Effect of Different Polar & Non Polar Extracts of *Plumbgo zeylanica* Linn. on Hyperlipidemia in STZ Induced Diabetes Mellitus

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ABSTRACT

AIM- The aim of the present investigation is to study the effect of Different Polar & Non Polar Extracts of *Plumbgo zeylanica* Linn. on Hyperlipidemia in STZ Induced Diabetes Mellitus. **MATERIAL & METHODS-** The leaves of *Plumbgo zeylanica* Linn. was collected from outfield and also purchased from local markets during the month of July that shows the green color with rough surface. The ash content of crude drug is generally taken to be the residue remaining after incineration. The total ash usually consists of carbonates, phosphates, silicates and silica. About 10g of leaves (without preliminary drying), after accurately weighing (weight to within 0.01g) was placed in a tarred evaporation dish. It was then dried at 105^{o}C for 5 hours and weighed. The drug was continuously extracted with petroleum ether for about 72 hours. The mare was dried in air to remove traces of petroleum ether. Defatted drug was subjected to extraction with chloroform, ethyl acetate, ethanol and finally with water in soxhlet apparatus, the extraction was completed in 17-18 hrs. After fasting 18 hours, the rats were injected intraperitoneal injection through tail vein with a single dose of 40 mg/kg Streptozocin (Sigma, St. Louis, Mo, USA), freshly dissolved in citrate buffer (pH 4.5). Then serum samples were also used to analyze for serum Total Cholesterol (TC), Triglycerides (TG), High Density Lipoprotein Cholesterol (HDL-C), Low Density Lipoprotein Cholesterol (LDL-C) and Very Low Density Lipoprotein Cholesterol (VLDL-C). **RESULTS-** The study on selected plant material, shows, that the difference of two consecutive weighing after drying for 30min. and cooling for 30min. in a desiccators- 0.08 & 0.28 gm for leaves. Petroleum ether, chloroform, ethyl acetate extracts had moderately significant effects (p<0.01) on 14th and 21st days. However, aqueous extracts didn't show any significant decrease in glucose levels. Untreated diabetic rats showed significant hypercholesterolemia, hyper triglyceridemia, elevated LDL-Cholesterol, VLDL-Cholesterol and decrease in HDL–Cholesterol in comparison to that of normal group. Ethanolic extract of leaves showed a very good effect on lipid profile. It showed highly significant (p<0.001) effect on lipid profile in comparison to that of diabetic group. **CONCLUSION-** The results obtained in this study have shown that various extracts shown significant anti-diabetic activity.

KEYWORDS-

Polar & Non Polar Extracts, *Plumbgo zeylanica* Linn., Hyperlipidemia, STZ Induced Diabetes Mellitus, Blood Glucose Level

Doi: 10.31838/ecb/2022.11.11.36

INTRODUCTION

Carbohydrates from various dietary sources are the primary exogenous source of glucose. Glucose is the main fuel for energy requirement of the body. Therefore, a continuous supply of glucose is necessary to ensure proper function and survival of all organs. Homeostatic mechanisms are in place to maintain blood glucose levels within a very narrow range (of around 5 mM), protecting the body against hypoglycemia during periods of fasting and against excessively high levels following the ingestion of a high carbohydrate diet. These goals are met chiefly through the hormonal modulation of the production of glucose by the liver and the peripheral uptake of glucose by skeletal muscle, heart muscle and fat. When mammals fast, glucose homeostasis is achieved by triggering expression of gluconeogenic genes in response to glucagon, and when they take a carbohydrate-rich diet, the function is taken over by insulin for its uptake and utilization peripherally. The impairment in glucose metabolism, therefore, may lead to physiological imbalance and warrants proper management (Tamarina *et al*., 2005).

Glucose stimulation of pancreatic islet β-cells initiates a cascade of events resulting in insulin secretion and is dependent on an increase in intracellular Ca^{2+}. This increases the phosphoinositide hydrolysis, inositol 1, 4, 5- triphosphate (IP-3) production and mobilizes Ca^{2+} from intracellular IP-3-sensitive Ca^{2+} stores in the pancreatic β-cells (Karnieli and Armoni, 2008). Regulation of glucose metabolism is a key aspect of metabolic homeostasis and insulin is the dominant hormone influencing this regulatory system. One of the major effects of insulin is to enhance overall glucose disposal, and this is achieved by stimulation of glucose uptake into the target tissues. This task is facilitated by insulin-sensitive glucose transporter (GLUT-4), which is uniquely expressed in skeletal muscles, cardiac muscles and adipose tissues. This action of insulin in the regulation of glucose homeostasis in post-absorptive state is a very important function in maintaining euglycemia and preventing hyperglycemia. Further, glucose absorption process in small intestine and kidney involves two types of glucose transporters i.e. Na^{+} - glucose cotransporters (SGLTs) and facilitated glucose transporters (GLUTs) (Debnam *et al*., 1990).

Herbal extracts produce diverse range of natural products including isoflavonoids, indoles, phytosterols, polysaccharides, sesquiterpenes, alkaloids, glucans and tannins which exhibit complex pharmacological properties. Unlike most synthetic drugs that have pure ingredients, medicinal herbs represent a complex mixture of ingredients. Such different ingredients may

balance, buffer each other, or act synergistically to make the systemic effect more powerful. Therefore, contrary to the allopathic medicines, herbal therapy has emerged as a promising alternative with least toxicities and fewer complications. There is an over growing interest in investigating different medicinal plants in order to identify their potential therapeutic applications (Koehn & Carter, 2006).

As per the literature review, it has been observed that *Plumbgo zeylanica* Linn. (Leaves) is listed among the various medicinal plants widely been used as a antibacterial, demulcent, bitter tonic, laxative, carminative, refrigerant, and febrifuge, diuretic, useful in chronic cystitis, gonorrhea and cadiotonic, acute-chronic inflammatory conditions and in treatment of diabetes mellitus, liver diseases and as a antiulcer. In the absence of any scientific evidence for their anti-diabetic activity in animals, so there is a need in scientifically establishing the anti-diabetic activity so that we are able to come up with a more effective and potent bioactive phytoconstituents with less side effects in comparison with existing synthetic drugs.

MATERIAL & METHODS

Collection and authentication of the leaves

The leaves of *Plumbgo zeylanica* Linn. was collected from outfield and also purchased from local markets during the month of July that shows the green color with rough surface. Plant was identified by the Botanist, Research Officer; Botany at Sangam University, Bhilwara, Rajasthan and herbarium specimen was submitted in Department of Pharmacognosy for the future reference.

Determination of Physico chemical parameters

A. Ash Values

The ash content of crude drug is generally taken to be the residue remaining after incineration. The total ash usually consists of carbonates, phosphates, silicates and silica. Sulphate present in the drug on long storage gets converted in to carbonates and oxide. On treatment of drug with conc. H_2SO_4 the carbonates and oxides get reconverted to sulphate which is stable at high temperature. The procedures given in Indian Pharmacopoeia were used to determine the different ash values. (Mukherjee, P.K., 2002)

a. ***Determination of total Ash value***

Accurately weight about 3 gm of air dried drug was taken in a tarred silica crucible and incinerated by gradually increasing the temperature to make it dull red hot until free from carbon. Cooled and weighed, repeated for constant value. Then the percentage of total ash was calculated with reference to the air dried drug. The determination of total ash value was calculated by using following formula. (Mukherjee, P.K., 2002)

b. ***Determination of acid insoluble Ash value***

The ash obtained as directed under total ash was boiled with 25 ml of HCl for 5 minutes. The insoluble matter was collected on an ash less filter paper, washed with hot water, ignited and weighed, then calculated the percentage of acid insoluble ash with reference to the air dried drug. (Mukherjee, P.K., 2002)

c. ***Determination of water soluble Ash value***

The total ash obtain was boiled with 25 ml of water for 5 minutes. The insoluble matter was collected on an ash less filter paper, washed with hot water ignited for 15 minutes. The weight of insoluble matter was subtracted from the weight of total ash. (Mukherjee, P.K., 2002)

B. Determination of Loss on Drying

Weight about 1.5 g of the powdered drug into a weighed flat and thin porcelain dish. Dry in the oven at 100^0c or 105^0c. Cool in a desiccators and watch. The loss in weight is recorded as moisture. (Mukherjee, P.K., 2002)

C. Determination of Moisture Content

About 10g of leaves (without preliminary drying), after accurately weighing (weight to within 0.01g) was placed in a tarred evaporation dish. It was then dried at 105^{o}C for 5 hours and weighed. Drying was continued and the root was weighed at 1 h interval until the difference between two successive weighing corresponded to not more than 0.25 percent. Constant weight was reached when two consecutive weighing after drying for 30min. and cooling for 30min. in a desiccators, did not show more than 0.01g difference.

D. Determination of Swelling Index (WHO, 2000)

Introduce the specified quantity of the plant material concerned, previously reduced to the required fineness and accurately weighed, into a 25 ml glass stoppered measuring cylinder. Add 25 ml of water and shake the mixture thoroughly every 10 minutes for 1 hour. Allow to stand for 3 hours at room temperature. Measure the volume in ml occupied by the plant material, including any sticky mucilage. Calculate the mean value of the individual determinations, related to 1 g of plant material. (Mukherjee, P.K., 2002)

Successive extraction methods

Powdered drug 100gm was weighed and packed in soxhlet. The drug was continuously extracted with petroleum ether for about 72 hours. Complete defatting was ensured by placing a drop form the thimble on a filter paper give any oily spot. The mare was dried in air to remove traces of petroleum ether. Defatted drug was subjected to extraction with chloroform, ethyl acetate, ethanol and finally with water in soxhlet apparatus, the extraction was completed in 17-18 hrs. The extract was dried & stored in dark place. The % Yield of the Petroleum ether, Chloroform, Ethyl acetate, Ethanol & Aqueous extract was calculated (Mukherjee, P.K., 2002).

Phytochemical Screening

All the extracts after they were stored in decicator and they were screened for the presence of various active phytocompounds i.e. steroids, terpenoids, phenolic compounds, flavonoids, glycosides, alkaloids etc **(**Kokate, C.K., 1996**;** Khandelwal, K.R., 2006**).**

Antidiabetic study of different extracts in STZ induced Diabetes Mellitus

Experimental Animals

Wistar Albino rats of either sex (150 to 200 g) were purchased from the CPCSEA approved vendor New Delhi. They were maintained under standard laboratory conditions at 25 ± 2°C, relative humidity (50 ± 15%) and normal photoperiod (12-hour light-dark cycle) were used for the experiment. Commercial pellet diet (MFD, by Nav Maharashtra Chakan Oil Mills ltd., New Delhi, India) and water were provided ad libitum throughout the course of study.

Selection of Dose

Acute oral toxicity test was carried out according to the OECD guideline No. 423. Wistar Albino Rats were kept for overnight fasting prior to drug administration. A total of three animals were used, which received a single oral dose in 2000 mg/kg, body weight of different extracts. The animals were observed for a period of 24 hr for the changes in behavior, hypersensitivity reactions etc. Mortality, if any, was determined over a period of 2 weeks. Hence in our studies we selected 1/10 and 1/5th dose i.e. 200 and 400 mg/kg dose.

Preparation of Doses

Doses equivalent to 200 mg and 400 mg of the crude drug per kilogram body weight were calculated, and suspended in 1% w/v Tween 80 solutions for the experiment.

Streptozotocin (STZ) induced diabetes in rats

After fasting 18 hours, the rats were injected intraperitoneal injection through tail vein with a single dose of 40 mg/kg Streptozocin (Sigma, St. Louis, Mo, USA), freshly dissolved in citrate buffer (pH 4.5). After injection, the rats had free access to food and water and were given 5% glucose solution to drink overnight to counter hypoglycemic shock. Diabetes in rats was observed by moderate Polydipsia and marked Polyuria. The diabetes was confirmed by estimating the blood glucose level after 3 days by glucometer based on glucose oxidation method. Rats having blood glucose level more than 250 mg/dl were selected for further study. (Ali *et al*., 2009)

Experimental Design of antidiabetic study of leaves of *Plumbago zeylanica* Linn.

In order to assess the anti-diabetic activity, the animals were divided in thirteen groups of six animals in each group.

Group 1: Normal control, 0.9% NaCl-treated animals
Group 2: Diabetic control, STZ -treated rats (40 mg/kg body weight)
Group 3: Treated with Pet. Ether extract of leaves of *PZ* (200 mg/kg body weight)
Group 4: Treated with Pet. Ether extract of leaves of *PZ* (400 mg/kg body weight)
Group 5: Treated with chloroform extract of leaves of *PZ* (200 mg/kg body weight)

Group 6: Treated with chloroform extract of leaves of *PZ* (400 mg/kg body weight)

Group 7: Treated with ethyl acetate extract of leaves of *PZ* (200 mg/kg body weight)

Group 8: Treated with ethyl acetate extract of leaves of *PZ* (400 mg/kg body weight)

Group 9: Treated with ethanolic extract of leaves of *PZ* (200 mg/kg body weight)

Group 10: Treated with ethanolic extract of leaves of *PZ* (400 mg/kg body weight)

Group 11: Treated with aqueous extract of leaves of *PZ* (200 mg/kg body weight)

Group 12: Treated with aqueous extract of leaves of *PZ* (400 mg/kg body weight)

Group 13: Standard drug, Glibenclamide-treated rats (5 mg/kg body weight)

The test drug and reference drug was administered orally at two dose level for a period of 21 days from starting day of diabetes.

Blood collection and biochemical estimations in serum

On 22nd day, fasting blood samples were collected from the tail vein of all the groups of rats. Whole blood was collected for estimation of blood glucose by using the glucometer (Easy Gluco, Morepen Laboratories Ltd.; New Delhi). (Tripathi & Chandra, 2010)

F. Determination of Parameters for Hypolipidemic Activity

Then serum samples were also used to analyze for serum Total Cholesterol (TC), Triglycerides (TG), High Density Lipoprotein Cholesterol (HDL-C), Low Density Lipoprotein Cholesterol (LDL-C) and Very Low Density Lipoprotein Cholesterol (VLDL-C) (Umamaheshwari *et al.*, 2007).

STATISTICAL ANALYSIS

Data were expressed as the mean standard error of mean (S.E.M.) of the means and statistical analysis was carried out employing one-way ANOVA. Differences between the data were considered significant at $P < 0.05$.

RESULTS

Determination of physicochemical parameters

Table No. 1: Physico-chemical parameters of *Plumbago zeylanica* Linn.

S. No.	Physico-chemical parameters	Leaves
1	Total ash	6.8
2	Acid insoluble ash	2.33
3	Water soluble ash	5.78
4	Loss on Drying	3.82

Determination of Moisture content

The study on selected plant material, shows, that the difference of two consecutive weighing after drying for 30min. and cooling for 30min. in a desiccators- 0.08 & 0.28 gm for leaves.

Determination of Swelling Index

The Experimental results on selected plant material shows – volume occupied by 1 gm of plant material= 1.52 ml for leaves.

% Yield Determination of Different extracts of *Plumbago zeylanica* Linn.

Table No. 2: %Yield (w/w) of different extracts

S No.	Solvent	Leaves
1	Petroleum ether	3.88
2	Chloroform	4.68
3	Ethyl Acetate	6.28
4	Ethanolic	9.56
5	Aqueous	3.84

Phytochemical Screening

Phytochemical screening of different extracts showed the presence of different phytochemical.

Table No. 3: Preliminary Phytochemical test for different extracts of *Plumbago zeylanica* Linn.

S. No.	Test	Petroleum ether	Chloroform	Ethyl acetate	Ethanolic	Aqueous
1.	Carbohydrate					
	➢ Molish test	-	-	-	-	+
	➢ Felling test	-	-	-	-	+
2.	Glycosides					
	➢ Bronteger test	-	-	+	-	+
3.	Alkaloid					
	➢ Mayer test	-	+	+	-	-
	➢ Hager test	-	+	+	-	-
4.	Phytosterol + Triterpinoids					
	➢ Salkowaski test	-	+	-	+	-
5.	Protein + Amino acid					
	➢ Biuret test	-	-	-	-	-
	➢ Ninhydrin test	-	-	-	-	-
6.	Phenolic test					
	➢ Ferric test	-	+	+	+	-
	➢ Lead acetate test	-	+	+	+	-
7.	Flavonoids					
	➢ Alkaline test	-	-	+	+	+
8.	Saponin					
	➢ Foam test	-	-	-	-	+
9	Mucilage					
	➢ Iodine test					+
						+
	➢ Ethanol test					

Note: (+) *ve* indicates positive result, whereas (–) *ve* indicates negative result

Antidiabetic study of leaves of *Plumbago zeylanica* Linn.

Effect on Blood glucose level

The induction of diabetes with streptozotocin increases the blood glucose level significantly (p<0.001) in group II rats as compared to normal rats. In 21 day study glibenclamide the standard drug restored the blood glucose highly significantly with the p<0.001 in 14 days whereas ethanolic extract (200 & 400 mg/kg) reduced the glucose level moderately and highly significant with p<0.01 & p<0.001. Petroleum ether, chloroform, ethyl acetate extracts had moderately significant effects (p<0.01) on 14th and 21st days. However, aqueous extracts didn't show any significant decrease in glucose levels. The results are shown in figures.

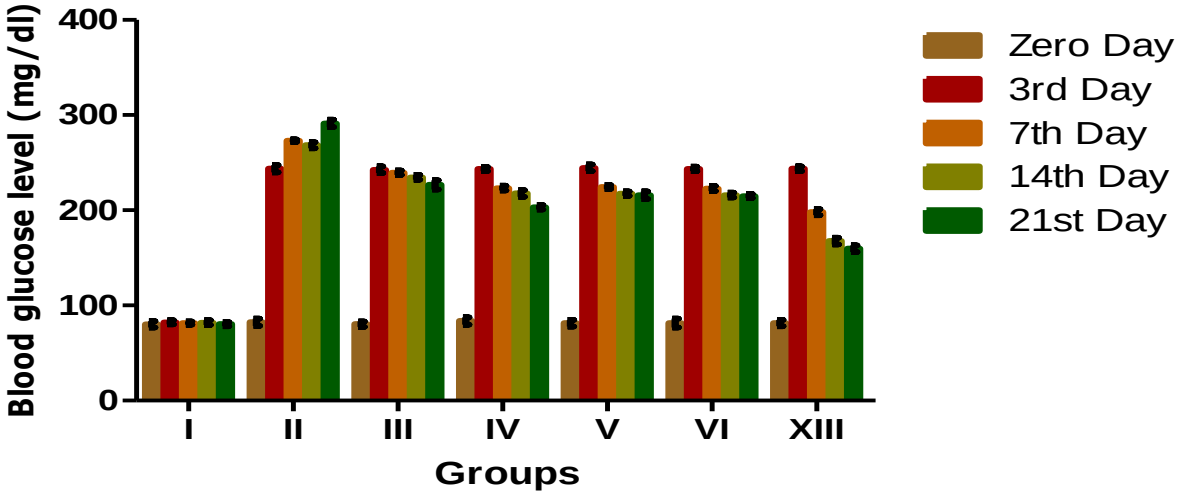

Figure No. 1: Effect of Petroleum ether and Chloroform extracts on Blood Glucose Level

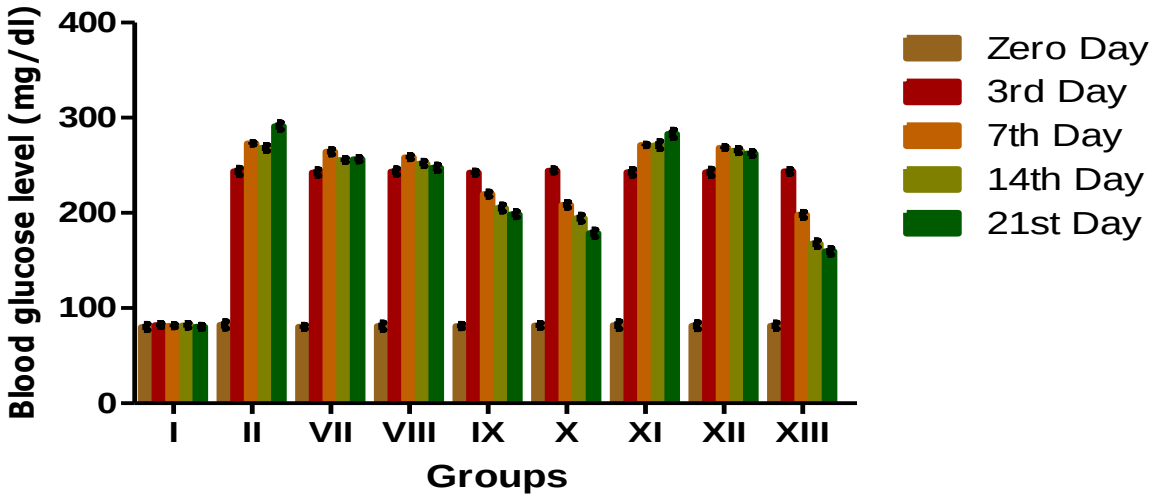

Figure No. 2: Effect of Ethyl acetate and Ethanolic extracts on Blood Glucose Level

Effect of different extracts on different lipid level

Untreated diabetic rats showed significant hypercholesterolemia, hyper triglyceridemia, elevated LDL-Cholesterol, VLDL-Cholesterol and decrease in HDL–Cholesterol in comparison to that of normal group. Ethanolic extract of leaves showed a very good effect on lipid profile. It showed highly significant (p<0.001) effect on lipid profile in comparison to that of diabetic group. Ethyl acetate extract also showed a moderately significant effect on various lipids and also increased HDL level as compared to disease group or diabetic animals. The results were summarized in graph.

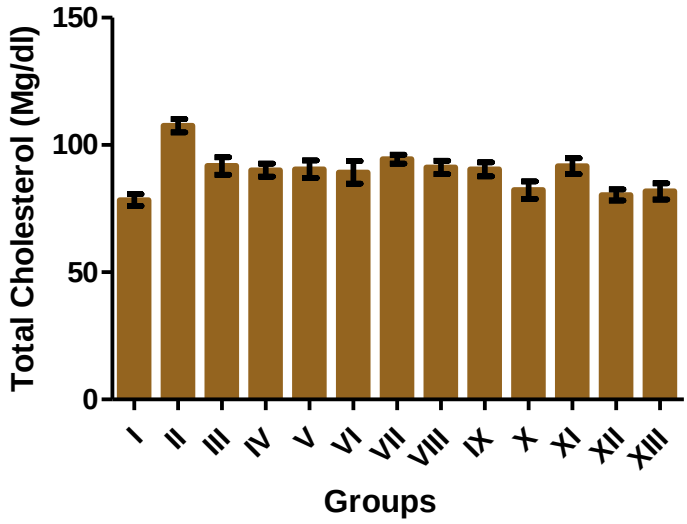

Figure No. 3: Effect of different extracts on Total Cholesterol Level

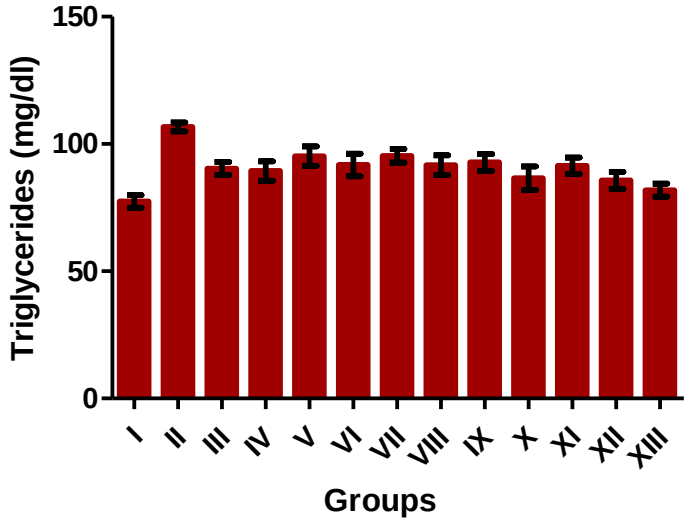

Figure No. 4: Effect of different extracts on Triglycerides Level

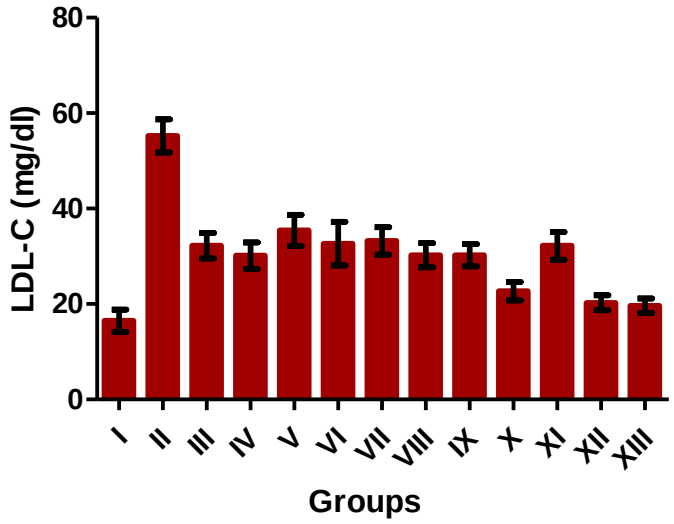

Figure No. 5: Effect of different extracts on LDL-C Level

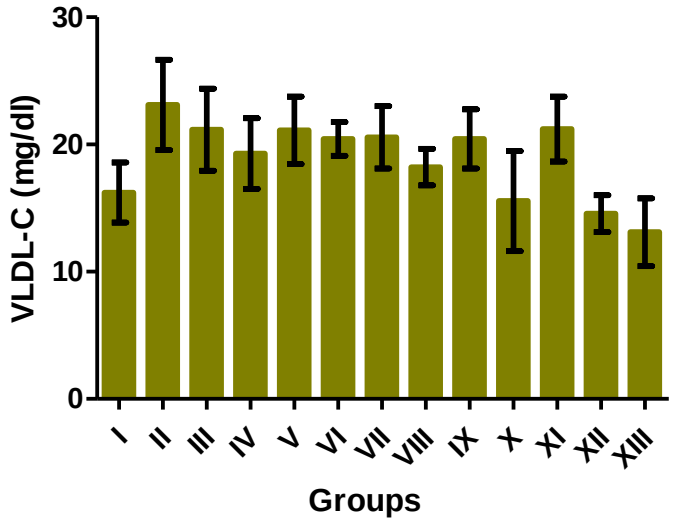

Figure No. 6: Effect of different extracts on VLDL-C Level

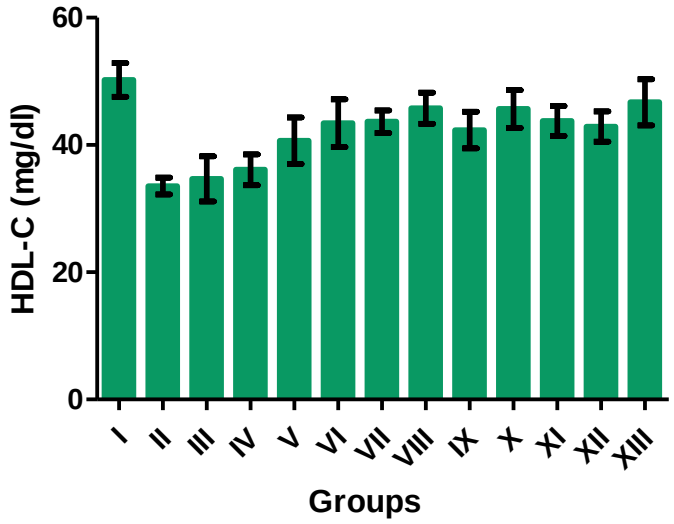

Figure No. 7: Effect of different extracts on HDL-C Level

DISCUSSION

Non-insulin dependent diabetes mellitus is a multifactorial sickness, which is characterized by hyperglycemia and lipoprotein abnormalities. These traits are hypothesized to be responsible for damage to cell membranes through non-enzymatic glycosylation of proteins, auto-oxidation of glucose or increase metabolism of glucose by the sorbitol–polyol pathway. Cell damages will in turn, result in elevated production of reactive oxygen species or ROS. High levels of ROS have been found to play a role in the pathogenesis of NIDDM (Al-Qattan *et al*., 2008). However, hormone fails as a curative agent for complications of diabetes and the major drawbacks of insulin therapy are the side effects like insulin allergy, lipodystrophy and lipoatropy, insulin antibodies, altered metabolic control, autoimmunity and other late complications like morphological changes in kidneys and severe vascular complications. Similarly, oral hypoglycemic drugs have many side effects such as nausea, vomiting, cholestatic jaundice, aplastic and hemolytic anemia's, generalized allergic reactions, dermatological reaction etc (Mallick *et al*., 2007; Pepato *et al*., 2005).

The research was envisaged for antidiabetic and hypolipidemic activity of different extracts of *Plumbago zeylanica* Linn. procured by successive extraction methods.

Total ash value asses the total amount of material remained after detonation and the amount of heavy metals and inorganic compounds present in the powder sample. The total ash content was

5 times greater than acid insoluble ash, the presence of calcium oxalate crystals or acid soluble inorganic matter.

The water and volatile content of a crude drug were determined by test for loss on drying. High water content will deprecate phytochemical constituents followed by hydrolysis and enhance growth of microorganisms. Hence there should be a set of confines for water content for a plant under research. Extractive values are chiefly used for the determination of exhausted or adulterated drug. The alcohol soluble extractives values were found to be higher than water soluble extractive value. Alcohol being a moderately non polar solvent, able to extract polar and non polar components yields higher extractive value.

Preliminary phytochemical evaluation of both plants report illustrates that petroleum ether extract showed the existence of triterpenoids, steroids and fatty acids, chloroform extract showed presence of saponins, phytosterols, flavonoids, phenols, steroids, terpenoids ethanolic extract showed the presence of alkaloids, flavonoids and glycosides and aqueous extract showed the presence of carbohydrates, as phytoconstituents **(**Stahl, 1969**)**.

The islet β-cells are susceptible to damage caused by oxygen free radicals (Prince and Menon, 1998; Cai *et al*., 2005) since the antioxidant defense system is weak under diabetic condition. The levels of antioxidant defense system are altered in streptozotocin-induced diabetic rats, which are in good correlation with the present observation. Non protein thiols like glutathione are one of the important primary defenses that counteract the oxidative stress. Decreased levels of serum glutathione in streptozotocin diabetic rats, which is in consistent with earlier reports (Cai *et al*., 2005). The observed decrease may be due to utilization of non protein thiols by increased oxygen-free radicals produced in hyperglycemic conditions associated with diabetes mellitus. The ethanolic extract produced a marked decrease in blood glucose levels at 200 mg/kg and 400 mg/kg body weight in streptozotocin-diabetic rats after 21 days treatment. The antidiabetic effect may be due to increased release of insulin from the existing β-cells of pancreas similar to that observed after glibenclamide administration. Streptozotocin-induced diabetes is characterized by a severe loss in body weight (Al Shamaorry *et al.*, 1994). The decrease in body weight is due to the loss or degradation of structural proteins, since structural proteins are known to contribute to the body weight. Previous reports show that protein synthesis is decreased in all tissues due to decreased production of ATP and absolute or relative deficiency of insulin (Murray *et al.*, 2003).

Glycogen is the primary intracellular storable form of glucose and its level in various tissues especially in liver indicates direct reflection of insulin activity since it regulates glycogen storage by stimulating glycogen synthase and inhibiting glycogen phosphorylase (Golden *et al.,* 1979). Since STZ causes destruction of β-cells and resulting in marked decrease in insulin levels, the glycogen content in liver decrease as the invasion of glucose in the liver is inhibited in the absence of insulin (Weber *et al.,* 1966; Vats *et al.,* 2004). Our results showed that on administration of ethanolic extract causes significantly decreased glucose levels in diabetic rats as well as significant improvement of body weight, which could be due to increased insulin levels. The probable anti-diabetic mechanism may be significant release of insulin.

STZ-diabetic rats showed increase in plasma cholesterol and triglyceride concentrations (Sachdewa and Khemani, 2003), which may contribute to the development and progression of micro and macro-vascular complications (Tan *et al.,* 2005). It has been known that hyperlipidemia induced with hyperglycemia is an important determinant of cardiovascular mortality and is linked to diabetes mellitus. Alterations in plasma lipoprotein metabolism are common in diabetes and tend to exaggerate any preexisting tendencies towards elevated lipid levels (Merzouk, 2004).

The rise in plasma triacylglycerols, cholesterol and LDL-cholesterol levels in the present study indicate derangement of lipid metabolism and increased incidence of cardiac dysfunction in diabetic rats. On the other hand, glucagon and other hormones enhance lipolysis. The marked hyperlipidemia that characterizes the diabetic state may, therefore, be regarded as a consequence of uninhibited actions of lipolytic hormones on the fat deposits. Studies on STZ-induced diabetes in experimental animals have suggested that an increase in circulatory VLDL and their associated triglycerides are largely due to defective clearance of these particles from the circulation (Suresh Babu, 1997).

Normally circulating LDL-C undergoes reuptake in the liver via specific receptors and gets cleared from the circulation (Suresh Babu, 1997). HDL-C is protective by reversing cholesterol transport, inhibiting the oxidation of LDL-C and by neutralizing the atherogenic effects of oxidized LDL-C. The increased levels of LDL-C and VLDL-C decreases HDL-C as there is a reciprocal relationship between the concentration of VLDL-C and LDL-C. In diabetic rats treated with methanolic and ethyl acetate extract showed an elevation in HDL-C and reduction in LDL-C and VLDL C. As there is a close relationship between the total cholesterol level of

elevated plasma and the occurrence of atherosclerosis, the ability of ethanolic extract is reflected in the selective reduction of total cholesterol through the reduction of VLDL and LDL components.

Accumulation of triglycerides is one of the risk factors in CHD. Increased triglyceride and reduced HDL cholesterol levels are the key characteristics of dyslipidemia in type 2 diabetes (Lehto *et al.*, 1997). Hyper triglyceridemia in type 2 diabetes can result from an increased hepatic VLDL over production and impaired catabolism of triglyceride rich particles. The function of lipoprotein lipase (LPL), a key enzyme in the removal and degradation of triglycerides from circulation, is attenuated by both insulin deprivation and insulin resistance. Dysfunction of LPL contributes to hypertriglyceridemia in the fasting and postprandial state. It has been postulated that a high plasma triglyceride level influences LDL size and density through a cycle of lipid exchange (Taskinen *et al.,* 1996).

CONCLUSION

The results obtained in this study have shown that various extracts shown significant antidiabetic activity. Among the various extracts, ethanolic extract had shown best antidiabetic & hypolipidemic activity. Besides from the obvious therapeutic importance, these components would be useful in understanding the mechanism of diseases with higher levels of cellular and molecular level. The present findings are significant for the development of alternative, inexpensive and perhaps safer strategies for the treatment of diseases.

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