# Antidiabetic Activity *Tinospora Cordifolia* Root On Streptozotocin Induced Rats

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**ABSTRACT**
Diabetes is a chronic disorder. It may be characterized by hyperglycaemia. These may help in insulin secretion defects and both insulin action. Due to development of insulin resistance the inadequate insulin secretion and tissues dimension may lead to abnormalities of fats, carbohydrate and metabolism of protein. Now a days, some herbal formulation is been used for this treatment like pedes of ginseng: it was used for health promoting. Present study shows evaluation of antidiabetic activity on root of *T. cordifolia* on experimental animals. Type 1 and type 2 diabetes is been introduced into Wistar *Albino* rats by STZ (Streptozotocin) and it was treated with the ethanolic root extract of *T. cordifolia* by using different concentration (150, 250 and 300 mg/kg/day). Extracts of *T. cordifolia* root extract shows the great efficacy in anti-diabetic activity in normal and Wistar albino diabetic rats.

**Keywords:** *Tinospora cordifolia*, Anti-diabetic activity, Wistar albino diabetic rats.

## 1. INTRODUCTION

Diabetes is a chronic disorder. It may be characterized by hyperglycaemia. These may help in insulin secretion defects and both insulin action. Due to development of insulin resistance the inadequate insulin secretion and tissues dimension may lead to abnormalities of fats, carbohydrate and metabolism of protein. These may lead to change or may increases the concentration of blood glucose level. These may damage many systems of the body like blood vessels, nerves. Diabetes are one of the most leading causes of morbidity and mortality in all over the world. According to the survey it was concluded that 0.5 to 3% of person was surfer from these diseases. Now a days its reaches to more than 7 %. Around 200 to 300 million people are affected and it should be double or triple in next few years.[1,2]

### 1.1 Types of diabetes

#### 1.1.1 Type 1 diabetes mellitus (T1DM) or Juvenile Onset Diabetes

This is also known as an insulin dependent diabetes mellitus (IDDM). It contains 5 to 10% of population. In this type of insulin deficiency immune system of the body may did not see the insulin producing cells in the pancreases as a foreign particle and destroys them.[3,4] For example, islets of Langerhans, blood glucose. These may produce normal glucose level and may reduce the sugar level. This is known as islet of Langerhans. Blood glucose level is use for normalized the sugar level and destruction of β- cells. This may include the antibiotic cell of islet, insulin to autoantibodies, GAD to antibodies, tyrosine phosphate and IA-2 β.[5,6]

#### 1.1.2 Type 2 diabetes mellitus (T2DM) or Adult-Onset Diabetes

This may know as non-insulin dependent diabetes mellitus. This diabetes may affect 90 to 98% of the population. This may be linked to modern style factor. This was common in adults. This may be decreased the disease condition.[7,8] This may decline the insulin action. It has heterogeneous disorder by progressive decline and inability of pancreatic beta cells of insulin resistance or dysfunction of beta cells. This disease may be associated with obesity, age older and has a history of diabetes.[9,10]

*T. cordifolia* are the spreading shrubs. It has several elongated twining branches. This may be axillaty and old leafless stems, slender, pseudo-racemose cymes. These may have greenish yellow, leafless and has a terminal raceme.[11,12] Male flowers are clustered and females usually solitary. Flowers are usually growing in march to June. Fruits are drupes, ovoid or globose, globous, shining, bright red when ripe. This is also known as moonseed. As seeds are curved in shape, embryo also turned in to curve shape automatically.[13,14]

## 2. MATERIAL AND METHODS

### 2.1 Drugs and chemicals

**Preparation of the plant material**

The plant material is collected from botanical garden of our university. With the help of a botanist, it was identified as *T. cordifolia.* Sample is been preserved and documented in the herbarium. A small pieces of plant root were washed. Then it will be dried in room temperature. By the use of electric mixer these roots are converted into the powder form. experiment is carryout to study the effects of ethanolic roots extract of *T. cordifolia.* Around 60g of powder is been weighed and soaked into 600ml of 90% ethanol solution at room temperature. For occasionally shaking this preparation is leave for overnight. Whatman filter paper is use for filtration of extraction. By using Soxhlet evaporation method for the filtration and it should be done until drying and dried to obtained 5g of dried extract.

### 2.2 Design for animal Experiment

Two set of experimental models is been performed, in first set of experiment type 1 diabetes is been induced by using STZ and also treated with the use of *T. cordifolia* root extract. In second set of experiment high fat feed is use for the induction of type 2 diabetes and it was also treated with same root extract of *T. cordifolia.*

#### 2.2.1 Experimental protocol for type 1 and type 2 diabetes

This experiment is done for the investigation and determination of effect of ethanolic root extract of *T. cordifolia* on the STZ induced diabetic rats. Animals are weighed around 150 to 190g. animals are feed by the laboratory food and ad libitum water is been provided thought out the experiment. Animals were grouped into 6 for 6 weeks of age. Each group consist of 10 animals. Group (I) control, Control group with 150 mg/kg/day *T. cordifolia* root extract treatment (II), Group (III) Diabetic control, Group (IV) Diabetic treated with 150 mg/kg/day, Group (V) Diabetic treated with 250 mg/kg/day *T. cordifolia* root extract and Group (VI) diabetic treated with 300 mg/kg/day *T. cordifolia* root extract. Animals of groups IV, V and VI were given a single injection of streptozotocin (STZ-50 mg/kg) with citrate buffer (pH 4.5). Animals with Group I, II and III injected with buffer alone. After 72 to 75 hr of injection, blood were taken from the tail of conscious rats and by the use of glucometer glucose were estimated. This process is repeated every week until autopsy. After 10 to 11 days of STZ injection animals of group II and III received 150 mg/kg/day and group VI received 300 mg/kg /day *T. cordifolia* root extract which were given orally for minimum 6 weeks. By the using of intubations tube these doses were given daily. Body of each rat is weighed in every group. After completion of 6 weeks animals were ready for autopsy and make the animals fasted overnight. Autopsy is been done by the use of light ether anaesthesia. 5 % EDTA vials is used for the collection of blood which were taken out from superior and inferior vena cava punctures. This is been used for the further experiment (biochemical parameters measurement).

### 2.3 Biochemical parameters measurement

Diabetic state is been judge by blood glucose measurement. By the use of GOD/POD method estimation of autopsy plasma glucose. GOD/POD enzymes in glucose kit is used for chromogen 4-aminoantipyrine and phenol. D-glucomic acid and hydrogen peroxide is been given by GOD enzyme. Phenol is been oxidised in POD oxidises. It combined with 4-aminoantipyrine which produce red coloured quinoneinne dye. RIA kit is been used for the duplication of plasma insulin level with rat insulin consider as a standard. Glycosylated haemoglobin measurement (HbAlc) was used for the diagnosis of diabetes. Triglyceride were used for the measuring of enzyme-colorimetric method. LDL particles are been modified to form glycated LDL, oxidized LDL and glyco-oxidized LDL. These are more susceptible than native LDL. HDL may protect LDL. It may form the anticoagulant and antiplatelet. By using enzymatic method, Serum cholesterol, HDL-cholesterol were measured. LDL-cholesterol and VLDL-cholesterol is also measured by cholesterol Oxidises peroxides method.

### 2.4 Histological Studies

Rat pancreases were dipped into the Bouin-Hollande sublimate solution around 24 hours. these were standardized in various fixatives. These are the preservative, fixative test comparisons. Pancreas were embedded by Paraffin at 5 to 6 µ. It was mounted on albumin coated glass slides. Every second slide was used for staining. staining techniques, Chromalum-Hematoxylin and Phloxin (CHP) method shows the best result in between islets and the surrounding exocrine pancreas. These were also use for the differentiated between two types of cells within islets of pancreas. In CHP staining method, alcohol is use for the hydration which is been treated with $KMnO_4$ solution. It is been decolourised by sodium bisulphite solution. It will be stained with haematoxylin for 15 minutes. counter stained in phloxin for few minutes then mordent in phosphotungstic acid, differentiated in 95% alcohol, dehydrated and mounted with DPX. This was observed in the whole pancreases at regular interval of time.

### 2.5 Morphometric analysis

For type 1 and type 2 diabetes, from all group of animal single rat 100 islets were measured from 100 randomly selected cross sections of the pancreas in experiment from each of the rat and their β cell is also counted. For morphometric analyses each group consist of total 700 to 800 islets are used. Islet of Langerhans measurement was done at their longest axis at 400 to 600X and size was calculated. This was done by the use of ocular microscope and light microscope. blood cell

counter is use for the counting of total number of β-cells of the islets. CHP-stained histological sections photographed by using Olympus microscope.

### 2.6 Statistical analysis

ANOVA is use for the statistical analysis. student's "t" test, body weight, relative pancreas weight, biochemicals parameters, islet size and β-cell count of all the groups were measured. Duncan's new multiple range test (DMRT)was also use for this analysis. Maximum significant level was fixed at 0.05.

## 3. RESULTS AND DISCUSSIONS

### Results of type 1 and type 2 diabetes experiment

Body weight of the experimental animals are shown. Group I (control group), group II (control + *T. cordifolia* root extract 150 mg/kg/day) animals showed a significant increase in the final body weight (182 ± 13.57 g, 184 ± 5.04 g) compared to initial body weight (148 ± 7.12 g, 143 ± 3.73 g). A significant decrease in the final body weight of 104.4 ± 3.84 g compared to the initial body weight of 156.8 ± 7.33 g in group III (diabetic group). A significant increase in body weight in groups IV, V and VI (diabetes treated with *T. cordifolia* root extract 150 mg/kg/day and diabetes treated with *T. cordifolia* root extract 250 mg/kg/day and 300 mg/kg/day) group of animals to 158.2 ± 12.7 g and 165.51 ± 9.3 g as compared to the initial body weight (147.4 ± 4.65 g and 154.5 ± 3.05 g. the body weight did not reach the group I and group II animal. Hyperglycaemia is occurred during the experiment in failure of diabetic rats to gain weight. Group IV, V and VI animals has higher gain in weights but it is less then control group. The fasting blood glucose level in experimental animals were shown in table 2 and figure 2. There is no difference in group I and group II animals blood glucose level (84.2 ± 1.21 mg/dl and 75.6 ± 5.14 mg/dl) in entire experimental period. There is a significant increase in the blood glucose level in group III animals 500 ± 16.75 mg/dl after the induction of diabetes and the hyperglycaemic condition was maintained. Animals of group IV, V and VI also shows hyperglycaemic condition due to the administration of diabetes (380 ± 26.54 mg/dl and 398 ± 14.89 mg/dl). It was down in non-diabetic state (135 ± 6.25mg/dl and 98 ± 6.45 mg/dl) after treatment with *T. cordifolia* root extract150 mg/kg/day and 250 mg/kg/day and 300 mg/kg/day treatment.

| Body weight / groups | Normal | Final |
|---|---|---|
| **Control I** | 148±7.12 | 182±13.57 |
| **Control + *T. cordifolia* 150 mg/kg/day II** | 143±3.73 | 184±5.04 |
| **Diabetic III** | 147±4.65 | 158.2±12.7 |
| **Diabetic + *T. cordifolia* 150 mg/kg/day IV** | 154.5±3.05 | 165.51±9.3 |
| **Diabetic T. *cordifolia* 250 mg/kg/day V** | 156.5±3.75 | 167.55±8.5 |
| **Diabetic T. *cordifolia* 300 mg/kg/day VI** | 152.48±2.48 | 169.45±5.48 |
| **ANOVA F-value (df= 4,35)** | 0.321 P<0.05 | 17.147 P<0.05 |

**Table 1.** Effects of *T. cordifolia* root extract on body weight of control and experimental groups of type

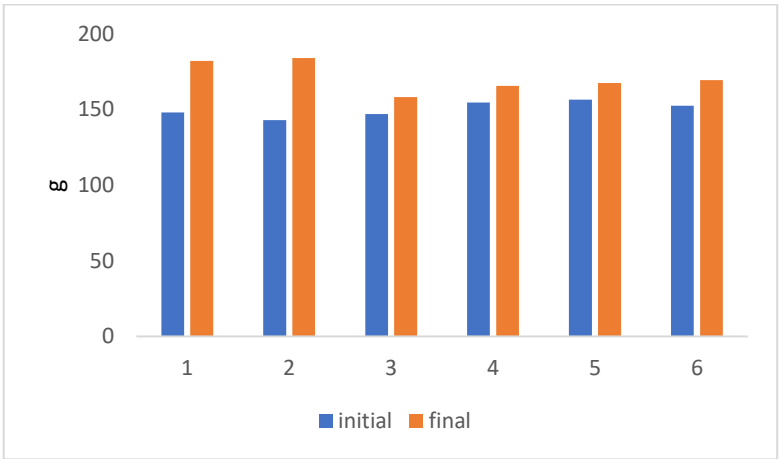


**Figure 1.** Effects of *T. cordifolia* root extract on body weight (g) of control and experimental groups of type 1 diabetic rats

| duration / groups | 0 days | 1st day | 10th day | 20th day | 30th day | 40th day |
|---|---|---|---|---|---|---|
| **Control I** | 85.4±3.12 | 79.84±4.57 | 87±2.45 | 87±2.47 | 87±4.5 | 89±1.9 |
| **Control + *T. cordifolia* 150 mg/kg/day II** | 72.4±4.73 | 81.45±5.47 | 75.1±3.15 | 68.14±3.48 | 65±4.5 | 68±2.8 |
| **Diabetic III** | 72.48±6.59 | 500±15.74 | 380±45.28 | 385±21.78 | 371.45±17.48 | 387±8.47 |
| **Diabetic + *T. cordifolia* 150 mg/kg/day IV** | 73.4±4.05 | 380±26.3 | 298±17.45 | 288±16.58 | 185±19.47 | 135±7.15 |
| **Diabetic T. *cordifolia* 250 mg/kg/day V** | 75.5±4.75 | 390.47±14.5 | 328±19.45 | 219.4±5.48 | 168±13.47 | 145±5.4 |
| **Diabetic T. *cordifolia* 300 mg/kg/day VI** | 77.51±5.48 | 395.14±15.48 | 339±18.45 | 220±4.85 | 166±13.75 | 99±3.54 |
| **ANOVA F-value (df= 4,35)** | 2.47 P<0.05 | 115.45 P<0.05 | 39.7 P<0.05 | 57.15 P<0.05 | 138.47 P<0.05 | 58.45 P<0.05 |

**Table 2.** Effects of T. cordifolia root extract on blood glucose levels (mg/dl) of control and experimental groups of type 1 diabetic rats

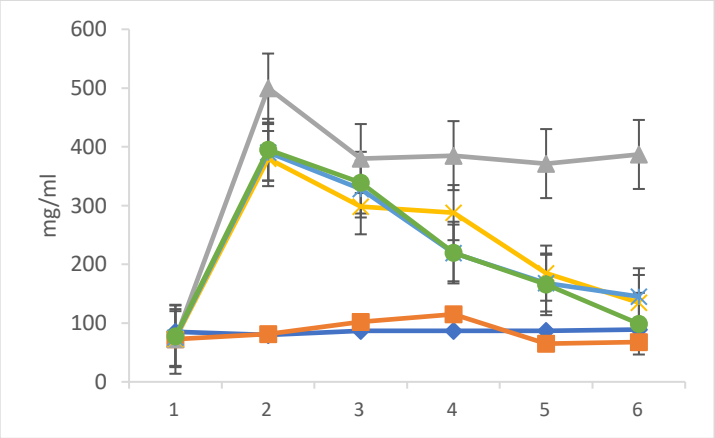


**Figure 2.** Effects of *T. cordifolia* root extract on blood glucose levels (mg/dl) of control and experimental groups of type 1and type 2 diabetic rats

The fasting glycosylated haemoglobin (HbAlc) level in experimental animals were shown. HbAlc elevated level in group III (15.18 ± 0.40%) this is been restore to the control group I (6.18 ± 0.15%) in group IV, V and VI (6.48 ± 0.48%, 7.27 ± 0.68% and 8.27 ± 0.85%) *T. cordifolia* root extract (150, 250 and 300 mg/kg/day) use for the treatment of diabetic group. This will lower the HbAlc level and reaches to the control animals.

Fasting blood triglyceride after 6 weeks in experimental animals were shown. There is no difference of triglyceride in group I and II (54 ± 0.89mg/dl, 53.6 ± 2.12 mg/dl) but the level of triglyceride is been different in group III (85.6 ± 2.5 mg/dl). The level of triglyceride is been decrees after treated with *T. cordifolia* 150 mg/kg/day in group IV (76 ± 1.5 mg/dl) this level is not goes to the control group, 250 mg/kg/day treated with *T. cordifolia* in group V and group VI (68.45 ± 4.5 mg/dl and 70.71 ± 5.4 mg/dl).

Total cholesterol in experimental animals after 6 weeks were shown. The level of cholesterol is not differed in group I and group II (45.70 ±3.11 mg/dl, 48.8 ±2.11 mg/dl). This was elevated in group III (76.6 ± 2.52 mg/dl). When it was treated with *T. cordifolia* extract (150 and 250 mg/kg/day) it brought to non- diabetic in group IV, V and VI (48.8 ± 2.02 mg/dl, 49.35 ± 4.2 mg/dl and 43.55 ± 4.5 mg/dl).

| Parameter / groups | Glycosylated Haemoglobin (%) | triglyceride (mg/dL) | Cholesterol (mg/dL) |
|---|---|---|---|
| **Control I** | 6.18±0.15 | 54 ± 0.89 | 45.70 ±3.11 |
| **Control + *T. cordifolia* 150 mg/kg/day II** | 4.87±3.73 | 53.6 ± 2.12 | 48.8 ±2.11 |
| **Diabetic III** | 15.18 ± 0.40 | 85.6 ± 2.5 | 76.6 ± 2.52 |
| **Diabetic + *T. cordifolia* 150 mg/kg/day IV** | 6.48 ± 0.48 | 76 ± 1.5 | 48.8 ± 2.02 |
| **Diabetic T. *cordifolia*** | 7.27 ± 0.68 | 68.45 ± 4.5 | 49.35 ± 4.2 |

| | | | |
|---|---|---|---|
| **250 mg/kg/day V** | | | |
| **Diabetic T. *cordifolia* 300 mg/kg/day VI** | 8.27 ± 0.85 | 70.71 ± 5.4 | 43.55 ± 4.5 |
| **ANOVA F-value (df= 4,35)** | 165.47 P<0.05 | 105.47 P<0.05 | 102.47 P<0.05 |

**Table 3.** Effects of T. cordifolia root extract on Triglyceride, Glycosylated haemoglobin and cholesterol levels of control and experimental groups of type 1 diabetic rats.

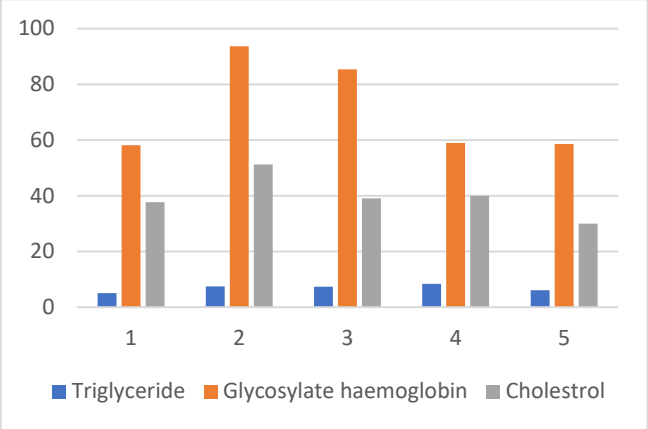


**Figure 3.** Effects of T. cordifolia root extract on Triglyceride, Glycosylated haemoglobin and cholesterol levels of control and experimental groups of type 1 and type 2 diabetic rats.

LDL level is been shown in table 6 and figure8. There is no differ in group I and group II LDL level (26.42 ± 2.10 mg/dl and 20.40 ± 1.61 mg/dl). There is a slightly elevated in group III (38.2 ± 5.82 mg/dl). When this was treated with *T. cordifolia* extract (150, 250 and 300mg/kg/day) it brought to non- diabetic state in group IV, V and VI (29.7 ± 1.86 mg/dl, 25.12 ± 6.3 mg/dl and 23.12 ± 5.4 mg/dl).

After 6 weeks, VLDL level in experimental animals were shown in table7 and figure9. There is no differ in group I and group II VLDL level (14.42 ± 0.10 mg/dl and 12.40 ± 0.61 mg/dl). It will increase in group III (24.2 ± 0.82 mg/dl). When this was treated with *T. cordifolia* extract (150, 250 and 300 mg/kg/day) to diabetic group it lowers the VLDL level in group IV, V and VI (14.72 ± 0.56 mg/dl, 12.18 ± 5.3 mg/dl and 13.12 ± 4.4 mg/dl) and it will reach to control animals.
After 6 weeks, HDL level in experimental animals were shown in table 8 and figure10. There is no differ in group I and group II HDL level (21.42 ± 0.80 mg/dl and 23.40 ± 0.71 mg/dl). It will decrease in group III (14.2 ± 0.54 mg/dl). When this was treated with *T. cordifolia* extract (150, 250 and 300 mg/kg/day) to diabetic group it increases the HDL level in group IV, V and VI (28.72 ± 3.56 mg/dl, 29.18 ± 4.3 mg/dl and 31.12 ± 5.4 mg/dl) and it will reach to control animals.
Fasting of blood urea in experimental animals were shown in table9 and figure11. There is no difference of triglyceride in group I and II (44 ± 0.89mg/dl, 45 ± 2.12 mg/dl) but the level of blood urea is been elevated in group III (66.6 ± 7.45 mg/dl). The level of blood urea is been reduced after treated with *T. cordifolia* 150, 250 and 300 mg/kg/day in group IV, V and VI (46 ± 1.5 mg/dl, 41.45 ± 5.5 mg/dl and 42.71 ± 6.4 mg/dl)

| **Parameter / groups** | **VLDL (mg/dL)** | **LDL (mg/dL)** | **HDL (mg/dL)** | **Blood urea (mg/dL)** |
|---|---|---|---|---|
| **Control I** | 14.42 ± 0.10 | 26.42 ± 2.10 | 21.42 ± 0.80 | 44 ± 0.89 |
| **Control + *T. cordifolia* 150 mg/kg/day II** | 12.40 ± 0.61 | 20.40 ± 1.61 | 23.40 ± 0.71 | 45 ± 2.12 |
| **Diabetic III** | 24.2 ± 0.82 | 38.2 ± 5.82 | 14.2 ± 0.54 | 66.6 ± 7.45 |
| **Diabetic + *T. cordifolia* 150 mg/kg/day IV** | 14.72 ± 0.56 | 29.7 ± 1.86 | 28.72 ± 3.56 | 46 ± 1.5 |
| **Diabetic T. *cordifolia* 250 mg/kg/day V** | 12.18 ± 5.3 | 25.12 ± 6.3 | 29.18 ± 4.3 | 41.45 ± 5.5 |
| **Diabetic T. *cordifolia* 300 mg/kg/day VI** | 13.12 ± 4.4 | 23.12 ± 5.4 | 31.12 ± 5.4 | 42.71 ± 6.4 |
| **ANOVA F-value (df= 4,35)** | 68.45 P<0.05 | 14.47 P<0.05 | 104.45 P<0.05 | 28.48 P<0.05 |

**Table 4.** Effects of *T. cordifolia* stem extract on LDL, VLDL, HDL and blood urea levels of control and experimental groups of type 1 diabetic rats

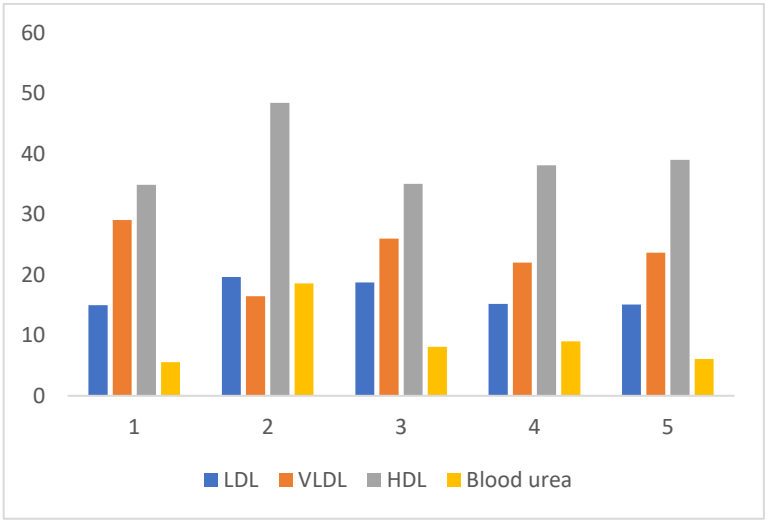


**Figure 4.** Effects of *T. cordifolia* stem extract on LDL, VLDL, HDL and blood urea levels of control and experimental groups of type 1 diabetic rats

Relative weight in experimental animals were shown in table10 and figure12. This was calculated by formula pancreas weight /body weight of rat x 100. The weight of the pancreases is same and did not have any differ in group I, II, IV, V and VI (0.347 ± 0.07 µm, 0.357 ± 0.03 µm, 0.378 ± 0.05 µm, 0.319 ± 0.09 µm and 0.328 ± 0.10 µm). in diabetic group III the weight of the pancreas (0.478 ± 0.08 µm).

The islets diameters of experiment animal are shown in figure13, table11 and plate 1. In group I, II (168.86 ± 5.27 µm and 178.06 ± 4.83 µm) there are no differ in islet diameter. Due to the induction of diameter β-cells were damage. the islet size decreased significantly in group III (119.44 ± 4.78 µm). Experimental animals were treated with *T. cordifolia* (150, 250 and 300 mg/kg/day) in group IV, V and VI (170.62 ± 3.07 µm, 173.35 ± 3.55 µm and 179.38 ± 4.72 µm) resulted into a damage of β-cell in restoring of islet of diameter.

The β-cell of experiment animal are shown in figure14, table12 and plate 1(A, B, C, and D). In group I, II (175.31± 4.3, 165± 3.78 µm) there are no differ in β-cell. In group III β-cell was reduces 99.48± 5.10 µm. Experimental animals were treated with *T. cordifolia* (150, 250 and 300 mg/kg/day) in group IV, V and VI (195.55 ± 4.34, 196.19 ± 5.69 µm and 199.19 ± 6.69 µm) when compared to diabetic group.

| **Parameter / groups** | **Diameter of islets(µm)** | **Number of β cells/islet** | **Relative weight of pancreases** |
|---|---|---|---|
| **Control I** | 168.86 ± 5.27 | 175.31± 4.3 | 0.347 ± 0.07 |
| **Control + *T. cordifolia* 150 mg/kg/day II** | 178.06 ± 4.83 | 165± 3.78 | 0.357 ± 0.03 |
| **Diabetic III** | 119.44 ± 4.78 | 99.48± 5.10 | 0.478 ± 0.08 |
| **Diabetic + *T. cordifolia* 150 mg/kg/day IV** | 170.62 ± 3.07 | 195.55 ± 4.34 | 0.378 ± 0.05 |
| **Diabetic T. *cordifolia* 250 mg/kg/day V** | 173.35 ± 3.55 | 196.19 ± 5.69 | 0.319 ± 0.09 |
| **Diabetic T. *cordifolia* 300 mg/kg/day VI** | 179.38 ± 4.72 | 199.19 ± 6.69 | 0.328 ± 0.10 |
| **ANOVA F-value (df= 4,35)** | 35.48<br>P<0.05 | 97.85<br>P<0.05 | 28.48<br>P<0.05 |

**Table 5.** Effects of *T. cordifolia* root extract on relative weight of pancreas, Diameter of islet and number of β-cells of control and experimental groups of type 1 diabetic rats.

In plate A, figure A of islet of Langerhans is done by photomicrograph of control group animal. The exocrine portion of the pancreas is shown by Photomicrograph. Large number of *β*-cells is been distributed. Phloxin stained pink cells is been observed. endocrine property of the islets cells was indicated by Blood vessels with RBCs.
In plate B, figure B of islet of Langerhans diabetic group is done by photomicrograph of control group animals. Streptozotocin use for the introduction of diabetes it is been caused by damage/necrosis of β cells. In diabetic group hyperglycaemia was observed.

In plate B, figure (C &D) of islet of Langerhans diabetic group is done by photomicrograph. Treated with *T. cordifolia* root extract with 150, 250 and 300 mg/kg. after this treatment β cells does not observed. At 300 mg/kg treatment of *T. cordifolia* root extract the recovery of necrosis is been pronounced then the 150mg/kg group treatment.

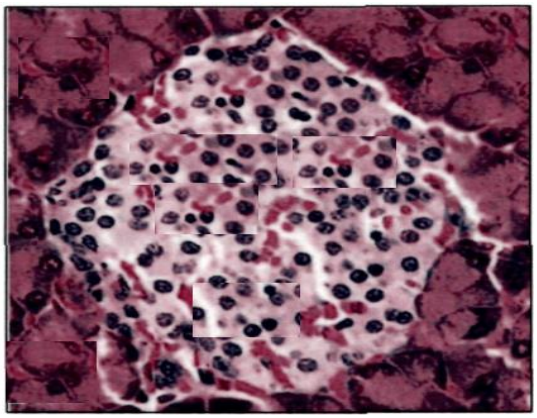

**Figure A**

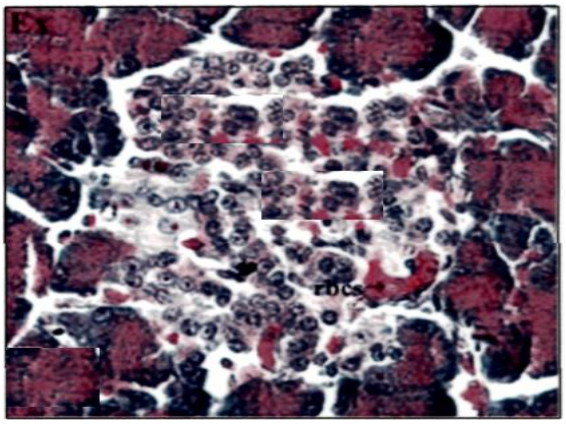

**Figure B**

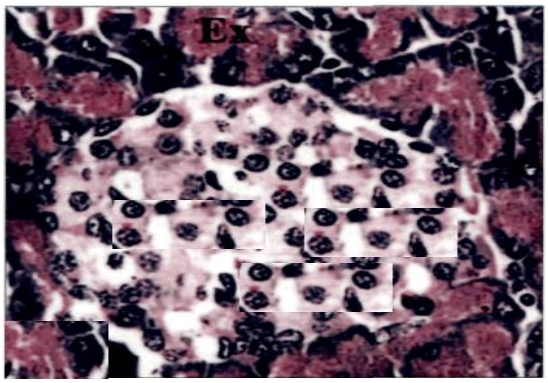


**Figure C**

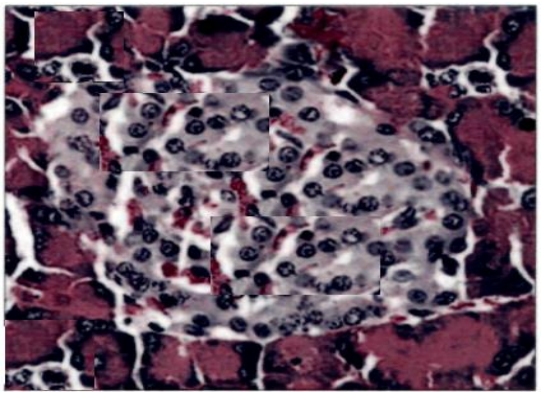

**Figure D**

## 4. SUMMARY AND CONCLUSION

The main aim of the present study is to develop an animal model for traditional medicine (*T. cordifolia)* in anti-diabetic activity. Animals become obese by high fat fed and the blood glucose level reached 129 mg/dl. Animal model may cause obesity and causes stress this may result into hyperglycaemia. The present work was to evaluate the therapeutic efficacy of *T. cordifolia* stem extract on type 1 and type 2 diabetes induced animal model Wistar rat. Various biochemical parameters investigated include blood glucose, triglyceride, cholesterol, LDL, VLDL, HDL, glycosylated hemoglobin percentage (HbAlc %) and blood urea. Except HDL, levels of blood glucose, triglyceride, cholesterol, LDL, VLDL, glycosylated haemoglobin percentage and blood urea were elevated in diabetic group. After treatment with *T. cordifolia* root extract with 150,250 and 300 mg/kg/day to diabetic group. Whereas HDL level decreased in diabetic group and the level of HDL was restored to that of control group of for treatment with *T. cordifolia* root extract. The studies on the islets of Langerhans suggest that the plant extract treatment to diabetic group (150,250 and 300 mg/kg/day) to type 1 and type 2 diabetic rats resulted in the recovery of damaged islets and restoring the β cells number, hence enhanced the insulin secretion. The plant extract of *T. cordifolia* root extract has improved the damaged islets of Langerhans and enhanced insulin secretion of β cells in type 1 and type 2 diabetes. Therefore, the plant extract of *T. cordifolia* has a therapeuticefficacy in alleviating type 1 diabetes and type 2 diabetes. Though the *T. cordifolia* stem extract has therapeutic efficacy, the actual chemical compound which will alleviate diabetes is further to be investigated.

## 5. REFERENCES

**1)** Dorman, D.E., and Roberts, J.D. (1970). Nuclear magnetic resonance spectroscopy. C-13 spectra of some pentose and hexose aldopyranoses. *J of the American Chemical Society* **92,** 1355-1361.

**2)** Dousset, J. C, Trouilh, M. and foglieti, M. J. (1983). plasma malonaldehyde levels during myocardic infarction *Clin. Chim. Acta* **129,** 319-322.

**3)** El-assaad, W., Jean, B., Marie-Line, P., Christopher, N., and Raphae, R., (2003) Saturated fatty acids synergize with elevated glucose to cause pancreatic P-cell death. *Endocrinol* 144,4154-4163.

**4)** El-Hilaly, J., Adil, T., Zafar, H. I., and Badiaa, L. (2006). Hypolipidemic effects of acuteand sub-chronic administration of an aqueous extract of *Ajuga iva* L.Whole plant in normal and diabetic rats. *J. of Ethnopharmacol* **105,**441-448.

**5)** Epple, A., Brinn, J.E., and Young J.B. (1980). Evolution of pancreatic islet functions. In "Evolution of vertebrate endocrine systems" (P.K.T.Pang, and A. Epple, Eds) Texas tech Press, Lubbock pp 269-321.
**6)** Fajans, S. S., (1995). Diabetes Mellitus; Definition Classification; Tests. In Endocrinology. DeGroot, *et ah,* 3"* ed. Vol -2 Saunders Company, Philadelphia,London pp. 1411.
**7)** Felig, I., and Waheren, J. (1975). Fuel homeostatsis in exercise. *New England J of Medicine.* **293,** 1078-108. Fossati, P., and Prencipe, L. (1982). Serum triglycerides determined calorimetrically with an enzyme that produces hydrogen peroxide. *Clin Chem.* 28, 2077-2080.
**8)** Harada M, and Makino S. (1986). Suppression of overt diabetes in NOD mice by antithymocyte serum or anti-Thy 1.2 anti-body. *Exp Animals.* **35,** 501-504.
**9)** Hattersley, A. T. (2004). Unlocking the secrets of the pancreatic P cell. Man and mouse provide the key. *The J. of Clinical Investigation.* **114,** 314-316.
**10)** Hellerstrom, C, Swenne, I., and Andersson, A. (1988). Islet cell replication and diabetes. In the pathology of the endocrine pancreas in diabetes. Lefebvre P. J., Pipeleers DG, Eds. Heidelberg, Germany, Springer-Verlag, pp. 141-170.
**11)** Herman, W. H., and Crofford, O.B. (1997).The relationship between diabetic control and complication In: Text book of diabetes. (Pickup. J.C. and Willams. G. eds). Oxford Blackwell Scientific pp 411.
**12)** Hikino, H., Yoshizawa, M., Suzuki, Y., Oshima, Y., and Konno, C. (1989). Isolation and hypoglycemic activity of trichosans A, B, C, D, and E: glycans of *Trichosanthes kirilowii* roots. *Planta Med* **55,** 349-350.
**13)** Hoppener, Jow. M., Boahren, M. D., and Comelis, J. M. (2000). Islet amyloid and type 2 diabetes mellitus. *N EnglJ Med.* **343,**411-419.
**14)** Hotta, M., Fumi, T., Hiroshi, I, Hitoshi, N., Toshio, O., Junji, Y. and Jun-ichi, M.(1998). Pancreatic P-Cell-specific expression of thioredoxin, an antioxidative and antiapoptoticprotein, prevents autoimmune and streptozotocin-induced *J. Exp. Med.* **188,**1445-1451.