±1.71 b	19.21±1.32 b
Diabetic control	22.68±1.81 a	79.66±4.95 a	47.51±3.79 a
Diabetic + SS (40 mg/kg bw)	41.67±3.12 b	41.56±3.12 b	28.91±2.12 b
Diabetic + SS (80 mg/kg bw)	40.12±3.01 b	32.14±2.71 b	25.71±1.86 b

Each value is mean ±SD for 6 rats in each group.
a: p<0.05 by comparison with normal rats.
b: p<0.05 by comparison with STZ diabetic rats.
- : No significance

DISCUSSION

The present investigation was to evaluate the efficiency of the aqueous leaves extract of SS on STZ-induced metabolic changes diabetic rats. Decreased Hb content was observed in diabetic rates might be due to increased formation of glycosalated Hb. Generally total hemoglobin levels is much below the normal levels in diabetic subject [10] and HbA1c levels has been reported to be increased in patients with diabetes mellitus [11]. It was reported that during diabetes mellitus, the excess of glucose present in the blood reacts with hemoglobin to form HbA1C [12] . The levels of HbA1C are always monitored as a reliable index of glycemic control in diabetes [13]. Elevated levels of HbA1C and reduced levels of Hb observed in our study reveals that diabetes animals had prior high blood glucose levels. Administration of aqueous leaves extract of SS (100 mg/ Kg bw/day) had brought back the elevated HbA1C levels to near normal levels. It has already been reported that decreased liver glycogen content was due to insulin deficiency and associated glycogenolysis process [14]. The possibility of restoration of glycogen content in STZ-induced diabetic rats by the administration of SS aqueous leaves extract may be due to increased insulin secretion and reactivation of glycogen synthase enzyme system. Hypercholesterolemia and hypertriglyceridemia in STZ- induced diabetic rats are well documented Insulin deficiency leads to increased serum lipids because of increased lipolysis [15].The elevated levels of serum total cholesterol, triglycerides and LDL cholesterol were significantly decreased after treatment with SS leaves extract. Similar findings were also reported with the methanolic extract of the Talinum triangulare [16].

CONCLUSION

From this study it can be concluded that the administration of aqueous extract of *Sapindous saponaria* (SS) leaves is beneficial in normalizing the alterations in carbohydrate metabolism during diabetes.

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