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Antidiabetic and antihyperlipidemic activities of extracts of Barleria cuspidata Heyne ex Nees on streptozotocin induced diabetic rats

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ABSTRACT

Traditionally, Barleria cuspidata Heyne ex Nees is utilized for antidiabetic action with the absence of logical investigation. Thus, the current examination was attempted to explore for its antidiabetic and antihyperlipidemic movement in streptozotocin instigated diabetic animal models. Blood glucose levels were estimated in normoglycemic rats at initial, 60th and 120th minutes intervals and in glucose feed hyperglycemic rats at initial, 30, 60, 90 and 120 minutes after a solitary portion of streptozotocin at 55 mg/kg body weight intraperitoneal were made diabetic in albino rats. Blood glucose levels were estimated at week by week spans after everyday administration of chloroform and methanol extracts of Barleriacuspidata at dosages of 250 and 500 mg/kg body weight. Other biochemical boundaries of serum triglycerides, cholesterol, HDL-cholesterol, LDL-cholesterol, VLDL-cholesterol, total protein, albumin, globulin, uric acid, creatinine, urea, transaminases, alkaline phosphatase, alanine aminotransaminase, insulin and glycosylated hemoglobin were likewise estimated toward the finish of the investigation. Chloroform and methanol extracts of Barleria cuspidata by an oral organization for 21 days altogether (P<0.001) decreases the elevated blood glucose extents in diabetic rats whereas in normoglycemic rats it doesn’t adjust the blood glucose amounts altogether and in glucose feed hyperglycemic rats significantly decreases the raised blood glucose levels. Likewise, the chloroform and methanol extracts of Barleria cuspidata improved other biochemical boundaries related to diabetes. Moreover, the extracts of Barleria cuspidata favourable affect the histopathological changes of pancreas in streptozotocin initiated diabetic rats.

INTRODUCTION

Diabetes Mellitus (DM) is a complex and multifarious gathering of a metabolic issue with chronic hyperglycaemia that disturbs the metabolism of carbohydrates, lipids and proteins. The starting point and etiology of DM can differ enormously yet consistently remember deserts for either insulin discharge or response of target tissues or in both (Baynest, 2015). The signs of DM are excessive urine creation (polyuria), extreme thirst (polydipsia) and over the top eating (polyphagia). It is extended to

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become one the world’s primary driver for death inside the next 25 years. Areas with the most prominent potential are Asia and Africa, where DM rates could increase to a few folds than the current rate (Ammayappan et al., 2012).

As stated by the report of World Health Organization (WHO), in India alone, just about around 31 million individuals have endured with diabetes in the year 2000 and later on, it is relied upon to raise up to 79 million by 2030 (Jeedi and Koti, 2017) and on the world at 2000 an expected 171 million individuals had diabetes and this is extended to increment to 366 million by 2030 (Piero et al., 2015). The two principle types of DM are insulin-dependent diabetes mellitus (Type 1) and non-insulin-dependent diabetes mellitus (Type 2).

Type 1 DM is fundamentally managed with dietary limitation, exercise and insulin treatment while Type 2 DM is managed with weight decrease, dietary limitation, exercise and medication like oral hypoglycaemics and antihyperglycaemics (Nair, 2007). Constant utilization of oral hypoglycaemics and antihyperglycaemics in Type 2 DM causes hematological impacts and influences the elements of significant organs of the liver, kidney and so on., Worldwide now daily’s a number of restorative plants have been accounted for and utilized for treatment of DM, as they are powerful, nontoxic with practically zero reactions and furthermore amazing material for oral treatment (Jeedi and Koti, 2017).

Barleria cuspidata Heyne ex Nees is one of the important species in Barleria belongs to the family Acanthaceae. It is a shrub found in waste places, poor soils and along with roadways (Balkwill and Balkwill, 1997). The roots and leaves were used traditionally in stomach ache, tonic, febrifuge, cough, bronchitis and in inflammation. An earlier study has proved that the plant contains alkaloids, terpenoids, triterpenoids, esters, aliphatic ketones, β-carotene and so on (Tamilselvi et al., 2017). Barleria cuspidata is proved for wound healing property (Mazumder et al., 2009) and hepatoprotective activity (Tabassum et al., 2020). Still, there is a lack in the scientific study of the antidiabetic effect of Barleria cuspidata to substantiate the traditional claim. Hence, the current work was embraced to assess the antidiabetic and antihyperlipidemic activities of chloroform and methanol extracts of Barleria cuspidata in streptozotocin incited diabetic rodents.

MATERIALS AND METHODS

Collection of plant material

The fresh whole plant of Barleria cuspidata Heyne ex Nees (Acanthaceae) pulled together from chittoor districts in the areas of Tirumala Hills and Tirupathi surroundings and authentified by Dr K. Madava Chetty, Professor, Department of Botany, Sri Venkateswara University, Tirupathi. Andhra Pradesh, India. Voucher specimen (No: BB- 1419) of this plant has been kept in the P. Rami Reddy Memorial College of Pharmacy, Kadapa, Andhra Pradesh, India.

Preparation of plant material

The assembled whole plant of Barleria cuspidata was washed with running water, cut into little pieces and shade dried at room temperature to keep an essential separation from loss of phytoconstituents of a plant. The total shade-dried materials pounded for powder and sieved up to 80 meshes. At that point, it was homogenized to a fine powder and put away in an air-tight compartment for additional antidiabetic considers.

Preparation of plant extracts

Whole plant powder of the Barleria cuspidata was extracted successively with two different solvents like chloroform (30-60°C) & methanol (50-70°C) in a Soxhlet apparatus in batches of 500 gm each. The overabundance solvent was expelled from extract utilizing a rotary vacuum evaporator and later on concentrated on a water bath. The rate yield of the extracts was determined. At last dried extracts were put away in desiccators for antidiabetic and antihyperlipidemic activities.

Procurement of animals and maintenance

Albino rats of either sex, gauging the bodyweight of 150-250 gms were acquired from Sri Venkateswara Enterprises, Bangalore, India. Animals were kept up according to rules of National Institute of Nutrition, India animal client manual. Animals are adjusted for ten days to our creature house, kept up at a temperature of 22°C to ± 2°C. The animals were directed by a 12 hours light, 12 hours dark calendar. Six animals are housed per cage estimated 41 cm length, 28 cm width and height of 14 cm. Paddy husk was utilized for bedding and on an elective day, bedding was replaced and washed altogether with water along side domex, a disinfectant and detergenic. The rats were benefited from a standard pellet diet bought from Suresh organizations, Hyderabad, India and water not obligatory. The examination convention was investigated and endorsed by the Institutional Animal Ethical Committee (IAEC) and trials were led according to the rules of CPCSEA. Reg. Number: 1423/PO/Re/S/11/CPCSEA, date 30th October 2017.
Experimental design

Plant extract used

The chloroform and methanol extracts of *Barleria cuspidata* were used. A weighed amount of the dried extracts are suspended in 1% V/V Tween 80 solution and administered through orally to rats at a dose of 250 mg/kg & 500 mg/kg body weights sequentially.

Test drug

Streptozotocin was used for this study, at 55 mg/kg by i.p. route.

Standard drug

Glibenclamide was used for this study as a standard drug at a dose of 10 mg/kg b.w.

Effect of CEBC & MEBC treatment on blood glucose level in normoglycemic rats

The animals were partitioned into six gatherings of 6 rodents in each gathering.

Group I - Animals acquired 1%V/V Tween 80, 2 ml/kg b.w per orally.

Group II - Animal acquired chloroform extract of *Barleria cuspidata* (CEBC) 250 mg/kg per orally.

Group III - Animal, acquired chloroform extract of *Barleria cuspidata* (CEBC) 500 mg/kg per orally.

Group IV - Animal acquired methanol extract of *Barleria cuspidata* (MEBC) 250 mg/kg per orally.

Group V - Animal acquired methanol extract of *Barleria cuspidata* (MEBC) 250 mg/kg per orally.

Group VI - Animals acquired Glibenclamide 10 mg/kg and glucose solution at a the dose of 2 g/kg per orally.

In this investigation, the whole group of animals were abstained and treated with the above measurement plan orally. The CEBC, MEBC (At 250 mg/kg and 500 mg/kg) and Glibenclamide (10 mg/kg) were regulated thirty minutes before the organization of glucose arrangement. Blood tests were gathered at first before glucose organization and at 30, 60, 90 and 120th min after glucose organization to decide the blood glucose level as the above method.

Effect of CEBC & MEBC on blood glucose level on glucose fed hyperglycemic rats (oral glucose tolerance test)

The animals were partitioned into seven gatherings of 6 rodents in each gathering.

Group I - Animals acquired glucose solution at a dose of 2g/kg per orally.

Group II - Diabetic rats, acquired glucose solution at a dose of 2g/kg per orally.

Group III - Animals acquired CEBC 250mg/kg b.w. and glucose solution at a dose of 2 g/kg per orally.

Group IV - Animals acquired CEBC 500mg/kg b.w. and glucose solution at a dose of 2 g/kg per orally.

Group V - Animals acquired MEBC 250mg/kg b.w. and glucose solution at a dose of 2 g/kg per orally.

Group VI - Animals acquired MEBC 500mg/kg b.w. and glucose solution at a dose of 2 g/kg per orally.

Group VII - Animals acquired Glibenclamide 10mg/kg and glucose solution at a the dose of 2 g/kg per orally.

In this examination, the whole group of animals were abstained and treated with the above measurement plan orally. The CEBC, MEBC (At 250 mg/kg and 500 mg/kg) and Glibenclamide (10 mg/kg) were regulated thirty minutes before the organization of glucose arrangement. Blood tests were gathered at first before glucose organization and at 30, 60, 90 and 120th min after glucose organization to decide the blood glucose level as the above method.

Effect of CEBC & MEBC on various biochemical levels in streptozotocin induced diabetic rats

42 Albino rats of either sex were utilized in this examination. The rats were randomized and partitioned into seven gatherings of six creatures each.

Group I - Control rats, acquired citrate buffer (0.01M, pH 4.5) (Bolkent et al., 2000). The infusion volume was set up to contain 1.0 ml/kg (Murali et al., 2002). The creatures were allowed to drink 5% glucose solution short-term to vanquish the drug incited hypoglycemia. Following three days, blood glucose levels were assessed and the creatures with a glucose convergence of more than 250 mg/dL were assigned diabetic (Cetto et al., 2000) and taken for the examination. Association of the chloroform and methanol concentrates of *Barleria cuspidata* (CEBC and MEBC) was started on the fourth day after STZ infusion and this was seen as the first day of treatment, which was proceeded for 28 days.
Group IV - Diabetic rats, acquired chloroform extract of *Barleria cuspidata* (CEBC) 500 mg/kg body weight per orally.

Group V - Diabetic rats, acquired methanol extract of *Barleria cuspidata* (CEBC) 250 mg/kg body weight per orally.

Group VI - Diabetic rats, acquired methanol extract of *Barleria cuspidata* (CEBC) 500 mg/kg body weight per orally.

Group VII - Diabetic rats acquired 10 mg/kg body weight of Glibenclamide orally.

This is a sub chronic investigation. This trial was led for a time of 28 days, during this all the creatures in the above gathering get their segments as necessities to be for the assessment season of 28 days once day by day. Plasma glucose levels of rats are checked at the intervals of 7 days. At the completion of the investigation, all the experimental animals were beheaded ensuing to fasting for 16 hours. Blood was assembled and centrifuged at 3000 rpm for 10 min (Kim et al., 2006) to acquire serum for various biochemical appraisals.

**Biochemical analysis**

Toward the finish of the experiment for example following 28 days serum was isolated from the gathered blood samples by retro-orbital with a capillary for different biochemical boundaries like plasma glucose, serum lipid profiles (triglycerides, total cholesterol, LDL cholesterol, HDL cholesterol, VLDL cholesterol), hepatic marker enzymes (total proteins, albumin, globulins, SGOT, SGPT, ALT, ALP), Kidney work markers (uric acid, creatinine, urea) and serum insulin and glycosylated hemoglobin (HbA1c).

**Measurement of blood glucose concentration**

Blood glucose levels were dictated by utilizing the Trinder method (Glucose, GOP-POD) by the expansion of reagents existing in the reagent pack (Erba Mannheim). The absorbance of standard and test against reagent blank was estimated at 505 nm. The estimations of glucose existing in blood were communicated in mg/dL.

**Measurement of serum triglycerides concentration**

Serum triglycerides levels were determined by utilizing GPO-POD technique by the expansion of reagents existing in the reagent unit (Lifechem). The absorbance of standard and test against reagent blank was estimated at 546 nm. The estimations of triglycerides existing in the serum were communicated in mg/dL.

**Measurement of serum cholesterol and HDL cholesterol concentration**

Serum cholesterol and HDL Cholesterol levels were determined by utilizing CHOD-POD strategy by the expansion of reagents existing in reagent kit (Erba Mannheim). The absorbance of standard and test on reagent blank was assessed at 505 nm. The estimations of cholesterol and HDL cholesterol present in serum were communicated in mg/dL.

**Measurement of serum very low-density lipoprotein cholesterol concentration**

Very low-density lipoprotein (VLDL) Cholesterol was calculated as per Friedewald’s equation (Friendwald et al., 1972)

\[ \text{VLDL cholesterol} = \frac{\text{Triglycerides}}{5} \]

And the values are expressed in mg/dL.

**Measurement of serum low-density lipoprotein cholesterol concentration**

Low-density lipoprotein (LDL) cholesterol was calculated as per Friedevald’s equation (Friendwald et al., 1972)

\[ \text{LDL-Cholesterol} = \text{Total Cholesterol} - \text{VLDL cholesterol} - \text{HDL cholesterol} \]

And the values are expressed in mg/dL.

**Measurement of serum total protein concentration**

Serum total protein levels were dictated by utilizing End Point Assay technique by the expansion of reagents present in reagent pack (Span Diagnostic Ltd.). The absorbance of standard and test against reagent blank was estimated at 578 nm. The estimations of total proteins present in the serum were communicated in g/dL.

**Measurement of serum albumin concentration**

Serum albumin levels were dictated by utilizing Bromocresol Green, End Point Assay strategy by the expansion of reagents present in reagent unit (Span Diagnostic Ltd.). The absorbance of standard and test against reagent blank was estimated at 630 nm. The estimations of albumin existing in the serum were communicated in g/dL.

**Measurement of serum globulins concentration**

Serum globulins levels were determined by using the equation:

\[ \text{Globulins} = \text{Total proteins} - \text{Albumin} \]

And the values are expressed in g/dL.

**Measurement of serum uric acid concentration**

Serum uric acid levels were dictated by utilizing URICASE-PAP TRINDER’S strategy by the expansion
Measurement of serum creatinine
Serum creatinine levels were dictated by reagents present in reagent pack (AGDBiomedicals Pvt. Ltd.). The absorbance of standard and test against reagent blank was estimated at 520 nm (Kim et al., 2006). The estimations of creatinine present in the serum were communicated as mg/dL.

Measurement of serum urea
Serum urea levels were dictated by utilizing GLDH/UV-Kinetic strategy utilizing business unit (Coral/clinical System, India) (Cholongitas et al., 2007). The absorbance of standard and test were estimated at 540 nm. The assessments of urea existing in serum were conveyed in mg/dL.

Measurement of serum transaminases (GOT & GPT)
Serum transaminases (GOT and GPT) were dictated by the technique of Reitman and Frankel (Raja and Ravindranadh, 2017) by the expansion of reagents present in reagent pack (Span Diagnostic Ltd). The absorbance of standard and test against reagent blank was estimated at 505 nm. Information was communicated as IUL⁻¹.

Measurement of serum alkaline phosphatase (ALP)
Serum alkaline phosphatase (ALP) was dictated by the technique for Kind and King (Raja and Ravindranadh, 2017) by the expansion of reagents present in reagent pack (Span Diagnostic Ltd). The absorbance of standard and test against reagent blank was estimated at 640 nm. Data were communicated as UL⁻¹.

Measurement of serum alanine amino transaminase (ALT)
Serum alanine amino transaminase (ALT) were dictated by IFCC strategy utilizing commercial pack (Coral/clinical System, India) (Jamwal and Kumar, 2019). The absorbance of standard and test against reagent blank was estimated at 540 nm. Information was communicated as UL⁻¹.

Measurement of serum insulin
Serum insulin levels were dictated by solid-phase enzyme connected immunosorbent test utilizing commercial unit (ELISA Kit, Roche Diagnostic). The estimations of insulin present in the serum were communicated in μU/mL.

Measurement of glycosylated haemoglobin (HbA1c)
The glycosylated haemoglobin was determined utilizing entire blood by commercially available units. Information was communicated as % Hb.

Statistical analysis
All investigation information’s were communicated as mean ± standard error mean (SEM). This statistical analysis was done utilizing one-way ANOVA strategy go along with Dunnet-t test with SPSS statistical programming for correlation with the control group. P<0.001 was considered statistically significant.

Histopathological studies
On day 28, one from each gathering of the exploratory animals were sacrificed under mild ether sedation. The pancreas was moved to 10% formalin arrangement following washing with normal saline and the part of the pancreas are read for histological assessments.

RESULTS AND DISCUSSION
A metabolic disorder which is characterized by hyperglycemia either because of reduction in the coursing levels of insulin or an inadequate response of targeted tissues to insulin is diabetes. In streptozotocin prompted diabetic model, the medication streptozotocin is captured up by pancreatic cells through glucose carrier GLUT2. In pancreatic cells, it brings about alkylation of DNA by freeing elevated levels of nitric oxide and nitrosourea, which brings about the harmfulness of cells. At last, hyperglycemia creates and blood insulin levels decline (Szkudelski, 2001).

In the current investigation, the chloroform and methanol extracts of Barleria cuspidata at the dosages of 250 and 500 mg/kg body weights didn’t significantly suppress the blood glucose levels in overnight abstained normoglycemic rats. While with the standard glibenclamide at the portion of 10 mg/kg body weight shows a noteworthy reduc-
Figure 2: Effect of CEBC and MEBC on plasma glucose in glucose fed hyperglycemic normal rats

Figure 3: Effect of CEBC and MEBC on plasma glucose levels in streptozotocin induced diabetic rats

Figure 4: Effect of CEBC and MEBC on serum lipid levels in control and experimental groups

Figure 5: Effect of CEBC and MEBC on serum protein levels in control and experimental groups

Figure 6: Effect of CEBC and MEBC on hepatic marker enzymes levels in control and experimental groups

Figure 7: Effect of CEBC and MEBC on kidney function markers levels in control and experimental groups

Figure 8: Effect of CEBC and MEBC on serum insulin and glycosylated hemoglobin levels in control and experimental groups

Figure 9: Histopathological observations

9.a) Normal rat, 9.b) Diabetic rat, 9.c) Diabetic rat treated with chloroform extract, 9.d) Diabetic rat treated with methanol extract, 9.e) Diabetic rat treated with standard glibenclamide.
tion in blood glucose levels in overnight abstained normoglycemic rats after introductory, first and the second hour of the oral organization when diverged from control grade of animals which were showed up in Figure 1.

Results, as appeared in Figure 2 of oral glucose tolerance test, uncovered that plasma glucose levels were significantly expanded in glucose is taken care of diabetic control when contrasted with glucose took care of non-diabetic control. Treatment with chloroform and methanol concentrate of Barleria cuspidata at a portion of 250 and 500 mg/kg body weight per oral and glibenclamide at a segment of 10 mg/kg body weight per oral shows a huge reduction in raised plasma glucose levels of glucose dealt with normal hyperglycemic rats when contrasted and animals got only glucose at a bit 2 g/kg body weight per oral after starting, 30 min, 60 min, 90 min, 120 min.

In a subchronic antidiabetic study, the consequences of plasma glucose level alternate acquired in normal, streptozotocin instigated diabetic rats and chloroform and methanol extract of Barleria cuspidata treated diabetic rats were appeared in Figure 3. The plasma glucose level of the untreated diabetic rats of Group II stayed raised significantly all through the exploratory period on contrasted with normal rats of Group I. Administration of chloroform and methanol extract of Barleria cuspidata at the portions of 250 and 500 mg/kg body weight per oral and glibenclamide at a portion of 10 mg/kg body weight per oral reductions the raised plasma glucose levels essentially in streptozotocin prompted diabetic rats of Group III, IV, V, VI and VII when contrasted and untreated diabetic rats of Group II. The outcomes were discovered to be in a dose-dependent way and among these the most noticeable antidiabetic movement was seen inside the methanol extract of Barleria cuspidata at the portion of 500 mg/kg body weight when contrasted and that of the standard glibenclamide.

In diabetes mellitus because of different metabolic confusions and advancement of insulin obstruction may animate lipolysis in the fat tissue and offer ascent to hyperlipidemia. Hence, diabetes hyperlipidemia happens which is related to cardiovascular danger (Jamwal and Kumar, 2019; Suman et al., 2013). Figure 4 uncover the chloroform and methanol concentrate of Barleria cuspidata consequences for serum lipid levels in control and experimental groups. It was seen that the diabetic rats of group II indicated the raised degrees of serum triglycerides, total cholesterol, LDL cholesterol and VLDL cholesterol and diminished degrees of HDL cholesterol on contrasted and normal rats of group I. Oral treatment with chloroform and methanol extract of Barleria cuspidata at tried portions of 250 and 500 mg/kg body weight significantly brought down the raised degrees of serum triglycerides, total cholesterol, LDL cholesterol and VLDL cholesterol and expanded the degrees of HDL cholesterol on contrasted and diabetic control. These impacts are giving off an impression of being equivalent with that of standard glibenclamide at the portion of 10 mg/kg body weight. In this manner, the aftereffects of chloroform and methanol concentrate of Barleria cuspidata consequences for serum lipid levels reports in a decrease in the cardiovascular danger related to diabetes.

Diabetes mellitus is frightfully speculated by an outrageous substitute in the protein digestion and by negative nitrogen equality and loss of nitrogen from most organs (Prakasam et al., 2004; Pasupathi et al., 2009). Figure 5 speaks to the adequacy of chloroform and methanol concentrates of Barleria cuspidata on serum protein levels in diabetic rats. The total protein, albumin and globulin levels were significantly (P<0.001) changed in STZ instigated diabetic rats contrasted with normal control group rats. The decrease in serum total protein, globulin and albumin levels had been accounted for in diabetic rats and this is demonstrated by an expansion in the lipid peroxidation and a diminished antioxidant shielding system (Chandramohan et al., 2009). The current investigation uncovered that diabetic rats treated with chloroform and methanol extracts at portions of 250 and 500 mg/kg body weight of Barleria cuspidata and standard glibenclamide at the portion of 10 mg/kg body weight significantly improved the serum total protein, globulin and albumin levels in contrast with both normal and diabetic control groups.

The liver has a conspicuous function in the metabolism of insulin and upkeep of glucose homeostasis in fasting and non-fasting conditions. Liver dysfunction results in hepatic insulin resistance and causes progression in diabetes (Jamwal and Kumar, 2019). Aminotransferases, for example, SGOT, SGPT, ALP and ALT are the common hepatic marker compounds are referred to reflects in hepatoacellular necrosis as they are delivered into the blood course after cell membrane damage (Bhatia and Jain, 2003). The mild and chronic elevation of aminotransferases is a marker of hepatic insulin resistance. The builds levels of ALT and SGOT are a clinical component of metabolic syndrome in type 2 diabetic (Jamwal and Kumar, 2019). In the present investigation, modification in hepatic marker catalysts is adjusted with builds levels...
of aminotransferases in diabetic rats. Figure 6 shows the exercises of hepatic marker enzymes in exploratory rats. When contrasted and the normal rats, the diabetic rats significantly (p<0.001) rise the degrees of SGOT, SGPT, ALP and ALT. In the current investigation the diabetic rats treated with chloroform and methanol extracts at portions of 250 and 500 mg/kg body weight of Barleria cuspidata and standard glibenclamide at the portion of 10 mg/kg body weight altogether (p<0.001) brings down the raised degrees of SGOT, SGPT, ALP and ALT in contrast with diabetic control groups. In this manner, the consequences of chloroform and methanol extract of Barleria cuspidata impacts on hepatic marker enzymes improves the liver capacity in diabetic rats and furthermore diminishes the hepatic insulin resistance.

Diabetic nephropathy is the harm of kidney, the accepted reason for which is deserted raised glucose and raised blood pressure. Diabetic nephropathy related to morphological and ultrastructural changes inside the kidney is dictated by the clinical indication of the ailment. Streptozotocin-induced rats exhibit the trademark highlights of diabetic nephropathy, for example, expanded measures of serum creatinine, urea and uric acid (Reddy et al., 2019). In the current investigation, kidney function markers, for example, creatinine, urea and uric acid extent were significantly (p<0.001) brought up in diabetic rats contrasted with ordinary rats. The diabetic rats handled with chloroform and methanol extracts at portions of 250 and 500 mg/kg body weight of Barleria cuspidata and standard glibenclamide at the portion of 10 mg/kg body weight significantly (p<0.001) brings down the raised degrees of serum creatinine, urea and uric acid in contrast with diabetic control groups. Along these lines, the outcomes appeared in Figure 7 of chloroform and methanol extract of Barleria cuspidata consequences for kidney function markers improves the kidney function in diabetic rats.

Figure 8 speaks to the adequacy of chloroform and methanol concentrates of Barleria cuspidata on serum insulin and glycosylated hemoglobin levels. Streptozotocin causes an irregular β-cell working by weakening glucose oxidation and diminishing glucose biosynthesis and discharge (Koksal, 2015). In the current examination on the organization of streptozotocin diminishes the serum insulin levels in diabetic rats, contrasted and normal rats speak to the β-cell damage. The diabetic rats treated with chloroform and methanol extracts at portions of 250 and 500 mg/kg body weight of Barleria cuspidata and standard glibenclamide at the portion of 10 mg/kg body weight significantly (p<0.001) rises the serum insulin levels in contrast with diabetic rats. Increment in the serum insulin levels on treated with extracts of Barleria cuspidata in streptozotocin-diabetic rats might be because of its defensive activity against streptozotocin interceded harm to the pancreatic β-cells and furthermore conceivable due to recovery of harmed β-cell or expanded insulin delivery or discharge.

Glycosylated haemoglobin (HbA1c) is the result of non-enzymatic response among glucose and free amino acid groups of haemoglobin (glycosylation). It is a marker of the rise of long-term glycemic control in diabetic patients and predicts risk for the improvement of and additionally, movement of diabetic complications (Ramachandran et al., 2012). In the current investigation, the aftereffects speak to the expanded degrees of HbA1c in diabetic rats contrasted with normal control rats which demonstrate the event of glycosylation in diabetic rats because of hyperglycemia. Treatment with chloroform and methanol extracts at dosages of 250 and 500 mg/kg body weight of Barleria cuspidata and standard glibenclamide at the portion of 10 mg/kg body weight significantly (p<0.001) diminished the serum HbA1c levels contrasted with diabetic rats. Subsequently, the aftereffects of chloroform and methanol extract of Barleria cuspidata impacts on HbA1c speaks to a capacity to prevent the improvement of diabetes-related complications.

Figure 9 portrayed the histopathological observations of STZ incited diabetic rat pancreas of various groups treated with chloroform and methanol extracts of Barleria cuspidata for 28 days. The structural changes in pancreas reflect changes in metabolic cycles of discharge; sensitivity and regulation of insulin. Atrophy of islets, the decline in the beta cells, and cell degeneration are showing highlights of pancreatic destruction. Fat and amyloid tissue deposition happen in the islets, and the quantity of beta cells is radically decreased in terminal phases of diabetes (Jaiswal et al., 2017). In the current investigation islets of the pancreas were watched as without change in size and structure in normal control rats whereas the pancreas of STZ initiated diabetic rats, damage of islets with shrunk in size and destruction of cells. In STZ instigated diabetic rats handled with chloroform and methanol extracts of Barleria cuspidata at 500 mg/kg body weight and standard glibenclamide at the portion of 10 mg/kg body weight individually, pancreatic islets are practically identical with normal rats and very little change in their size and structure in spite of the fact that with slight damage were watched.
CONCLUSIONS

The aftereffects concluded that chloroform and methanol extracts of *Barleria cuspidata* are justified for its traditional use of antidiabetic and antihyperlipidemic activity. The extracts of *Barleria cuspidata* shows significant antidiabetic activity which is comparable to that of standard drug glibenclamide. Accordingly, the chloroform and methanol extracts of *Barleria cuspidata* can be useful, at least as an adjunct, in the therapy of diabetes. Present endeavours are composed to separate the dynamic constituents from the various extract of plant and explanation of component of the activity.

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Conflict Of Interest

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