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A Comparative Antidiabetic Activity of the Three Plants Found in Terai and Duars Region of West Bengal, India

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The northernmost piece of West Bengal touching the feet of Eastern Himalaya is by and large alluded as Terai and Duars (West and East of the stream Tista, separately). From this area the leaves of Swietenia macropphylla, Litsea glutinosa Robinson and Phlogacanthus thyrsiformis were selected for antidiabetic activity and till date no scientific evidence available for antidiabetic activity. The Ethyl acetate extracts of these three plants were orally administered to the Streptozotocin induced diabetic rats. These extracts significantly regulate the blood glucose levels in diabetic rats and indicating the antidiabetic activity of these plants. The antidiabetic activity demonstrated by plants were in following order Phlogacanthus thyrsiformis>Swietenia macrophylla>Litsea glutinosa, respectively. In addition, it significantly recovered lipid profile levels and prevented the decrease in body weight as well as serum insulin level.

Keywords: Antidiabetic; Glibenclamide; Medicinal Plant from Terai- Duars; Lipid Profile; Streptozotocin.

So far as the detection of a crude medication is concerned, the present day technique has turned out to be more logical. Prior, every single crude medication was utilized to be for the most part recognized by contrasting those and the standard portrayals found in different writings. In any case, throughout the years, with the arrival of novel strategies, the procedure of distinguishing proof of crude homegrown medications has likewise undergone a deliberate change. Eventually, however the procedure of recognizable evidence through writing information, morphological, microscopical and substance examinations are performed to discover the dynamic constituents of any crude medication. The whole strategy of evaluation of a crude medication thus infers temperament of its character and confirmation of its quality and purity. This can be done by basically three styles of assessment methodology, which are basically pharmacognostical, phytochemical and pharmacological assessments.

Medicinal plants have a vital role to play in achieving 'health for all' in India by 2020. In India, it is trusted that nature gives us

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appropriate medications for treatment of a wide range of ailments. A few hundred society cures are honed in India even today. The northernmost piece of West Bengal touching the feet of Eastern Himalaya is by and large alluded as Terai and Duars (West and East of the stream Tista, separately). The nature of the Terai and Duars of Jalpaiguri, Darjeeling, Cooch Behar has bloomed her beauty in an extreme point of view with Flora & Fauna here, as the Switzerland of North Bengal. Swietenia macropphylla King, Litsea glutinosa (Lour.) Robinson and Phlogacanthus thyrsiformis (Roxb. ex Hardw) Mabb. have been selected as medicinal plants for antidiabetic activity as preliminary phytochemical study[1-3] and different part of these three plants indicating that they may have potent antidiabetic property like Swietenia macropphylla on seed[4] Litsea glutinosa on bark[5, 6] and Phlogacanthus thyrsiformis on flower[7,8] and this three plant are used as ethnomedicine in Terai and Duars areas as well. It was found that no thorough Antidiabetic study have not performed on these three plants leaves. Therefore, the current research work was aimed to investigate the antidiabetic activity of young leaves of Swietenia macropphylla, Litsea glutinosa and Phlogacanthus thyrsiformi, and were acquired from Terai and Duars areas of West Bengal, India.

MATERIAL AND METHODS

Plant Collection

The plant species of Swietenia macrophylla King (Meliaceae), Litsea glutinosa (Lour.) Robinson (Lauraceae) and Phlogacanthus thyrsiformis (Roxb. ex Hardw) Mabb. (Acanthaceae) were gathered from Terai and Duars situated in West Bengal, India. These plants were identified by Botany department of University of North Bengal and herbarium were submitted with voucher specimens (Accession No. 09691, 09692, 09693). The collected leaves were washed with distilled water and shade dried. The dried leaves were made coarsely powdered for further studies.

Extract Preparation

The various extracts were prepared by using petroleum ether, ethyl acetate, methanol and water through continuous successive Soxhlet extractor. From that four extract Ethyl Acetate extract has been selected for evaluation of the antidiabetic activity. The ethyl acetate extract of Swietenia macrophylla, Litsea glutinosa and Phlogacanthus thyrsiformis were abbreviated as SM, LG and PT and respectively.

Experimental Animals

The male Wistar albino rats (180-230gm) were used for antidiabetic study. The protocol was approved by the Institutional Animal Ethic Committee with Reg. No. of1321/PO/ReBi/S/10/ CPCSEA. The procedure of evaluating Antidabetic activity describes by the Sharma U. *et al* in 2010 and Singh J. *et al* in 2011[9, 10] was followed with few modifications.

Determination of Oral Glucose Tolerance Test of Extract

The rats were divided into nine groups and each group comprising six animals, and details are given below:

Group I: normal control rats, administered drinking water daily

Group II: glucose control rats administered glucose (2 g/kg)

Group III: administered standard drug Glibenclamide (0.5 mg/kg).

Groups IV & V: animals treated orally with SM extract (200 mg/kg and 400 mg/kg), respectively

Groups VI & VII: animals treated orally with LG extract at (200 mg/kg and 400 mg/kg), respectively

Groups VIII & IX: animals treated orally with PT extract (200 mg/kg and 400 mg/kg), respectively

The rats of Group II to Group IX were administered Glucose (2 g/kg) prior 30 minutes administration of extracts and standard drug. The blood was collected at an interval of 0, 30, and 90 minutes from rats after treating with extract and standard drug. The blood serum obtained were used for the valuation of fasting glucose levels by using kit glucose oxidase–peroxidase[9-11].

Determination of Induction of Non-Insulin Dependent Diabetes Mellitus

The diabetes was induced in animals by administering single dose of 60 mg/kg Streptozotocin (STZ) through i.p, 15 min post administration of nicotinamide (120 mg/kg b.wt; i.p). After 72 hrs of treatment the blood glucose level was monitored, and rats showed glucose level greater than 126 mg/dl were deemed to be diabetic rats and comprised in the study[9- 13].

Evaluation of Antidiabetic Activity

The rats were divided into nine groups and

each group comprising six animals. The treatment with vehicles, extract and standard drug to rats were done for 28 days, and details are given below:
Group I: normal control rats, administered water
Group II: diabetic control rats (Streptozotocin (60 mg/kg., i.p) and Nicotinamide (120 mg/kg., i.p))
Group III: administered standard drug Glibenclamide (0.5 mg/kg).
Groups IV & V: animals treated orally with SM extract (200 mg/kg and 400 mg/kg), respectively
Groups VI & VII: animals treated orally with LG extract at (200 mg/kg and 400 mg/kg), respectively
Groups VIII & IX: animals treated orally with PT extract (200 mg/kg and 400 mg/kg), respectively

The serum glucose levels of experimental animals were measured on days 0, 7th, 14th and 28th. Further, the body weight of animals was calculated during the study[9- 11, 14- 18].

Assessment of Lipid Profile

At the end of study, the lipid profile namely total cholesterol, triglycerides (TGL), high-density lipoprotein (HDL) and low-density lipoprotein (LDL) of experimental animals were determined[9, 11, 19- 22].

Effect of Extract on Insulin Level

At the end of study, blood was collected, and insulin was determined by using GLAZYME INSULIN-EIA TEST.[9, 10, 23- 25]

Statistical Analysis

The results obtained were expressed as mean ± SEM for all the experiments. The significant difference between the study group was calculated by using One-way analysis of variance (ANOVA) through Dunet's test. The value of findings of $p < 0.05$ was considered to be statistically significant.

RESULTS

Natural Traditional medicines cure diabetes by improving insulin sensitivity and secretion and thus maintain the optimal glucose level in the blood. The phytochemicals present in the plant can monitor the glucose level which is imbalance due to improper functioning of glycolysis, Kreb's cycle, glycogenesis, pentose phosphate pathways and glycogenolysis [26]. Hence, there are large numbers of plants which controlled the blood glucose level in diabetes, and we conducted antidiabetic activity of leave of Swietenia macrophylla, Litsea glutinosa and Phlogacanthus thyrsiformis.

Oral Glucose Tolerance Test

The effects of ethyl acetate extracts of the leaves of Swietenia macrophylla, Litsea glutinosa and Phlogacanthus thyrsiformis on the glucose level of experimental animals are shown in Table 1. The fasting glucose in the diabetic control group of rats was seen as fundamentally higher when contrasted with the normal rats. These raised fasting glucose levels were found to have been kept up all through the treatment demonstrating that that the rats are rendered diabetic. The diabetic rats treated with SM, LG and PT shows a significantly reduced dynamic, it shows profoundly critical qualities in decrease of fasting glucose during the single dose of treatment period in contrast with the diabetic group of rats. The diabetic rats treated with SM, LG and PT indicated significant decrease in fasting glucose during the treatment period in contrast with diabetic group of rats (Table 1).

Antidiabetic Activity

Table 2 demonstrated the antidiabetic activity of the different doses of ethyl acetate extract of SM, LG and PT. The fasting serum glucose in the diabetic control group of rats was higher when compared with the normal rats. These raised fasting serum glucose levels were found to have been kept up all through the 28 days of treatment period demonstrating that the rats are rendered diabetic. The SM, LG and PT treated diabetic rats' shows huge decrease of fasting serum glucose during the treatment time frame in contrast with diabetic group of rats (Table 2). The antidiabetic activity in decreasing order were found Phlogacanthus thyrsiformis>Swietenia macrophylla>Litsea glutinosa, respectively.

Lipid Profile

The guidelines of lipid profiles in various groups of rats are displayed in Table 3. The significant increment in TGL, total cholesterol and LDL whereas increase in HDL observed in diabetic control rats contrasted and normal rats. The SM, LG, PT and standard drug treated rats significantly decreased the level of TGL, total cholesterol and LDL, while increased HDL compared to diabetic control group rats. The aftereffects of study demonstrate the antihyperlipidaemic activity of SM, LG and PT. The antihyperlipidaemic activity in decreasing order were found Phlogacanthus thyrsiformis>Swietenia macrophylla>Litsea

glutinosa, respectively. Table 4 exhibited that the after onset of diabetes, reduced in body weight of rats. But after treatment of extract and standard drug, increased in body weight of rats was observed.

Insulin Level

Table 5 demonstrated the significant decreased in insulin in the diabetes rats compared to normal groups. While the extract and standard drug treated groups significantly enhanced the insulin level compared to control group.

DISCUSSIONS

The streptozotocin is a diabetic agent leads to develop oxidative stress and destruct the ß-cells of pancreas. The reactive oxygen species produce by streptozotocin, reduced the intracellular NAD and NADP level responsible for the electron transport and energy metabolism in ß-cells.

The outcomes demonstrated that the administration of streptozotocin caused increased in glucose level in rats. Consequently, the administration of SM, LG and PT significantly declined the blood glucose level in diabetic rats. In addition, significantly increased in body weight was observed in extract treated rats. The various researchers documented decreased in glucose level is due to modifying the insulin effect of plasma by regulating the pancreatic secretion of insulin from the existing beta cells or by its release from the bound form. Hence, this suggested the same

Table 1. Consequence of different extracts of SM, LG and PT on oral glucose tolerance test

Treatment	Plasma glucose level (mg/dl)		
	0 min	30 min	90 min
Normal Control	77.31±3.52	75.24±2.18	76.14±3.21
Glucose control	78.52±1.89	176.35±2.56[a]	153.82±4.15[a]
Glucose +Glibenclamide (0.5 mg/kg)	79.63±2.53	103.82±3.47*	75.18±4.28*
SM (200 mg/kg)	76.29±3.26	128.62±3.51	101.52±4.73*
SM (400mg/kg)	80.37±2.19	107.58±4.78*	78.24±2.55*
LG (200 mg/kg)	77.47±4.62	136.43±2.85*	115.73±3.76*
LG (400 mg/kg)	79.24±5.27	118.61±3.45*	87.67±2.49*
PT (200 mg/kg)	78.51±3.79	125.34±2.85*	95.25±4.61*
PT (400 mg/kg)	80.37±4.57	98.73±3.48*	75.14±2.95*

Data stated as mean ± SEM; [a]P<0.05 significant difference from normal while *P<0.05 significant difference from control group

Table 2. Consequence of different extracts of SM, LG and PT on fasting plasma glucose level in rats

Treatment	Plasma glucose concentration (mg/dl)			
	0 Day	7th Day	14th Day	28th Day
Normal Control	78.25±4.15	76.54±3.47	80.34±5.31	77.17±4.72
Diabetic control (Streptozotocin)	139.42±5.28[a]	205.49±4.19 [a]	241.78±3.49[a]	285.61±3.96 [a]
Diabetic + Standard Glibenclamide (0.50 mg/kg)	137.29±3.82	101.17±5.28*	88.53±3.75*	75.43±4.82*
Diabetic+ SM (200 mg/kg)	136.73±5.02	158.59±4.36*	136.25±5.29*	107.63±5.12*
Diabetic+ SM (400mg/kg)	139.72±3.49	135.61±3.73*	117.48±4.71*	92.18±4.28
Diabetic+ LG (200 mg/kg)	140.21±3.73	180.14±4.58*	151.86±4.56*	121.32±5.18*
Diabetic+ LG (400 mg/kg)	137.53±35.28	162.47±3.69*	133.92±3.48*	108.38±3.74*
Diabetic+ PT (200 mg/kg)	141.29±3.79	145.34±4.78*	122.53±5.25*	109.42±5.43*
Diabetic+ PT (400 mg/kg)	138.42±4.05	122.56±5.34*	101.68±4.61*	82.75±4.18

Data stated as mean ± SEM; [a]P<0.05 significant difference from normal while *P<0.05 significant difference from control group

mechanism of antidiabetic followed by the extract of SM, LG and PT.

The hyperlipidemia of blood is due to the highest level of blood glucose. The findings of lipid profile study indicate the significantly enhanced in TGL, total cholesterol and LDL, while significantly decrease in HDL of diabetic rats compared to normal rats. The diabetic rats treated with the

Table 3. Efficacy of different extracts of SM, LG and PT on biochemical parameters

Treatment	Triglyceride	Total Cholesterol	HDL	LDL
Normal control	91.42±2.35	88.63±2.38	59.42±4.25	51.47±4.53
Diabetic control (Streptozotocin)	179.26±3.14[a]	159.72±3.19[a]	29.43±2.48[a]	165.83±2.14[a]
Diabetic + Standard Glibenclamide (0.50 mg/kg)	82.53±4.02	85.47±4.10*	58.14±3.42*	68.29±3.52*
Diabetic+ SM (200 mg/kg)	111.14±3.58*	117.68±3.20*	39.18±4.17	108.63±2.47*
Diabetic+ SM (400mg/kg)	98.62±2.76	91.34±2.47*	50.72±2.68*	85.43±1.59*
Diabetic+ LG (200 mg/kg)	121.43±3.14*	129.51±1.69*	35.24±2.05	131.46±3.49*
Diabetic+ LG (400 mg/kg)	110.52±2.19*	105.72±2.48*	41.63±1.25*	120.82±2.75*
Diabetic+ PT (200 mg/kg)	101.47±2.95*	105.82±3.15*	43.19±2.49*	98.57±4.08*
Diabetic+ PT (400 mg/kg)	89.63±3.14*	78.59±2.47*	56.74±3.41*	69.43±3.32*

Data stated as mean ± SEM; [a]P<0.05 significant difference from normal while *P<0.05 significant difference from control group

Table 4. Effect of different extracts of SM, LG and PT on changes in body weight in rats

Treatment	Body weight (gm)		
	Before Induction	After Induction	After Treatment
Normal control	186.42±3.15	176.84±4.18	192.43±3.58
Diabetic control (Streptozotocin)	183.61±2.14	142.76±3.92	125.65±4.29
Diabetic + Standard Glibenclamide (0.50 mg/kg)	198.72±1.63	140.53±4.27	181.47±3.63
Diabetic+ SM (200 mg/kg)	192.61±3.47	151.48±3.53	175.59±2.72
Diabetic+ SM (400mg/kg)	188.35±4.5	135.49±2.58	176.94±4.18
Diabetic+ LG (200 mg/kg)	185.58±1.89	125.61±3.49	152.83±3.26
Diabetic+ LG (400 mg/kg)	192.41±3.91	155.72±4.37	181.53±4.05
Diabetic+ PT (200 mg/kg)	201.62±2.73	176.24±3.18	184.73±3.68
Diabetic+ PT (400 mg/kg)	194.34±3.46	161.72±4.24	186.35±4.42

Table 5. Effect of different extracts of SM, LG and PT in insulin level of diabetes rats

Treatment	Initial Reading	Final Reading
Normal control	0.79±0.05	0.83±0.09
Diabetic control	0.81±0.12	0.30±0.05[a]
Standard drug Glibenclamide (0.50 mg/kg)	0.88±0.06	0.76±0.13*
SM (200 mg/kg)	0.81±0.15	0.69±0.08*
SM (400mg/kg)	0.82±0.09	0.75±0.14*
LG (200 mg/kg)	0.78±0.14	0.59±0.06*
LG (400 mg/kg)	0.81±0.08	0.75±0.11*
PT (200 mg/kg)	0.83±0.04	0.69±0.08*
PT (400 mg/kg)	0.80±0.02	0.73±0.07*

Data stated as mean ± SEM; [a]P<0.05 significant difference from normal while *P<0.05 significant difference from control group

extract regulate the lipid profile and bring it near to normal rats. The significant antidiabetic activity of SM, LG and PT propose the availability of potent antidiabetic secondary metabolite. This secondary metabolite also created antihyperglycemic effect in diabetic rats. The results of lipid profile make the leaves of Swietenia macrophylla, Litsea glutinosa and Phlogacanthus thyrsiformis potent antidiabetic properties.

The present study has indicated the fact that the plants Swietenia macrophylla, Litsea glutinosa and Phlogacanthus thyrsiformis has antidiabetic and antihyperlipidemic constituents. The antidiabetic activity in decreasing order were found Phlogacanthus thyrsiformis>Swietenia macrophylla>Litsea glutinosa respectively.

CONCLUSION

The outcomes of present study expressed the antidiabetic activity of ethyl acetate extract of leaves Swietenia macrophylla, Litsea glutinosa and Phlogacanthus thyrsiformis by regulating the blood glucose level. Furthermore, the extract showed hypolipidemic activity by modulating the lipid profile in diabetic rats. Hence, these suggest the antidiabetic and antihyperlipidemic activity of the leave of Swietenia macrophylla, Litsea glutinosa and Phlogacanthus thyrsiformis. Moreover, the ethyl acetate extracts of Phlogacanthus thyrsiformis displayed higher antidiabetic activity compared to Swietenia macrophylla and Litsea glutinosa extract. Further the mechanisms of action of different phytochemicals are in evolution to recognize the specific active compounds responsible for biological activities.

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