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Research Article

Antidiabetic activity of ethanolic extract of *Sesbania grandiflora*

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ABSTRACT

Herbal medicines are commonly measured to be fewer toxic and also free from side effects, than synthetic ones. Therefore, the present study is an effort to study antihyperglycemic property of ethanolic remove of *Sesbania grandifloria* counter to streptozotocin encouraged diabetes. The outcome of ethanolic remove of *Sesbania grandifloria* on blood glucose and liver glycogen remained studied in the diabetic rats. The study also measured for the outcome of herbal extract for their outcome on SOD, catalase, GSH and LPO in the homogenates of the pancreas. The outcomes of the current study shows important antidiabetic and antioxidant possible for the selected plants alone and also in combination as a projecting reduction in blood glucose and liver glycogen remained experimental in the rats treated with the extracts of the particular plants. Likewise, the levels of the defensive antioxidant enzymes like SOD, catalase and GSH were improved along with fall in the LPO levels. The current study offers a systematic evidence for antidiabetic and antioxidant potential of *Sesbania grandifloria*.

Keywords: Antidiabetic activity; hypoglycemic activity; *Sesbania grandifloria*.

INTRODUCTION

DIABETES is a major wellbeing problem universal as around 5% of the world's populace suffers from diabetes. Worldwide forecasts advise that more than 300 million persons will ensure diabetes by the year 2025 and the global cost of handling diabetes and its problem could reach US$1 trillion annually (Abbott, et al., 1992). The active control of blood glucose is the key in stopping or retreating diabetic problems and refining the superiority of life for both type I and type II diabetic patients. While unlike types of oral hypoglycemic proxies are accessible along with insulin for the action of diabetes mellitus, none is proposing whole glycemic control [Aebi, 1974). Traditional plant drugs are used throughout the world for a range of diabetic performances. Therefore, study on such proxies from traditional healing plants has develop more vital. India has a rich history of spending various potent herbs and herbal gears for treating diabetes. Numerous Indian plants must been examined for their helpful use in various types of diabetes (Andrade Cetto, et al., 2000). To date, here are hundreds of herbs and traditional herbal formulations stated to need remained used for the action of diabetes mellitus (Babu V, et al., 2002). Later, the current study is an attempt to study Anti hyperglycemic property of *Sesbania grandifloria* in contradiction of streptozotocin induced diabetes.

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MATERIALS AND METHODS

Animals

Male Wistar albino rats (180 ± 20 g) remained nominated for the study. The animals were housed in clean polypropylene cages beneath hygienic and standard conservational circumstances at 22 ± 1 ^{0}C, 12:12 h light: dark cycle and 60 ± 4% relative humidity with free admission to standard laboratory food and water ad libitum (Sai Durga Feeds and Foods, Bangalore). Mice were familiarized to laboratory circumstances for 1 week earlier the test. All the trials were carried out through the light period (08:00-16:00) and showed in accordance with the strategies given by the committee for the resolve of control and direction of experiments on animals (CPCSEA), New Delhi (India) and the Organized Animal Ethics Committee accepted the experimental protocol.

Plant material and preparation of extract

The leaf of *Sesbania grandifloria* was collected after the Anantapur forests, A.P, India in the month of June 2013 and was authenticated by J. Raveendra Reddy, Professor and Head, Department of Pharmacognosy, Raghavendra Institute of Pharmaceutical Education

Research (RIPER), Anantapuramu. The 500 g of the ground plant material was defatted with petroleum ether (60-80°C) using a soxhlet extractor and then it is consecutively removed with CHCl3, Ethyl acetate and 70% ethanol each for 72 h and the extracts found from the solvents were sieved and concentrated using rota evaporator..

Preliminary phytochemical screening

All the excerpts of *Sesbania grandifloria* were screened for the presence of carbohydrates, proteins, alkaloids, flavonoids, glycosides, triterpenoids, tannins and phenolic compounds, fats and fixed oils using the standard procedures (Bailey C, et al., 1997).

Acute oral toxicity study

The acute oral toxicity study was done rendering to the method defined by Lorke. Procedures (Bailey C, et al., 1989). Ethanolic excerpt when compared to other extracts up to a dose of 2000 mg/kg did not yield any signs of toxicity and death. Based on this the amounts for ethanolic excerpt of *Sesbania grandifloria* (EESG) for further trial study were designated.

STZ-induced Diabetic Rats

Later fasting for 18 hours, the rats remained injected with a single dose of 60 mg/kg STZ through i.p. route, newly melted in citrate buffer (0.01 M, pH 4.5). Diabetes in the rats was documented by polydipsia and polyuria and by assessing the non-fasting serum glucose concentration 48 hours after injecting STZ. Rats with a serum glucose level above 250 mg/dL remained selected for further trials.

Diabetes Mellitus Induced by streptozotocin (STZ)

Investigational diabetes was persuaded by single injection of 60 mg/kg of STZ intraperitoneally and melted in cold citrate buffer of pH 4.5 (Bouch C, et al., 2004; Barney DA, et al., 2001). The control animals were preserved only with citrate buffer. Later five days of STZ injection, the animals by fasting blood glucose above 250 mg/dl remained considered as diabetic and combined in the study. Throughout the study, no opposing effect was experimental at the tested concentration.

G. Oral Glucose Tolerance Test (OGTT)

The rats were fasted immediate and were divided into five groups with six animals in each group. Group-I was given purified water to aid as control. Group-II animals established glibenclamide (0.5 mg/kg, p.o) to aid as standard. Group-III animals established ethanolic excerpt of *Sesbania grandifloria* (EESG) 100 mg/kg b.w.p.o., Group-IV animals established ethanolic excerpt of *Sesbania grandifloria* (EESG) 200 mg/kg b.w.p.o., and Group V animals were preserved with ethanolic extract of *Sesbania grandifloria* (EESG) 400 mg/kg b.w.p.o. The groups test, standard and control remained treated with drugs 30 minutes previous to the glucose load (2.5 g/kg, p.o). Blood samples were composed at 15, 30, 45, 60, 75, 90 and 120 minutes after glucose filling. Serum was separated and glucose amount were calculated directly (Chattopadhyay S, et al., 1997).

Experimental Design

All the rats were divided in to six groups of six each

Group1: Normal treated rats

Group2: Diabetic control rats

Group3: Diabetic rats given aqueous solution of glibenclamide (500 µg/kg, p.o.) for 28 days

Group4: Diabetic rats given (EESG) 100 mg/kg b.w.p.o. for 28 days

Group5: Diabetic rats given (EESG) 200 mg/kg b.w.p.o. for 28 days

Group6: Diabetic rats given (EESG) 400 mg/kg b.w.p.o. for 28 days.

The blood samples drawn for every 7th, 14th, 21st, and 28th day from the retro orbital venous plexus of the rats under ether anaesthesia 12 hours fast with the help of capillary tube later centrifuged the blood (2,500 rpm/10 min) to become the serum. The serum was used for biochemical estimate of blood glucose, LDL-cholesterol, HDL-cholesterol, total proteins, cholesterol, and triglycerides. Later 28 days, the rats were sacrificed; liver and pancreas were gathered and instantly frozen in liquid nitrogen for biochemical estimation.

Statistical analysis

Results are expressed as mean±SEM. The treated groups were compared with control by ANOVA following Dunnett test. All the statistical analyses were carried out by using Graph pad Prism version 5.1 software.

RESULTS

Effect of EESG on serum glucose in normal fasted rats

Significant increase blood glucose in control group recorded after 60 minutes, followed reduction after 120 minutes (Table 1). Treatment with standard drug (group-III) glibenclamide, observed rate of blood glucose at 30 minutes and it is going to be reduced up to 120 minutes. Current study experimental glucose rate was increased after 30 minutes and 120 minutes of administration of EESG. So observed hypoglycaemia results. Rats treated with EESG at 400 mg/kg showing an increase in blood glucose levels followed by a reduction in blood glucose levels from 60 minutes onwards. A substantial decrease in the blood sugar rate was designed in the tested groups when compared with the control group.

Effect of EESG on Serum Glucose in Diabetic Rats

Serum glucose extensively raise in diabetic rats rate was observed on the 7th, 14th, 21st , and 28th day, once compared to the normal group (G-I). Group III given standard drug (0.5 mg/kg p.o glibenclamide) showed a serum glucose rates decrease considerably on the 7th, 14th, 21st, and 28th day, once compared to the diabetic control group (G-II). With the administration of EESG in three different doses (G-IV, V and VI), were reduced blood glucose rates on the 7th, 14th, 21st, and 28th day, once compared to the control group (G-II) (Table 2).

Effect of EESG on Serum Lipid Parameters

Group II animals (diabetic control) designated a significant rise in LDL, triglyceride, and cholesterol and significant decrease in the total protein levels and serum HDL on the 28th day, when matched to the normal group (G-I). The rats treated with glibenclamide (G-III) and EESG (G-IV, G-V, and G-VI) had considerably reduced LDL, triglyceride, cholesterol, total protein levels, and serum HDL on the 28th day, once compared to the diabetic control group (G-II) (Table 3).

Table 1: Effect of ethanolic extract of *Sesbania grandifloria* on glucose tolerance in normal fasted rats

Group	Treatment	Serum glucose (mg/dl) (Mean± SEM)				
		Time after glucose administration in minutes				
		0	30	60	90	120
I	Diabetic Control	73.6±1.2	111.4±0.40	127.2±0.12	176.1±2.6	157.1±1.2
II	Glibenclamide 0.5 mg/kg	64.9±1.7	85.1±1.02*	88.2±1.9*	63.2±1.30*	62.1±1.6*
III	EESG 100 mg/kg	74.4±1.2	92.2±1.4*	102.4±1.6*	72.9±0.11*	73.6±1.2*
IV	EESG 200 mg/kg	74.5±1.91	82.4±1.2*	103.2±1.2*	82.4±1.1*	74.1±1.8*
V	EESG 400 mg/kg	66.5±1.3	84.9±1.3*	81.2±1.1*	71.4±1.1*	64.4±1.2*

All values expressed as mean± SEM. * = p < 0.001, when compared to control. (G-I).

Table 2: Effect of ethanolic extract of *Sesbania grandifloria* on serum glucose levels in diabetic rats

Group	Treatment	Serum glucose (mg/dl)				
		0th day	7th day	14th day	21st day	28th day
I	Normal	63.2±1.5	65.8±1.4	68.7±0.45	68.7±1.7	70.0±1.3
II	Diabetic Control	261.8±1.6	268.4±6.4*	279.9±6.2 *	299.5±1.5*	302.3±1.4*
III	Glibenclamide 0.5 mg/kg	168.2±1.5	95.8±2.6**	82.1±1.4 **	71.8±1.2**	72.6±1.7 **
IV	EESG 100 mg/kg	212.6±8.3	108.8±1.7**	96.8±1.1**	83.7±1.5**	75.0±1.2**
V	EESG 200 mg/kg	194.3±1.3	91.7±1.4**	84.3±1.5**	78.2±1.9**	64.3±1.3**
VI	EESG 400 mg/kg	188.1±1.2	91.2±1.5**	76.4±1.4**	68.2±1.6**	65.4±1.4**

* = p < 0.001, when compared to normal. (G-I), ** = p < 0.001, when compared to control. (G-II).

Table 3: Effect of ethanolic extract of *Sesbania grandifloria* on serum lipid parameters

Group	Treatment	Serum triglycer-ide (mg /dL)	cholesterol (mg /dl)	HDL (mg /dl)	LDL (mg /dl)	proteins (mg /dl)
I	Normal	129.3±5.8	75.6±6.5	43.5±4.4	43±1.5	12.1±3.1
II	Diabetic Control	289±7.3$^{\#}$	179.6±6.5$^{\#}$	22.3±5.8$^{\#}$	148±1.5$^{\#}$	2.3±2.5$^{\#}$
III	Glibenclamide 0.5 mg/kg	146.1±7.3*	67±5.5***	47.3±1.5**	56±2.5**	8.7±2.2*
IV	EESG 100 mg/kg	184.6±4.2*	97±6.5***	43.6±1.4**	57±3.5**	7.8±4.8*
V	EESG 200 mg/kg	158±5.6*	76.2±7.8***	47.2±4.8**	57.2±1.4**	10.3±3.7*
VI	EESG 400 mg/kg	143.9±6.7^{d}	65±5.4***	58.3±2.1**	46±6.8**	11.0±6.1*

Values were expressed as Mean ± SEM. #P≤0.001 Compared with G-1;***P≤0.001, **P<0.01, *P<0.05 compared with G-2.

Table 4: Effect of ethanolic extract of Sesbania grandifloria on liver glycogen levels in diabetic rats

Group	Treatment	Liver glycogen (mg/g) (Mean ± SEM) on 28th day
I	Normal	6.2±1.7
II	Diabetic Control	2.1±1.2*
III	Glibenclamide 0.5 mg/kg	6.5±0.46*
IV	EESG 100 mg/kg	4.2±1.2*
V	EESG 200 mg/kg	6.6±1.8**
VI	EESG 400 mg/kg	6.9±1.6***

* =p < 0.05, when compared to normal. (G-I), * =p <0.05, when compared to control (G-II), ** =p < 0.01, when compared to control. (G-II), ** =p <0.001, when compared to control (G-II).

Effect of EESG on Liver Glycogen Levels

The diabetic control group (G-II) has shown a significant decrease in the rate of liver glycogen on the 28th day, once compared to the normal group (G-I). The hepatic glycogen has shown a significant rise in the standard group (G-III) which received glibenclamide, once compared to the diabetic control group (G-II). With the management of EESG in three different doses (G-IV, G-V, and G-VI) on the 28th day, a significant increase in hepatic glycogen remained also noted, once compared to the diabetic control group (G-II) (Table 4).

Effect of EESG on Antioxidant Parameters

In the diabetic rats (G-II), the antioxidant enzymes i.e., GSH, CAT, and SOD have reduced significantly and the LPO has improved considerably, once compared to the normal group (G-I). The standard group has shown important increase in GSH, CAT, and SOD levels and a reduction in LPO levels, when compared to the control group (G-II). With the management of EESG (G-IV, G-V, and G-VI), a significant increase in SOD, CAT, and GSH levels and a significant reduction in the LPO levels were experimental, when compared with the diabetic control (G-II) group (Table 5).

Table 5: Effect of ethanolic extract of *Sesbania grandifloria* on antioxidant parameters

Group	Treatment	LPO mmol/wet wt g	GSH µg/wet wt g	CATALASE IU/wet wt g	SOD IU/ wet wt g
I	Normal	16.5±0.15	23.6±0.62	23.6±0.24	4±0.16
II	Diabetic Control	34. 5±0.1*	13.4±0.24*	9.2±0.28*	1.5±0.29*
III	Glibenclamide 0.5 mg/kg	18.4±0.34***	27.4±1.2***	13.9±0.15***	6.6±1.27***
IV	EESG 100 mg/kg	12.7±0.8***	39.7±0.5***	14.6±0.17***	5.7±0.52***
V	EESG 200 mg/kg	19.1±0.3***	34.6±0.57***	24.6±0.70***	6.4±0.37***
VI	EESG 400 mg/kg	11.8±0.4***	38.7±0.51***	32.1±0.73***	8.9±0.53***

Values are expressed as Mean ± S.E.M. number of rats=6. *P≤0.01 Compared with G-1; ***P≤0.001 compared with G-2.

Table 6: Effect of ethanolic extract of *Sesbania grandifloria* on insulin and glucose - 6 – phosphatase

Group	Treatment	Serum Insulin (µg/L)	Glucose–6–Phosphatase nmol/min/mg of protein
I	Normal	3.4±0.36	1.86±0.48
II	Diabetic Control	1.6±0.4***	0.94±0.14***
III	Glibenclamide 0.5 mg/kg	2.8±0.72***	1.47±0.25***
IV	EESG 100 mg/kg	1.9±0.23***	1.12±0.17***
V	EESG 200 mg/kg	2.1±0.12***	1.35±0.25***
VI	EESG 400 mg/kg	2.6±0.48***	1.36±0.47***

Values are expressed as Mean ± S.E.M. number of rats=6 ***P≤0.001 compared with G-2.

DISCUSSION

This study was complete to assess the antihyperglycemic activity of the ethanolic remove of *Sesbania grandifloria* in STZ-induced diabetic rats. STZ-stimulated diabetes is a recognized model of investigational diabetes. Previous reports show that the type of diabetes and features differ with the working dose of STZ and animal type used (Kolb H, et al., 1993; Chattopadhyay S, et al., 1997). It has been certain that STZ diabetic animals may display most of the diabetic problems intervened over the oxidative stress (Motkovcs B, et al., 1997; Kavalali G, et al., 2003). Studies also suggest free radical contribution in the pancreatic cell damage (Lenzen S, 2008). Glibenclamide is regularly used as an insulin stimulant in many studies and also used as a standard antidiabetic drug in STZ-induced diabetes to relate the antidiabetic belongings of a variety of hypoglycemic compounds (Andrade Cetto A, et al., 2000).

Now current drugs for the treatment of diabetes mellitus have numerous limits, such as unwanted effects and higher rate of secondary failure (Koski RR, 2004). As there is a rising tendency towards using usual medicines as adjuncts to conventional therapy, conservatively used plants might proposal a helpful source of new hypoglycemic compounds. The current study recognized for the topmost time the antioxidant and antihyperglycemic properties of ethanolic remove of Sesbania grandifloria. Current studies have exposed that modification of systemic glycemia in OGTT expose the activity of the abdominal glucose transporter SGLT1 (Ducrol R, et al., 2007). EESG reduced the overall OGTT response in three doses as proficiently as the reference oral hypoglycaemic drug glibenclamide. In focus of investigation, the sum of plants have been stated to have hypoglycemic effects and the possible mechanism optional for such hypoglycemic actions could be finished

an increased insulin secretion from â-cells of islets of Langerhans or its release from bound insulin or such hypoglycemic effects of plant removes could also be current since of their insulin-like actions (Kashiviswanath R, et al., 2005). Alike mechanisms may be careful responsible for the hypoglycemic action designated by EESG in the diabetic rats.

The remarkably high concentration of hepatic and plasma lipids in diabetes is mostly due to an rise in the mobilization of free fatty acids from the outlying storage area because insulin delays hormone delicate lipase. The distinct hyperlipidemia that differentiates the diabetic state is measured as a significant uninhibited measure of lipolytic hormones (glucagon and catecholamines) on the fat storage area (Ravi K, et al., 2005). On the other hand, improved LDL-cholesterol may arise from glycosylation of the lysyl residues of apoprotein B. The ability of LDL-cholesterol to form lipid peroxides was establish to be chiefly answerable for the atherogenesis in diabetic patients (Kendo A, et al., 2001). It is specified that a lack in lipoprotein lipase action in diabetics may funding to an significant upsurge of triglycerides in blood with insulin management; lipoprotein lipase action is improved and leads to decrease of plasma triglyceride concentrations. EESG management almost upturned these belongings as it condensed triglyceride and total cholesterol absorptions, LDL concentration, and improved HDL, notably in combination. In this context, EESG was originate to be as real as glibenclamide in dropping the plasma lipid profiles in the diabetic rats. Diabetic animals showed a decrease in hepatic glycogen content which may be due to a raise in glucose-6-phosphatase activity and a low amount of hexokinase activity (Shirwaikar, et al., 2004). The noted hypoglycemic action of EESG may be answerable for the experimental increase in hepatic glycogen. An rise in hepatic glycogen substance in EESG-administered animals advises that the activation of glycogen synthase for which the substrate glucose-6- phosphate might have been freely afforded by an improved hexokinase activity (Lawrence JC, et al., 1997; Bounche C, et al., 2004). These clarifications clearly show the possible of EESG to reduction gluconeogenesis. Lipid peroxidation is one of the characteristic structures of lipid peroxidation facilitated tissue damage and chronic diabetes has been detailed in diabetic circumstances (Feillet-Coudray C, et al., 1999). Hyperglycemia produces reactive oxygen species (ROS), which in turn generate membrane damage and lipid peroxidation. The diabetic animals in the present study noted reduced levels of GSH, reflecting its enlarged use due to oxidative stress, while a extensive rise of GSH levels in the EESG-administered diabetic rats overlaps with a significant weakening in lipid peroxidation. The antioxidant enzymes catalase and SOD play a dynamic role in dropping the cellular stress. SOD scavenges the superoxide radical by changing it to molecular oxygen and H2O2 (Robinson BH, 1998), where catalase takes about the reduction of hydrogen peroxides and defends higher tissues from the highly reactive hydroxyl radicals. In the existing examination, both these enzymes record low rates of action in diabetic controls, showing the diabetes-induced stress. Such a decline in these enzyme actions has also been reported before (Selvam R, et al., 1990). The EESG, when managed to the diabetic animals, better both catalase and SOD activities significantly, reflecting the antioxidant potency of EESG.

CONCLUSION

Created on the current findings, it takes remained concluded that the ethanolic remove of *Sesbania grandifloria* produced significant antidiabetic activity in experimental rats.

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