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INVESTIGATION OF ANTI-DIABETIC POTENTIAL OF *ICHNOCARPUS FRUTESCENS* IN STREPTOZOTOCIN-NICOTINAMIDE INDUCED DIABETIC MICE

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ABSTRACT

Herbal medications have grown in popularity in recent years due to their strength, purity, and cost-effectiveness. Plants are a major source of bioactive compounds that are used in both traditional and modern medicine to prevent and cure illness. People all across the globe have long relied on plant-derived products to cure a wide range of diseases. After going through above literature, we have designed a work to investigate herbal plant for the treatment of diabetes mellitus. Therefor we aimed to investigate effectiveness of *Ichnocarpus frutescens* in diabetes using *in vivo* models. From qualitative phytochemical screening it was observed that the extract possess numerous kind of chemicals such as alkaloid, carbohydrates, saponins, glycoside, fats and fixed oils, resins, phenols, tannins, diterpins, flavonoids, and proteins. *In vivo* antidiabetic activity of extract have been performed in STZ-induced diabetic model in rats. The antidiabetic potential have been determined by estimating different biochemical parameters such as body weight, serum glucose level, SGOT (AST), and SGPT (ALT) levels. The antidiabetic potential of the extract was comparable with that of Metformin, which is evidenced by decreased levels of blood glucose, SGOT, and SGPT. The extract was given to the animals at doses of 100 mg/kg (F1) and 200 mg/kg (F2). The decreased body weight was significantly ($p<0.001$) improved in F1, F2, and metformin treated groups. The basal serum glucose level of

animals of all groups was found to be statistically equivalent. The increased serum glucose level was significantly decreased with treatment of extract (at 100 and 200 mg/kg) and metformin ($p<0.001$). The mean serum SGOT level of NC group was 48 ± 1.5 U/L, which significantly ($p<0.001$) increased to 80 ± 1.3 U/L in DC group, the increased levels were significantly decreased in F1, F2, and metformin group ($p<0.001$), when compared to DC group. Diabetes induction caused significant increase ($p<0.001$) in SGPT levels from 43 ± 0.9 U/L to 94 ± 1.2 U/L, when compared to the NC group. The increased SGPT levels were significantly decreased in F1, F2, and metformin group ($p<0.001$), when compared to DC group. Thus, our findings demonstrate that the *Ichnocarpus frutescens* possess significant antidiabetic activity in dose dependent manner and if optimize latter can be used clinically to overcome diabetes in a very convenient way.

Keyword: *Ichnocarpus frutescens*, Diabetes mellitus, Dose dependent Antidiabetic medicine

1. INTRODUCTION

1.1 Diabetes Mellitus

Diabetes mellitus (DM) is a progressive metabolic disease with recurring hyperglycemia. It may be related to decreased insulin production, tolerance to peripheral insulin operation, or both. According to the International Diabetes Federation (IDF), about 415 million people aged 20 to 79 years had diabetes mellitus in 2015. DM is proving to be a global strain on public health, and is projected to grow to another 200 million by 2040. I Chronic hyperglycemia in synergy with other metabolic aberrations in patients with diabetes mellitus can trigger harm to different organ systems, contributing to the development of life-threatening complications, most of which are microvascular (retinopathy, nephropathy, and neuropathy) and macrovascular complications leading to 2-fold and 4-fold increased risk of cardiovascular diseases. Pancreatic beta cells (β-cells) generate an insulin hormone that stimulates the absorption of glucose into cells in order to provide energy and is often active in a number of other functions. DM is attributed to loss of insulin output or insulin sensitivity. It is critical that all types of diabetes should be identified and treated at an early stage to avoid or slow down future problems affecting other organs such as diabetic nephropathy, retinopathy, neuropathy, cardiovascular disease and diabetic foot ulcers.

1. 2 CLASSIFICATION

DM is typically divided into three groups of etiology and clinical course, type 1 diabetes, type 2 diabetes and gestational diabetes (GDM). Other less prevalent forms of diabetes include monogenic diabetes and secondary diabetes.

i) Type 1 Diabetes Mellitus (T1DM)

Type 1 diabetes mellitus (T1DM) accounts for 5 to 10 percent of DM and is distinguished by the autoimmune degradation of insulin-producing beta cells in the pancreatic islets. As a consequence, there is an absolute insulin deficit. A combination of hereditary vulnerability and environmental causes, such as virus

infection, toxin, or certain dietary factors, has been identified as reasons for autoimmunity. T1DM is more often seen in children and teenagers, but it can develop at any level.

ii) Type 2 diabetes mellitus (T2DM)

Type 2 diabetes mellitus (T2DM) reports for around 90 percent of all cases of diabetes. In T2DM, the response to insulin is decreased and characterized as insulin resistance. Insulin is inactive in this condition and is initially counteracted by a rise in insulin output to sustain glucose homeostasis, but over time, insulin production declines, resulting in T2DM. T2DM is more frequently found in people older than 45 years of age. However, rising levels of obesity, physical inactivity, and energy-dense diets are rapidly seen in teenagers, teens, and younger adults.

iii) Gestational Diabetes Mellitus

Hyperglycemia, which is first observed during pregnancy, is categorized as gestational diabetes mellitus (GDM), also known as hyperglycemia during pregnancy. While it can arise at any point during pregnancy, GDM usually affects pregnant people during the second and third trimesters. According to the American Diabetes Association (ADA), 7 percent of all pregnancy is complicated by GDM. Women with GDM and their children are at elevated risk of having type 2 diabetes mellitus in the future[15]. GDM can be complicated by hypertension, preeclampsia, which hydramnios, and can contribute to increased surgery. The fetus may have elevated weight and height (macrosomia) or congenital abnormalities. Well after birth, such children can have respiratory distress syndrome and childhood and teenage obesity. Older age, obesity, excessive gestational weight gain, history of congenital abnormalities in older infants, or stillbirth, or family history of diabetes are risk factors for GDM.

iv) Monogenic Diabetes

This form of diabetes is triggered by a single genetic defect in the autosomal dominant gene. Examples with monogenic diabetes include disorders such as neonatal diabetes mellitus and maturity-onset diabetes of the young (MODY). About 1% to 5% in all instances of diabetes are attributed to monogenic diabetes. MODY is a genetic condition that generally exists under the age of 25 years.

v) Secondary Diabetes

Secondary diabetes is triggered by symptoms of other conditions involving the pancreas (e.g. pancreatitis), hormonal abnormalities (e.g. Cushing's disease) or medications (for example, corticosteroids).

1.3 Herbals for the Treatment of Diseases

Dependence of human beings on plants dates back to the origin of the human race. The basic needs of life for human being are shelter, clothing, food, flavors and fragrances and not the least, medicines. Plants are a common source of medicine. Plants have shaped the creation of refined traditional medicine structures among which are Ayurvedic, Unani and Chinese are common. In Indian, Egyptian, Chinese, Roman and the Greek civilizations, plants were the very foundation of care system and deemed to possess a divine and supernatural power of healing. The Edwin Smith Papyrus (1700 BC) is an ancient Egyptian medical text on wound healing. Since ancient times, herbs have been used as natural remedies for curing many physiological

disorders. Traditional medicinal literature appreciated their value as nature's gift to mankind for the healing of illnesses.

2. MATERIAL AND METHODS

2.1 Collection of Plant Material and Authentication

The plants *Ichnocarpus frutescens* was collected and authenticated from Department of Botony, Sri Venkateswara University, Tirupati, India.

2.2 Preparation of Plant Material and Hydro-alcohlic Soxhlet Extraction

The collected plant have been washed with water to remove any dust or foreign particle present on it and shade dried for one week at room temperature to avoid excessive loss of volatile phytoconstituents. After drying, the plant material grinded individually and at least 100 gm of crude powder prepared from plant. The crude powder was subjected for Soxhlet extraction using hydro-alcoholic (30:70, water:ethanol) solvent. The extraction was carried out till the completion of 10 siphon cycle for at least 48 hours.

2.3 Pharmacognostical Evaluation

Colour: The untreated part of the drug was taken and colour of the drug was examined under sunlight.

2.3.1 Odour and Taste*:* A little amount of the drug was ingested, and the air was inhaled slowly and repeatedly over the substance to examine the odour. Additionally, a small amount of drug was placed on the tongue to evaluate the flavour of the drug.

2.3.2 Ash values: Three gm of drug were weighed and burned in a crucible at a temperature not exceeding 45 °C until carbon-free, cooled, then weighed three times more until a steady weight was achieved for three consecutive readings. The percentage of ash was estimated using the air dried drug as a reference.

$$Total\ Ash = \frac{\text{Wt. of ash}}{\text{Wt. of drug}} \times 100$$

2.3.3 Extractive values:

5 gm of accurately weighed powdered drug was placed in a stoppered conical flask and 100 ml of 90% alcohol was added. The flask was shaken continuously for 6 hours in an electrical shaker and then left overnight for maceration. The flask was then carefully filtered and the filter was evaporated to dryness. The weight of the extractive was taken and the percentage calculated.

$$Alcohol - Soluble\ Extractive = \frac{\text{Wt. of extractive}}{\text{Wt. of drug}} \times 100$$

2.4 Preliminary Phytochemical Screening

The crude drug sample was subjected for preliminary phytochemical screening by various qualitative tests to detect the presence of different class of phytoconstituents. The *Ichnocarpus frutescens* Plant extract acquire was subjected to the precursory phytochemical analysis following standard methods by Khandelwal and Kokate. The extract was screened to identify the presence of various active principles of alkaloids, glycosides, phenols, flavonoids, Terpenoids, Saponins, Steroids.

2.5 *In vivo* Antidiabetic Activity

2.5.1 Experimental Animals and Ethical Considerations

Swiss Albino mice of either sex weighing between 20 and 30 g were used. The mice were acclimatized to the animal house condition for 1 week before carrying out any experimental work. The mice were fed with normal animal pellet diet and water *at- libitum*. They were housed at standard housing conditions of temperature (23°C ± 12°C),

humidity (45 ± 5%), and 12-h light and dark cycle.

2.5.2 Acute Toxicity Studies

Safety Studies for dose titration were carried out according to of the Organization for Economic Co-Operation and Development (OECD 425) Guideline on normal mice with three different doses of the tea bag solution. The fasted mice were fed with single dose of 500, 1000 and 2000 mg/kg body weight by oral route to three different groups respectively. All the mice were keenly examined for 2 h to check any abnormalities in behavior of the animals and further continued to monitor and examine the mice for 24 and 72 h.

2.5.3 Induction of Chronic Diabetes & Experimental Design

Hyperglycemia was induced by a single intraperitoneal injection of freshly prepared streptozotocine (STZ) (55mg/kg body weight, in 0.1M citrate buffer (pH 4.5) to a group of overnight fasted rats. To control drug-induced hypoglycemia, a solution of 5% glucose overnight was given to rats. Hyperglycemia was confirmed on the third day after STZ injection by estimating glucose level by Glucometer. The rats having a glucose level of 300 mg/dl were used for the study.

On day 14 of post STZ injection, the diabetic rats were randomized based on their fasting blood glucose and regrouped into 7 groups, comprising 6 rats each. STZ-untreated rats served as non-diabetic control. Group I served as control. Group II served as diabetic control, group III and IV were treated with an oral dose of extract at dosage of 100 and 200 mL/kg respectively. Group V was served as a standard group that received Metformin 120mg/kg (Oral route). The rats were allocated to different treatment groups and were administered with different treatments for next 14 days.

Table 2.1 Experimental design of the animal activity

Group ID	Group Details	Treatment (Dose & Route)	No. of animals
G1	Normal Control	Saline, 10ml/kg/day, Oral Route	6
G2	Diabetic control	Saline, 10ml/kg/day, Oral Route	6
G3	Diabetic + F1	100 mL/kg/day, Oral Route	6
G4	Diabetic + F2	200 mL/kg/day, Oral Route	6
G5	Diabetic + Metformin	Metformin, 120 mg/kg/day, Oral	6

2.5.4 The Body Weight and Blood Glucose Level

The body weight and blood glucose level were estimated in rats at 0, 7th, 14th, and 21st day of the treatment. The initial body weight were measured and compared with normal control rats. Estimation of blood glucose level before and after 3 weeks of treatment was done by Glucometer (One touch). All animals were monitored for body weight during the treatment period. Blood was collected from tip of the tail vein and fasting blood glucose levels were measured.

2.5.5 Estimation of SGOT and SGPT

Estimation of Serum Glutamate Oxaloacetate Transaminase (SGOT)

Aspartate transaminase is also known as L-aspartate-2-oxoglutarate aminotransferase, AST. This enzyme catalyzes the reversible transfer of amino groups between an amino acid, and α-keto acids are called aminotransferase or transaminases. One of the aminotransferases is Aspartate aminotransferase (AST), or the old name was glutamic -oxaloacetic transaminase (GOT). This enzyme is distributed in all tissues (primarily all the tissues), but the highest concentration is found in the liver, heart, and skeletal muscles. AST (SGOT) concentration is more in heart >liver> muscles>kidneys>pancreas. This enzyme exists in two isoenzyme fractions: In the liver, it is present in cytosolic (cell cytoplasm), and the second form is mitochondrial. The intracellular concentration of the SGOT enzyme is 7000 times as compared to extracellular concentration. The cytoplasmic fraction isoenzyme is predominant in the serum.

Substrate start assay

0.1ml of sample was mixed with 0.8 ml of enzyme reagent and incubated at 350 C for 1 min and added 0.2 ml of starter reagent. Mixed well and read the initial absorbance change per minute (ΔA/min).

Sample start assay

1.0ml of working reagent is incubated at 350 C for 1 min and added 0.1 ml of starter reagent. Mixed well and read the initial absorbance A0 and repeat the absorbance reading after every 1, 2 and 3 min. calculate the mean absorbance changer per minute (ΔA/min).

SGOT (ASAT) activity in U/L =ΔA/min X 1546

Estimation of Serum glutamic pyruvic transaminase (SGPT)

This enzyme catalyzes the reversible transfer of amino groups between an amino acid, and α-keto acids are called aminotransferase or transaminases. One of the aminotransferases is Alanine aminotransferase (ALT), or the old name was glutamate-pyruvate transaminase (SGPT) which will catalyze the reversible transfer of the amino group between an amino acid and α-keto acid where vitamin B6 (pyridoxal phosphate) is the co-factor. ALT is an enzyme found predominantly in the liver. This enzyme is present in cytosolic and mitochondrial forms in the liver. The majority of the SGPT is present in the cytoplasm of liver cells. There is always a low level of this enzyme in the blood. This is a liver-specific enzyme of the transferases. The liver hepatocytes contain 3 to 4 times more AST (SGOT) than the ALT (SGPT). This is also normally found in bile, CSF, and saliva. It is not found in the urine unless there is a kidney lesion. Any damage to the liver

cells, SGPT enzyme, is released, specifically for liver cell necrosis. First cytosolic SGPT is released, and in the case of necrosis, then mitochondria SGPT is released into circulation.

SGPT catalyzes the transfer of amino group between L-Alanine and α Ketoglutarate to form pyruvate and glutamate. The pyruvate formed reacts with NADH in the presence of lactate Dehydrogenase to form NAD. The rate of oxidation of NADH to NAD is measured as a decrease in absorbance which is proportional to the SGPT activity in the sample. SGPT kit contains L1 (Enzyme reagent) L2 (Starter reagent)

Substrate start assay

0.1ml of sample was mixed with 0.8 ml of enzyme reagent and incubated at 350 C for 1 min and added 0.2ml of starter reagent. Mixed well and read the initial absorbance A0 and repeat the absorbance reading after every 1, 2 and 3 min. calculate the mean absorbance change per minute (ΔA/min).

Sample start assay

1.0ml of working reagent is incubated at 350 C for 1 min and adds 0.1 ml of starter reagent. Mix well and read the initial absorbance A0 and repeat the absorbance reading after every 1, 2, and 3 min. calculate the mean absorbance change per minute (ΔA/min).

SGPT (ALAT) activity in U/L = ΔA/min X 1546

3. RESULTS AND DISCUSSION

3.1 Result of Pharmacognostical of Hydro-alcoholic Extract

The % yield of the extract was found to be 7.90%. The appearance of extract was dark green but after drying light green powder was obtained with pungent to bitter odor.

Table 3.1. The pharmacognostic evaluation of the crude extract

Parameters	Values (% dry weight basis)
Moisture content	5.7 ± 0.14
Total ash content	6.2 ± 0.17
Water soluble ash content	1.6 ± 0.12
Acid soluble ash content	0.6 ± 0.08
Hot ethanol exactable matter	10.8 ± 0.19
Cold-ethanol extractable matter	8.9 ± 0.21
Hot-water extractable matter	7.7 ± 0.23
Cold-water extractable matter	4.2 ± 0.15

Data represented as mean ± SEM (standard error mean); *n* =6.

3.2 Result of Preliminary Phytochemical Investigation of Hydro-alcoholic Extract

Table 3.2. The preliminary phytochemical screening of the extract

Name of Chemical Class	Hydro-alcoholic extract
Alkaloid	+++
Carbohydrates	+++
Saponins	+++
Glycoside	+++
Fats and fixed oils	+
Resins	---
Phenols	++
Tannins	+++
Diterpins	+
Flavonoids	+++
Proteins	---

Whereas, + indicates present, ++ indicates moderately present, +++ indicates strongly present, --- indicates absent.

3.3 *In vivo* Antidiabetic Activity

The results of *in vivo* antidiabetic activity of the extract is tabulated in the tables given below. The graph of effect of formulations on body weight is depicted in Fig. 3.1. The graph of effect of formulations on serum glucose level is illustrated in Fig. 3.2. The effect of formulations on OGTT is illustarted in Fig. 3.3. The effect of formulations on SGOT and SGPT are exemplified in Fig. 3.4.

Table 3.3. Effect of extract on body weight and serum glucose levels

Day	Normal control	Diabetic control	F1	F2	Metformin
Body weight (g)					
0	215 ± 1.5	213 ± 1.3	215 ± 1.2	211 ± 1.1	213 ± 1.3
7	314 ± 1.2	$300 \pm 3.5^{\gamma}$	316 ± 2.5^{c}	318 ± 1.5^{b}	321 ± 1.2^{a}
14	334 ± 1.8	$248 \pm 2.2^{\alpha}$	316 ± 2.1^{a}	320 ± 2.1^{a}	350 ± 2.2^{a}
21	333 ± 1.4	$223 \pm 1.6^{\alpha}$	291 ± 3.1^{a}	303 ± 1.6^{a}	352 ± 1.4^{a}

Serum glucose (mg/dl)					
0	88 ± 1.2	93 ± 1.6	87 ± 1.4	92 ± 0.9	90 ± 1.8
7	112 ± 1.8	365 ± 2.1$^{\alpha}$	282 ± 2.2^{a}	261 ± 3.3^{a}	237 ± 2.8^{a}
14	130 ± 1.6	359 ± 1.3$^{\alpha}$	261 ± 2.9^{a}	249 ± 2.1^{a}	225 ± 2.4^{a}
21	123 ± 1.3	349 ± 1.3$^{\alpha}$	188 ± 1.5^{a}	176 ± 1.2^{a}	159 ± 1.7^{a}

Data were expressed as mean±SEM, n=6, and analyzed by ANOVA followed by Tukey's post hoc test. $^{\alpha}p<0.001$, $^{\gamma}p<0.05$, when compared to the normal control group; $^{a}p<0.001$, $^{b}p<0.01$, $^{c}p<0.05$, when compared to diabetic control group.

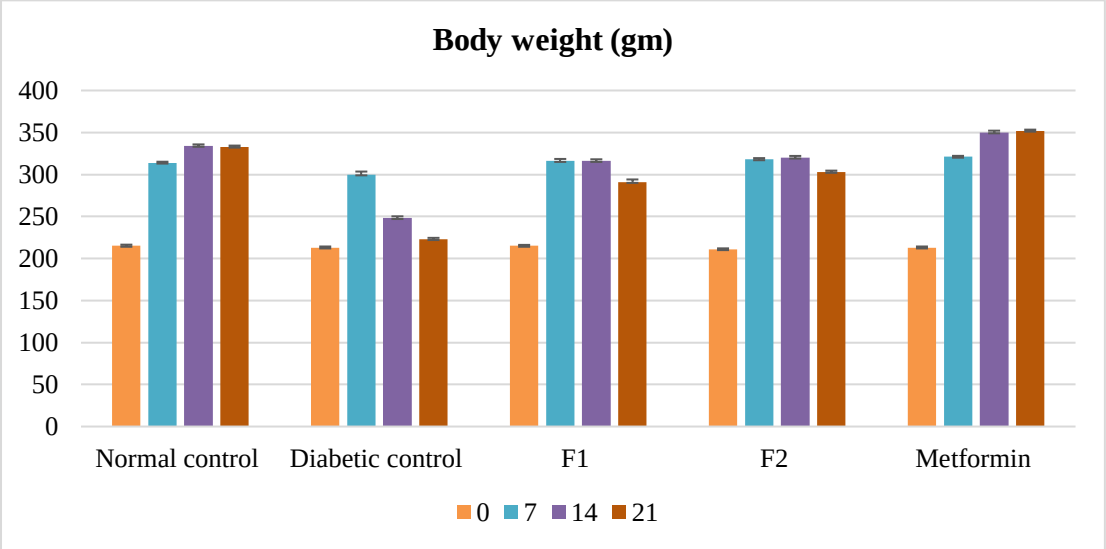

Figure 3.1. An effect of extract on body weight

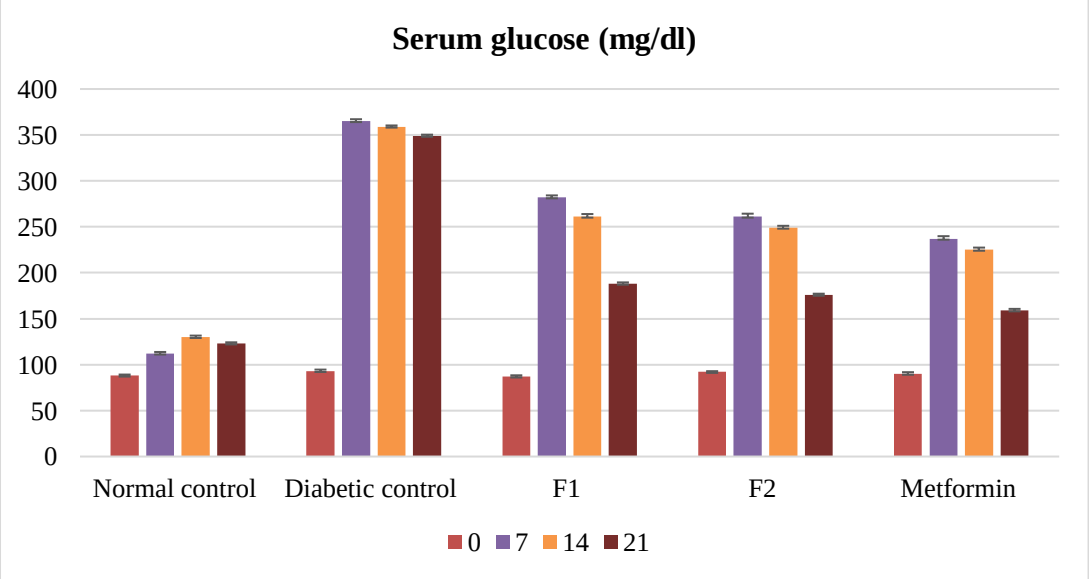

Figure 3.2. An effect of extract on serum glucose level

Hyperglycemia was induced by a single intraperitoneal injection of freshly prepared streptozotocine (STZ). Table 2.1 depicts the experimental design of the animal activity in which the basal body weight of animals of all the groups was found to be statistically equivalent. Diabetes induction caused significant

decrease in the body weight during the experimental period when compared to NC group. The mean body weights of NC group, at the end of the treatment period was found to be 333 ± 1.4 gm, this was significantly ($p<0.001$) decreased to 223 ± 1.6 gm in DC group. The decreased body weight was significantly ($p<0.001$) improved in F1, F2, and metformin treated groups. The basal serum glucose level of animals of all groups was found to be statistically equivalent. Over the course of the trial, the DC group had a considerable rise in blood glucose levels, indicating that they were diabetic. When comparing the DC to the NC group, the blood glucose levels of the DC group were considerably ($p<0.001$) higher (from 93 ± 1.6 to 349 ± 1.3 mg/dl) at the conclusion of the research. The increased serum glucose level was significantly decreased with treatment of extract (at 100 and 200 mg/kg) and metformin ($p<0.001$).

Table 3.4. Effect of extract on OGTT

Groups	0 min	30 min	60 min	120 min	AUC
Normal control	121 ± 4.1	166 ± 3.8	140 ± 2.2	122 ± 4.1	273 ± 4.7
Diabetic control	160 ± 2.2$^{\alpha}$	210 ± 2.1$^{\alpha}$	184 ± 2.2$^{\alpha}$	172 ± 3.3$^{\alpha}$	365 ± 2.9$^{\alpha}$
F1	135 ± 2.9^{a}	167 ± 3.2^{a}	154 ± 2.6^{a}	141 ± 2.6^{a}	297 ± 4.2^{a}
F2	129 ± 1.4^{a}	164 ± 3.6^{a}	153 ± 2.6^{a}	139 ± 2.2^{a}	294 ± 3.9^{a}
Metformin	123 ± 2.1^{a}	155 ± 2.3^{a}	145 ± 2.5^{a}	125 ± 2.2^{a}	274 ± 3.7^{a}

Data were expressed as mean±SEM, n=6, and analyzed by ANOVA followed by Tukey's post hoc test. $^{\alpha}p<0.001$, when compared to the normal control group; $^{a}p<0.001$, when compared to diabetic control group.

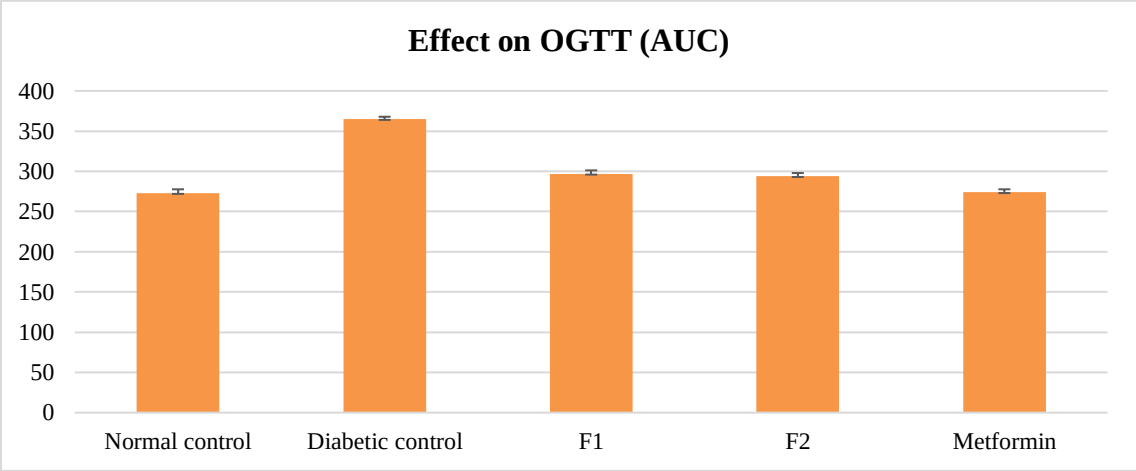

Figure 3.3. The effect of extract on OGTT (AUC)

NC group serum OGTT levels were observed at specific time intervals of 0 min, 30 min, 60 min, 120 min along with the AUC curve. NC group level was 273 ± 4.7, whereas DC group OGTT levels were

considerably ($p<0.001$) higher at 365 ± 2.9 mg/dl. Treatment with F1, F2, and metformin ($p<0.001$), considerably reduced these elevated levels.

Table 3.5. Effect of extract on SGOT and SGPT levels

Parameters	Normal control	Diabetic control	F1	F2	Metformin
SGOT (U/L)	48 ± 1.5	80 ± 1.3$^{\alpha}$	60 ± 1.2^{a}	60 ± 1.1^{a}	59 ± 1.8^{a}
SGPT (U/L)	43 ± 0.9	94 ± 1.2$^{\alpha}$	58 ± 1.7^{a}	61 ± 1.3^{a}	59 ± 1.6^{a}

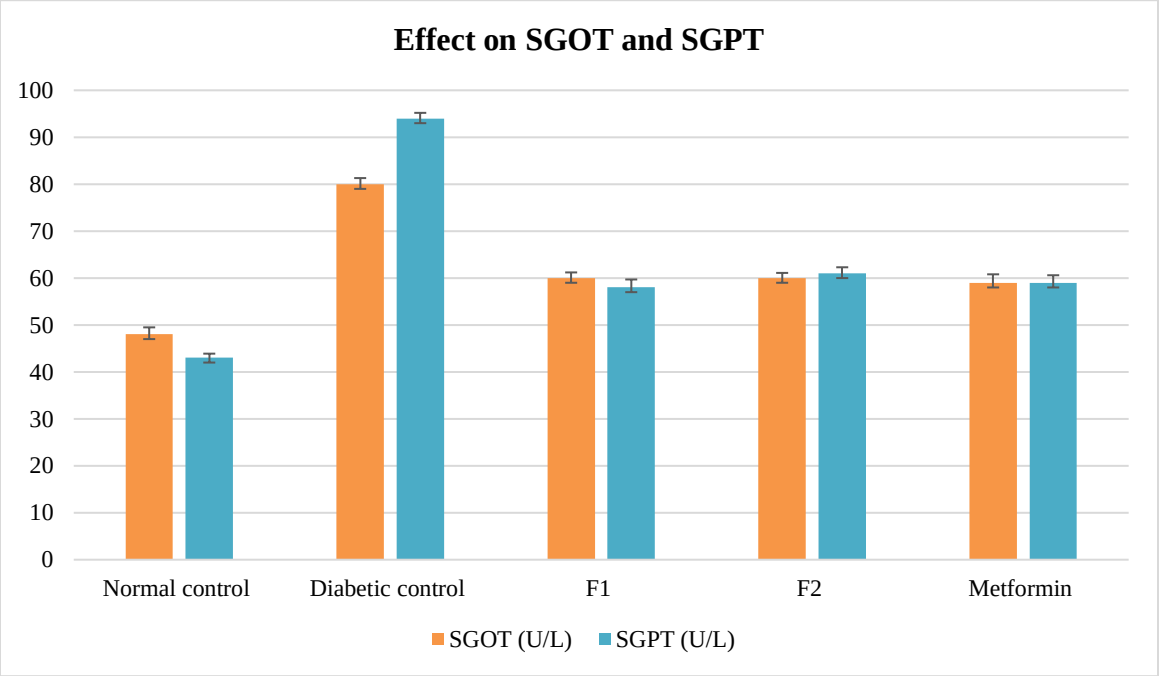

Figure 3.4. An effect of extract on SGOT and SGPT level

The mean serum SGOT level of NC group was 48 ± 1.5 U/L, which significantly ($p<0.001$) increased to 80 ± 1.3 U/L in DC group, the increased levels were significantly decreased in F1, F2, and metformin group ($p<0.001$), when compared to DC group. Diabetes induction caused significant increase ($p<0.001$) in SGPT levels from 43 ± 0.9 U/L to 94 ± 1.2 U/L, when compared to the NC group. The increased SGPT levels were significantly decreased in F1, F2, and metformin group ($p<0.001$), when compared to DC group.

CONCLUSION

There are a broad variety of underlying physiologic problems that may be treated using phytochemicals produced from plants. Herbal medications have grown in popularity in recent years due to their strength, purity, and low cost-effectiveness. Plants are a major source of bioactive compounds that are used in both traditional and modern medicine to prevent and cure illness. People all across the globe have long relied on plant-derived products to cure a wide range of diseases. After going through above literature, we have designed a work to investigate herbal plant for the treatment of diabetes mellitus. For the study, we had

selected *Ichnocarpus frutescens*. As the extract poses numerous class of chemicals such as alkaloids, glycosides, tannins, polyphenols, and terpenoids etc can contribute to the antidiabetic activity through the various enzyme inhibition. Therefor we aimed to investigate effectiveness of *Ichnocarpus frutescens* in diabetes using *in vivo* models.

From qualitative phytochemical screening it was observed that the extract possess numerous kind of chemicals such as alkaloid, carbohydrates, saponins, glycoside, fats and fixed oils, resins, phenols, tannins, diterpins, flavonoids, and proteins. *In vivo* antidiabetic activity of extract have been performed in STZ-induced diabetic model in rats. The antidiabetic potential have been determined by estimating different biochemical parameters such as body weight, serum glucose level, SGOT (AST), and SGPT (ALT) levels. The antidiabetic potential of the extract was comparable with that of Metformin, which is evidenced by decreased levels of blood glucose, SGOT, and SGPT. The extract was given to the animals at doses of 100 mg/kg (F1) and 200 mg/kg (F2).

Hyperglycemia was induced by a single intraperitoneal injection of freshly prepared streptozotocine (STZ). Diabetes induction caused significant decrease in the body weight during the experimental period when compared to NC group. The mean body weights of NC group, at the end of the treatment period was found to be 333 ± 1.4 gm, this was significantly ($p<0.001$) decreased to 223 ± 1.6 gm in DC group. The decreased body weight was significantly ($p<0.001$) improved in F1, F2, and metformin treated groups. The basal serum glucose level of animals of all groups was found to be statistically equivalent. Over the course of the trial, the DC group had a considerable rise in blood glucose levels, indicating that they were diabetic. When comparing the DC to the NC group, the blood glucose levels of the DC group were considerably ($p<0.001$) higher (from 93 ± 1.6 to 349 ± 1.3 mg/dl) at the conclusion of the research. The increased serum glucose level was significantly decreased with treatment of extract (at 100 and 200 mg/kg) and metformin ($p<0.001$).

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In recent years, plants have been studied as possible agents for disease prevention and therapy. Because of their broad availability and the wealth of available empirical and accessible evidence on their traditional usage, herbal products are often favored over synthetic ones. Traditional medicine may be supported by current scientific methodologies, which can be used to verify claims of the medicinal properties of herbs.

Therefore from the above results, we have concluded that *Ichnocarpus frutescens* can be used clinically for the treatment of diabetes mellitus. Thus, our findings demonstrate that the *Ichnocarpus frutescens* possess significant antidiabetic activity in dose dependent manner and if optimize latter can be used clinically to overcome diabetes in a very convenient way

FUTURE PROSPECTIVE

Due to their efficacy, safety, and cheap cost, herbal medicines have been more popular in recent years. There are many bioactive substances that may be found in plants, and these compounds are employed in both traditional and contemporary medicine for the purpose of treating and preventing disease. Plant-based medicines have been used for centuries all over the world to treat a plethora of illnesses. Herbal remedies sometimes consist of a combination of many different ingredients, each of which is thought to have its own unique effect, such as sedation, rejuvenation, or healing. We found considerable antidiabetic action in dosages of 100 and 200 mg/kg of *Ichnocarpus frutescens* extract in the suggested experiment. Our research shows that the plant we chose has strong antidiabetic action and, with little refinement, might be utilized therapeutically to treat diabetes. Moreover, every piece of work has an ultimate scope and ultimate goals. As a result of our current research, we hope to soon report on the *in vitro* and *in vivo* activities of certain phytoconstituents extracted from this plant.

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