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Extraction, Pharmacological Evaluation and Formulation of Selected Medicinal Herbs for Antidiabetic Activity

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Research Article

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Abstract

The aim of present investigation was to formulate and evaluate the polyherbal tablets containing the aqueous extracts of bark of *Albizia odoratissima* (L.F) Benth, Leaves of *Eryngium foetidum* Linn and tuberous roots of *Ipomoea digitata* Linn for its antidiabetic activity. The present investigation for its phytochemical and pharmacological evaluation. Phytochemical constituents were extracted by successive solvent extraction and identified by chemical test. Aqueous extracts showed the presence of majority of phytoconstituents. Hence it was selected for pharmacological evaluation. The prepared tablets including polyherbal tablets were subjected to hardness, thickness, weight variation, friability and disintegration time and the results showed that the tablets were within the limits of pharmacopeial specifications. All the tablets having good disintegration time between 3 minutes to 4 minutes. Acute toxicity studies were done by OECD guide line 423, LD_{50}, ED_{50} values were found out. The hyperglycemic activity of plant extracts of Leaves of *Eryngium foetidum* Linn was significant when compare to the other two plant extract tablets such as bark of *Albizia odoratissima* (L.F) Benth and tuberous roots of *Ipomoea digitata* Linn. The formulated tablets containing Gelatin (E_6L and E_5H) showed significant hyperglycemic effect when compare to the formulations containing HPMC K_4M and CMC as polymers. Hence it concluded that the plant leaves of *Eryngium foetidum* Linn having significant antihyperglycemic activity. The polyherbal formulations were proved effective antihyperglycemic effect than the single drug treatment.

Keywords: *Antihyperglycemic activity, Albizia odoratissima (L.F) Benth, Leaves of Eryngium foetidum Linn and tuberous roots of Ipomoea digitata Linn.*

Introduction

In the last few years there has been an exponential growth in the field of herbal medicine and these drugs are gaining popularity both in developing and developed countries because of their natural origin and less side effects. Many traditional medicines in use are derived from medicinal plants, minerals and organic matter. Diabetes mellitus is caused due to deficiency in production of insulin by the pancreas or by the ineffectiveness of the insulin produced. It is a global problems and number of those affected is increasing day by day. The plants provide a potential source of hypoglycemic drugs because many plants and plant derived compounds have been used in the treatment of diabetes. The main objective of this study was to focus on the antidiabetic activity of bark of *Albizia odoratissima* (L.F) Benth[(1-5)], Leaves of *Eryngium foetidum* Linn[(6-10)] and tuberous roots of *Ipomoea digitata* Linn[(11-15)] with special reference to its putative protective role in alloxan-induced diabetes animal model. Herbal drugs play an important role in the treatment of diseases. Numerous medicinal plants and their formulations are used for various disorders in ethno-medicinal practices as well as traditional systems of medicines in India. Since pre-historic days attempts have been made to find out suitable drugs from natural sources for treatment of different diseases. The rational approach on the experience of folk medicines provides a valuable approach in the search for the development of new and useful therapeutic agents. Diabetes mellitus ranks among top ten disorders causing mortality throughout the world. With the rapid advancement of medicine, a treatment without side effects for the long-term control of this disorder has become important. Alternative therapies have also received attention recently. A growing public interest in herbal medication for diabetes has been in the raise around the world. Application of medicinal plants in the control of diabetes has renewed and the WHO expert

committee on diabetes recommended such as alternative treatment. During the past decade, traditional systems of medicine have become a topic of global importance. Current estimates suggest that, in many developing countries a large proportion of the population relies heavily on traditional practices and medicinal plants to meet primary health care needs. Although modern medicine may be available in these countries, herbal medicines have often maintained popularity for historical and cultural reasons. Concurrently, many people in developed countries have begun to turn to alternative or complimentary therapies, including medicinal herbs. Although there are numerous traditional medicinal plants reported to have hypoglycemic and antidiabetic properties, many of them proved to be not very effective in lowering glucose levels in severe diabetes. Further, most of the hypoglycemic agents used in allopathic medicines are reported to have side effects in long term. Therefore, there is a need to search effective and safe drugs for diabetes. Herbal drugs are prescribed widely even when their biologically active compounds are unknown, because of their effectiveness, less side effects and relatively low costs. The objective of this work was to formulate and evaluate the polyherbal formulation of the selected medicinal plants such as bark of *Albizia odoratissima* (L.F.) Benth, Leaves of *Eryngium foetidum* Linn and tuberous root of *Ipomoea digitata* Linn with special reference for an anti-diabetic activity. Normally all the herbal plants are free from side effect, less toxicity levels, better therapeutic effect, good patient compliance and they are low cost effective medicine which will be beneficial to the society. So considerably of all the above factors, the above medicinal plants were selected to formulate and evaluate the conventional tablet dosage form for an anti-diabetic activity.

Material and Method

Plant materials and Chemical

The bark of *Albizia odoratissima* (L.F) Benth (Family: Mimosaceae), Leaves of *Eryngium foetidum* Linn (Family: Apiaceae) and tuberous roots of *Ipomoea digitata* Linn(Family: Convolvulaceae) were collected in the month of January 2009 from Salem District, Tamilnadu, India. The plant was identified and authenticated by the botanist Dr.A.Balasubramanian (consultant central siddha research) Executive Director ABS botanical garden, Salem, Tamilnadu. Hydroxyl propyl methyl cellulose(HPMC) K_4 M and Carboxyl methyl cellulose was gifted by Microlab (Bangalore). Gelatin was gifted by Research lab (Mumbai). Dibasic calcium phosphate, Aerosil and Methyl paraben was gifted by Zydus Cadila(India). And other chemical are gifted by chemical lab(India).

Animals

Sprague-Dawley rat (150-185g) of either sex and of approximately the same age were procured from the animal house of Central Drug Research Institute, Lucknow. The were kept in the departmental animal house at 26±2°C and relative humidity 44-56% in polyprophlene cages. Tha animals were exposed to alternate 12 hrs of darkness and light each. Animal were provided with standard rodent pellet diet (Dayal,India) and the food was withdrawn 18-24 before the experiment though water was allowed *ad libitu.* All experiments were performed in the morning according to current guidelines for investigation of experimental pain in conscious animals. Th standard orogastric cannula was used for oral drug administration in experimental animals.[16]

Preparation of plant extracts

Method of extraction: Cold percolation process and non polar to polar solvents and cold maceration process.

Requirements: Percolater, Shadedride coarse powder of bark of *Albizia odoratissima* (L.F.) Benth, Leaves of *Eryngium foetidum* Linn and Tuberous root of *Ipomoea digitata* Linn.

Solvents: Petroleum ether, Acetone, Alcohol and Aqueous (water and ethanol).

Preliminary Phytochemical Screening

Aqueous extracts of bark of *Albizia odoratissima* (L.F.) Benth, Leaves of *Eryngium foetidum* Linn and Tuberous root of *Ipomoea digitata* Linn. was subjected to qualitative tests for the identification of various active constitutens viz. Carbohydrates, gum and mucilage's, proteins and amino acids, saponins, phytosterols, flavonoids, phenolic compounds and tannins.[17,18]

Acute toxicity studies (OECD Guideline 423)

This test involves the administration of a simple bolus dose of test substances to faster healthy young adult rodents by oral gavage, observation for upto 15days after dosing and recording of body weight and the necropsy of all the animals. In this method prespecified fixed doses of the test substances were used ie, 5mg/kg, 50mg/kg, 300mg/kg, 2000mg/kg and the mortality due to this study and each dose group should consist of 3 animals. According to Khandelwal[19]

Evaluation of *In-Vitro* Antidiabetic Activity [20,21]

α- amylase inhibition activity

Alpha amylase enzyme is responsible for the metabolism of polysaccharides such as starch carbohydrate, etc. The aim behind present experiment is to study the effect of α-amylase concentration on the rate of reaction and inhibition activity of aqueous extract of A*lbizia odoratissima (L.F), Eryngium foetidum linn* and I*pomoea digitata linn*.

Antihyperglycemic Activity of Extracts on STZ Induced Diabetic Rats

The diabetic rats were divided into different groups, each group contain six rats.

Experimental design

Group I Normal control
Group II Diabetic control
Group III Standard drug (Glibenclamide 5mg/kg)
Group IV and V Received aq. Extract of *Albizia odoratissima* (250 and 500 mg/kg b.w)
Group VI and VII Received aq. Extract of *Eryingium foetidum* linn 250 and 500 mg/kg (b.wt)
Group VIII and IX Received aq. Extract of *Ipomea digitata* linn 250 and 500 mg/kg (b.wt)

All the rats were maintained with standard pellet diet, water and libitum. The blood glucose levels of all the rats were measured at 0,1,2,4,8 and 24 hours and analyzed statistically.

Formulation of Tablets

Table no: 1 Formulation of aqueous bark extract of Al*bizia odoratissima* (L.F) Benth (250mg)

A_1 L to A_6 L = Aquoues extract of bark of *Albizia odoratissima (*L.F.) Benth Low Dose
A_1H to A_6 H = Aquoues extract of bark of *Albizia odoratissima (*L.F.) Bent High Dose
E_1 L to E_6 L = Aqueous extract of the leaves of *Eryngium foetidum* Linn Low Dose
E_1 H to E_6 H = Aqueous extract of the leaves of *Eryngium foetidum* Linn Low Dose
I_1 L to I_6 L = Aqueous extract of roots of *Ipomoea digitata* Linn Low Dose
I_1 H to I_6 H = Aqueous extract of roots of *Ipomoea digitata* Linn High Dose
P_1 L = 83.3mg of *Albizia odoratissima (*L.F.) Benth + 83.3mg of *Eryngium foetidum* Linn+83.3mg of *Ipomoea digitata* linn Low Dose

S.No	INGREDIENTS	A_1 –L	A_2-L	A_3-L	A_4-L	A_5-L	A_6-L
1	Plant extract	250	250	250	250	250	250
2	HPMC K4 M	12.5	25	-	-	-	-
3	Carboxy methyl Cellulose	-	-	12.5	25	-	-
4	Gelatin	-	-	-	-	12.5	25
5	Micro crystalline cellulose	44	31.5	44	31.5	44	31.5
6	Dibasic calcium Phosphate	40.4	40.4	40.4	40.4	40.4	40.4
7	Aerosil	3	3	3	3	3	3
8	Methyl paraben	0.1	0.1	0.1	0.1	0.1	0.1
9	Total weight of Tablet	350mg	350mg	350mg	350mg	350mg	350mg

Table no: 2 Formualtion of aqueous bark extract of Al*bizia odoratissima* (L.F) Benth (500mg)

S.NO	INGREDIENTS	A_1 –H	A_2-H	A_3-H	A_4-H	A_5-H	A_6-H
1	Plant extract	500	500	500	500	500	500
2	HPMC K4 M	12.5	25	-	-	-	-
3	Carboxy methyl Cellulose	-	-	12.5	25	-	-
4	Gelatin	-	-	-	-	12.5	25
5	Micro crystalline cellulose	44	31.5	44	31.5	44	31.5
6	Dibasic calcium Phosphate	40.4	40.4	40.4	40.4	40.4	40.4
7	Aerosil	3	3	3	3	3	3
8	Methyl paraben	0.1	0.1	0.1	0.1	0.1	0.1
9	Total weight of Tablet	600mg	600mg	600mg	600mg	600mg	600mg

P_2 H =166.6mg of *Albizia odoratissima+* 166.6 mg *of Eryngium foetidum* Linn +166.6mg of *Ipomoea digitata* Linn. High Dose

Table no: 3 Formualtion of aqueous extract of the leaves of E*ryngium foetidum* linn (250 mg)

S.No	INGREDIENTS	E_1 –L	E_2-L	E_3-L	E_4-L	E_5-L	E_6-L
1	Plant extract	250	250	250	250	250	250
2	HPMC K4 M	12.5	25	-	-	-	-
3	Carboxy methyl cellulose	-	-	12.5	25	-	-
4	Gelatin	-	-	-	-	12.5	25
5	Micro crystalline cellulose	44	31.5	44	31.5	44	31.5
6	Dibasic calcium phosphate	40.4	40.4	40.4	40.4	40.4	40.4
7	Aerosil	3	3	3	3	3	3
8	Methyl paraben	0.1	0.1	0.1	0.1	0.1	0.1
9	Total weight of Tablet	350mg	350mg	350mg	350mg	350mg	350mg

Table no: 4 Formualtion of aqueous extract of the leaves of E*ryngium foetidum* linn (500mg)

S.NO	INGREDIENTS	E_1 –H	E_2-H	E_3-H	E_4-H	E_5-H	E_6-H
1	Plant extract	500	500	500	500	500	500
2	HPMC K4 M	12.5	25	-	-	-	-
3	Carboxy methyl cellulose	-	-	12.5	25	-	-
4	Gelatin	-	-	-	-	12.5	25
5	Micro crystalline cellulose	44	31.5	44	31.5	44	31.5
6	Dibasic calcium phosphate	40.4	40.4	40.4	40.4	40.4	40.4
7	Aerosil	3	3	3	3	3	3
8	Methyl paraben	0.1	0.1	0.1	0.1	0.1	0.1
9	Total weight of tablet	600mg	600mg	600mg	600mg	600mg	600mg

Table no: 5 Formualtion of aqueous extract of roots of I*pomoea digitata* linn (250 mg)

S.NO	INGREDIENTS	I_1 –L	I_2-L	I_3-L	I_4-L	I_5-L	I_6-L
1	Plant extract	250	250	250	250	250	250
2	HPMC K4 M	12.5	25	-	-	-	-
3	Carboxy methyl Cellulose	-	-	12.5	25	-	-
4	Gelatin	-	-	-	-	12.5	25
5	Micro crystalline cellulose	44	31.5	44	31.5	44	31.5
6	Dibasic calcium Phosphate	40.4	40.4	40.4	40.4	40.4	40.4
7	Aerosil	3	3	3	3	3	3
8	Methyl paraben	0.1	0.1	0.1	0.1	0.1	0.1
9	Total weight of Tablet	350mg	350mg	350mg	350mg	350mg	350mg

Evaluation of Tablets [22-27]

Physical Appearance

Prepared conventional tablets were evaluated for smoothness, absence of cracks, chips and other undesirable characteristics.

Hardness:

The hardness test was performed to measure the tablet strength. Tablet should be hard enough to withstand packing and shipping. Pfizer hardness tester was used for the determination of hardness of tablets. The hardness of 10 tablets were noted and the average hardness was calculated. It is expressed in kg/cm^2.

Thickness

Thickness was determined for 20 pre weighed tablets of each batch using a digital vernier scale and the average thickness were determined in mm**.** The thickness of the tablet is mostly related to

the tablet hardness and can be used as an initial control parameter.

Table no: 6 Formulation of aqueous extract of roots of I*pomea digitata* linn (500mg)

S.NO	INGREDIENTS	I_1 –H	I_2-H	I_3-H	I_4-H	I_5-H	I_6-H
1	Plant extract	500	500	500	500	500	500
2	HPMC K4 M	12.5	25	-	-	-	-
3	Carboxy methyl Cellulose	-	-	12.5	25	-	-
4	Gelatin	-	-	-	-	12.5	25
5	Micro crystalline cellulose	44	31.5	44	31.5	44	31.5
6	Dibasic calcium Phosphate	40.4	40.4	40.4	40.4	40.4	40.4
7	Aerosil	3	3	3	3	3	3
8	Methyl paraben	0.1	0.1	0.1	0.1	0.1	0.1
9	Total weight of Tablet	600mg	600mg	600mg	600mg	600mg	600mg

Table.no: 7 Polyherbal formulations

S. NO	INGREDIENTS	P_1 L	P_2 H
1	Plant Extract	250	500
2	Gelatin	12.5	25
3	MCC	44	31.5
4	Aerosil	3	3
5	Dibasic calcium Phosphate	40.4	40.4
6	Methyl paraben	0.1	0.1
	Total	350	600

Weight variation

20 tablets were randomly selected from each formulation and their average weight was calculated using digital balance. Individual weight of each tablet were also calculated using the same and compared with the average weight.

$$\% \text{ Deviation} = \frac{\text{Average weight} - \text{Tablet weight}}{\text{Average weight}} \times 100$$

Table no: 8 Percentage Deviation Allowed Under Weight Variation

Average tablet weight	% Deviation
Less than 80 mg	10
More than 80, less than 250 mg	7.5
250 mg or more	5

Friability

Friability of the tablet was checked by using Roche friabilator. This device subjects a number of tablets to the combined effect of the abrasion and shock by utilizing a plastic chamber that revolves at 25 rpm dropping at a distance of 6 inches with each revolution. Pre-weighed sample of tablets are placed in the friabilator, which was operated for 100 revolutions. The tablets were taken out and observed for capping. Tablets were de-dusted and reweighed. The formula used for calculating % Friability is

$$\% \text{ Friability} = \frac{(W_1 - W_2)}{W_1} \times 100$$

Where,

W_1 = Initial weight of the tablets taken;

W_2 = final weight of the tablets after testing.

Disintegration time

Disintegration time is the time required for a tablet to break up into granules of specified size (or smaller), under carefully specified test conditions. The disintegration test was carried out in an apparatus contain a basket rack assembly with six glass tubes of 7.75 cm length and 2.15 mm in diameter the bottom of which consists of a 10 mesh sieve. The basket was raised and lowered 28-32 times per minute in the medium of 900 ml which was maintained at 37±2°C. Six tablets were placed in each of the tubes and the time required for complete passage of tablet fragments through the sieve (# 10) was considered as the disintegration time of the tablet.

This test was performed to ensure disintegration of tablets in water, if it is to be used as a dispersible tablet. Dispersible tablets must disintegrate within 3 mins when examined by the disintegration test for tablets as per the compliance in the pharmacopoeia

***In-Vivo* Antidiabetic Studies of the Formulation**

Oral glucose tolerance test (OGTT)

Group I Normal control

Group II standard drug (Glibenclamide 5mg/kg)

Group-III&IV received the tablets of aqueous extract of*Albizia odoratissima*(L.F) Benth

(HPMC K_4M 250 and 500mg/kg)

Group V and VI received the tablets of aqueous extract of A*lbizia odoratissima*(L.F) Benth (CMC 250 and 500mg/kg)

Group VII and VIII received the tablets of aqueous extract of A*lbizia odoratissima*(L.F) Benth (Gelatin 250 and 500mg/kg)

Procedure

The oral glucose tolerance test (Balamurugan et.al) was performed on over night fasted (18 hours) normal rats. Glucose 2gm/kg b.w was given 30 min after the administration of the aqueous extracts and standard drug (glibenclamide 5mg/kg) respectively. Blood was withdrawn from the retro-orbital sinus under ether inhalation at 30, 60, 90, and 120 min of glucose administration and glucose levels were estimated using a glucometer.

The same experimental design was followed for the tablets of aqueous extract of *Eryngium foetidum* linn (250mg/kg, 500mg/kg) and *Ipomoea digitata* linn (250mg/kg, 500mg/kg) by using the polymer of HPMC K_4 M, CMC and Gelatin respectively. The above experimental design was followed for the polyherbal tablets (250mg/kg, 500mg/kg) by using Gelatin as a polymer.

Hypoglycemic Activity of Aqueous Extracts *A.odoratissima*(L.F) Benth , *E. foetidum* Linn And *I.digitata* Linn On Normal Rats [28,29]

Group I normal control (5ml/kg b.w. 0.9% Nacl p.o)

Group II and III Received aqueous Extract of *Albizia odoratissima* (L.F) Benth (HPMC K_4 M 250 and 500 mg/kg b.w)

Group IV and V Received aqueous extract of *Albizia odoratissima*(L.F) Benth(CMC 250 and 500 mg/kg b.w).

Group VI and VII received the tablets of aqueous extract of A*lbizia odoratissima*(L.F) Benth(Gelatin 250 and 500mg/kg)

Procedure

Healthy male wistar albino rats weighing 175-180mg were selected for this (pallabk haldar et.al) study. The animal used for the study were fasted for 12 hours (but still allowed free access of water throughout the fasting period). At the end of 12 hours fasting period, blood samples were collected from the tail tip at initial (before administration) 1hour, 2 hour, 3hours, 4 hours, intervals after administration. The blood sugar level was measured by using glucometer.

The same experimental design was followed for the tablets of aqueous extract of *Eryngium foetidum* linn (250mg/kg, 500mg/kg) and *Ipomoea digitata* linn (250mg/kg, 500mg/kg) by using the polymer of HPMC K_4 M, CMC and Gelatin respectively. The above experimental design was followed for the polyherbal tablets (250mg/kg, 500mg/kg) by using Gelatin as a polymer.

Antidiabetic Activity of Extracts on STZ Induced Diabetic Rats [30,31]

Experimental Design

Group I Normal control

Group II Diabetic control

Group III Standard drug (Glibenclamide 5mg/kg)

Group IV and V Received the tablets of aqueous extract of *Albizia odoratissima* (L.F) benth (HPMC K_4M 250 and 500 mg/kg b.w)

Group VI and VII Received the tablets of aqueous extract of *Albizia odoratissima* (L.F) benth (CMC 250 and 500 mg/kg b.w)

Group VIII and IX Received the tablets of aqueous extract of *Albizia odoratissima* (L.F) benth (Gelatin 250 and 500 mg/kg b.w)

Procedure:

The diabetic induced rats were randomly divided into nine groups, each consisting of six animals. Group one as a normal vehicle control received 0.9% sodium chloride p.o(5ml/kg). Group II as a diabetic control received only a vehicle. Group III diabetic animals received standard drug (Glibenclamide 5mg/kg p.o). Group IV and V diabetic animals received 250 and 500mg/kg HPMC K_4 M, Group VI & VII received 250 and 500mg/kg CMC and Group VIII and IX received 250 and 500mg/kg of Gelatin.

The same experimental design was followed for the tablets of aqueous extract of *Eryngium foetidum* linn (250mg/kg, 500mg/kg) and *Ipomoea digitata* linn (250mg/kg, 500mg/kg) by using the polymer of HPMC K_4 M, CMC and Gelatin respectively. The above experimental design was followed for the polyherbal tablets (250mg/kg, 500mg/kg) by using Gelatin as a polymer.

Determination of Body Weight [32]

Experimental design

Group I Normal control

Group II Diabetic control

Group III Standard drug (Glibenclamide 5mg/kg) group IV and V Received the tablets of aqueous extract of *Albizia odoratissima* (L.F) benth (HPMC K_4M 250 and 500 mg/kg b.w)

Group VI and VII Received the tablets of aqueous extract of *Albizia odoratissima* (L.F) benth(CMC 250 and 500 mg/kg b.w)

Group VIII and IX Received the tablets of aqueous extract of *Albizia odoratissima* (L.F) benth

(Gelatin 250 and 500 mg/kg b.w)

Procedure

Body weight has been measured totally five times during the course study period that is 1st day 5th day 8th day 11th day and 14th day of the treatment period using a digital weighing scale. In the diabetic rats were sub divided into nine groups. Group I as a normal control received 0.9% sodium chloride p.o(5ml/kg). Group II as a diabetic control received vehicle only. Group III diabetic animals received standard drug Glibenclamide 5mg/kg . Group IV & V diabetic animals received 250 and 500mg/kg HPMC K_4 M, group VI & VII diabetic animal received 250 and500mg/kg CMC and Group VIII and IX diabetic animals received 250 and 500mg/kg Gelatin respectively.

The same experimental design was followed for the tablets of aqueous extract of *Eryngium foetidum* linn (250mg/kg, 500mg/kg) and *Ipomoea digitata* linn (250mg/kg, 500mg/kg) by using the polymer of HPMC K_4 M, CMC and Gelatin respectively. The above experimental design was followed for the polyherbal tablets (250mg/kg, 500mg/kg) by using Gelatin as a polymer.

Bio-Chemical Parameters Investigation[33-36]

After blood glucose estimation on the 14th day, whole blood was collected by cardiac puncture under mild anaesthesia from rats. Total cholesterol, Triglycerides, HDL, LDL and VLDL were evaluated in normal and STZ induced diabetic rats. The biochemical estimation of the lipid profiles are performed from Salem Diagnostic & Reference Laboratory, Salem.

Estimation of total cholesterol

The serum cholesterol level was estimated by wybenga and pileggi method using cholesterol diagnostic reagent kit (Span Diagnostics, Surat, India)

Estimation of triglycerides

The triglycerides level was estimated by Glycerol phosphate oxidase (GPO) method (Qualigens diagnostics).

Estimation of High density lipoprotein (HDL)

The high density lipoprotein (HDL) was estimated by using Digital Spectrphotometer, by the following procedure. 500 µl of reagent one and 500 µl of serum was mixed and centrifuged for 10 min. Then from the above precipitated mixture, 10 µl of serum was taken and mixed with 1 ml of cholesterol reagent. It was incubated for 10 min then readings were observed in digital spectrophotometer at 520 nm.

Estimation of low density lipoprotein (LDL)

The low density lipoprotein can be estimated by using the formula. The sum of the estimated value and the calculated value of low density lipoprotein is subtracted to the value of total cholesterol gives the value of very low density lipoprotein.

LDL = TOTAL CHLOESTROL – (HDL + VLDL)

Where,

HDL = value of high density lipoprotein

VLDL = value of very low density lipoprotein

Estimation of Very low density lipoprotein (VLDL)

The low density lipoprotein can be estimated by using the formula. The estimated value of triglycerides divided by 5 gives the low density lipoprotein

$$VLDL = \frac{TGL}{5}$$

Where,

TGL = values of Triglycerides

Histopathological Studies

Sacrificing the animals of all groups on the 14th day, the pancreas was removed and used for histopathological studies.

A portion of the pancreatic tissue was fixed in 10% buffer neutral formal saline for histopathological studies. After fixation, tissues were embedded in paraffin. Solid section were cut 5 µm and stained with aldehyde. The sections were examined under light microscope and photo micrographs were taken (Gordon 1990).

Stability Studies

Stability testing forms an integral part of the formulation development process, as the stability of the active components is a major criteria in determining its acceptance or rejection. It provides evidence on how the quality of the product varies with time under the influence of a variety of environmental factors such as temperature and humidity and ensures the safety or efficacy of a formulation. In order to achieve this goal, a preliminary aging study was performed for the formulated tablets. The aging behavior of tablets packed in PVC blister was studied at room temperature. Samples were withdrawn at 1,3 and 6 months intervals and evaluated for their characteristics.

Statistical Analysis

The values were expressed as mean ± standard error of mean (SEM). The data were statistically analyzed using ANOVA with multiple comparisons versus control group by Dunnett's method. The value of $P<0.05$ were taken as significant.

Results and Discussion

Anti diabetic plants had an important role in inhibiting the glucose level and thus providing protection to human against hyperglycemia. Realizing the fact this research was carried out to formulate and evaluate the polyherbal tablets containing aqueous extracts of selected plant materials such as bark of *Albizia odoratissima* (L.F)benth, leaves of *Eryngium foetidum* Linn, tuberous roots of *Ipomoea digitata* Linn for the anti diabetic activity in streptozotocin induced diabetic rats.

The phytoconstituents were extracted by using different solvents of increasing polarity like

petroleum ether, acetone, and alcohol by continuous hot percolation method and aqueous extract by cold maceration method.

Table.no: 9 The extractive values of the plants

S.No:	Plant name	Parts used	Yield in percentage (%)			
			P.Ether Extract	Acetone Extract	Alcohol Extract	Aqueous Extract
1	***Albizia odoratissima***	**Bark**	2.5%	2.8%	5.9%	9.8%
2	***Eryngium foetidum***	**Leaves**	3.5%	4.1%	4.5%	16.5%
3	***Ipomoea digitata***	**Tuberous roots**	4.08%	7%	7.3%	19.5%

The qualitative chemical investigation of all the extracts of selected plants were carried out and the phytoconstituents were identified by chemical tests which showed the presence of various phytoconstituents. The results were shown in table.no:9-10.

Table no: 10 Preliminary phytochemical screening of bark of *Albizia odoratissima* (L.F) Benth.

S.no	Constituents	Aqueous ex. *A.odoratissima*	Aqueous ex. *E.foetidum*	Aqueous ex. *I.digitata*
1	**Carbohydrate**	+	+	+
2	**Glycosides**	+	+	+
3	**Fixed oils & Fats**	-	-	-
4	**Proteins & Amino acids**	+	+	+
5	**Saponins**	+	+	+
6	**Phytosterol**	+	+	+
7	**Alkaloids**	-	-	-
8	**Flavonoids**	+	+	+
9	**Gum & mucilages**	+	+	+
10	**Phenolic compounds and tannins**	+	+	+

+ = Presence **– = Absence**

Extracts name	**Presences of Phytoconstituents**
Petroleum Ether extracts	- Carbohydrates, gum and mucilage's.
Acetone extracts	-Carbohydrates, fixed oils and fats, saponins, phytosterols,flavonoids.
Alcohol extracts	-Phytosterols, alkaloids, gum and mucilage's.
Aqueous extracts	-Carbohydrates, gum and mucilage's, proteins and amino acids, saponins phytosterols, flavonoids, phenolic compounds and tannins.

In the above stated extracts, the aqueous extracts showed the presence of maximum number of phytoconstituents. Hence, the aqueous extracts of bark of *Albizia odoratissima* (L.F)benth (AEAO), leaves of *Eryngium foetidum* Linn(AEEF) and tuberous roots of *Ipomoea digitata* Linn (AEID) were selected for further formulations and pharmacological studies.

Acute Toxicity Studies

The selection of dose was made based upon the minimum concentration of drug required for therapeutic action which will be economically fruitful for further research and formulation.

EVALUATION OF TABLETS:

The physical parameters such as hardness, thickness, weight variation, friability and disintegration time were carried out for the formulated tablets and the results were shown in Table.no:12-18

The polyherbal formulation (P_1 L and P_2 H) were formulated by using gelatin as a polymer. Since the gelatin contained tablet formulations possessed good post compression parameters including the disintegration time when compare to the other two polymer ($HPMCK_4M$ and CMC) containing formulations.

IN-VITRO ANTIDIABETIC ACTIVITY:

α- Amylase inhibition activity of aqueous extracts of bark of *A.odoratissima* (L.F)benth, leaves of *E.foetidum* Linn and tuberous roots of *I.digitata* Linn in tablets

As the concentration of α-amylase increase the rate of reaction is also increase but the time of reaction decrease because of high concentration of α-amylase will digest the starch rapidly.

Table. no: 12 Post Compression Parameters for Formulation A_1-A_6 (L=250mg)

Batch Code	Hardness (kg/cm^2)	Thickness (mm)	Weight Variation (%)	Friability (%)	Disintegration Time
A_1-L	4.43±0.03	3.41±0.21	3.1±0.76	0.42±0.21	3mts 20sec
A_2-L	4.96±0.13	3.6±0.34	2.0±0.43	0.31±0.11	3mts7sec
A_3-L	4.37±0.12	3.42±0.63	2.23±0.76	0.48±0.21	3mts14 sec
A_4-L	4.38±0.31	3.66±0.54	3.24±0.87	0.51±0.23	3mts11 sec
A_5-L	4.44±0.08	3.6±0.65	2.25±0.81	0.42±0.10	3mts 4sec
A_6-L	4,68±0.32	3.70±1.12	2.92±0.52	0.48±0.13	3mts 5sec

Table. no: 13 Post Compression Parameters for Formulation A_1-A_6 (H=500mg)

Batch Code	Hardness (kg/cm^2)	Thickness (mm)	Weight Variation (%)	Friability (%)	Disintegration Time
A_1-H	4.98±0.13	3.89±0.23	2.4±0.10	0.42±0.31	3mts20 sec
A_2-H	5.12±0.04	3.82±0.14	2.24±0.11	0.48±0.01	3mts16 sec
A_3-H	5.40±0.32	3.96±0.13	2.58±0.12	0.39±0.12	3mts18 sec
A_4-H	5.87±0.21	4.21±0.02	2.24±0.31	0.22±0.12	3mts42 sec
A_5-H	4.86±0.23	4.14±0.21	3.17±0.23	0.37±0.21	3mts10 sec
A_6-H	5.2±0.71	3.88±0.31	2.81±0.15	0.34±0.30	3mts15 sec

Table. no: 14 Post Compression Parameters for Formulation E_1-E_6 (L=250mg)

Batch Code	Hardness (kg/cm^2)	Thickness (mm)	Weight Variation (%)	Friability (%)	Disintegration Time
E_1-L	5.15±0.14	4.41±0.21	2.0±0.23	0.46±0.08	2mts45sec
E_2-L	4.74±0.12	4.30±0.19	2.6±0.19	0.38±0.18	3mts17sec
E_3-L	4.94±0.34	3.65±0.17	2.19±0.25	0.25±0.17	3mts30sec
E_4-L	4.48±0.22	3.98±0.05	2.37±0.31	0.36±0.15	3mts10sec
E_5-L	4.15±0.25	4.10±0.34	2.43±0.27	0.39±0.24	3mts4sec
E_6-L	4.89±0.65	3.92±0.37	2.54±0.37	0.41±0.32	3mts3sec

Table. no: 15 Post Compression Parameters for Formulation E_1-E_6 (H=500mg)

Batch Code	Hardness (kg/cm^2)	Thickness (mm)	Weight Variation (%)	Friability (%)	Disintegration Time
E_1-H	5.94±0.21	3.97±0.25	2.46±0.05	0.44±0.19	3mts50sec
E_2-H	5.76±0.18	3.27±0.23	3.1±0.25	0.14±0.02	3mts40sec
E_3-H	5.68±0.19	3.60±0.21	2.92±0.12	0.25±0.17	3mts35sec
E_4-H	5.21±0.24	3.38±0.07	2.86±0.19	0.23±0.05	3mts42sec
E_5-H	5.89±0.27	3.36±0.29	3.24±0.29	0.28±0.08	3mts28sec
E_6-H	6.21±0.32	4.40±0.32	2.12±0.37	0.16±0.04	2mts30sec

Table. no: 16 Post Compression Parameters for Formulation I_1-I_6 (L=250mg)

Batch Code	Hardness (kg/cm^2)	Thickness (mm)	Weight Variation (%)	Friability (%)	Disintegration Time
I_1-L	4.67±0.18	3.89±0.14	2.51±0.19	0.39±0.15	3mts42sec
I_2-L	4.43±0.16	3.47±0.17	2.48±0.21	0.28±0.17	3mts30sec
I_3-L	4.98±0.23	4.24±0.19	1.99±0.07	0.24±0.02	2mts50sec
I_4-L	4.89±0.25	3.78±0.25	2.6±0.25	0.34±0.07	3mts50sec
I_5-L	4.36±0.21	3.44±0.23	2.21±0.27	0.36±0.19	3mts24sec
I_6-L	4.48±0.31	3.92±0.27	2.71±0.29	0.39±0.13	3mts28sec

Table. no: 17 Post Compression Parameters for Formulation I_1-I_6 (H=500mg)

Batch Code	Hardness (kg/cm^2)	Thickness (mm^2)	Weight Variation (%)	Friability (%)	Disintegration Time
I_1-H	5.44±0.17	4.27±0.17	2.13±0.21	0.52±0.09	3mts44sec
I_2-H	5.26±0.21	4.28±0.15	2.12±0.23	0.36±0.02	3mts35sec
I_3-H	5.44±0.07	4.62±0.18	2.20±0.27	0.38±0.19	3mts28sec
I_4-H	5.48±0.25	4.24±0.21	2.10±0.19	0.29±0.01	3mts40sec
I_5-H	5.98±0.31	4.82±0.23	2.16±0.29	0.32±0.07	3mts2sec
I_6-H	5.62±0.19	4.56±0.31	2.13±0.33	0.54±0.32	3mts20sec

Table. no: 18 Post Compression Parameters for Polyherbal Formulation (P_1 L, P_2 H)

Batch Code	Hardness (kg/cm^2)	Thickness (mm)	Weight Variation (%)	Friability (%)	Disintegration Time
P_1 L	5.84±0.21	4.91±0.19	3.21±0.27	0.48±o.31	3mts 40 sec
P_2 H	6.20±0.34	5.12±0.25	3.41±0.07	0.54±0.32	3mts 12 sec

Table No: 19 Observation of Normal Control tube of α-amylase solution.

Tube	Amylase Solution	Buffer Solution PH 6.8	Time Until Starch Disapperar (In Min)
1	1 ml tube 1 + 0.5 ml starch solution+0.25 amylase solution	20 drops	14.5
2	1 ml tube 1 + 0.5 ml starch solution+0.5% amylase solution	20 drops	12.5
3	1 ml tube 1 + 0.5 ml starch solution+1% amylase solution	20 drops	11.5
4	1 ml tube 1 + 0.5 ml starch solution+2% amylase solution	20 drops	7.5

Fig No: 1 Control tube of amylase solution.

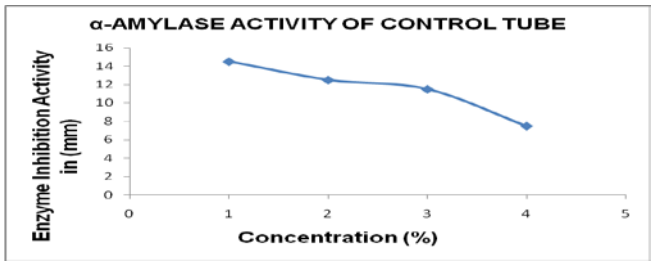


Table No: 20 Observation of standard drug (Glibenclamide) on α-amylase inhibition

Tube	Amylse Solution	Buffer Solution pH 6.8	Time Until Starch Disappear (In Min)
1	1 ml tube 1 + 0.5 ml starch solution+0.25 amylase solution+0.25% standard drug solution	20 drops	24.75
2	1 ml tube 1 + 0.5 ml starch solution+0.5% amylase solution+0.5% standard drug solution	20 drops	19.75
3	1 ml tube 1 + 0.5 ml starch solution+1% amylase solution+1% standard drug solution	20 drops	17.50
4	1 ml tube 1 + 0.5 ml starch solution+2% amylase solution+2% standard drug solution	20 drops	14.25

Glibenclamide is an antidiabetic drug which has α-amylase inhibition activity. As the concentration of Glibenclamide increase the time of reaction is also increase because the number of enzyme required for digest for starch is not sufficient.

Fig no 2 Observation of standard drug (Glibenclamide) on α-amylase inhibition

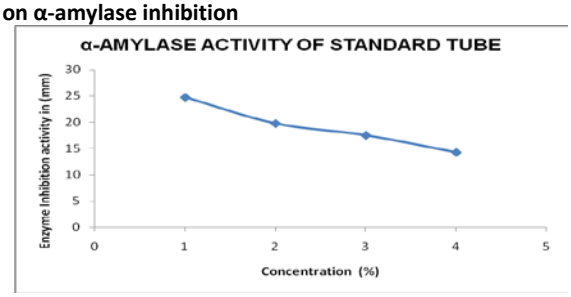


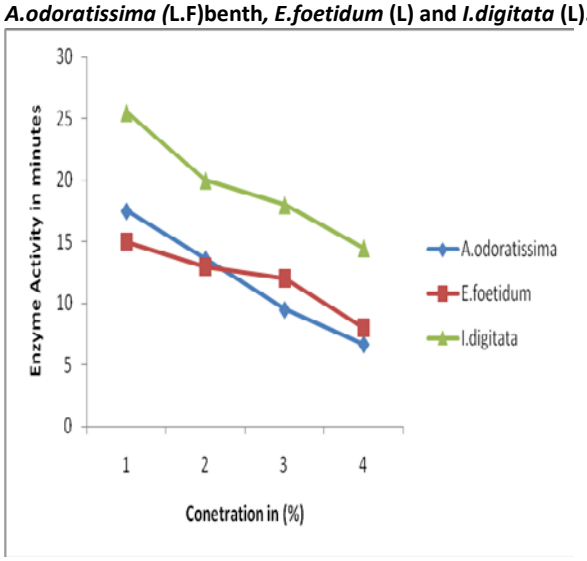
Table No: 21 α-amylase inhibitory activity of aqueous extracts of *A.odoratissima* (L.F)Benth, *E.foetidum* (L) and *I.digitata* (L)

Tube	Amylase Solution	Buffer Solution pH 6.8	Time Until Starch Disapperar (Min)		
			A. odoratissima	*E. Foetidum*	*I. Digitata*
1	1 ml tube 1 + 0.5 ml starch solution+0.25 amylase solution+0.25% aqueous extract solution	20 drops	17.5	15	25.5
2	1 ml tube 1 + 0.5 ml starch solution+0.5% amylase solution+ 0.5% aqueous extract solution	20 drops	13.6	13	20
3	1 ml tube 1 + 0.5 ml starch solution+1%	20 drops	9.5	12	18

	amylase solution+1% aqueous extract solution				
4	1 ml tube 1 + 0.5 ml starch solution+2% amylase solution+2% aqueous extract solution	20 drops	6.7	8	14.5

The aqueous extracts of *A.odoratissima* (AEAO), *E.foetidum* (AEEF) and *I.digitata* (AEID) having α-amylase inhibitory activity. From the observation, it was found that as the concentration of extract increases the time of reaction is also increases but when compared to standard drug they have less activity.

Fig no: 3 α-amylase inhibitory activity of aqueous extracts of *A.odoratissima* (L.F)benth, *E.foetidum* (L) and *I.digitata* (L).



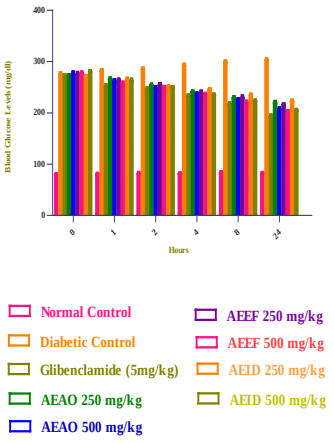
	Glibenclamide (5mg/kg)				**		
4	AEAO 250 mg/kg	271.82±2.25**	264.66±2.94**	252.88±2.74**	240.50±1.86**	228.44±2.64**	218.44±3.45**
5	AEAO 500 mg/kg	275.44±3.81**	260.82±3.91**	248.44±1.94**	236.40±2.10**	224.68±2.41**	206.68±2.698
6	AEEF 250 mg/kg	274.44±4.11**	262.71±2.68**	254.44±2.10**	238.40±3.68**	229.46±3.20**	215.48±1.94**
7	AEEF 500 mg/kg	277.74±1.66**	258.44±1.12**	248.84±2.32**	235.81±1.81**	219.72±2.81**	199.86±4.10**
8	AEID 250 mg/kg	270.69±1.83*	263.17±4.1*	251.46±0.86*	244.88±1.94*	233.46±2.88*	222.44±2.16*
9	AEID 500 mg/kg	279.44±2.81**	262.45±2.82**	249.66±1.66**	234.48±1.87**	222.87±1.89**	204.67±1.79**

Antihyperglycemic Activity Of Aqueous Extracts Of Bark Of *Albizia Odoratissima* (L.F)Benth, Leaves Of *Eryngium foetidum* Linn And Tuberous Root Of *Ipomoea digitata* Linn:

Table.no: 22 Effect of Antihyperglycemic activity of Aqueous Extracts of bark of *Albizia odoratissima* (L.F)Benth, Leaves of *Eryngium foetidum* Linn and tuberous root of *Ipomoea digitata* Linn.

S.No	Treatment	Blood Glucose Level(mg.dl)					
		0 hour	1 hour	2 hour	4 hour	8 hour	24 hour
1	Normal control	79.5±1.48	79.8±2.1	80.89±2.82	80.88±1.72	81.39±3.14	81.98±1.49
2	Diabetic control	275.47±2.48***	281.88±1.94***	284.20±2.54***	291.5±3.21***	298.64±1.98***	302.66±2.10***
3	Standard drug	270.44±3.69***	251.82±2.45***	246.22±1.88***	233.41±1.08*	217.47±1.48***	192.68±2.91***

Fig.no:4 Effect of Antihyperglycemic activity of Aq. Extracts of bark of *Albizia odoratissima* (L.F) Leaves of *Eryngium foetidum* Linn and tuberous roots of *Ipomoea digitata* Linn.



Evaluation of *In-Vivo* Antihyperglycemic Activity

Hypoglycemic activity of bark of *A.odoratissima* (L.F)benth, leaves of *E.foetidum* Linn, tuberous

roots of *I.digitata* Linn and polyherbal tablets on normoglycemic rats.

Table no: 23 Hypoglycemic effect of aqueous extracts of bark of *Albizia odoratissima* (L.F)benth tablets in normoglycemic rats

S. No	Treatment	Blood glucose level(mg/dl)				
		1st hour	2nd hour	3rd hour	4th hour	5th hour
1		80.5±0.92	79.66±1.96	80±0.57	79.83±1.89	79.83±0.74
2	A_2L	80±0.72	78.66±0.8	79.66±2.17	79.81±1.86	79.95±0.8
3	A_2H	80.88±0.6	79.66±1.84	79.16±2.49	79±0.31	80.12±0.42
4	A_4L	80.33±0.84	78.21±0.42	79.23±0.2	79.8±0.55	80.21±0.47
5	A_3H	81±0.63	78.92±1.45	79.44±0.9	80.5±0.4	81.52±0.59
6	A_5L	80.58±0.47	78.52±2.12	79.48±1.24	79.95±0.49	80.24±0.88
7	A_5H	81.48±0.79	78.98±3.22	79.85±2.48	80.48±3.08	81.26±1.98

L=Low dose(250mg), H=High dose(500mg)

Fig.no: 5 Hypoglycemic effect of aqueous extracts of bark of *Albizia odoratissima* (L.F) Benth tablets in normoglycemic rats

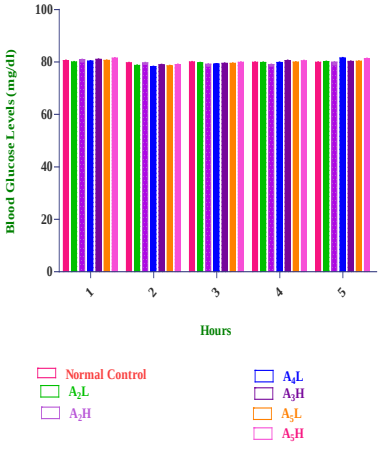


Table no: 24 Hypoglycemic effect of aqueous extracts of leaves of *Eryngium foetidum* Linn tablets in normoglycemic rats

S. No	Treatment	Blood glucose level(mg/dl)				
		1st hour	2nd hour	3rd hour	4th hour	5th hour
1	Normal control	79.33±0.26	78.5±0.67	78.9±0.9	79.12±0.49	79.2±0.57
2	E_2L	80.45±0.55	78.45±0.47	78.79±0.76	79.5±0.82	80.34±0.26
3	E_2H	80.16±0.8	78±1.48	78.5±0.79	79.42±0.44	80.1±0.22
4	E_4L	80.66±0.6	79.47±2.44	79.8±0.55	80.1±1.25	80.5±0.47
5	E_3H	80.83±0.7	78.4±0.21	78.76±0.52	79.12±2.66	79.89±1.69
6	E_6L	81.68±0.94	78.88±2.41	79.05±0.75	80.92±2.48	81.44±2.41
7	E_5H	80.94±0.66	78.66±2.91	79.48±2.34	79.91±0.22	80.62±0.48

L=Low dose(250mg), H=High dose(500mg)

Fig.no: 6 Hypoglycemic effect of aqueous extracts of leaves of *Eryngium foetidum* Linn tablets in normoglycemic rats

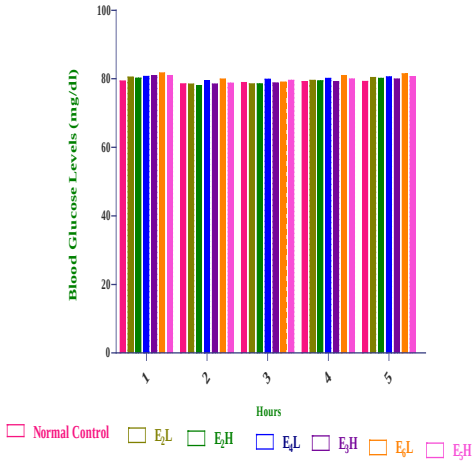


Table no: 25 Hypoglycemic effect of aqueous extracts of tuberous roots of *Ipomoea digitata* Linn tablets in normoglycemic rats

S. No	Treatment	Blood glucose level(mg/dl)				
		1st hour	2nd hour	3rd hour	4th hour	5th hour
1	Normal control	81.33±1.14	80.08±0.55	79.38±1.05	79±0.42	81.2±0.79
2	I_2L	80±0.76	79.89±0.	79.16±1.	79.86±1.	79.98±0.

			36	69	44	67
3	I_2H	81.16±0.87	79.26±0.71	79.52±0.47	80.44±0.91	81±2.47
4	I_3L	81.33±0.91	80.83±0.47	80.94±0.54	81.14±0.47	81.28±1.83
5	I_3H	81.66±1.25	79.47±0.81	79.84±0.22	80.58±0.32	81.5±0.71
6	I_5L	80.94±0.33	78.46±0.41	79.42±2.12	80.10±0.46	80.58±0.82
7	I_5H	81.48±2.12	79.4±3.11	79.81±0.81	80.98±0.92	81.25±2.15

L=Low dose(250mg), H=High dose(500mg)

Fig.no:7 Hypoglycemic effect of aqueous extracts of tuberous roots of *Ipomoea digitata* Linn tablets in normoglycemic rats

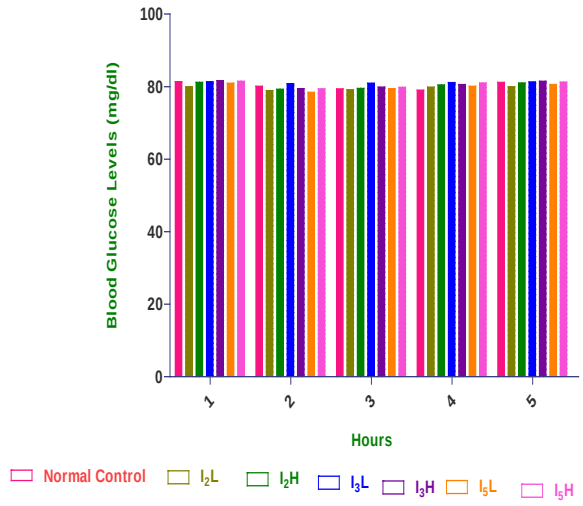
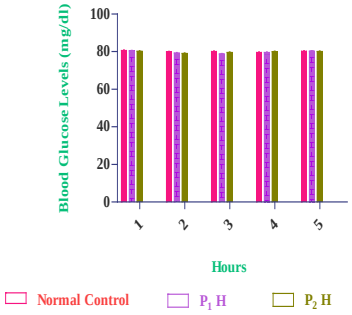


Table no: 26 Hypoglycemic effect of polyherbal tablets in normoglycemic rats

S. No	Treatment	Blood glucose level(mg/dl)				
		1st hour	2nd hour	3rd hour	4th hour	5th hour
1	Normal control	80.5±0.42	79.83±1.47	80±0.36	79.5±0.49	80.16±2.62
2	P_1 L	80.33±0.33	79.16±0.77	78.66±2.16	79.52±0.42	80.12±0.22
3	P_2 H	80.16±1.74	78.92±0.57	79.46±2.35	79.86±0.22	80±2.11

L=Low dose(250mg), H=High dose(500mg)

Fig.no:8 Hypoglycemic effect of polyherbal tablets in normoglycemic rats



Effect of Aqueous extracts of bark of *A.odoratissima* (L.F)benth, leaves of *E.foetidum* Linn, tuberous roots of *I.digitata* Linn and polyherbal tablets on oral glucose tolerance test:

Table no:27 Effect of aqueous extracts of bark of *Albizia odoratissima* (L.F) benth tablets on OGTT in normal rats

S. No	Treatment	Blood Glucose Level(mg.dl)				
		0 mts	30 mts	60 mts	90 mts	120 mts
1	Normal control	76.67±0.76	148±0.76	169.17±0.4	138.83±0.65	122.83±0.72
2	Standard drug Glibenclamide 5mg/kg	75±0.58	140.67±2.78***	158.67±0.67***	135±0.47*	119±0.49**
3	A_2L	76±0.86	147.67±0.72***	174.67±0.64***	149.33±1.02*	139±0.73**
4	A_2H	78.17±0.79	145.67±0.83***	162.83±0.69***	146.33±0.67*	133±0.39**
5	A_4L	77.33±3.2	148.67±2.91***	176±0.58***	150±1.28*	140.33±0.92**
6	A_3H	78±0.95	146.67±0.28***	165.83±0.69***	148.67±2.70*	136.83±0.76**
7	A_5L	78.44±0.26	149.5±0.5	178.55±0.89*	146.88±1.	135.45±2.

			1***	**	12*	16**
8	A_5H	79.82 ±1.68	143.42 ±2.14***	160.21±0.99***	140.62 ±0.81*	128.44 ±2.44***

L=Low dose(250mg), H=High dose(500mg)

		±0.66	3±0.6***	67±0.79***	0.51*	±0.63***
8	E_5H	75.67 ±0.71	144.33±2.86***	155.83±1.33***	139.17±0.54*	122 ±1.55***

L=Low dose(250mg), H=Highdose(500mg)

Fig.no: 9 Effect of aqueous extracts of bark of *Albizia odoratissima* (L.F) Benth tablets on OGTT in normal rats

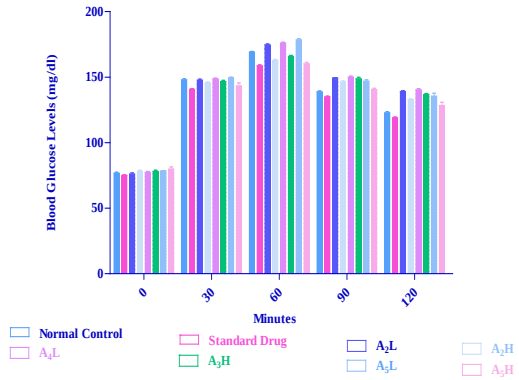


Fig.no: 10 Effect of aqueous extracts of leaves of *Eryngium foetidum* Linn tablets on OGT normal rats

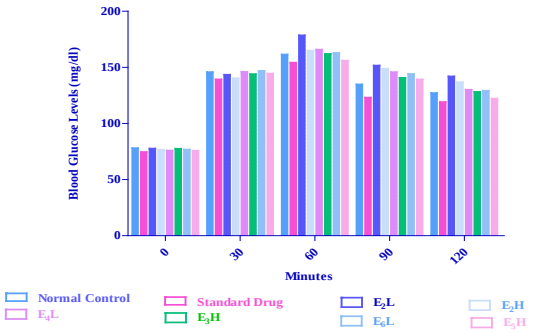


Table no: 28 Effect of aqueous extracts of leaves of *Eryngium foetidum* Linn tablets on OGTT in normal rats

S.No	Treatment	Blood glucose level(mg/dl)				
		0 mts	30 mts	60 mts	90 mts	120 mts
1	Normal control	78±0.89	145.67±0.8	161.33±3.88	134.67±1.05	127 ±0.96
2	Standard drug Glibenclamide 5mg/kg	74.5± 1.18	139.17±1.01***	154± 0.57***	123± 0.36*	119 ±0.63***
3	E_2L	77.54 ±0.48	143.28±0.94***	178.44±3.8***	151.48±0.47*	141 .85 ±0.78***
4	E_2H	76.57 ±1.86	140.12±3.51***	164.74±0.58***	148.72±0.36*	136 .55 ±0.73***
5	E_4L	75.83 ±0.8	145.83±1.35***	165.67±0.49***	145.67±0.42*	130 ±2.44***
6	E_3H	77.5± 1.77	143.83±0.68***	161.83±0.33***	140.5 ±0.72*	128 ±0.57***
7	E_6L	76.67	146.8	162.	144±	129

Table no: 29 Effect of aqueous extracts of tuberous roots of *Ipomoea digitata* Linn tablets on OGTT in normal rats

S.No	Treatment	Blood glucose level(mg/dl)				
		0 mts	30 mts	60 mts	90 mts	120 mts
1	Normal control	78.16±0.48	140± 0.59	163.83 ±0.83	142±0.64	126.67± 0.82
2	Standard drug Glibenclamide 5mg/kg	79.5 ±0.77	141.33±1.66***	152 ±0.61***	133.17 ±0.43*	119.5±0.8***
3	I_2L	80.5 ±0.56	150.83±0.62***	161 .83 ±0.43***	144.83 ±0.89*	137.88± 0.92***
4	I_2H	81.33±0.81	145.33±1.86***	154 .67 ±0.47***	141.67 ±0.58*	129.96± 0.89***
5	I_3L	81.5	151.	164	148.83	138.17±

		±0.77	17±0.58***	.67±0.6***	±0.46*	0.72***
6	I_3H	80.17±2.35	146.6±0.95***	162±0.82***	143.5±0.38*	136.83±0.47***
7	I_5L	81.44±0.39	148.68±0.67***	164.77±1.15***	144.82±1.18*	131.83±0.6***
8	I_5H	80.65±0.68	145.23±2.17***	162.12±1.13***	141.86±1.16*	127±0.79***

L=Low dose(250mg), H=High dose(500mg)

Fig.no: 11 Effect of aqueous extracts of tuberous roots of *Ipomoea digitata* Linn tablets on OGTT in normal rats

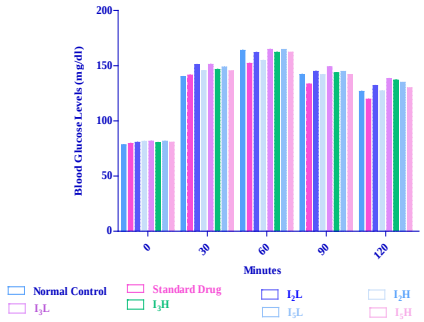
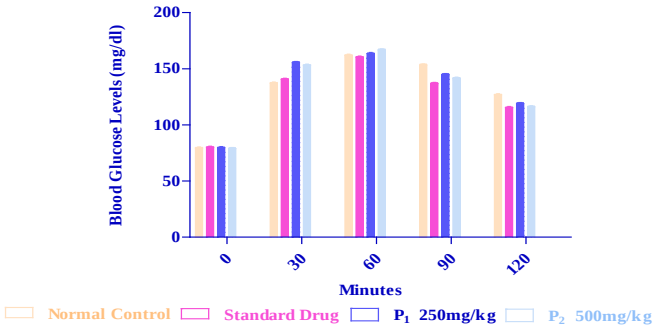


Table no: 30 Effect of polyherbal tablets on OGTT in normal rats

S.No	Treatment	Blood glucose level(mg/dl)				
		0 mts	30 mts	60 mts	90 mts	120 mts
1	Normal control	79.33±0.49	137.17±1.19	162±0.86	153.33±0.33	126.83±0.64
2	Standard drug Glibenclamide 5mg/kg	80±0.57	140.5±1.77***	160.33±0.49**	136.83±0.47*	115.5±0.76***
3	P_1 L	79.67±0.66	155.5±1.87***	163.5±0.56**	144.83±0.88*	119±0.36***
4	P_2 H	78.83±0.	153.17±0	166.67±0.3	141.5±0.42	116.17±0.54*
		37	.68***	3**	*	**

L=Low dose(250mg), H=High dose(500mg)

Fig.no:12 Effect of polyherbal tablets on OGTT in normal rats



ANTIHYPERGLYCEMIC ACTIVITY OF TABLETS :

Table no: 30 Antihyperglycemic effect of aqueous extract of bark of *Albizia Odoratissima* (L.F)benth tablets on STZ induced diabetic rats

S.No	Treatment	Blood glucose level(mg/dl)				
		1st day	5th day	8th day	11th day	14th day
1	Normal control	78.17±1.89	79.83±0.86	81.67±1.94	81.16±2.48	81.83±0.43
2	Diabetic control	257±0.92***	284.83±1.01***	293.5±0.88***	301.17±0.94***	311.67±0.5***
3	Standard drug Glibenclamide, 5mg/kg	258±0.86***	214.5±0.61***	158.33±0.99***	134.5±0.76***	127.2±0.72***
4	A_2L	251.3±0.98**	237.83±1.07**	176.83±1.14**	165.17±0.44**	149.67±1.43**
5	A_2H	255.67±1.19**	232.33±0.92**	173.67±1.01**	155.5±0.42**	142.67±0.66**
6	A_4L	253.55±0.76**	221.83±0.94**	186.33±0.71**	171.5±0.42**	154.83±0.6**
7	A_3H	252.83±1.86**	219.67±0.66**	178.67±0.	166.83±2.67*	146.66±0.76**

				8**	*	
8	A_5L	250.61±2.11**	238±2.81**	175.66±0.89**	163.21±0.47**	146.51±0.62**
9	A_5H	254.22±1.18**	231.24±1.21**	170.42±0.48**	150.42±0.69**	141.24±0.81**

L=Low dose(250mg), H=High dose(500mg)

Fig.no: 13 Antihyperglycemic effect of aqueous extract of bark of *Albizia Odoratissima* (L.F) Benth tablets on STZ induced diabetic rats

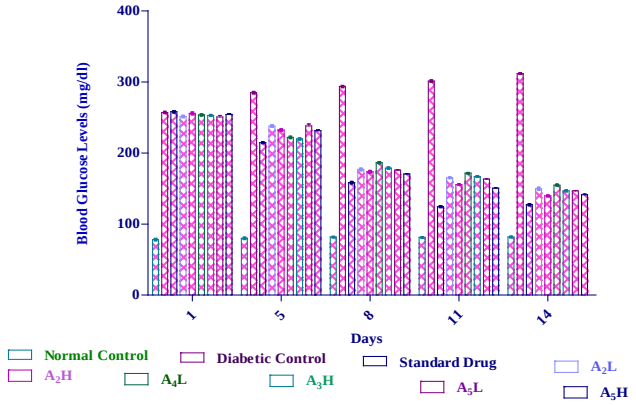
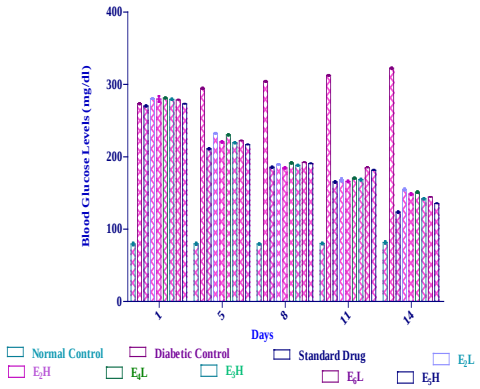


Table no: 31 Antihyperglycemic effect of aqueous extract of leaves of *Eryngium foetidum* Linn tablets on STZ induced diabetic rats

S. No	Treatment	Blood glucose level(mg/dl)				
		1st day	5th day	8th day	11th day	14th day
1	Normal control	79.50±1.69	79.83±1.4	79.5±0.67	80.17±0.87	81.67±1.4
2	Diabetic control	273.33±0.66***	294.5±0.76***	304.17±3.30***	312.5±0.56***	322.33±0.71***
3	Standard drug Glibenclamide, 5mg/kg	270.17±2.41**	211±0.57**	185.5±0.78**	165.17±0.87**	123.5±0.68**
4	E_2L	280.41±0.33*	232.42±0.48*	189.48±1.18*	168.46±2.12*	154.87±1.13*
5	E_2H	274.84±3.86**	220.5±0.83**	184.68±0.78**	165.95±0.84**	148.49±1.26**
6	E_4L	281.17±0.6	230.33±0.6	191.5±	170.5±	151.17
			**	6**	1.78**	2.4**	±0.88**
7	E_3H	279.33±0.88**	219.33±0.71**	188.17±1.48**	168.5±1.05**	146.33±0.77**
8	E_6L	278.33±0.88**	222±0.72**	192.17±0.6**	184.83±1.47**	144.32±0.6**
9	E_5H	273±0.57**	216.5±1.48**	190.5±1.76**	181.33±1.17**	135.33±0.66**

L=Low dose(250mg), H=High dose(500mg)

Fig.no:14 Antihyperglycemic effect of aqueous extract of leaves of *Eryngium foetidum* Linn tablets on STZ induced diabetic rats



S. No	Treatment	Blood Glucose Level(mg/dl)				
		1st day	5th day	8th day	11th day	14th day
1	Normal control	80.17±0.6	79.83±0.43	79.5±0.77	79.9±0.95	80.14±0.55
2	Diabetic control	261.33±0.89***	272±0.58***	284±1.24***	291.5±0.77***	304.33±0.67***
3	Standard drug Glibenclamide 5mg/kg	249.5±1.86**	215.5±2.77**	184.5±1.54**	168±0.58**	128.5±0.77**
4	I_2L	259.67±0.89*	233.67±1.06*	198±1.69*	182±0.58*	157.5±1.18*
5	I_2H	252.5±0.77**	231.83±2.78**	185.83±1.48**	169.67±0.95**	147.67±2.19**
6	I_3L	251.5±0.77*	241.67±0.5*	198.83±2.44*	180.5±1.06*	156.33±0.8*

7	I_3H	250.5±0.97**	239.33±0.66***	189.83±2.89**	164±0.73**	148.67±0.56***
8	I_5L	254.81±2.74*	242.68±0.81*	194.76±0.74*	1745.42±0.62*	152.44±0.92*
9	I_5H	256.48±0.82*	237.46±0.48*	188.44±0.55*	162.88±1.12*	146.44±2.18*

L=Low dose(250mg), H=High dose(500mg)

Fig.no:15 Antihyperglycemic effect of aqueous extract of tuberous roots of *Ipomoea digitata* Linn tablets on STZ induced diabetic rats

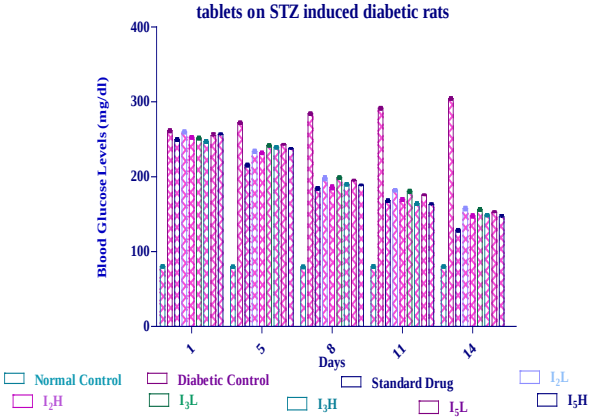
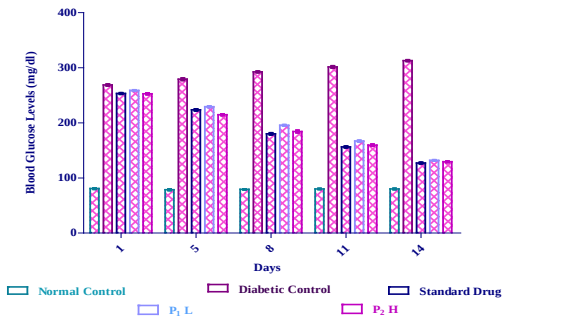


Table no: 33 Antihyperglycemic effect of polyherbal tablets on STZ induced diabetic rats

S.No	Treatment	Blood glucose level(mg/dl)				
		1st day	5th day	8th day	11th day	14th day
1	Normal control	80.77±0.6	78.67±0.7	79.44±1.86	79.98±0.27	80.12±0.47
2	Diabetic control	268.83±1.06***	279.16±1.49***	292.5±0.77***	301.5±1.38***	313±0.85***
3	Standard drug Glibenclamide 5mg/kg	253.33±0.71**	223.66±1.05**	180.16±1.13**	156.33±0.8**	121.16±0.72**
4	P_1 L	258.83±0.44**	229.33±0.66**	195.66±0.57**	166.96±0.9**	127.86±0.6**
5	P_2 H	252.83±0.87**	214.72±0.73**	184.33±1.5**	159.66±1.02**	124.42±0.57**

L=Low dose(250mg), H=High dose(500mg)

Fig.no:16 Antihyperglycemic effect of polyherbal tablets on STZ induced diabetic rats



Effects of Aqeuous extracts tablets on Body weight in STZ induced diabetic rats:

Table no: 34 Effect of aqueous extract of bark of *Albizia odoratissima* (L.F) Benth tablets on body weight in STZ induced diabetic rats.

S. No	Treatment	Body weight (gm)				
		1st day	5th day	8th day	11th day	14th day
1	Normal control	177.5±1.23	178.16±0.54	177.4±0.49	178.33±1.14	179.33±0.88
2	Diabetic control	176.33±1.86***	167.83±1.16***	164.5±2.32***	157±1.06***	150.5±1.98***
3	Standard drug Glibenclamide, 5mg/kg	177.5±0.8***	175.5±1.22***	176.33±1.3***	179.67±1.5***	180.33±0.6***
4	A_2L	176.17±1.1***	175.67±1.1***	176±2.97***	176.33±2.2***	176.5±0.87***
5	A_2H	177.33±1.1***	177±1.11***	177.67±1.3***	178.17±1.5***	178.83±2.5***
6	A_4L	176.67±1.3***	176.17±1.0***	176.5±1.07***	177.8±1.39***	177.92±1.6***
7	A_3H	177.5±1.35***	177.67±1.0***	177.82±0.7***	178.2±0.4***	178.83±1.7***
8	A_5L	178.42±0.4***	178.14±2.1***	178.24±0.4***	178.54±0.6***	179.44±0.8***
9	A_5H	177.60±1.9***	177.12±1.8***	177.81±0.7***	178.42±0.84***	178.94±0.24***

L=Low dose(250mg), H=High dose(500mg)

Fig.no:17 Effect of aqueous extract of bark of Albizia odoratissima (L.F) Benth on body weight of the STZ induced diabetic rats.

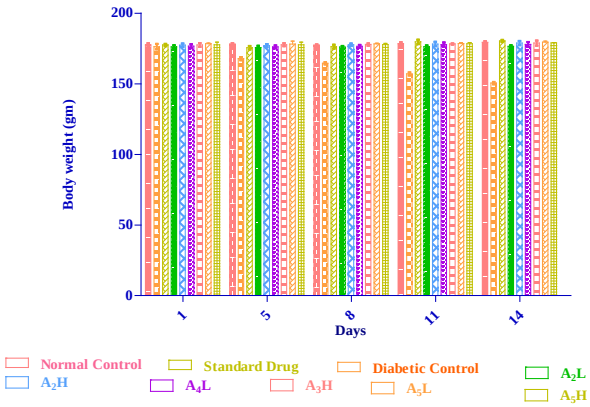


Fig.no: 18 Effect of aqueous extract of leaves of *Eryngium foetidum* Linn on body weight of the STZ induced diabetic rats.

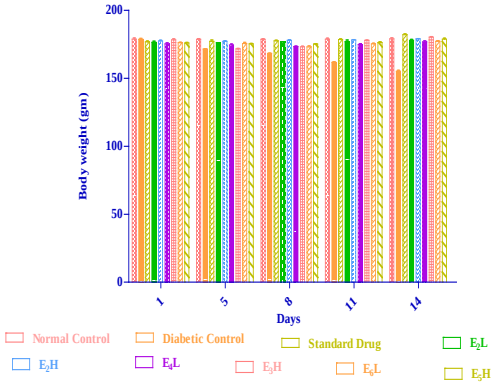


Table no: 35 Effect of aqueous extract of leaves of *Eryngium foetidum* Linn tablets on body weight in STZ induced diabetic rats.

S. No	Treatment	Body weight (gm)				
		1st day	5th day	8th day	11th day	14th day
1	Normal control	178.83±0.79	178.67±0.57	178.67±1.87	178.83±0.71	179±1.44
2	Diabetic control	178.67±0.76***	171.5±0.42***	168.33±0.3***	161.66±0.66***	155.17±0.72***
3	Standard drug Glibenclamide, 5mg/kg	176.83±0.6***	177.17±0.95***	177.58±2.61***	178.52±0.56***	182.17±0.52***
4	E_2L	176.48±0.86***	176.26±0.12***	176.84±0.15***	176.96±1.21***	177.88±0.76***
5	E_2H	177.41±0.61***	177.16±0.55***	177.92±0.48***	178.12±0.41***	178.98±0.33***
6	E_4L	175.33±1.71**	174.5±0.76**	173.33±0.4**	174.91±0.89**	176.86±2.76**
7	E_3H	178.33±0.76**	171.67±0.35**	173.08±0.52**	177.98±0.26**	180.24±0.47**
8	E_6L	176.17±0.47**	175.66±0.8**	176.17±0.7**	176.33±0.49**	178.17±0.6**
9	E_5H	176.5±0.42**	175.33±0.47**	176.89±0.33**	178.44±0.6**	180.89±0.71**

L=Low dose(250mg), H=High dose(500mg)

Acknowledge

Table no: 36 Effect of aqueous extracts of tuberous roots of *Ipomoea digitata* Linn tablets on body weight in STZ induced diabetic rats.

S. No	Treatment	Body weight (gm)				
		1st day	5th day	8th day	11th day	14th day
1	Normal control	181.67±0.76	180.33±0.66	179.16±0.6	180.5±0.56	182±0.72
2	Diabetic control	182.83±1.68***	177.67±2.46***	167.83±0.7**	159.83±0.85**	149±0.36**
3	Standard drug Glibenclamide 5mg/kg	181.67±0.6**	175±2.74**	177.33±0.49***	178.83±0.19**	186.16±0.79**
4	I_2L	176.83±1.1*	177.66±1.67*	177.83±0.47*	178±0.861*	171.67±0.55*
5	I_2H	178.33±0.66***	178.54±0.41***	179±0.68**	179.16±2.26**	179.5±1.91**
6	I_3L	179.66±0.95***	177.16±0.4**	177.33±2.49***	178.47±0.36**	180.33±0.55**
7	I_3H	179.35±0.99***	178.66±0.49***	178.66±1.49***	179.83±0.47**	180.4±0.89**
8	I_5L	180.42±0.49***	179.46±0.86***	179.84±0.98***	180.62±0.19**	181.41±0.82**
9	I_5H	180.86±0.21***	179.44±0.28***	179.89±0.34***	180.91±0.18***	181.98±0.17***

L=Low dose(250mg), H=High dose(500mg)

Fig.no:19 Effect of aqueous extract of tuberous roots of *Ipomoea digitata* Linn on body weight of the STZ induced diabetic rats.

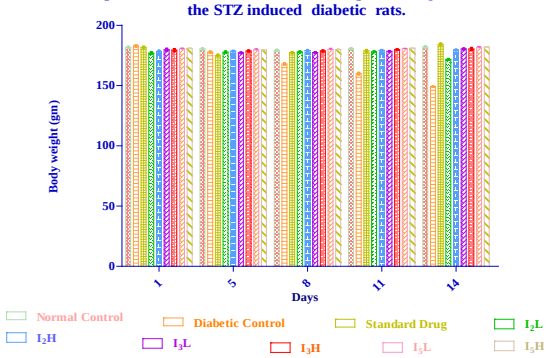
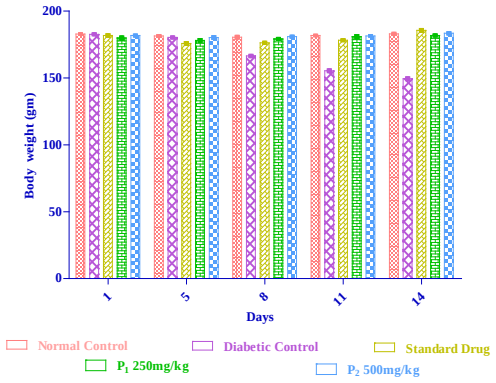


Table no:37 Effect of polyherbal tablets on body weight in STZ induced diabetic rats.

S. No	Treatment	Body weight (gm)				
		1st day	5th day	8th day	11th day	14th day
1	Normal control	182.83±0.25	181.47±0.32	180.5±0.71	181.78±0.2	183±0.47
2	Diabetic control	182.68±0.4**	180.3±0.47**	166.47±0.57**	155.4±1.07**	149.4±1.88**
3	Standard drug Glibenclamide 5mg/kg	181.78±0.61*	175.86±0.71*	176.33±0.39*	178.24±0.72*	188.62±2.74*
4	P_1 L	179.83±0.94*	178.14±0.71*	179.21±2.47*	180.86±2.91*	183.78±0.47*
5	P_2 H	180.78±0.41*	180.24±0.71*	180.92±1.48*	181.48±0.21*	185.42±0.52*

L=Low dose(250mg), H=High dose(500mg)

Fig.no: 20 Effect of polyherbal tablets on body weight in STZ induced diabetic rats.



ANTIHYPERLIPIDEMIC ACTIVITY OF DIFFERENT PLANT EXTRACTS ON STZ INDUCED DIABETIC RATS

Table.no: 38 Antihyperlipidemic activity of aqueous extracts of bark of *Albizia odoratissima* (L.F) Benth tablets on STZ induced diabetic rats on 14th day.

S. No:	Group	Changes In Biochemical Parameters (mg/dl)				
		Serum Cholesterol mg/dl	Serum TGL mg/dl	Serum HDL mg/dl	Serum LDL mg/dl	Serum VLDL mg/dl
1	Normal control	115.8±1.9	89±2.46	46.83±3.21	23.4±2.2	29.6±2.7
2	Diabetic control	138.6±2.89***	189±0.92***	28.42±2.8***	58.4±3.2***	45.5±2.2***
3	Glibenclamide 5 mg/kg	112.24±0.72***	105±2.41***	46.2±1.88***	28.4±1.82***	26.82±0.24***
4	A_2L	132±0.52***	134.5±0.24***	32.44±2.5*	46.2±2.8**	31.42±0.56***
5	A_2H	125.8±0.45***	124.84±0.58***	34.92±1.86*	41.8±3.1***	27.48±2.8***
6	A_4L	134±0.81**	135.6±0.74***	33.48±0.56*	45.7±2.43**	32.8±0.49***
7	A_4H	129.5±0.24***	126.7±2.48***	37.47±0.78*	39.41±1.96***	29.5±2.4***
8	A_5L	129±2.81***	136.4±0.46***	30.46±0.91***	46.47±1.12**	34.36±2.86**
9	A_5H	124±0.99***	132.5±0.82***	37.9±0.75*	41.28±0.66***	30.41±0.43***

L=Low dose(250mg), H=High dose(500mg)

Fig.no:21 Antihyperlipidemic activity of aqueous extract of bark of *Albizia odoratissima* (L.F) Benth tablets on STZ induced diabetic rats on 14th day

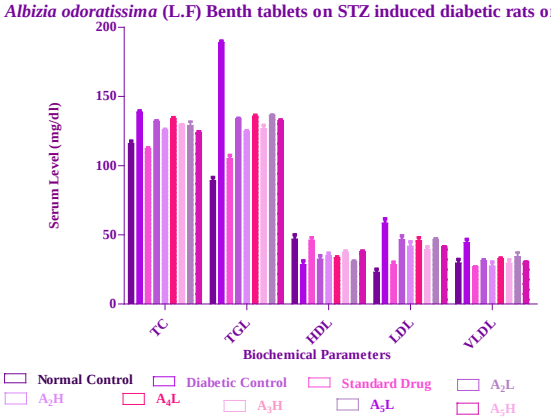


Table.no: 39 Antihyperlipidemic activity of aqueous extract of leaves of *Eryngium foetidum* Linn tablets on STZ induced diabetic rats on 14th day

S. No:	Groups	Changes In Biochemical Parameters (mg/dl)				
		Serum Cholesterol mg/dl	Serum TGL mg/dl	Serum HDL mg/dl	Serum LDL mg/dl	Serum VLDL mg/dl
1	Normal control	116.7±2.8	94.48±2.62	48.5±1.4	25.4±2.9	30.5±2.82
2	Diabetic control	140.5±0.74***	186.49±0.88***	26.51±1.29***	62.8±2.6***	46.8±1.95***
3	Glibenclamide 5mg/kg	109.82±3.60***	108.6±3.6***	47.4±1.56***	28.9±2.5***	27.2±0.85***
4	E_2L	127.65±0.48**	146.8±0.33***	26.81±0.21*	46.7±1.8***	35.41±1.26***
5	E_2H	122.86±0.42*	134.12±0.63***	32.45±0.91*	38.91±0.84***	28.31±0.22***
6	E_4L	125.72±1.82***	144.8±3.2***	31.46±2.8*	43.7±1.9***	34.5±1.89***
7	E_3H	120.42±2.85***	132.36±3.8***	35.75±3.8***	37.2±2.8***	29.8±2.3***
8	E_6L	126.8±0.94**	141.8±1.78***	29.45±1.05*	44.5±3.8***	33.8±0.48***
9	E_5H	119.28±3.1***	127.4±2.94***	36.82±2.4*	36.7±2.2***	26.4±2.22***

L=Low dose(250mg), H=High dose(500mg)

Fig.no:22 Antihyperlipidemic activity of aqueous extract of leaves of *Eryngium foetidum* Linn tablets on STZ induced diabetic rats on 14th day

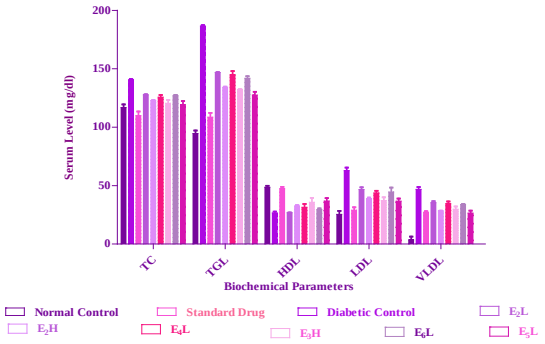


Table.no: 40 Antihyperlipidemic activity of aqueous extract of tuberous roots of *Ipomoea digitata* Linn tablets on STZ induced diabetic rats on 14th day

S.No	Group	Changes In Biochemical Parameters (mg/dl)				
		Serum Cholesterol mg/dl	Serum TGL mg/dl	Serum HDL mg/dl	Serum LDL mg/dl	Serum VLDL mg/dl
1	Normal control	127.3±1.89	94.81±3.4	47.5±1.74	27.42±2.8	33.47±0.85
2	Diabetic control	141.72±2.24***	179.6±2.67***	24.78±2.9***	61.47±1.87***	48.4±2.74***
3	Glibenclamide 5 mg/kg	116.5±2.14***	106.91±3.62***	38.64±0.88***	30.2±3.4***	28.4±2.6***
4	I_2L	138.8±2.65*	133.62±0.96***	31.46±1.89*	42.38±1.87***	33.47±2.2***
5	I_2H	133.44±1.82*	128.86±3.45***	33.91±2.2*	37.44±2.4***	28.9±2.47***
6	I_3L	137.82±2.68*	134.69±2.35***	34.68±2.55**	43.78±2.5***	34.69±2.11***
7	I_3H	133.86±2.91*	131.48±0.98***	37.47±1.28***	39.44±2.24***	29.87±0.98***
8	I_5L	139.81±0.41*	137.81±0.86***	33.81±0.91**	45.20±0.49***	36.86±0.55***
9	I_5H	133.91±0.26*	133.42±0.35***	38.22±0.46***	41.86±0.28***	29.98±0.19***

L=Low dose(250mg), H=High dose(500mg)

Fig.no:23 Antihyperlipidemic activity of aqueous extract of tuberous roots of *Ipomoea digitata* Linn. tablets on STZ induced diabetic rats on 14th day

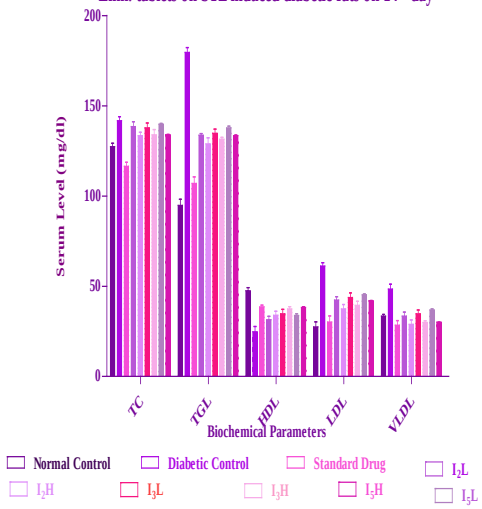
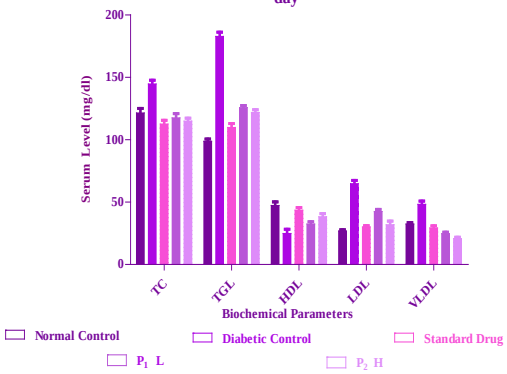


Table.no: 41 Antihyperlipidemic activity of polyherbal tablets on STZ induced diabetic rats on 14th day

S. No:	Group	Changes In Biochemical Parameters (mg/dl)				
		Cholesterol mg/dl	TGL mg/dl	HDL mg/dl	LDL mg/dl	VLDL mg/dl
1	Normal control	121.4±3.6	98.64±1.89	47.25±2.87	26.8±1.05	32.4±1.2
2	Diabetic control	144.67±2.94***	182.67±3.48***	24.86±3.34***	64.78±2.64***	48.20±2.6***
3	Glibenclamide 5 mg/kg	112.46±3.1***	109.8±3.08***	43.48±2.1***	30.12±0.94***	29.24±1.75***
4	P_1 L	117.46±3.46***	125.67±1.79***	32.46±1.8ns	42.46±1.7***	24.72±1.21***
5	P_2 H	114.85±2.42***	121.84±2.21***	38.26±2.48***	31.87±2.9***	20.82±1.05***

L=Low dose(250mg), H=High dose(500mg)

Fig.no:24 Antihyperlipidemic activity of Polyherbal tablets on STZ induced diabetic rats on 14th day



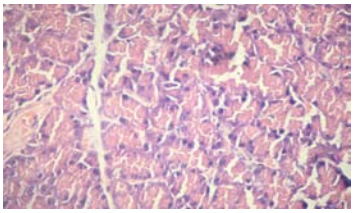
Histopathology of Pancreases:- (Streptozotocin Induced model)

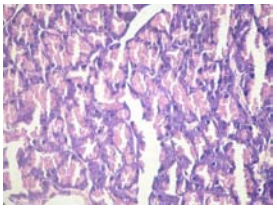
The normal architecture was restored to the same as that of the standard drug (Glibenclamide). This is evident that aqueous extract of bark of *Albizia odoratissima* (L.F.) Benth, Leaves of *Eryngium foetidum* Linn and Tuberous root of *Ipomoea digitata* Linn posses good antidiabetic activity.

Examination of Pancreatic tissue of diabetic rats treated with aqueous extracts of *Albizia odoratissima* (L.F) Benth tablets(AEAO) that of control and normal groups.

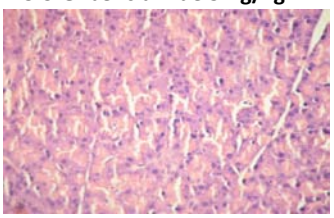
Fig.no:25 Histopathology of Pancreases AEAO

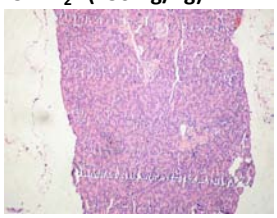
25.1.Normal Control **25.2. STZ 55mg/kg induced diabetic**



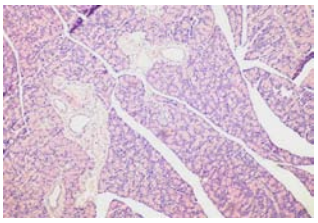


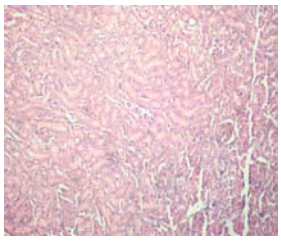
25.3.Glibenclamide 5mg/kg **25.4.A_2L (250mg/kg)**



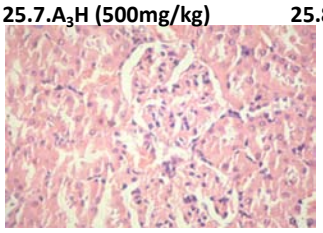


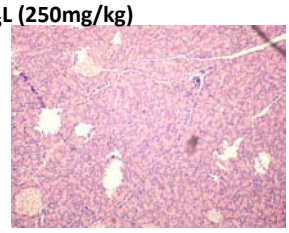
25.5.A_2H (500mg/kg) **25.6.A_4L (250mg/kg)**



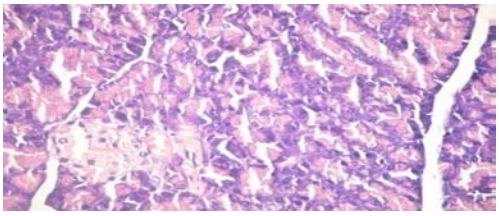


25.7.A_3H (500mg/kg) **25.8.A_5L (250mg/kg)**





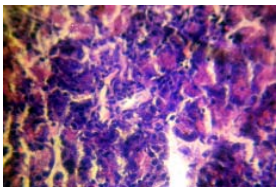
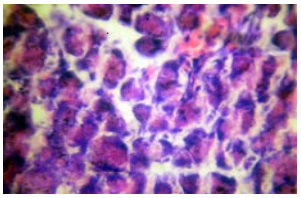
25.9.A_5H (500mg/kg)



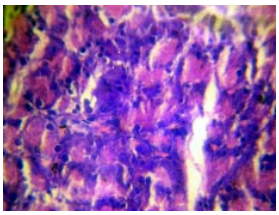
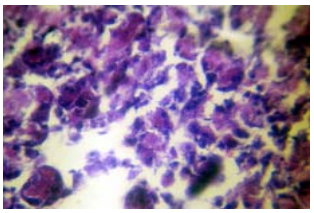
Examination of Pancreatic tissue of diabetic rats treated with aqueous extracts of leaves of *Eryngium foetidum* Linn tablets (AEEF) that of control and normal groups.

Fig.no:26 Histopathology of Pancreases AEAO

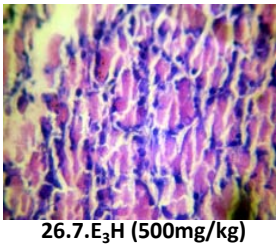
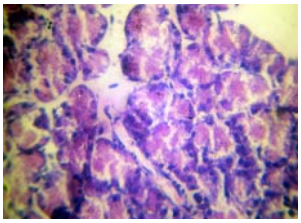
26.1.Normal Control 26.2.STZ 55mg/kg induced diabetic

26.3.Glibenclamide 5mg/kg 26.4.E_2L (250mg/kg

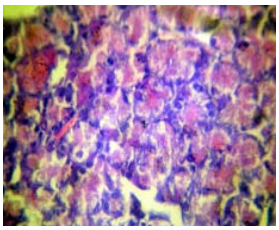
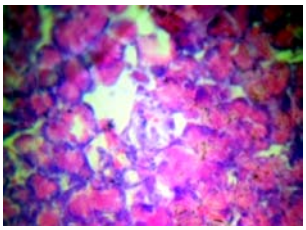



26.5.E_2H (500mg/kg) 26.6.E_4L (250mg/kg)

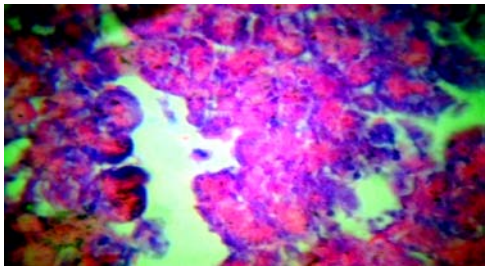



26.7.E_3H (500mg/kg)

26.8.E_6L (250mg/kg)

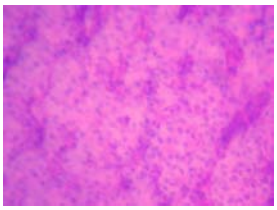
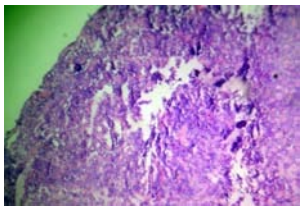
26.9.E_5H (500mg/kg)



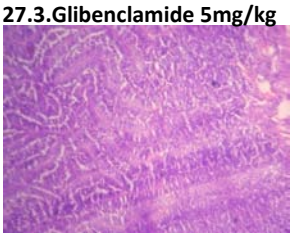
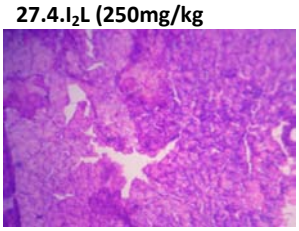
Examination of Pancreatic tissue of diabetic rats treated with aqueous extracts of tuberous root of *Ipomoea digitata* Linn tablets (AEID) that of control and normal groups.

Fig.no:27.Histopathology of Pancreases AEAO

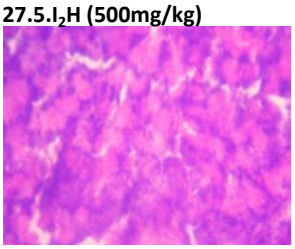
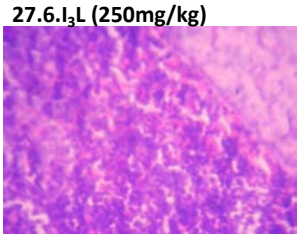
27.1.Normal Control 27.2.STZ55mg/kg induced diabetic

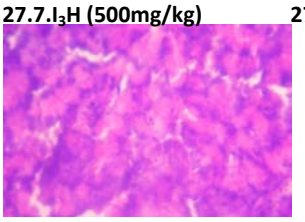
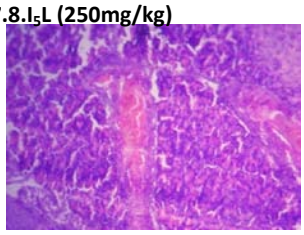
27.3.Glibenclamide 5mg/kg 27.4.I_2L (250mg/kg

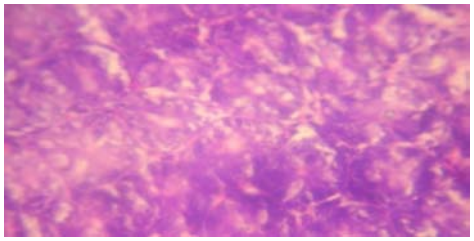
27.5.I_2H (500mg/kg) 27.6.I_3L (250mg/kg)

27.7.I_3H (500mg/kg) 27.8.I_5L (250mg/kg)

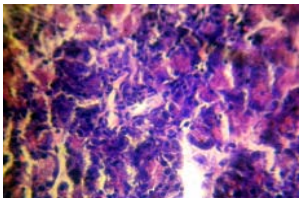



27.9.I_5H (500mg/kg)

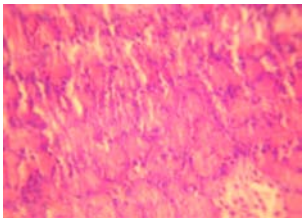


Histopathology of Pancreases Polyherbal
Fig.no:28.Histopathology of Pancreases AEAO

28.1.Normal rats

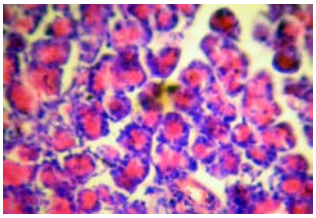


28.2.STZ 55mg/kg induced diabetic rats

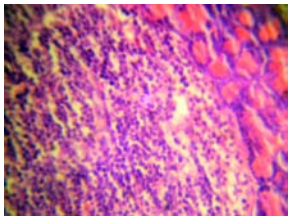


		time	12 seconds	22 seconds	35 seconds	48 second
		Hardness	6.2	6.26	6.54	6.62

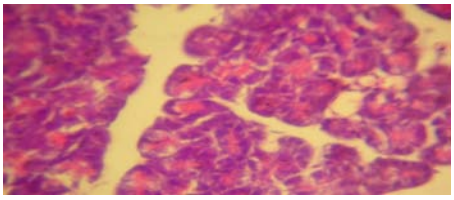
28.3.Glibenclamide (5mg/kg) treated rats



28.4.Polyherbal(P_1 L) 250 mg/kg



28.5.Polyherbal(P_2 H) 500 mg/kg



STABILITY STUDIES

Table.no:42 Stability Studies of Optimized Formulations Stored At Room Temperature

S.no	Batch	Parameter	Initial	1 Month	3 Month	6 Month
1	E_6 L	Colour	Pale green	Pale green	Pale green	Pale green
		Taste	Bitter	Bitter	Bitter	Bitter
		Disintegration time	3 minutes 3seconds	3 minutes 10 seconds	3 minutes 40 seconds	3 minutes 56 seconds
		Hardness	4.89	5.01	5.24	5.5
	E_5 H	Colour	Pale green	Pale green	Pale green	Pale green
		Taste	Slightly Bitter	Slightly Bitter	Slightly Bitter	Slightly Bitter
		Disintegration time	3 minutes 28 seconds	3 minutes 37 seconds	3 minutes 43 seconds	3 minutes 58 seconds
		Hardness	5.89	6.10	6.34	6.5
2	P_1 L	Colour	Light brown	Light brown	Light brown	Light brown
		Taste	Bitter	Bitter	Bitter	Bitter
		Disintegration time	3 minutes 40 seconds	3 minutes 42 seconds	3 minutes 45 seconds	4 minutes
		Hardness	5.84	5.94	6.1	6.25
	P_2 H	Colour	Light brown	Light brown	Light brown	Light brown
		Taste	Bitter	Bitter	Bitter	Bitter
		Disintegration	3 minutes	3 minutes	3 minutes	3 minutes

Summary and Conclusion

The aim of present investigation was to formulate and evaluate the polyherbal tablets containing the aqueous extracts of bark of *Albizia odoratissima* (L.F) Benth, Leaves of *Eryngium foetidum* Linn and tuberous roots of *Ipomoea digitata* Linn for its antidiabetic activity.

The bark, leaves and tuberous roots of plant *Albizia odoratissima* (L.F) Benth, *Eryngium foetidum* Linn and *Ipomoea digitata* Linn belonging to the family Mimosaceae, Apiaceae and Convolvulaceae respectively were subjected to carryout for Phytochemical, Pharmaceutical, Pharmacotherapeutic and Pharmacological studies.

Extraction was carried out with the non polar to polar solvents and cold maceration process. Preliminary phytochemical analysis of aqueous extracts of bark of *Albizia odoratissima* (L.F) Benth, Leaves of *Eryngium foetidum* Linn and tuberous roots of *Ipomoea digitata* Linn showed the presence of carbohydrates, gum and mucilage's, protein and amino acids, saponins, phytosterols, flavonoids, phenolic compound and tannins.

In-vitro antidiabetic activity was carried out and the results showed that the aqueous extracts of bark of *Albizia odoratissima* (L.F) Benth, Leaves of *Eryngium foetidum* Linn and tuberous roots of *Ipomoea digitata* Linn having significant inhibitory effect against α amylase enzyme.

The acute oral toxicity study was done by following OECD guide lines -423 (Acute toxic class method) showed that the aqueous extracts of bark of *Albizia odoratissima* (L.F) Benth, Leaves of *Eryngium foetidum* Linn and tuberous roots of *Ipomoea digitata* Linn showed lethal effect at 2500mg/kg. Hence 250mg/kg was selected as the effective dose. In order to investigate the dose dependent activity, two doses of the extracts (250 and 500mg/kg) were used throughout the study.

Twelve formulations of each plant were prepared with low dose (250mg) and higher dose (500mg). The average weight of the tablets were 350 and 600mg respectively. Direct compression method was used for the formulation of tablet consisting of individual extract powder and polyherbal. The polyherbal formulations (P_1 L and P_2 H) were formulated by using equal quantities of three selected plant extracts of low dose 83.33 and high dose 166.66mg respectively.

The prepared tablets including polyherbal tablets were subjected to hardness, thickness, weight variation, friability and disintegration time and the results showed that the tablets were within the limits of pharmacopeial specifications. All the tablets having good disintegration time between 3 minutes to 4 minutes.

Stability studies were carried out for the optimized formulations. The results indicated that there was no significant changes in hardness and disintegration time.

Antihyperglycemic activity was carried out for the aqueous extracts of selected plants for the period of 1 day. The results showed that the plant extracts exhibited antihyperglycemic effect. Glibenclamide was used as a standard antidiabetic drug in STZ induced diabetes to compare the efficacy of variety of hypoglycemic compounds. Flavonoids, phytosterol, triterpenoids, alkaloids and phenols are known to be bioactive antidiabetic principles. Flavonoids are known to regenerated the damaged β cells in the STZ diabetic rats. Phenols are found to be effective Antihyperglycemic agents.

STZ produced various cardinal symptoms of diabetes such as hyperglycemia, hypoinsulinmia, loss of body weight, poly phagia, poly urea and poly dipsia. The extracts treatment significantly prevented the loss of body weight in the diabetic animals.

The selected aqueous extracts tablets were evaluated for its hypoglycemic effect in normal rats and results showed that the tablets didnot show any significant action on hypoglycemic effect. In oral glucose tolerance test, treatment with tablets showed significant increasing glucose tolerance. In STZ induced diabetic rats, tablets treated groups exhibited significant ($P<0.01$) antidiabetic activity when compared to standard drug (Glibenclamide) at the end of 14^{th} day experiment, but the maximum effect was found in aqueous extract of leaves of *Eryngium foetidum* Linn (E_6L and E_5H). The effects of tablets on body weight determination of STZ induced diabetic rats also exhibited significant effect at the end of the experiment, which was compared to standard drug Glibenclamide.

Normoglycemic effect, oral glucose tolerance test, antihyperglycemic activity and body weight determination were carried out for polyherbal tablets. The results indicated that the prepared polyherbal tablets were having synergistic effect. Since it have significant antihyperglycemic activity.

The lipid profile study also showed that significant decrease of TC, TG, LDL and VLDL and significant increase of HDL level at the end of the experiment in aqueous extract tablets of bark of *Albizia odoratissima* (L.F) Benth, Leaves of *Eryngium foetidum* Linn and tuberous roots of *Ipomoea digitata* Linn treated rats. So the biochemical parameters are also supports this tablets having antidiabetic activity.

Histopatholgical study results reveal that the damage of pancreatic β cells in STZ treated diabetic control rats and regeneration of pancreatic β cells by Glibenclamide was also observed. Comparable regeneration was also shown by aqueous extracts tablets of bark of *Albizia odoratissima* (L.F) Benth, Leaves of *Eryngium foetidum* Linn and tuberous roots of *Ipomoea digitata* Linn, specifically the aqueous extracts of leaves of *Eryngium foetidum* Linn tablets (E_6L and E_5H) showed more significant effect than other two selected plants.Thus it concluded that the aqueous extract tablets were capable of exhibiting significant Antihyperglycemic effect in diabetes rats.

Based on the traditional uses literature review of earlier studies the three plants bark of *Albizia odoratissima* (L.F) Benth, Leaves of *Eryngium foetidum* Linn and tuberous roots of *Ipomoea digitata* Linn were selected for the present investigation for its phytochemical and pharmacological evaluation. Phytochemical constituents were extracted by successive solvent extraction and identified by chemical test. Aqueous extracts showed the presence of majority of phytoconstituents. Hence it was selected for pharmacological evaluation. Micromeritic properties, FT-IR studies and post compression parameters showed that the extract powders were compressible and the prepared tablets were having good tablet properties. Acute toxicity studies were done by OECD guide line 423, LD_{50}, ED_{50} values were found out. The hyperglycemic activity of plant extracts of Leaves of *Eryngium foetidum* Linn was significant when compare to the other two plant extract tablets such as bark of *Albizia odoratissima* (L.F) Benth and tuberous roots of *Ipomoea digitata* Linn.

The formulated tablets containing Gelatin (E_6L and E_5H) showed significant hyperglycemic effect when compare to the formulations containing HPMC K_4M and CMC as polymers. Hence it concluded that the plant leaves of *Eryngium foetidum* Linn having significant antihyperglycemic activity.

The polyherbal formulations were proved effective antihyperglycemic effect than the single drug treatment.

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AUTHORS' CONTRIBUTIONS

Authors contributed equally to all aspects of the study.

PEER REVIEW

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CONFLICTS OF INTEREST

The authors declare that they have no competing interests.