Antidiabetic and antihyperlipidemic activities of extracts of *Barleria buxifolia* Linn on streptozotocin induced diabetic rats

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Abstract

Traditionally, Barleria buxifolia Linn is utilized for antidiabetic action with 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 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 every day administration of chloroform and methanol extracts of Barleria buxifolia 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 buxifolia by oral organization for 21 days altogether ($P<0.001$) decreases the elevated blood glucose levels in diabetic rats whereas in normoglycemic rats it doesn't alter the blood glucose levels significantly and in glucose feed hyperglycemic rats significantly decreases the raised blood glucose levels. Likewise, the chloroform and methanol extracts of Barleria buxifolia improved other biochemical boundaries related with diabetes. Moreover, the extracts of Barleria buxifolia favorable affect the histopathological changes of pancreas in streptozotocin initiated diabetic rats. Delayed consequences legitimize the traditional utilization of Barleria buxifolia for its antidiabetic action.

Keywords: *Antidiabetic activity, Barleria buxifolia Linn, Biochemical parameters, Histopathology.*

Introduction

The regular reason for chronic morbidity and handicap among the working populace is the entanglements which are caused because of diabetes. Diabetes Mellitus (DM) is a metabolic issue portrayed by the presence of chronic hyperglycaemia joined by more noteworthy or lesser disability in the metabolism of carbohydrates, lipids and proteins, carbohydrates digestion is diminished while the lipid and protein digestion are expanded. 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 [1]. The hallmarks of DM are excessive urine production (polyuria), excessive thirst (polydipsia) and excessive eating (polyphagia) [2].

DM can influence kids, youngsters and adults and is getting more normal. It stays third driving reason for death and second driving reason for visual impairment just as of renal failure [3]. According to the report of World Health Organization (WHO), in India alone, almost 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 [4] and on the world at 2000 an expected 171 million individuals had diabetes and this is extended to increment to 366 million by 2030 [5].

The two principal types of DM are insulin dependent diabetes mellitus (Type 1) and non-insulin dependent diabetes mellitus (Type 2). Type 1 records for 5–10% of all analyzed cases, while Type 2 records for 85–90% of patients with DM. Notwithstanding Type 1 and Type 2, there are different sorts of diabetes, for example, gestational diabetes, diabetes because of side-effects of steroid treatment and diabetes related with hormonal issues [3]. Type 1 DM are fundamentally managed with dietary limitation, exercise and insulin treatment while Type 2 DM are managed with weight decrease, dietary limitation, exercise and medication like oral hypoglycemics and antihyperglycaemics. Constant utilization of oral hypoglycaemics and antihyperglycaemics in Type 2 DM causes hematological impacts and influences the elements of significant organs of liver, kidney and so on., Worldwide now daily's number of restorative plants have been accounted for and utilizing for treatment of DM, as they are powerful, nontoxic with practically zero reactions and furthermore amazing material for oral treatment [4].

Barleria buxifolia Linn 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 road ways [6]. The roots and leaves were used traditionally in cough, bronchitis and in inflammation [7]. Earlier study has proved that the plants contain saponins and flavonoid [8]. *Barleria buxifolia* is proved for anthelmintic activity [9], antifeedant activity [10], anxiolytic activity, antidepressant activity [11], prophylactic and curative activities [12]. Still there is lack in scientific study of antidiabetic effect of *Barleria buxifolia* 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 buxifolia* in streptozotocin incited diabetic rodents.

Materials and methods

Collection of plant material

Fresh whole plant of *Barleria buxifolia* Linn (Acanthaceae) were pull 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- 1418) of this plant has been kept in the P. Rami Reddy Memorial College of Pharmacy, Kadapa, Andhra Pradesh, India.

Preparation of plant material

The gathered entire plant of *Barleria buxifolia* was washed with running water, cut into little pieces and shade dried at room temperature to maintain a strategic distance from loss of phytoconstituents of plant. The total shade dried materials pounded for powder and sieved up to 80 meshes. At that point it was homogenized to fine powder and put away in air-tight compartment for additional antidiabetic considers.

Preparation of plant extracts

Whole plant powder of the *Barleria buxifolia* was extracted successively with two different solvents like chloroform and methanol 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 were determined. At last dried extracts were put away in desiccators for antidiabetic and antihyperlipidemic activities [13].

Procurement of animals and maintenance

Albino rats of either sex, gauging the body weight 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 10 days to our creature house, kept up at temperature of 22ºC to ± 2 ºC. 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 elective day bedding was changed and washed altogether with water alongside 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.

Plant extract used

The chloroform and methanol extracts of *Barleria buxifolia* were used. 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 respectively.

Test Drug

STZ 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 chloroform and methanol extracts of *Barleria buxifolia* treatment on blood glucose level in normoglycemic rats

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

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

Group II - Animal received chloroform extract of *Barleria buxifolia* (CEBB) 250 mg/kg per orally.

Group III - Animal received chloroform extract of *Barleria buxifolia* (CEBB) 500

mg/kg per orally.

Group IV - Animal received methanol extract of *Barleria buxifolia* (MEBB) 250 mg/kg per orally.

Group V - Animal received methanol extract of *Barleria buxifolia* (MEBB) 250 mg/kg per orally.

Group VI - Animals received Glibenclamide 10 mg/kg b.w per orally

In this investigation, the whole group of animals were for the time being abstained before the experimentation and regulated with the individual medications according to the previously mentioned measurements plan. Blood samples were gathered at first before organization of the drug and at 60^{th} and 120^{th} min after drug organization to decide the blood glucose level by utilizing electronic glucometer.

Induction of diabetes to albino rats

Following multi week of acclimatization, the rats were exposed to expedite fasting. Diabetes initiated with a solitary intraperitoneal injection of streptozotocin (STZ) at a portion of 55 mg/kg body weight. The STZ was newly disintegrated in citrate buffer (0.01M, pH 4.5) [14]. The injection volume was set up to contain 1.0 ml/kg [15]. The animals were permitted to drink 5% glucose solution overnight to conquer the medication actuated hypoglycemia. Following 3 days, blood glucose levels were estimated and the animals with a glucose concentration of in excess of 250 mg/dL were delegated diabetic [16] and taken for the examination. Organization of the chloroform and methanol extracts of *Barleria buxifolia* (MEBB and CEBB) was begun on fourth day after STZ injection and this was viewed as the first day of treatment, which were proceeded for 28 days.

Effect of chloroform and methanol extracts of *Barleria buxifolia* on blood glucose level on glucose fed hyperglycaemic rats (oral glucose tolerance test)

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

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

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

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

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

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

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

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

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

Effect of chloroform and methanol extracts of *Barleria buxifolia* 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, received citrate buffer (0.01M, pH 4.5).

Group II - Diabetic controls, received STZ (55 mg/kg body Weight, i.p.) once.
Group III - Diabetic rats, received chloroform extract of *Barleria buxifolia* (CEBB) 250 mg/kg body weight per orally.
Group IV - Diabetic rats, received chloroform extract of *Barleria buxifolia* (CEBB) 500 mg/kg body weight per orally.
Group V - Diabetic rats, received methanol extract of *Barleria buxifolia* (MEBB) 250 mg/kg body weight per orally.
Group VI - Diabetic rats, received methanol extract of *Barleria buxifolia* (MEBB) 500 mg/kg body weight per orally.
Group VII - Diabetic rats received 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 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. Toward the finish of the analysis, all the rats were decapitated subsequent to fasting for 16 hours. Blood was gathered and centrifuged at 3000 rpm for 10 min [17] to acquire serum for different biochemical assessments.

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, HDL cholesterol, LDL 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 Trinder method (Glucose, GOP-POD) by the expansion of reagents present in reagent pack (Erba Mannheim). The absorbance of standard and test against reagent blank were estimated at 505 nm. The estimations of glucose present 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 present in reagent unit (Lifechem). The absorbance of standard and test against reagent blank were estimated at 546 nm. The estimations of triglycerides present in 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 present in reagent kit (Erba Mannheim). The absorbance of standard and test against reagent blank were estimated 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 Friedevald's equation [18]:

VLDL cholesterol = 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 [18]:

LDL-Cholesterol = Total Cholesterol – VLDL cholesterol – 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 were estimated at 578 nm. The estimations of total proteins present in 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 were estimated at 630 nm. The estimations of albumin present in serum were communicated in g/dL.

Measurement of serum globulins concentration

Serum globulins levels were determined by using the equation:

Globulins = Total proteins – Albumin

And the values are expressed in g/dL.

Measurement of serum uric acid concentration

Serum uric acid levels were determined by utilizing URICASE-PAP TRINDER'S strategy by the expansion of reagents present in reagent pack (Avecon Healthcare Pvt. Ltd.). The absorbance of standard and test against reagent blank were estimated at 505 nm. The estimations of uric acid present in serum were communicated in mg/dL.

Measurement of serum creatinine

Serum creatinine levels were dictated by reagents present in reagent pack (AGD Biomedicals Pvt. Ltd.). The absorbance of standard and test against reagent blank were estimated at 520 nm [17]. The estimations of creatinine present in 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) [19]. The absorbance of standard and test were estimated at 540 nm. The estimations of urea present in serum were communicated in mg/dL.

Measurement of serum transaminases (GOT & GPT)

Serum transaminases (GOT and GPT) were determined by the method of Reitman and Frankel [20] by the expansion of reagents present in reagent pack (Span Diagnostic Ltd). The absorbance of standard and test against reagent blank were estimated at 505 nm. Information were communicated as IUL^{-1}.

Measurement of serum alkaline phosphatase (ALP)

Serum alkaline phosphatase (ALP) was dictated by the technique for Kind and King [20] by the expansion of reagents present in reagent pack (Span Diagnostic Ltd). The absorbance of standard and test against reagent blank were estimated at 640 nm. Data were communicated as UL^{-1}.

Measurement of serum alanine amino transaminase (ALT)

Serum alanine amino transaminase (ALT) were determined by IFCC strategy utilizing commercial pack (Coral/clinical System, India) [21]. The absorbance of standard and test against reagent blank were estimated at 540 nm. Information were 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 serum were communicated in µU/ml.

Measurement of glycosylated haemoglobin (HbA1c)

The glycosylated hemoglobin was determined utilizing entire blood by commercially available units. Information were communicated as % Hb.

Statistical analysis

All investigations information was communicated as mean ± standard error mean (SEM). This statistical analysis was done utilizing one-way ANOVA strategy followed by Dunnet-t test with SPSS statistical programming for correlation with the control group. $p \leq 0.001$ was considered as 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 pancreas are read for histological assessments.

Results and discussion

Diabetes is an endocrine metabolic issue wherein blood glucose levels are high (Hyperglycemia) due to either diminish in the circling levels of insulin by insulin inadequacy or abatement in the response of target tissues to insulin by insulin opposition. In streptozotocin prompted diabetic model, the medication streptozotocin is taken up by pancreatic β cells through glucose carrier GLUT2. In pancreatic β cells it causes alkylation of DNA by freeing elevated levels of nitric oxide and nitrosourea, which brings about harmfulness of cells. At last, hyperglycemia creates and blood insulin levels decline [22].

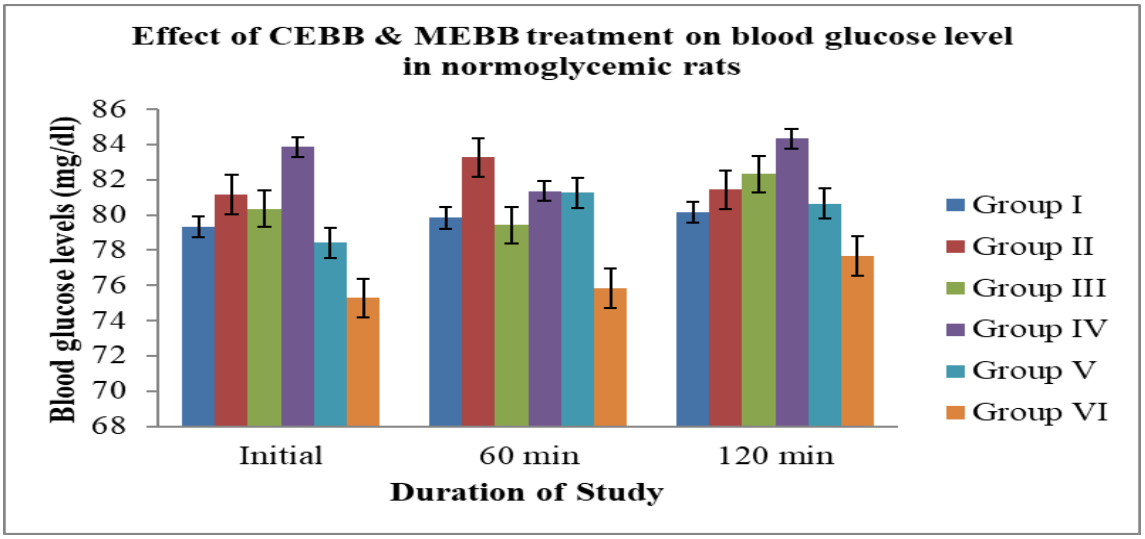

Figure 1: Effect of chloroform and methanol extracts of *Barleria buxifolia* treatment on blood glucose level in normoglycemic rats

In the current investigation, the chloroform and methanol extracts of *Barleria buxifolia* 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 noteworthy reduction in blood glucose levels in overnight abstained normoglycemic rats after introductory, first and second hour of oral administration when contrasted with control group of animals which were appeared in Figure 1.

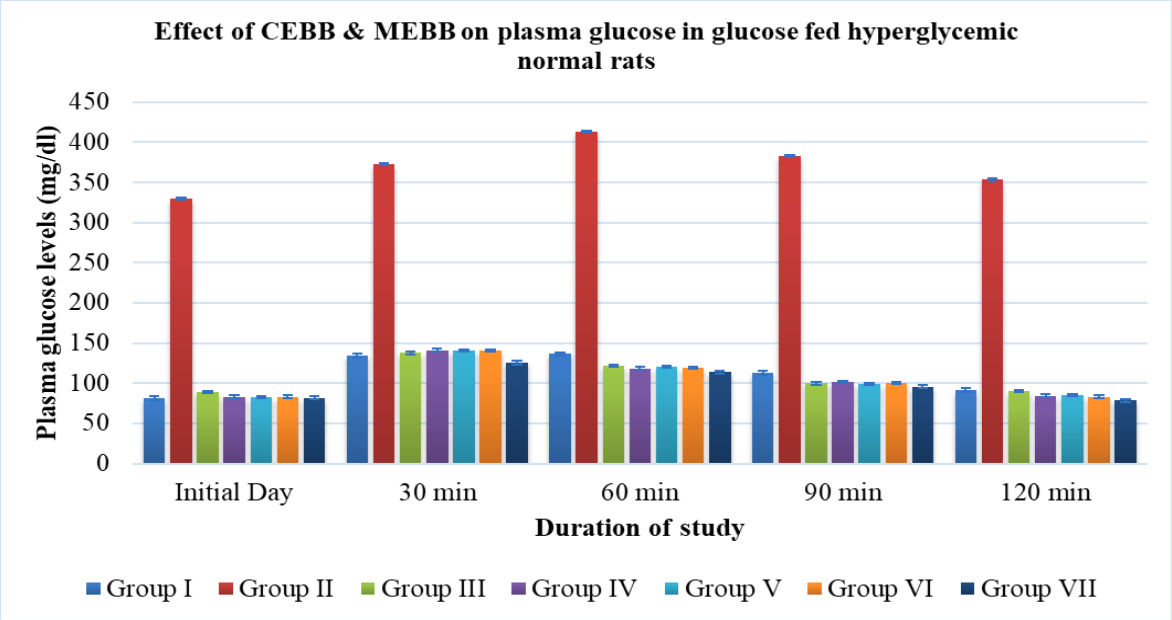

Figure 2: Effect of chloroform and methanol extracts of *Barleria buxifolia* treatment on plasma glucose in glucose fed hyperglycemic normal rats

Results as appeared in Figure 2 of oral glucose tolerance test uncovered that plasma glucose levels were significantly expanded in glucose taken care of diabetic control when contrasted with glucose took care of non-diabetic control. Treatment with chloroform and methanol concentrate of *Barleria buxifolia* at a portions of 250 and 500 mg/kg body weight per oral and glibenclamide at portion of 10 mg/kg body weight per oral shows significant decrease in raised plasma glucose levels of glucose took care of hyperglycemic normal rats when contrasted and animals got just glucose at a portion 2 g/kg body weight per oral after initial, 30 min, 60 min, 90 min, 120 min.

In a sub chronic antidiabetic study the consequences of plasma glucose level changes acquired in normal, streptozotocin instigated diabetic rats and chloroform and methanol extract of *Barleria buxifolia* 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 buxifolia* at the portions of 250 and 500 mg/kg body weight per oral and glibenclamide at 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 buxifolia* at the portion of 500 mg/kg body weight when contrasted and that of the standard glibenclamide.

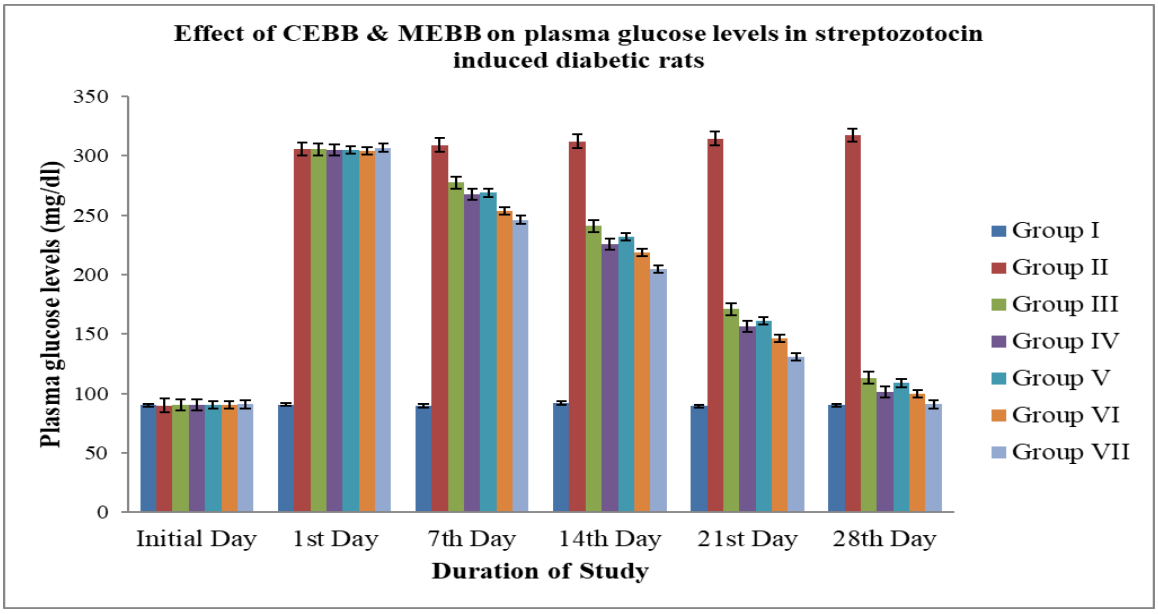

Figure 3: Effect of chloroform and methanol extracts of *Barleria buxifolia* treatment on on plasma glucose levels in streptozotocin induced diabetic rats

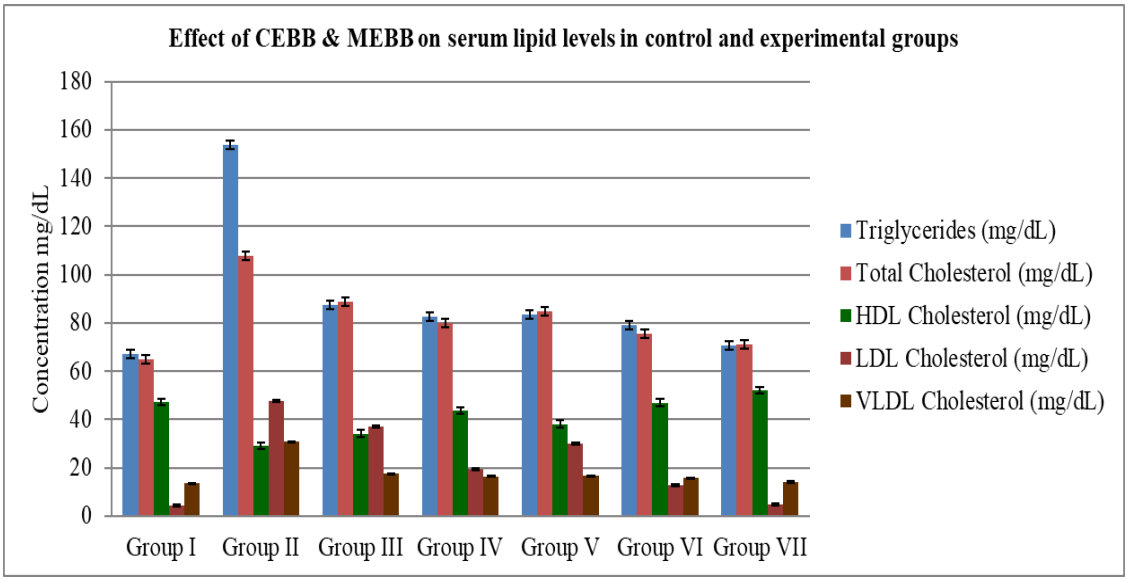

Figure 4: Effect of chloroform and methanol extracts of *Barleria buxifolia* treatment on serum lipid levels in control and experimental groups

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 and which is related with cardiovascular danger [21 & 23]. Figure 4 uncover the chloroform and methanol concentrate of *Barleria buxifolia* 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 buxifolia* 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 buxifolia* consequences for serum lipid levels reports in decrease in the cardiovascular danger related with diabetes.

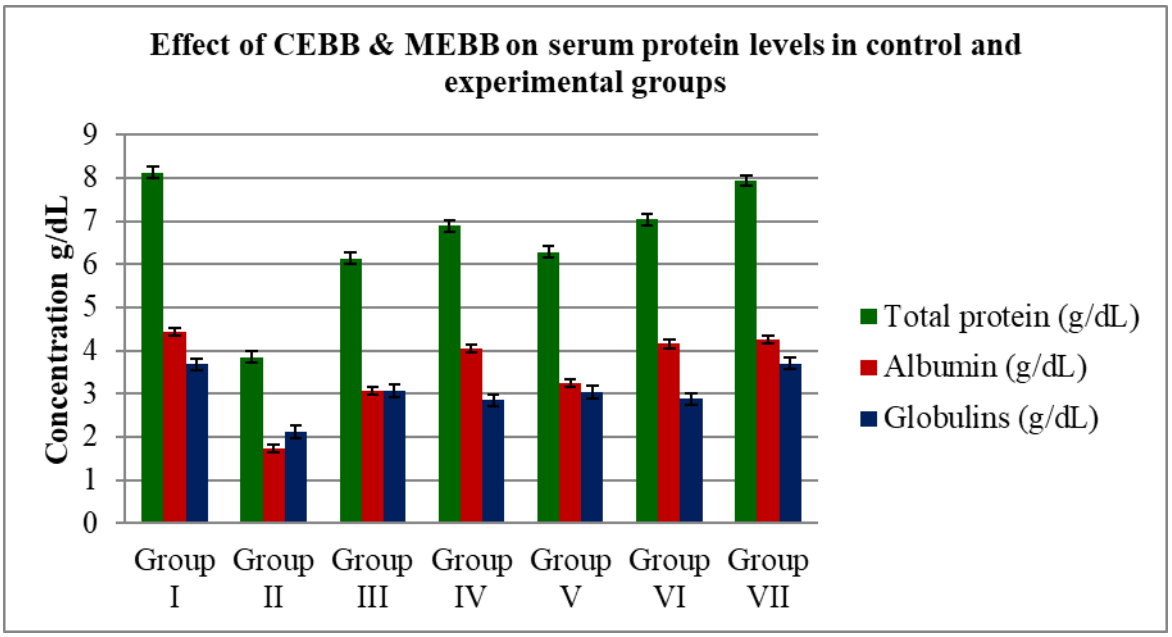

Figure 5: Effect of chloroform and methanol extracts of *Barleria buxifolia* treatment on serum protein levels in control and experimental groups

Diabetes mellitus is terribly reflected by extreme changes in the protein metabolism and by a negative nitrogen parity and loss of nitrogen from most organs [24 & 25]. Figure 5 speaks to the adequacy of chloroform and methanol concentrates of *Barleria buxifolia* 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. Decrease in serum total protein, albumin and globulin levels had been accounted for in diabetic rats and this is demonstrated by an expansion in the lipid peroxidation and a diminished antioxidant defense system [26]. The current investigation uncovered those diabetic rats treated with chloroform and methanol extracts at portions of 250 and 500 mg/kg body weight of *Barleria buxifolia* and standard glibenclamide at the portion of 10 mg/kg body weight significantly improved the serum total protein, albumin and globulin levels in contrast with both normal and diabetic control groups.

The liver has conspicuous function in metabolism of insulin and upkeep of glucose homeostasis in fasting and non-fasting conditions. The liver dysfunction results into hepatic insulin resistance and cause progression in diabetes [27]. Aminotransferases, for example, SGOT, SGPT, ALP and ALT are the common hepatic marker compounds are referred to reflects in hepatocellular necrosis as they are delivered into the blood course after cell membrane damage [28]. The mild and chronic elevation of aminotransferases is marker of hepatic insulin resistance. The builds levels of ALT and SGOT are clinical component of metabolic syndrome in type 2 diabetic [27]. In 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 ($p<0.001$) rises 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 buxifolia* 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 buxifolia* impacts on hepatic marker enzymes improves the liver capacity in diabetic rats and furthermore diminishes the hepatic insulin resistance.

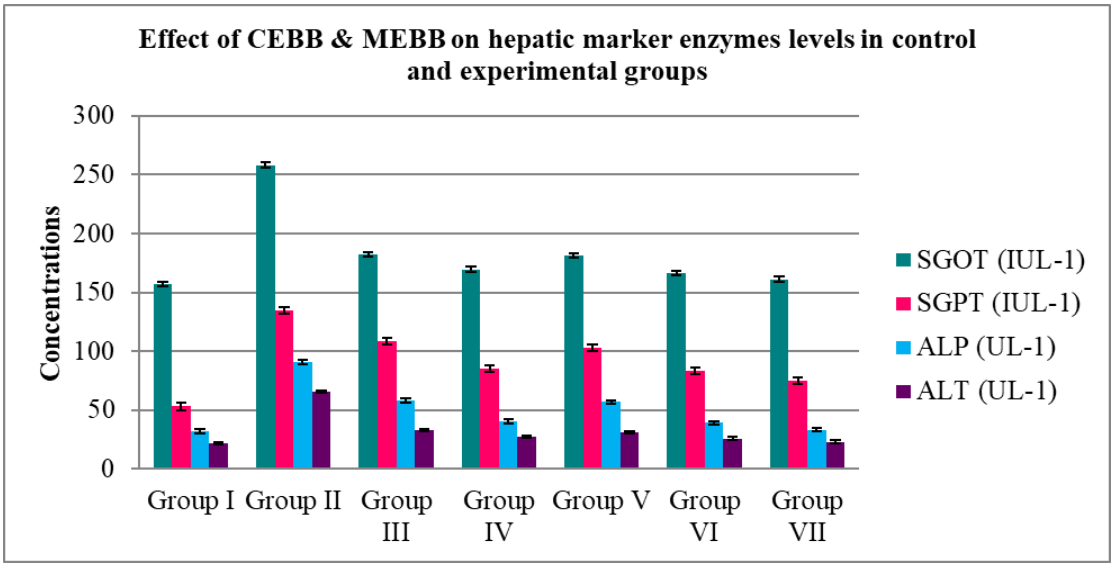

Figure 6: Effect of chloroform and methanol extracts of *Barleria buxifolia* treatment on hepatic marker enzymes levels in control and experimental groups

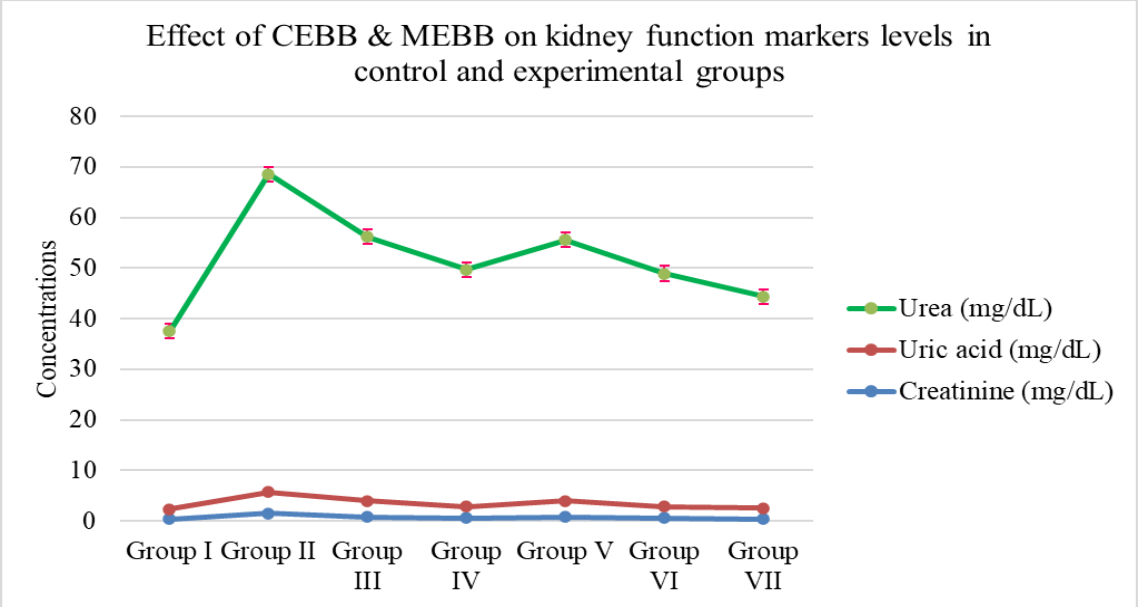

Figure 7: Effect of chloroform and methanol extracts of *Barleria buxifolia* treatment on kidney function markers levels in control and experimental groups

Diabetic nephropathy is a harm of kidney, the accepted reason for which is deserted raised glucose and raised blood pressure. Diabetic nephropathy related with 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 [29]. In the current investigation kidney function markers, for example, creatinine, urea and uric acid levels were

significantly ($p<0.001$) brought up in diabetic rats contrasted with ordinary rats. The diabetic rats treated with chloroform and methanol extracts at portions of 250 and 500 mg/kg body weight of *Barleria buxifolia* 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 buxifolia* consequences for kidney function markers improves the kidney function in diabetic rats.

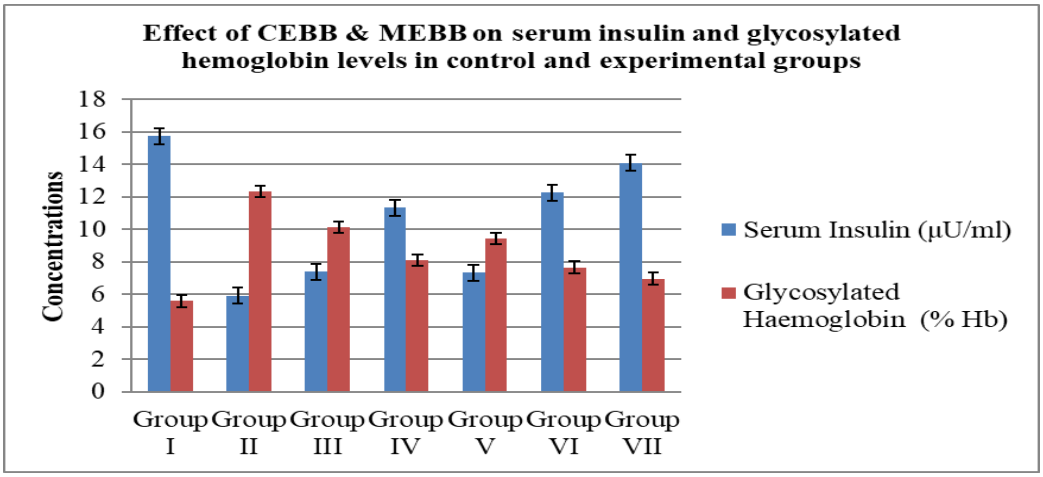

Figure 8: Effect of chloroform and methanol extracts of *Barleria buxifolia* treatment on serum insulin and glycosylated hemoglobin levels in control and experimental groups

Streptozotocin causes an irregular β-cell working by weakening glucose oxidation and diminishing glucose biosynthesis and discharge [30]. In the current examination on organization of streptozotocin diminishes the serum insulin levels in diabetic rats contrasted and normal rats speaks 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 buxifolia* 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, which appeared in Figure 8. Increment in the serum insulin levels on treated with extracts of *Barleria buxifolia* 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 hemoglobin (HbA1c) is the result of non-enzymatic response among glucose and free amino acid groups of hemoglobin (glycosylation). It is a marker of rise of long-term glycemic control in diabetic patients and predicts risk for the improvement of and additionally movement of diabetic complications [31]. In the current investigation the aftereffects of Figure 8 speak to the expanded degrees of HbA1c in diabetic rats contrasted with normal control rats which demonstrates 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 buxifolia* 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 buxifolia* impacts on HbA1c speaks to a capacity to prevent the improvement of diabetes related complications.

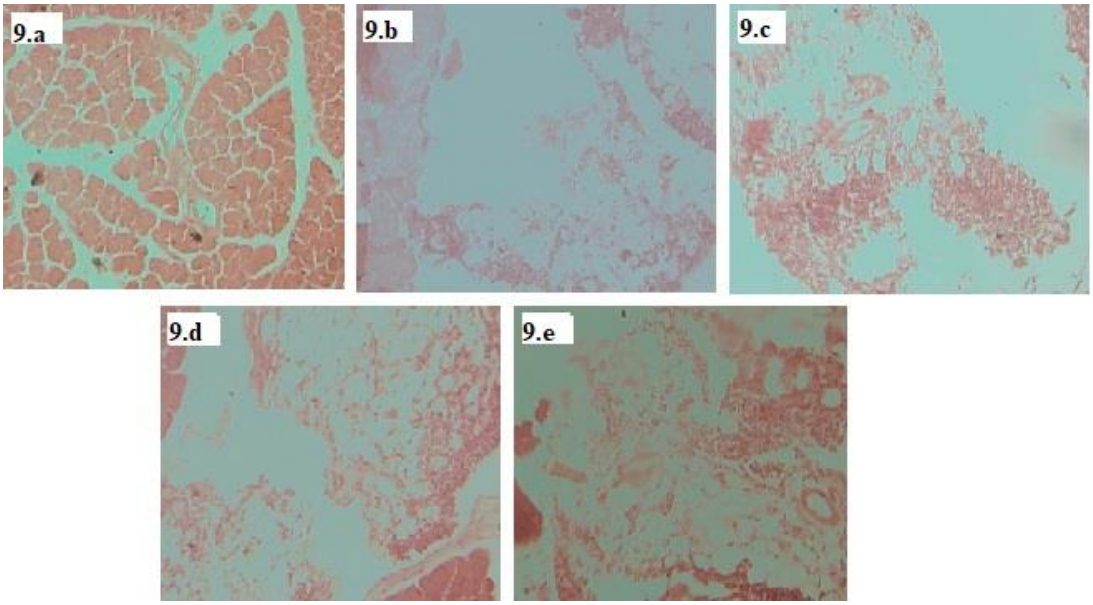

Figure 9: Histopathological observations. 9.a) Normal rat, 9.b) Diabetic rat, 9.c) Diabetic rat treated with chloroform extract, 9.d) Diabetic rat treated with methanol extract, 9.e) Diabetic rat treated with standard glibenclamide.

Figure 9 portrayed the histopathological observations of STZ incited diabetic rat pancreas of various groups treated with chloroform and methanol extracts of *Barleria buxifolia* for 28 days. The structural changes in pancreas reflect changes in metabolic cycles of discharge; sensitivity and regulation of insulin. Atrophy of islets, decline in the beta cells, and cell degeneration are showing highlights of pancreatic destruction. Fat and amyloid tissue deposition happens in the islets, and the quantity of beta cells is radically decreased in terminal phases of diabetes [32]. In the current investigation Figure 9.a shows the pancreas of normal control rats, islets without change in size and structure were watched. Figure 9.b shows the pancreas of STZ initiated diabetic rats, damage of islets with shrunken in size and destruction of cells. Figure 9.c, 9.d and 9.e shows the pancreas of STZ instigated diabetic rats treated with chloroform and methanol extracts of *Barleria buxifolia* 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.

Conclusion

The aftereffects concluded that chloroform and methanol extracts of *Barleria buxifolia* is justified for its traditional use of antidiabetic and antihyperlipidemic activity. The extracts of *Barleria buxifolia* shows significant antidiabetic activity which is comparable to that of standard drug glibenclamide. Accordingly, the chloroform and methanol extracts of *Barleria buxifolia* can be useful, at least as an adjunct, in the therapy of diabetes. Present efforts are directed to isolate the active constituents from various extract of plant and elucidation of mechanism of action.

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Conflict of interests
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