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EVALUATION OF ANTIDIABETIC AND HYPOLIPIDEMIC ACTIVITY OF CLERODENDRUM INFORTUNATUM LINN. IN ALBINO RATS

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ABSTRACT

Background: Diabetes mellitus is a chronic metabolic disorder of carbohydrate, lipid, and protein metabolism. It is characterized by hyperglycemia, glycosurea, hyperlipidemia and negative nitrogen balance, due to insufficient or complete cessation of insulin synthesis, or secretion and/or peripheral resistance to insulin action. Diabetes has been known to medical sciences longer than any other hereditary metabolic disorder. *Clerodendrum infortunatum* family: Verbenaceae is commonly known as Bhant in Hindi, has been traditionally used in the Siddha system of medicine as a chief ingredient of many polyherbal formulations for the treatment of various ailments. However, no scientific evidence is available to validate the folklore claim. **Objective:** The present study has been designed to evaluate the antidiabetic and hypolipidemic activity of *Clerodendrum infortunatum*. **Materials and methods**: The antihyperglycaemic activity was evaluated in normal, glucose-loaded and Streptozotocin-induced hyperglycaemic rats (single and multi dose treatment). **Results:** In normoglycaemic rats, the test extracts showed progressive fall of blood glucose level till the end of 8 h. In glucose loaded animals (OGTT), reduction in blood glucose level was observed after 60 minutes of administration of the test substances. The maximum reduction was observed at 4 h with Methanol: Dichloro methane extract exhibiting maximum improvement in glucose tolerance. Continuous administration of extracts or 14 days leads to significant decrease in serum total cholesterol, triglycerides, LDL and VLDL levels, while increase in total protein and HDL levels was recorded. **Conclusion:** The present study demonstrated that the leaves of *C. infortunatum* had remarkable preclinical anti-hyperglycemic activity in STZ-induced diabetic rats. Our results contribute towards validation of the traditional use of *C. infortunatum* in the treatment of diabetes.

KEYWORDS: Anti-hyperglycemic, hypolipidemic, *C. infortunatum*, Streptozotocin, Glibenclamide.

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder of carbohydrate, lipid and protein metabolism. It is characterized by hyperglycemia, glycosurea, hyperlipidemia and negative nitrogen balance, due to insufficient or complete cessation of insulin synthesis, or secretion and/or peripheral resistance to insulin action.[1] Diabetes has been known to medical sciences longer than any other hereditary metabolic disorder. The latest World Health Organization estimate (for the number of people worldwide, in 2000) is 177 million. This will increase to at least 300 million by the year 2025.[2] Nevertheless, the existing methods of treatment for this age old illness are not completely satisfactory. Since the treatment of patients with type-2 diabetes with oral hypoglycemic agents like sulfonylureas and biguanides, is always associated with various unwanted effects.[3] Therefore, now days Researchers have shifted their research focus towards herbal remedies and herbal drugs which are gaining popularity in the treatment of diabetes mellitus. *C. infortunatum* L. belonging to family Verbanaceae, commonly called Bhant in Hindi, Ghentu in Bengali, Gurrpuin in Telugu and Hill glory bower in English is a terrestrial shrub having square, blackish stem and simple, opposite, decussate, petiole, exstipulate, coriacious, hairy leaves with a disagreeable odour.[4] The plant is commonly grow throughout the year in the plains of India.[5] Various parts of the plant have been used by local tribes for the treatment of colic, scorpion sting, snake bite, diabetes tumors and certain skin diseases.[6] They are also used in Indian folk medicine in the treatment of bronchitis, asthma, fever, diseases of the blood, inflammation, burning sensation and epilepsy.[7] *C. infortunatum* has certain ethno-medicinal properties that are practiced by various tribes of our country. The leaf juice of the plant is given orally for the treatment of

fever and bowel troubles among the Kuki and Rongmai Naga tribes of North-East India. Also fresh flower juice is introduced in the rectum for removal of ascarides. Leaf and flower juices are used to cure scorpion sting by Rabha, Rajbanshi, Polia and Lepcha tribes of North Bengal use fresh root-bark juice of *C. infortunatum* to cure diarrhea.[8] Kachari, Hmar and Riang tribes of Barak Valley and North- Cachar hills use leaf extract in stomach pain and diabetes. Also a root paste is used as bandage in swelling.[9] Fresh juice of the leaves and flowers has been used as vermifuge and in treatment of malaria. *C. infortunatum* leaves were reported to contain various phytochemicals among them a saponin, clerodin (a bitter diterpene), some enzymes, alkyl sterols and 2,-(3, 4-dehydroxyphenyl) are phytochemicals which may responsible for its antidiabetic activity.

MATERIALS AND METHODS

Chemicals and instruments

Streptozotocin (STZ) was procured from Sigma life science (Mumbai) and Glibenclamide tablet (Daonil; Emcure- Sanofi India Ltd.) was purchased from local market. Total cholesterol, HDL cholesterol, LDL cholesterol, VLDL, total protein, triglycerides, total bilirubin and creatinine were assayed by using the kits procured from Span Diagnostics Ltd. (India). Blood glucose level was measured by using Dr. Morpen Gluco meter (Model No-01-mini). The entire chemicals used in this study were of analytical grade.

Plant materials and preparation of extracts

Clerodendrum infortunatum was collected from Boriguma forest region in koraput district, Odisha, in the month of October – November and authenticated by Dr. K. B. Satapathy, P.G. Department of Botany, Utkal University, Bhubaneswar, Odisha, India and given the voucher specimen number as SR-234. After authentification, the leaves and flowers was collected in bulk quantity, washed under running tap water to remove the adhering dirt and shade dried at room temperature. The dried plant material i,e both flowers and leaves in equal proportions was crushed to course powder by using mechanical grinder. The powdered plant material was extracted successively with petroleum ether (60-80 C) and Methanol: Dichloro methane (MDM) (50:50). The extracts were concentrated by evaporating the solvent under reduced pressure using Rotary evaporator (IKA Rv 10 V digital). The yield of petroleum ether and Methanol: Dichloro methane (50:50) extracts were found to be 8.76 and 12.24% w/w respectively.

Preliminary phytochemical screening of extracts

The present study was undertaken for the detection of preliminary phytochemical present in petroleum ether and MDM extract of *C. infortunatum*. Qualitative phytochemical analysis of the plant extract was carried out according to the methods described by Ghosh *et al*, 2010 to confirm the presence of various phytochemicals.[10]

Acute oral toxicity study of extracts

Swiss albino mice of either sex were fasted overnight prior to the experiment. The study was carried out as per OECD guidelines, 2000. The different doses of the extracts were administered to mice by oral route in different dose levels of 500, 1000, 2000, 3000 and 4000 mg/kg of body weight. The food was withheld for further 3-4 h after drug administration to avoid any complications relating to absorption of test extracts arising from food. Animals were critically observed individually at least once during the first 30 minutes of dosing followed by occasional observation for first 24 h and continued for 72 h for the recording of mortality, if any. The LD_{50} was calculated according to Miller and Tainter.[11] One-tenth ($1/10^{th}$) of the lethal dose was taken as a screening dose.[12] The rats were observed continuously and the following profiles were observed.

- Behavioral profile: Alertness, restlessness, irritability and fearfulness
- Neurological profile: Spontaneous activities, reactivity, touch response, pain response, and gait
- Autonomic profile: Defecation and urination.

After a period of 72 h the rats were observed for any lethality or death. Since no mortality was observed up to the dose level of 4000 mg/kg body weight (b.w), so the dose of 400 mg/kg was fixed for screening of anti-diabetic activity.

Evaluation of antidiabetic activity of extracts

The antidiabetic activity of the extracts (petroleum ether and MDM (50:50) of *C. infortunatum* was assessed in normoglycaemic, glucose-loaded, streptozotocin-induced single dose and multi dose treated hyperglycaemic animals.

Preparation of test extracts for animal experiments

The suspension of petroleum ether and MDM extracts was prepared by using distilled water and Tween-40 which was used for animal experiments.

Evaluation of activity of *C. infortunatum* extracts on normoglycaemic animals

Healthy Wistar albino rats of either sex weighing 150-200 g deprived of food for 12 h before the experiment were divided into four groups of six rats each. At the end of the fasting period, taken as zero time (0 h), blood was withdrawn from the tip of tail and the fasting blood glucose level was estimated. Group-I animals served as control received only solvent (distilled water + Tween 40, 2 ml/kg, b.w.), group-II standard group received Glibenclamide (10 mg/kg b.w) and group-III and IV served as test group animals were treated with the suspensions of petroleum ether and MDM (50:50) extracts of *C. infortunatum* (400 mg/kg, b.w.). All the treatments were made by oral route. The blood glucose level was determined at 0, 1, 2, 4, 6 and 8 h after administration of test extracts and standard. The blood samples were collected from tail vein of the animals and

blood glucose level was measured by using glucose oxidase-peroxidase reactive strips and glucometer.[13]

Evaluation of activity of *C. infortunatum* extracts on glucose-loaded animals (OGTT)

The oral glucose tolerance test was performed as per the method of Shirwaikar.[14] In this method, rats were fasted for 16 h before and during the experiment. Rats were divided into four groups of six rats each. Group-I solvent treated group received (distilled water + Tween 40, 2 ml/kg); Group-II standard group was treated with Glibenclamide (10 mg/kg, b.w.); and test groups Group-III and IV received suspensions of petroleum ether and MDM (50:50) extracts of *C. infortunatum* (400 mg/kg, b.w) respectively. Glucose (3 g/kg) was fed 30 minutes after the administration of vehicle, standard and test extracts. Blood was withdrawn from tail vein of the animal at 0, 1, 2 and 4 h of glucose administration. The blood glucose level was estimated by using glucose oxidase-peroxidase reactive strips and glucometer.

Evaluation of activity of *C. infortunatum* extracts on streptozotocin-induced diabetic animals (Single dose)

The effect of extracts on blood glucose level was studied in STZ-induced diabetic rats. The rats were divided into five groups of six rats each and fasted for 12 h with free access of water. Six normal rats were treated only with solvent and served as solvent control. The treatments were made orally as: Group-I Solvent control (distilled water + Tween 40, 2 ml/kg, b.w.); Group-II Diabetic control (distilled water + Tween 40, 2 ml/kg, b. w.); Group-III Glibenclamide (10 mg/kg); Group-IV Petroleum ether extract (400 mg/kg); Group-V Methanol: Dichloro methane (50:50) extract (400 mg/kg). The blood glucose level was estimated at 0, 1, 2, 4, 8, and 10 h following the treatment.[13]

Evaluation of antihyperglycaemic activity of *C. infortunatum* extracts on STZ-induced diabetic animals (Multi-dose)

The Wistar albino rats of either sex of body weight of 150-200 g were divided into five groups, six animal each (n=6) and kept fasting for 24 h. Diabetes was induced by intra-peritoneal injection of STZ freshly dissolved in citrate buffer (pH 4.5) immediately before use at a dose of 65 mg/kg body weight.[15] In order to avoid STZ induced hypoglycaemic mortality, 5% glucose solution was given for 24 h to STZ treated rats.[16] After 72 h of STZ 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. Group-I: Six normal rats were treated only with distill water and solvent and served as solvent control. (distilled water + Tween 40, 2 ml/kg b.w); Group-II: Diabetic control (distilled water + Tween 40, 2 ml/kg b.w); group-III served as standard group received standard drug, Glibenclamide (10 mg/kg b.w) by oral route once daily for 14 days. Test group animals received various extracts of *C. infortunatum* in a dose range of 400mg/kg. Group-IV & V received petroleum ether and MDM (50:50) extracts respectively. The blood samples were collected from tail vein and blood glucose level was measured. The blood glucose levels were determined on 1st, 2nd, 4th, 7th and 14th day after administration of solvent, standard drug and test extracts.[17]

Serum lipid profile

The lipid profile was done at the end of the experiments i,e on 14th day after induction of diabetes. The serum lipid parameters such as total cholesterol, triglycerides, high density lipoproteins, low density lipoproteins and very low density lipoproteins, total bilirubin and creatinine were estimated using commercial kits procured from Span Diagnostics Ltd. (India).

RESULTS

Preliminary phytochemical screening

The preliminary phytochemical screening of the extracts of *C. infortunatum* revealed the presence of different chemical constituents like alkaloids, tannins, glycosides, Phenolic, Flavonoids, Steroids, Terpenoids, resins Fixed oil and Sugars.

Acute oral toxicity study

The gross observational results revealed that the extracts did not show any sign of toxicity and mortality up to 72 h of the study at the dose level of 4000 mg/kg b.w Hence, 400 mg/kg b.w was fixed as the screening dose during antidiabetic evaluation.

Effect of extracts on normoglycaemic rats

The effect of extracts on blood glucose level of normal rats is presented in Table 1. The test extracts at 400 mg/kg body weight showed a significant fall of blood glucose level when compared with solvent control group at the end of 8 h ($p<0.01$). MDM extract (400 mg/kg) exhibited the highest reduction of blood glucose level with the percentage reduction of (20.56%) followed by petroleum ether extract (17.09%).

Effect of extracts on glucose loaded hyperglycaemic rats

As per the results depicted in Table 2, petroleum ether and MDM extracts showed significant fall of blood glucose level with $p<0.01$ & $p<0.001$, respectively at 4 h following the administration of test substances. MDM extract (400 mg/kg) exhibited maximum reduction of blood glucose and better glucose tolerability (30.40%) as compared to petroleum ether extract (21.12%). However the standard drug exhibits the blood glucose reduction of (34.73%) after four hour of study.

Effect of *C. infortunatum* extracts on STZ-induced diabetic animals (Single dose)

The results revealed that MDM extract (400 mg/kg)exhibited highest reduction of blood glucose level with the percentage reduction of 57.42 followed by petroleum ether extract (43.22%) at 10 h after

administration of test substances when compared with the diabetic control group (Table 3).

Effect of extracts of *C. infortunatum* on STZ-induced diabetic animals (Multi-dose)

The effect of extracts on STZ-induced diabetic rats in multi dose treatment is presented in Table 4. The results of MDM and petroleum ether extracts respectively showed 59.31 and 52.34% reduction of blood glucose level at the end of 14th day when compared with the diabetic control group.

Biochemical parameters of STZ-induced diabetic animals after 14th day

The results of extracts on biochemical parameters of STZ-induced diabetic animals after 14th day treatment are depicted in Table 5. Overall, the Methanol: Dichloro Methane extract (400 mg/kg) showed significant activity as compared to the petroleum ether extract. The Methanol: Dichloro Methane extract at a dose range of 400 mg/kg b.w was found to exhibit highest degree of action in reducing the triglyceride, total cholesterol, total bilirubin, creatinine, LDL and VLDL levels followed by methanol and petroleum ether extracts. Methanol: Dichloro Methane extract (400 mg/kg) significantly increase the total protein and HDL levels after 14th day treatment.

Table (1) Effect of extracts of *C. infotunatum* on blood glucose levels in normoglycaemic animals.

Groups and treatment	Blood glucose level (mg/dl)						
	0hr	1hr	2hr	4hr	6hr	8hr	% decrease at the end of 4 hrs
Solvent control (2 ml/kg	105.50± 0.76	101.83 ± 0.60	103.50 ± 0.76	91.83 ± 0.60	91.07± 0.58	97.55± 0.74	----
Glibenclamide (10mg/kg)	95.33± 0.66 **	95.33 ± 0.71**	85.62 ± 0.68**	69.57± 0.73**	65.29± 0.64**	54.61± 0.75**	44.01
Petroleum ether extract (400mg/kg)	95.16± 0.94**	94.66± 0.80**	90.50± 0.72**	88.56± 0.72**	88.50± 0.76*	77.49± 0.67**	17.09
MDM extract (400mg/kg)	96.16± 0.47**	94.91 ± 0.52**	91.57 ± 0.71**	95.83 ± 0.79**	90.50 ± 0.76**	88.16 ± 0.60**	20.56

Values expressed as mean ± SEM (n=6). The data were statistically analysed by one-way ANOVA, followed by Dunnet's ttest. p values less than 0.05 were considered significant. *: p <0.05; **: p <0.01; ***: p <0.001.

Table (2) Effect of extracts of *C. infotunatum* on blood glucose levels in glucose loaded animals.

Groups and treatment	Blood glucose level (mg/dl)				
	Pre-treatment	Post-treatment			
	0hr	1hr	2hr	4hr	% decrease at the end of 4 hrs
Solvent control (2 ml/kg)	85.01± 0.75	139.45± 0.41	133.16± 0.60	121.50± 0.76	----
Glibenclamide (10 mg/kg)	75.50± 0.76**	125.85± 0.69**	99.16± 0.74**	79.30± 0.77***	34.73
Petroleum ether extract (400 mg/kg)	90.66± 0.66**	135.54± 0.73**	127.05± 0.94*	95.83± 0.79**	21.12
MDM (400mg/kg)	81.33±. 0.55**	131.48± 0.71**	118.66± 0.88**	84.56± 0.72***	30.40

Values expressed as mean ± SEM (n=6). The data were statistically analysed by one-way ANOVA, followed by Dunnet's t-test. p values less than 0.05 were considered significant. Rats of all groups were loaded with glucose (2 g/kg p.o.) 30 min after extracts, Glibenclamide and water * p < 0.05; ** p < 0.01; ***: p <0.001.

Table (3) Effect of extracts of *C. infotunatum* on blood glucose levels in single dose treated streptozotocin induced diabetic animals.

Groups and treatment	Blood glucose level (mg/dl)						
	0hr	1hr	2hr	4hr	8hr	10hr	% decrease at the end of 4 hrs
Solvent control (2 ml/kg)	86.87± 0.75	83± 0.57	87.16± 0.83	92.07± 0.68	89.27±0.72	86.64± 0.68	----
Diabetic Control	282.66± 0.66	279.88± 0.70	280.28± 0.62	288.83± 0.79	276.30± 0.70	274.77± 0.61	----
Glibenclamide (10 mg/kg)	260.50± 0.73**	218.26± 0.63**	189.68± 0.71**	145.50± 0.67**	124± 2.11**	106.55± 0.72**	61.22
Petroleum ether extract (400 mg/kg)	255.16± 0.60**	249.2± 0.49**	236.64± 0.68**	217.97± 0.57**	181.36± 0.72**	156.60± 0.69**	43.22
MDM extract (400 mg/kg)	253.66± 0.71**	245.66± 0.55**	214.01± 0.73**	169.94± 0.65**	139.75± 0.64**	116.99± 0.33**	57.42

Values expressed as mean ± SEM (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. Diabetic control vs all other groups * $p < 0.05$; **$p < 0.01$; ***: $p < 0.001$.

Table (4) Effect of extracts of *C.infotunatum* on blood glucose levels in multi dose treated streptozotocin induced diabetic animals.

Groups and treatment	Blood glucose level (mg/dl)					
	Day 1	Day2	Day4	Day7	Day14	% decrease at the end of 14th Day
Solvent control (2 ml/kg)	87.37± 0.50	91.33± 1.76	93.92± 0.58	91.24± 0.64	88.44± 0.71	----
Diabetic control	281.66± 0.55	285.35± 0.75	303.50± 0.70	318.39± 0.72	338.59± 0.70	----
Glibenclamide (10mg/kg)	266.32± 0.67**	251.10± 0.58**	235.86± 0.60**	173.89± 0.72**	104.32± 0.71**	69.18
Petroleum ether Extract (400 mg/kg)	262.57± 0.75**	259.42± 0.49**	263.80± 0.60**	214.80± 0.65**	161.36± 0.72**	52.34
MDM extract (400 mg/kg)	263.66± 0.71**	256.66± 0.76**	243.21± 0.70**	179.77± 0.61**	137.75± 0.664**	59.31

Values expressed as mean ± SEM (n=6). The data were statistically analysed by one-way ANOVA, followed by Dunnet's ttest. p values less than 0.05 were considered significant. Diabetic control vs all other groups * $p < 0.05$; **$p < 0.01$; ***: $p < 0.001$.

Table (5) Effect of extracts of *C. infotunatum* on Lipid profile and other biochemical parameters in multi dose treated streptozotocin induced diabetic rat.

Groups and treatment								
	TC (mg/dl)	TG (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	VLDL (mg/dl)	TP (mg/dl)	TB (mg/dl)	Creatinine (mg/dl)
Solvent control (2 ml/kg)	122.66± 1.20	87.33± 1.11	61.16± 0.60	72.5± 0.76	16.66± 1.05	8.33± 0.88	0.53 0.10	0.64± 0.08
Diabetic control (STZ-65 mg/kg)	243.83± 1.07	132.16± 0.87	32.83± 1.16	135.60± 1.16	38.5± 0.76	4.5± 0.76	2.5± 0.56	2.30± 0.49
Glibenclamide (10 mg/kg)	117.16± 0.94	68.10± 0.83	59.66± 1.58	84.16± 1.19	17.83± 1.13	7.33± 0.88	0.89± 0.01	0.64± 0.06
Petroleum ether extract (400 mg/kg)	137.83 ± 0.56	85.83± 1.13	36.33± 0.88	103.66± 0.88	27.5±0.7 6	6.33± 0.66	1.04± 0.22	0.98±0.22
MDM extract (400 mg/kg)	129.50± 0.56	79.66± 0.88	46.16± 1.60	98.5± 1.17	24.33±0. 71	6.83± 0.94	1.12± 0.17	0.92± 0.06

Values expressed as mean ± SEM (n=6). The data were statistically analysed by one-way ANOVA, followed by Dunnet's ttest. p values less than 0.05 were considered significant. TC-Total cholesterol, HDL - High density lipoprotein, LDL - Low density lipoprotein, VLDL- Very low density lipoprotein, TP-Total protein, TG-Triglycerides, TB-Total bilirubin.

DISCUSSION

C. infortunatum is a medicinally important plant indigenous to tropical and subtropical regions of the world. The present study was undertaken to evaluate the antihyperglycaemic activity of *C. infortunatum* in normal, glucose-loaded and STZ-induced hyperglycaemic rats (single and multi dose treatment). Sulfonylureas like glibenclamide are commonly used as a standard antidiabetic drug in STZ-induced diabetes to compare the efficacy of a variety of antihyperglycaemic compounds. In normoglycaemic rats, the test extracts showed progressive fall of blood glucose level till the end of 8 h. Among the extracts, Methanol: Dichloro Methane extract (400 mg/kg) showed maximum degree of activity. In glucose loaded animals (OGTT), reduction in blood glucose levels was observed after 60 minutes of administration of both the standard and test substances. The maximum reduction was observed at 4 h where both methanol and petroleum ether extracts showed a significant reduction in blood glucose level, However Methanol: Dichloro Methane extract (400 mg/kg) exhibited maximum improvement in glucose tolerance.

The extracts produced significant decrease in the blood glucose level in STZ-induced hyperglycaemic rats when compared with the diabetic control group in the single dose treatment study at the tested dose levels. In multi-dose treated hyperglycaemic rats, both the extracts showed various degree of blood glucose reduction. Methanol: Dichloro Methane extract (400 mg/kg) exhibited highest percentage of reduction in blood glucose level. This might suggest that the said effect is

due to extra intestinal action of the test substances. From the results of the biochemical parameter study, it was observed that there was an increase in total bilirubin and serum creatinine levels in streptozotocin induced diabetic rats. However, 14 days of administration of extracts lead to a significant fall in total bilirubin and serum creatinine levels when compared with the diabetic control group. It was also observed that there was an increase in serum total cholesterol, triglycerides, LDL and VLDL levels and decrease in total protein and HDL levels in STZ-induced hyperglycaemic rats. Continuous administration of petroleum ether and Methanol: Dichloro Methane extract (400 mg/kg) for 14 days leads to significant decrease in serum total cholesterol, triglycerides, LDL and VLDL levels, while increase in total protein and HDL cholesterol levels was recorded. The results indicate that, the treatment of diabetic rats with *C. infortunatum* prevents the alteration in serum biochemistry values and returns nearer to their normal values, which supports its anti-diabetic and hypolipidemic activity.

Medicinal plants that exhibit anti-diabetic activity usually contains active substances which are able to mimic the action of insulin or which exert similar effect on the β-cells of the pancreas, causing them to synthesize and secrete insulin. The blood glucose lowering ability of the test substances showed encouraging results in our study among which MDM extract (400 mg/kg) possesses highest degree of blood glucose lowering effect. Lack of insulin affects the metabolism of carbohydrates, proteins, fat and causes significance disturbance of water and electrolyte homeostasis. Recent advances in understanding the activity of intestinal enzymes have lead to the development of newer pharmacological agents. The plant may help to prevent or delay the onset of the complications caused by diabetes, such as increased levels of total cholesterol, triglycerides and LDL. In the present study, there was a significant reduction in the levels of total cholesterol and triglycerides. Further investigations are necessary to recognize the hypolipidemic mechanism of the active principles present in the extracts of *C. infortunatum.*

CONCLUSION

The experimental results of the present investigation conclude that the extracts of *C. infortunatum* showed various degree of antihyperglycaemic effect, among which Methanol: Dichloro Methane extract (400 mg/kg) showed potent antihyperglycaemic activity in both streptozotocin induced single and multi-dose treated diabetic animals. The antihyperglycaemic activity of the test substances was comparable with the standard drug. These findings suggest that the plant may be a potential source for the development of new oral antihyperglycaemic and hypolipidemic agent.

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