Asian Journal of Chemistry; Vol. 24, No. 10 (2012), 4749-4753

ASIAN JOURNAL OF CHEMISTRY

www.asianjournalofchemistry.co.in

Antihyperglycemic Activity of Methanolic Extract of *Scindapsus officinalis* Root in Normal and Streptozotocin-Induced Diabetic Rats

D. DAS*, G. GHOSH, L. BADJENA and B. DASH

School of Pharmaceutical Sciences, Siksha 'O' Anusandhan University, Kalinga Nagar, Bhubaneswar-751 003, India

*Corresponding author: E-mail: debajyotids@gmail.com

(*Received*: 8 September 2011; *Accepted*: 12 May 2012) AJC-11484

The aim of this study is to evaluate the antihyperglycemic effect of methanolic extract of *Scindapsus officinalis* (MESO) in different models of rats. The antidiabetic activity was evaluated by oral administration of methanolic extract of *Scindapsus officinalis* at the doses of 200, 400 and 600 mg/kg using normal, glucose-loaded hyperglycemic and streptozotocin-induced diabetic rats. The effect of repeated oral administration of aqueous extract on serum lipid profile and plasma enzyme levels in diabetic rats was also examined. The three doses caused significant reduction in blood glucose levels in all the models. The effect was more pronounced in 400 and 600 mg/kg than 200 mg/kg. In oral glucose tolerance test, reduction of fasting blood glucose levels took place from 1 h of extract administration. The extracts produced a dose-dependent fall in fasting blood glucose. This dose showed almost similar effect as that of standard drug, glibenclamide (10 mg/kg bw). After 15 days of treatment with the extracts the maximum reduction in fasting blood glucose (54.25 %) was observed in diabetic rats treated with methanolic extract at a dose of 600 mg/kg. Total cholesterol, low density lipoprotein and triglyceride levels were decreased by 32, 72 and 25 %, respectively in diabetic rats, whereas, cardioprotective, high density lipoprotein was increased by 16 %. Methanolic extract of *Scindapsus officinalis* also restored the altered plasma enzyme (aspartate aminotransferase, alanine aminotransferase and alkaline phosphatase) levels to near normal. These results clearly indicate that methanolic extract of *Scindapsus officinalis* possess high antihyperglycaemic potential along with significant hypolipidemic properties.

Key Words: *Scindapsus officinalis*, Antihyperglycemic, Hypolipidemic, Streptozotocin.

INTRODUCTION

Diabetes mellitus is an endocrine disorder that is characterized by hyperglycemia[1]. A number of investigations, of oral antihyperglycemic agents from plants used in traditional medicine, have been conducted and many of the plants were found with good activity[2]. World Health Organization (WHO) has also recommended the evaluation of the plants' effectiveness in conditions where we lack safe modern drugs[3]. According to World Health Organisation projections, the diabetic population is likely to increase to 300 million or more by the year 2025[4]. Currently available therapies for diabetes include insulin and various oral antidiabetic agents such as sulfonylureas, biguanides, α-glucosidase inhibitors, glinides, which are used as monotherapy or in combination to achieve better glycaemic regulation. Many of these oral antidiabetic agents have a number of serious adverse effects[5]. This leads an increasing demand of research on antihyperglycemic natural products which produce minimal or no side effects[6].

Scindapsus officinalis (Roxb.) Schott. (Family: Araceae) commonly known as "Gajapippali" in India, is an epiphytic climber clinging to trees and rocks by its adventitious aerial roots having obliquely ovate-oblong, cuspidate leaves[7]. The plant possesses antioxidant activity[8]. The ethanolic extract is used to have antiinflammatory and analgesic activity[9]. It also has significant application in treating bronchitis and helminthiasis[10,11]. The objective of this investigation was to ascertain the scientific basis of its use in treatment of diabetes. The present investigation reports the antihyperglycemic and hypolipidemic activity of the methanolic extract of *Scindapsus officinalis* on which previous data are not available.

EXPERIMENTAL

The fresh roots of *Scindapsus officinalis* were collected in the month of November from the Trisulia forest, Nayagarh, Odisha and were authenticated by senior taxonomist Dr. P.C. Panda, Regional Plant Resource Centre, Bhubaneswar, Odisha. A voucher specimen of the herbarium has been deposited at the Department of Pharmacognosy, School of Pharmaceutical Sciences, Siksha 'O' Anusandhan University, Bhubaneswar, Odisha, India.

Preparation of the test samples: *Scindapsus officinalis* roots were cut into small pieces and were allowed to dry in the

shade. About 100 g of the dried material was coarsely powdered and was defatted by using pet. ether and subsequently extracted with methanol in Soxhlet extractor for 24 h. The extract was then filtered and evaporated to dryness under vacuum using a rotary evaporator, which yielded a sticky material (yield: 15.42 %, w/w).

Preliminary phytochemical screening: Methanolic extract obtained from *Scindapsus officinalis* was subjected to various qualitative tests for the identification of various plant constituents present in this species[12].

Animals: Wistar albino rats (150-200 g) and Wistar albino mice (20-25 g) of both sexes were obtained from the experimental animal facility of Siksha 'O' Anusandhan University, Bhubaneswar, Odisha. Before and during the experiment, rats were fed with standard diet. After randomization into various groups and before initiation of experiment, the rats were acclimatized for a period of 7 days under standard environmental conditions of temperature (25 ± 2 ºC), relative humidity (35-60 %) and dark/light cycle (12/12 h). Animals described as fasted, were deprived of food and water for 16 h *ad libitum*. The conditions in the animal house and at the study, protocol were approved by Committee for the Purpose of Control and Supervision on Experiments on Animals (CPCSEA) vides registration No. 1171/C/ 08/CPCSEA.

Sample collection: Blood samples were collected by retro-orbital plexus puncture method and blood glucose levels were estimated using Accucheck Active glucose stripes in Accucheck active test meter.

Acute toxicity studies: Healthy adult Wistar albino rats of either sex, starved overnight were divided into four groups (n = 6) and were orally fed with the methanolic extract of *Scindapsus officinalis* in increasing dose levels of 100, 500, 1000 and 3000 mg/kg body weight[13]. The rats were observed continuously for 2 h for behavioural changes and after a period of 24 and 72 h for any lethality or death.

Induction of diabetes: The Wistar albino rats of either sex of body weight of 150-200 g were kept on fasting for 24 h and thereafter diabetes was induced by intra-peritoneal injection of streptozotocin (STZ) freshly dissolved in citrate buffer (pH 4.5) immediately before use. Streptozotocin was given at a dose of 65 mg/kg body weight[14]. In order to avoid streptozotocin induced hypoglycemic mortality, 5 % glucose solution was given for 24 h to streptozotocin treated rats. After 72 h of streptozotocin administration, the blood glucose levels were measured and the rats showing blood glucose level greater than 220 mg/dl were considered to be diabetic and were used for the present study. The Wistar albino rats were divided into six groups (n = 6). The test and standard drugs were administered as per the treatment schedule given in the previous experiment. The blood samples were collected through tail vein puncturing with hypodermic needle and blood glucose levels were measured by glucometer based on glucose oxidase peroxidase method at 0, 1, 2, 4, 8 and 24 h of administration of test and standard drug.

Assessment of extracts of *Scindapsus officinalis* on normal rats: Animals were divided in five groups of 6 rats each and treated orally for 15 days as follow: group I, the control was fed 2 mL/kg/day of distilled water; groups II, III and IV were administered 200, 400 and 600 mg/kg/day of methanol extract of *Scindipsus officinalis*, using rat gastric tube under the sample experimental conditions

Assessment of extracts of *Scindapsus officinalis* on glucose loaded rats: The oral glucose tolerance test was performed as per the method of Shirwaikar *et al.*[15]. In this method, rats were kept on fast for 16 h before and during the experiment. Rats were divided into five groups of six rats each and solvent (2 mL/kg), Glibenclamide (10 mg/kg, b.w.) and suspensions of methanol extract of SR (200, 400 and 600 mg/kg, b.w.) were administered to Gr. I, II, III, IV, V, respectively. Glucose (3 g/kg) was fed 0.5 h after the administration of extracts. Blood was withdrawn from retro orbital sinus under ether inhalation at 0, 30, 60 and 120 min of glucose administration. The blood glucose levels were estimated using glucose oxidase-peroxidase reactive strips and a glucometer (Accucheck, Roche Diagnostics, USA).

Assessment of extracts of *Scindapsus officinalis* on streptozotocin-induced diabetic rats (acute study): The Wistar albino rats were divided into five groups (n = 6). Group I served as solvent control which received normal water (2 mL/kg, b.w.) and group II received Glibanclamide (10 mg/kg, b.w.) by oral route of administration. The suspensions of methanol extract of the plant at the dose of 200, 400 and 600 mg/kg body weight were administered to Gr. III, IV and V, respectively in a similar manner. The blood samples were collected through tail vein puncturing with hypodermic needle and blood glucose levels were measured at 0, 1, 2, 4, 8 and 24 h of administration of single dose for acute study.

Assessment of extracts of *Scindapsus officinalis* on streptozotocin-induced diabetic rats (long term study): Animals were divided into five groups of six rats each. The extract was administered for 15 days. Group I: diabetic control rats were administered with drinking water daily for 15 days; Group II: diabetic rats were administered with standard drug Glibenclamide (10 mg/kg) for 15 days. Group III: diabetic rats were administered with *Scindipsus officinalis* methanol extract (200 mg/kg); Group IV: diabetic rats were administered with methanol extract (400 mg/kg) and Group V: diabetic rats were administered with methanol extract (600 mg/kg). The effects of administration of *Scindapsus officinalis* methanol extract to diabetic rats were determined by measuring fasting plasma glucose levels. Fasting plasma glucose was estimated on days 1, 3, 5, 7 and 15 of extract administration.

Estimation of biochemical parameters: On day 15, blood was collected from retro-orbital plexus of the overnight fasted rats under light ether anesthesia and kept aside for 0.5 h for clotting. Serum was separated by centrifuging the sample at 6000 rpm for 20 min. The serum was analyzed for total protein[16], total cholesterol[17], triglyceride, low density lipoprotein, VLDL, high density lipoprotein[18] serum glutamate pyruvate transaminase (SGPT), serum glutamate oxaloacetate transaminase (SGOT) and alkaline phosphatase[19].

Statistical analysis: All the values of body weight, fasting blood sugar and biochemical estimations were expressed as mean ± standard deviation (SD) and analyzed for ANOVA followed by Dunnet's t test. Differences between groups were considered significant at $p < 0.05$ and $p < 0.01$.

RESULTS AND DISCUSSION

The phytochemical screening of *Scindapsus officinalis* revealed the presence of flavonoids, phenolic acids, sterols, alkaloids and tannins. The acute toxicity study result of the methanol extract of *Scindapsus officinalis* on mice showed no mortality and no significant gross behavioural changes observed even at a higher dose level of 5 g/kg b.w. Therefore, it is evidenced that the plant extracts are non-toxic in nature and hence found suitable to explore their blood glucose lowering activity in different animal models. The antihyperglycemic effect of extract of *Scindapsus officinalis* on the fasting blood sugar level of normal, glucose loaded and streptozotocin-induced diabetic rats is shown in Tables 1-4. In normal animals, significant ($p < 0.05$) reduction in the blood glucose level was observed by the methanol extract as compared to the solvent control (Table-1). The maximum hypoglycaemic activity was induced by 400 and 600 mg/kg dose of extract at 15 day (17.65 and 19.48 %, respectively) (Table-1. Hypoglycaemic activity of glibenclamide, the reference drug, was found to be 21.81 %. However, the effects of tested doses (400 and 600 mg/kg) of *Scindapsus officinalis* extract were near similar to the reference drug.

Both doses of *Scindapsus officinalis* (400 and 600 mg/kg) significantly ($p < 0.05$) improved the glucose tolerance test up to 2 h (Table-2). The methanol extract of *Scindapsus officinalis* at the doses of 400 and 600 mg/kg showed approximately 21.87 and 31.52 % reduction in glycaemia from control values in 2 h. Glibenclamide also improved the glucose tolerance test upto 2 h. The methanol extract of *Scindapsus officinalis* at a dose level of 600 mg/kg b.w. produced the maximum fall of 38 % in the blood glucose levels of diabetic rats after 8 h of treatment (Table-3). The *Scindapsus officinalis* extract at a dose level of 600 mg/kg b.w. produced the maximum fall of 54.25 % in the blood glucose levels of diabetic rats after 15 days of treatment. Treatment with glibenclamide

TABLE-1
EFFECT OF METHANOLIC EXTRACT OF *Scindapsus officinalis* ON BLOOD GLUCOSE LEVELS IN NORMAL RATS

Groups and treatment	Blood glucose levels (mg/dl)					
	0 h	1 h	2 h	4 h	8 h	F value
Normal control (2 mL/kg)	90.45 ± 9.15	88.5 ± 11.12	92.76 ± 8.33	96.81 ± 6.03	98.97 ± 10.13	0.86
Glibenclamide (10 mg/kg	90.35 ± 6.22	76.98 ± 8.16	67.33 ± 5.37*	62.5 ± 8.25*	59.25 ± 6.32** (34.42)	128.24
Methanolic extract (200 mg/kg)	97.56 ± 5.29	94.33 ± 5.16	81.5 ± 4.77	78.65 ± 5.59*	70.05 ± 3.18** (28.19)	28.45
Methanolic extract (400 mg/kg)	95.33 ± 6.88	88.86 ± 4.53	79.25 ± 4.97*	67.66 ± 5.29*	65.5 ± 4.19** (31.29)	46.15
Methanolic extract (600 mg/kg)	89.83 ± 5.11	80.5 ± 5.69	75.16 ± 5.52*	66.25 ± 5.11*	62.85 ± 4.92** (30.03)	98.35

Values expressed as mean ± SD (n = 6). Treatment was done for 15 days. The data were statistically analyzed by one- way ANOVA, followed by Dunnet's *t*-test. *p* values less than 0.05 were considered significant. *: $p < 0.05$; **: $p < 0.01$

TABLE-2
EFFECT OF METHANOLIC EXTRACT OF *Scindapsus officinalis* ON BLOOD GLUCOSE LEVELS IN GLUCOSE LOADED RATS

Groups and treatment	Blood glucose levels (mg/dl)				
	0 h	0.5 h	1 h	1.5 h	2 h
Normal control (2mL/kg)	93 ± 3.22	136.5 ± 3.95	132.16 ± 3.60	129 ± 3.28	125.82 ± 3.6
Glibenclamide (10 mg/kg)	91.5 ± 3.6	111.83 ± 4.53** (18.07)	101.5 ± 3.61** (23.19)	92.6 ± 2.94** (28.21)	80.66 2.58** (35.89)
Methanolic extract (200 mg/kg)	89.66 ± 4.13	125.33 ± 8.35 (8.18)	117.5 ± 6.75* (13.91)	108.33 ± 7.45** (16.02)	98.5 ± 5.12** (21.71)
Methanolic extract (400 mg/kg)	88.50 ± 3.76	119.66 ± 6.51 (12.33)	111.5 ± 4.21** (15.63)	98.61 ± 4.17** (23.55)	91.30 ± 3.61** (27.43)
Methanolic extract (600 mg/kg)	90.33 ± 2.9	113.5 ± 4.37 (16.84)	106.83 ± 4.21** (19.16)	94.33 ± 5.17** (26.87)	87.16 5.70** (30.72)

Values expressed as mean ± SD (n = 6). The data were statistically analyzed by one- way ANOVA, followed by Dunnet's *t*-test. P values less than 0.05 were considered significant. *: $p < 0.05$; **: $p < 0.01$. Figure in parenthesis indicates % fall in BGL as compared to 0 h.

TABLE-3
EFFECT OF METHANOLIC EXTRACTS OF *Scindapsus officinalis* ON BLOOD GLUCOSE LEVELS IN STREPTOZOTOCIN-INDUCED DIABETIC RATS (ACUTE STUDY)

Groups and treatment	Blood glucose levels (mg/dl)						
	0 h	1 h	2 h	4 h	8 h	24 h	F values
Normal control (2 mL/kg)	232.16 ± 8.68	238.84 ± 17.62	231.50 ± 8.98	234.86 ± 17.38	235.66 ± 15.50	252.45 ± 16.08	0.44
Glibenclamide (10 mg/kg)	242.66 ± 5.78	234.5 ± 7.47	209.33 ± 8.43**	172.72 ± 10.78**	139.5 ± 4.16** (42.51)	240.83 ± 3.65	210
Methanolic extract (200 mg/kg)	238.45 ± 8.75	235 ± 5.93	227.83 ± 6.04*	203.24 ± 8.48**	188.16 ± 8.97** (21.09)	245.76 ± 6.18	0.70
Methanolic extract (400 mg/kg)	237.33 ± 7.03	227.5 ± 5.09	210.5 ± 5.28**	197.88 ± 5.29**	155.35 ± 6.30** (34.54)	239.27 ± 6.28	25.15
Methanolic extract (600 mg/kg)	254.46 ± 15.18	240.42 ± 13.14	213.66 ± 15.84**	173.16 ± 13.16**	157.75 ± 8.80** (38)	242.85 ± 12.14	128.17

Values expressed as mean ± SD (n = 6). The data were statistically analyzed by one- way ANOVA, followed by Dunnet's *t*-test. P values less than 0.05 were considered significant. *: $p < 0.05$; **: $p < 0.01$. Figure in parenthesis indicates % fall in BGL as compared to 0 h.

TABLE-4
EFFECT OF METHANOLIC EXTRACT OF *Scindapsus officinalis* ON BLOOD GLUCOSE LEVELS IN STREPTOZOTOCIN-INDUCED DIABETIC RATS (LONG TERM STUDY)

Groups and treatment	Blood glucose levels (mg/dl)					
	Day 0	Day 3	Day 5	Day 7	Day 15	F value
Diabetic control (2 mL/kg)	233 ± 10.39	238.5 ± 9.48	227.5 ± 9.81	232.5 ± 7.42	237.83 ± 8.30	1.51
Glibenclamide (10 mg/kg)	241.66 ± 10.36	187.83±10.64**	148.5 ± 8.15**	121.83 ± 6.85**	87.33 ± 10.61** (63.86)	248.84
Methanolic extract (200 mg/kg)	234.33 ± 10.05	227.33 ± 5.57	194.33 ± 6.43*	161.16 ± 4.35*	126.15 ± 5.86* (46.16)	96.45
Methanolic extract (400 mg/kg)	235 ± 6.54	218.33 ± 7.25	172.83 ± 6.24**	146.83 ± 6.01**	111.5 ± 5.24** (52.55)	176.18
Methanolic extract (600 mg/kg)	238.15 ± 8.32	192.5 ± 9.00**	156.33±10.30**	130.16 ± 7.90**	102.95 ± 8.21** (56.77)	198.64

Values expressed as mean ± SD (n = 6). The data were statistically analyzed by one- way ANOVA, followed by Dunnet's *t*-test. P values less than 0.05 were considered significant. *:$p < 0.05$; **: $p < 0.01$. Figure in parenthesis indicates % fall in BGL as compared to day.

TABLE-5
EFFECT OF METHANOLIC EXTRACT OF *Scindapsus officinalis* ON SERUM PROFILES IN STREPTOZOTOCIN-INDUCED DIABETIC RATS

Groups and treatment	Total cholesterol (mg/dl)	Triglyceride (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	VLDL (mg/dl)	ALP (IU/dl)	SGPT (IU/dl)	SGOT (IU/dl)
Normal (2 mL/kg)	107.5 ± 6.33	57.20 ± 7.46	53.21 ± 6.91	15.14 ± 4.33	13.15 ± 4.85	123.6 ± 8.25	23.35 ± 8.24	56.24 ± 4.66
Diabetic control (2 mL/kg	245.5 ± 4.32	217 ± 6.55	34.66 ± 4.46	215.85 ± 8.45	48.25 ± 6.52	237.5 ± 6.54	54.86 ± 4.78	95.2 ± 6.78
Glibenclamide (10 mg/kg)	131.03 ± 5.88**	120.45 ± 8.40**	56.75 ± 4.25**	36.17 ± 3.63**	23.78 ± 5.33**	130.82 ± 5.78*	27.66 ± 6.14**	61.55 ± 8.95**
Methanolic extract (600 mg/kg)	166.25 ± 9.35** (32)	162.25 ± 8.22** (25)	41.5 ± 4.66** (16)	57.95 ± 7.66* (73)	30.61 ± 4.77* (36)	161.33 ± 7.17* (32)	35.5 ± 9.25* (35)	71.66 ± 5.32* (24)
Methanolic extract (400 mg/kg)	187.66 ±9.16*	157.5 ± 6.08*	38.15 ± 7.45*	76.42 ± 5.66*	33.5 ± 4.10*	172.86 ± 5.74*	41.42* ± 5.75	78.5 ± 7.5

Values expressed as mean ± SD (n = 6). Treatment was done for 15 days. The data were statistically analyzed by one- way ANOVA, followed by Dunnet's *t*-test. *p* values less than 0.05 were considered significant. *:$p < 0.05$; **: $p < 0.01$.

at a dose of 10 mg/kg b.w. resulted in 57.65 % fall in the blood glucose levels of diabetic rats after 15 days of treatment (Table-4). Significant differences were observed in serum lipid profiles (total cholesterol, triglyceride, high density lipoprotein, low density lipoprotein, VLDL, total proteins, serum glutamate oxaloacetate transaminase, serum glutamate pyruvate transaminase and alkaline phosphatase (Table-5 in methanol extract treated diabetic animals, when compared with the solvent control ($p < 0.01$).

The post-treatment levels of total cholesterol, low density lipoprotein cholesterol and triglyceride of the treated group were significantly lesser than the diabetic animals (Table-5). A fall of 32 % in total cholesterol, 73 % in low density lipoprotein cholesterol, 36 % in VLDL, 25 % in triglyceride levels were observed in diabetic rats after 15 days of extract treatment. There was an increase of 16 % in high density lipoprotein cholesterol in the treated diabetic groups. The increased levels of alkaline phosphatase, serum glutamate oxaloacetate transaminase and serum glutamate pyruvate transaminase in the diabetic rats reflected the increased hepatic damage in streptozotocin-induced diabetes. The elevated levels of all the above biochemical parameters were significantly decreased on treatment with methanolic extract of *Scindapsus officinalis* for 15 days. The data revealed a defined role of the methanolic extract of *Scindapsus officinalis* in suppressing blood glucose level in normoglycaemic, glucose-hyperglycaemic and streptozotocin-induced diabetic rats.

In normal and glucose loaded rats, the hypoglycaemic action of the extract was observed to be dose dependent, with prolonged hypoglycaemia at the higher doses. As far as most effective dose is concerned, it has been found to be 600 mg/kg in all the groups. This dose has almost similar effect as that of synthetic drug glibenclamide, especially during OGTT and streptozotocin-induced diabetes.

The mechanism by which streptozotocin brings about its diabetic state includes selective destruction of pancreatic β-cells, which make the cells less active leading to poor sensitivity of insulin for glucose uptake by the tissues[20]. The increased levels of plasma glucose in streptozotocin-induced diabetic rats were lowered by the administration of *Scindapsus officinalis* extracts. The reduced glucose levels suggested that the extracts might exert insulin-like effect on peripheral tissues by either promoting glucose uptake metabolism by inhibiting hepatic gluconeogenesis or by absorption of glucose into the muscle and adipose tissues through the stimulation of revitalisation of the remaining β-cells[21]. Another possible mechanism by which *Scindapsus officinalis* brings about its hypoglycemic action may be by potentiating the insulin effects of plasma by increasing either the pancreatic secretion of insulin from the existing β-cells or by its release from the bound form[22].

The total protein content in serum was significantly lowered in the solvent treated group, but it returned to nearly normal in the extract treated groups. Affected liver functioning also resulted in the decreased protein synthesis in diabetic rats while it was almost restored in the treated animals.

Serum enzymes including serum glutamate pyruvate transaminase, serum glutamate oxaloacetate transaminase and alkaline phosphatase are used in the evaluation of hepatic disorders. An increase in these enzyme activities reflects active liver damage. Inflammatory hepatocellular disorders result in extremely elevated transaminase levels[23]. The increase in the

activities of plasma serum glutamate pyruvate transaminase, serum glutamate oxaloacetate transaminase and alkaline phosphatase indicated liver dysfunction[24]. Therefore, an increase in the activities of serum glutamate pyruvate transaminase, serum glutamate oxaloacetate transaminase and alkaline phosphatase in plasma might be mainly due to the leakage of these enzymes from the liver cytosol into the blood stream[25]. On the other hand, treatment of the diabetic rats with eremanthin caused reduction in the activity of these enzymes in plasma when compared to the solvent group and consequently alleviated liver damage. These results are in agreement with those obtained by El-Demerdash *et al.*[26]. The results suggest that *Scindapsus officinalis* could be used as a drug to bring about hypoglycemic and hypolipidemic effects.

Hyperlipidemia has been reported to accompany hyperglycemia states[27]. High levels of total cholesterol and more importantly low density lipoprotein cholesterol are major coronary risk factors whereas several studies showed that an increase in high density lipoprotein cholesterol is associated with a decrease in coronary risk. Most of the drugs that decrease total cholesterol also decrease high density lipoprotein cholesterol[28].

However, it is interesting to found that in the present study the dose of 200 mg/kg of body weight of the methanol extracts not only lowered the total cholesterol, triglyceride and low density lipoprotein, but also enhanced the cardio protective lipid high density lipoprotein after 15 days treatment. This would definitely reduce the incidence of coronary events, which is the major cause of morbidity and deaths in diabetic subjects[29]. Under normal conditions, the enzyme lipoprotein lipase hydrolyses triglycerides. Diabetes mellitus results in failure to activate this enzyme thereby causing hypertriglyceridemia. Dietary fibers lower the cholesterol and triglyceride levels[30]. Therefore, the significant control of levels of serum lipids in the treated groups may be attributed to the rich fiber content in *Scindapsus officinalis*. As the test extracts reduced the VLDL, total cholesterol and triglyceride, hence it might be presumed that the methanol extract is responsible for the enhancement of transcription of lipoprotein lipase similar to that of insulin.

A significantly ($p < 0.01$) elevated activity of serum glutamate pyruvate transaminase was observed in the solvent control rats suggesting hepatic dysfunction in these animals. Treatment of methanol extract and glibenclamide significantly reduced hepatic dysfunction ($p < 0.01$).

Conclusion

The results of the present study show that methanol extract of *Scindapsus officinalis* possess potent blood glucose lowering activity, both in the normal as well as streptozotocin-diabetic rats. The effective dose of methanolic extract of *Scindapsus officinalis* was found to be 600 mg/kg b.wt. Administration of methanolic extract of *Scindapsus officinalis* to the diabetic rats for 15 days not only significantly lowered the fasting blood glucose of the diabetic animals to almost normal level but also lower the lipid profiles of the diabetic animals. Methanolic extract of *Scindapsus officinalis* also caused reversal of the damage of liver as seen in the diabetic animals. It was found to have a high margin of safety and thus *Scindapsus officinalis* seems to have a promising value for the development of a potent phytomedicine for diabetes.

REFERENCES

1. A. Chandra, R.K. Singh, V.K. Singh, L. Tewari and A.A. Mahdi, *SFRR-Indian Bull.*, **3**, 24 (2004).
2. A.N. Kesari, S. Kesar, S.K. Singh, R.K. Gupta and G. Watal, *J. Ethnopharmacol.*, **112**, 305 (2007).
3. C. Day, *Br. J. Nutr.*, **80**, 5 (1998).
4. J.P. Boyle, A.A. Honneycutt, K.M. Narayan, T.J. Hoerger, L.S. Geiss, H. Chen and T.J. Thompson, *Diabetes Care*, **24**, 1936 (2001).
5. B.B. Zhang and D.E. Moller, *Curr. Opin. Chem. Biol.*, **4**, 461 (2000).
6. B.K. Rao, M.M. Kesavulu and R.A.C. Giri, *J. Ethnopharmacol.*, **67**, 103 (1999).
7. R.P. Rastogi and B.N. Mehrotra, Compendium of Indian Medicinal Plants, National Institute of Science Communication, CSIR, New Delhi, India (1990).
8. M. Singh and M. Velraj, *Afr. J. Basic Appl. Sci.*, **1**, 83 (2009).
9. B.D. Patel, R. Shekhar, P. Sharma and A. Singh, *Am.-Eur. J. Toxicol. Sci.*, **2**, 158 (2010).
10. M. Akhtar, Z. Iqbal, M. Khan and M. Lateef, *J. Ethnopharmacol.*, **38**, 99 (2000).
11. M.D. Hedaytullah, G. Arya, N. Singh, A. Mishra and P. Chaturvedi, *Adv. Biol. Res.*, **4**, 305 (2010).
12. J.B. Harborne, Phytochemical Methods, Chapman & Hall, London (1998).
13. M.N. Ghosh, Fundamental of Experimental Pharmacology, Hilton and Company, Kolkata, edn. 3 (2005).
14. N.A. Theodorou, H. Vrbova, M. Tyhurst and S.L. Howell, *Diabetol.*, **18**, 313 (1980).
15. A. Shirwaikar, K. Rajendran and R. Barik, *J. Ethnopharmacol.*, **107**, 285 (2006).
16. R.T. Burkhardt and J.C. Batsakis, *Am. J. Clin. Pathol.*, **70**, 508 (1978).
17. N.M. Pierre, A. Demaekerl, H. Marja, T.D. Helga and B. Henk, *Clin. Chem.*, **43**, 663 (1997).
18. M.W. MeGown, J.D. Artiss, D.R. Strandberg and B. Zak, *Clin. Chem.*, **29**, 538 (1983).
19. P.R.N. Kind and E.J. King, *J. Clin. Pathol.*, **7**, 322 (1954).
20. E. Jacot and J.P.H. Assal, In ed.: Schorderet, Regulation de la Glycemie, in Pharmacologiedes Concepts Fondamentaux aux Applications Therapeutiques, pp. 481-494 (1989).
21. A. Kamanyi, D. Dajmen and B. Nkeh, *Phytother. Res.*, **8**, 369 (1994).
22. S. Jain, G. Bhatia, R. Barik, P. Kumar, A. Jain and V.K. Dixit, *J. Ethnopharmacol.*, **127**, 325 (2010).
23. W.C. Foreston, F.J. Tedesco and E.C. Starnes, *J. Clin. Gastroenterol.*, **76**, 502 (1985).
24. O.C. Ohaeri, *Biosci. Rep.*, **21**, 19 (2001).
25. C.M. Navarro, P.M. Montilla, A. Martin, J. Jimenez and P.M. Utrilla, *Planta Med.*, **59**, 312 (1993).
26. F.M. El-Demerdash, I. Yousef and N.I.A. El-Naga, *Food Chem. Toxicol.*, **43**, 57 (2005).
27. T.P. Almdal and H. Vilstrup, *Diabetologia*, **31**, 114 (1988).
28. M.R. Taskinen, In eds.: F. Belfiore, R.N. Bergnan, G.M. Molinatt, Lipoprotein and Apoproteins in Diabetes, in Current Topics in Diabetes Research, Informa Health Care, Vol. 12 (1993).
29. P.W.F. Wilson, *Am. J. Cardiol.*, **66**, 7A (1990).
30. D.M. Huse, G. Oster, A.R. Killen, M.J. Lacey and G.A. Golditz, *J. Am. Med. Assoc.*, **262**, 2708 (1988).