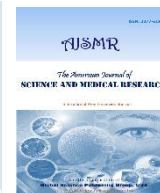




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Research Article

Antidiabetic Activity and Lipid Profiles in Diabetic Induced Wistar Rats Treated with Plant Extracts and Comparative Studies

Lingaiah M¹, Estari Mamidala² and Nagaraja Rao P³



^{1,3} Department of Zoology, Osmania University, Hyderabad-500 007, Telangana State, India

² Department of Zoology, Kakatiya University, Warangal-506 009, Telangana State,

*Corresponding author:

E-mail: lingaiahzoology@gmail.com

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ABSTRACT

Type 2 Diabetes mellitus is a chronic metabolic disorder, characterized by hyperglycemia resulting from defects in insulin secretion, insulin action or both. This investigation was designed to study the antidiabetic activity and lipid profiles was investigated in diabetic induced Wistar rats treated with plant extracts and comparative studies. Diabetes was induced after a single intra peritoneal injection of Alloxan drug (120 mg/ kg). Rats were divided into seven groups with 6 rats in each group: 1. Normal control rats, 2. Diabetic Control rats (Untreated, Alloxanized), 3. Diabetic rats administered with Glybenclamide drug (600µg/kg/bw) as reference standard drug while, 4. Diabetic rats administered with *Hemidesmus indicus* leaf extract (11mg/bw), 5. Diabetic rats administered with *Cassia auriculata* flower extract (7 mg/bw), 6. Diabetic rats administered with *Chloroxylon swietenia* bark extract (8 mg/bw), 7. Diabetic rats administered with *Tinospora cordifolia* leaf extract (10 mg/bw). The parameters studied were lipid profile like Total cholesterol (TC), Triglyceride (TG), High-density lipoprotein (HDL), Low-density lipoprotein (LDL). The result of test drug was compared with diabetic control. Glibenclamide (600µg/kg/bw) was selected as standard hypoglycaemic drug. Administration of plant extracts shows the antidiabetic activity and reduction in blood glucose level at 7th day. Administration of plant extracts also shows decreased in serum TC, TG, HDL, LDL in diabetic induced Wistar rats. The results obtained from the present study revealed the potential Antidiabetic activity of selected plant extracts *Hemidesmus indicus*, *Cassia auriculata*, *Chloroxylon swietenia* and *Tinospora cordifolia*.

1. Introduction

Diabetic mellitus (DM) is characteristic by hyperglycemic due to disturbance in the group of metabolisms of carbohydrates, fat and protein, resulting from defects in insulin secretion action or both (Georg et al., 2000). The World Health Organization (WHO) published estimates for the years 2000 and 2030, using data from 40 countries but extrapolated to the 191 WHO member states (Shaw et al., 2010). Currently there are over 150 million diabetes worldwide this number is likely to increase 300 million or more by the year 2025 due to increase in sedentary lifestyle, consumption of energy rich diet, and obesity (Yajnik et al., 2001). This disorder results from relative or absolute deficiency of insulin due to impairment of insulin action and or moderate to gross inadequacy of insulin secretion (Kamthoung et al., 2006). Hence, diabetes mellitus is characterized by chronic hyper glycemia with glucosuria and a

tendency to develop ketoacidosis (Vuksan et al., 2005). In recent times, many medicinal plants continue to provide valuable therapeutic agents for the treatment of both in modern medicine and by the traditional system throughout the world (Mallika Jainu et al., 2006; Janakiramulu et al., 2025).

Though different types of oral hypoglycemic agents are available along with insulin for the treatment of diabetes mellitus, there is a growing interest in herbal remedies due to the side effects associated with these therapeutic agents (Kamesawara et al., 2000). *Hemidesmus indicus* plant has been used traditionally for the treatment of blood disorders, low digestion, anorexia, diarrhea, asthma, fever, cough, itching, and skin diseases including leprosy (Anjaria et al., 2002). Various effects of *Hemidesmus indicus*, such as hypoglycemic (Murshed et al., 2005), hypolipidemic (Bopanna et al., 2005), antioxidant, antithrombotic (Mary et al., 2003; Namthabad et al., 2014), anti-

inflammatory (Lamprontietal., 2008), antiulcerogenic (Anoopetal., 2008), hepatoprotective (Prabakan et al., 2000), Reno protective (Alam et al., 2004), and neutralization of viper venom (Alamet al.,1996) have been reported. *Cassia auriculata*. It is widely used in ayurvedic medicine as tonic, astringent and as remedy for diabetes, conjunctivitis and ophthalmia (Joshi et al.,2000). The flowers and seeds of *Cassia auriculata* has been reported to show a very significant antidiabetic effect (Shrotri et al.,1960). It establishes good control of sugar levels in the treatment of diabetes (Shrotri et al.,1961and Shrotri et al.,1968). We have already reported the antiperoxidative effect of aqueous extract of *Cassia auriculata* flowers in diabetic rats (Jayaprasad et al.,2014; Swapna et al., 2024).

A literature survey showed that the antihyperglycemic activity of *Cassia auriculata* has been demonstrated by Shrotri et al. in alloxan induced diabetic rabbits (Shrotri et al.,1968). *Chloroxylon swietenia* has been used in the folkloric medicine (Jayaprasad et al.,2014). Tribes apply the leaf paste on wounds, cuts, burns and skin diseases for quick relief (Venkataswam et al., 2010)to treat worm infested wound of animals, fungal infection of skin and rheumatism (Reddy et al.,2007; Lunavath et al., 2013) and used as a Anti diabetic (Aravind Patchimatlaet al.,2014). *Tinospora cordifolia* the plant is of great interest to researchers across the globe because of its reported medicinal properties like anti-diabetic, anti-periodic, anti-spasmodic, anti-inflammatory, anti-arthritis, anti-oxidant, anti-allergic, anti-stress, anti-leprotic , immunomodulatory and anti-neoplastic activitie (Soham Saha et al.,2012).In diabetic patients, elevated blood lipid levels (HDL,LDL) are also associated with the risk of coronary heart disease, just as they are in the general population(Grundy et al., 1999).Diabetic patients should be managed as a very high risk group for premature atherosclerosis, especially coronary heart disease (Lipmanet al .,1997). Dyslipidemia, also a major risk factor for atherosclerotic disease and, is usually characterized by hypercholesterolemia, hypertriglyceridemia, and low high-density lipoprotein (HDL) cholesterol (Webster et al.,1997; Kumar et al., 2020; Porika et al., 2014). Now we are looking anti-diabetic activity of these four plant extracts and Lipid Profile comparison in diabetic induced rats treated with plant extract and controls.

2. Materials and Methods

2.1. Chemicals

Alloxan monohydrate and Glibenclamide are procured from Sigma, Bangalore. Wellion LUNA duo Glucometer and Blood gluco-strips procured from Med Trust-Gluoworld, Kerala. EDTA; NaCl(0.9% w/v); Phosphate buffer (pH 6.5) 90 mmol/L; Phenol 26 mmol/L;4-Aminoantipyrine 0.4 mmol/L ; Cholesterol Esterase 500U/L; Cholesterol Oxidase500U/L; Peroxidase 1250U/L,Glycerol kinase 1250U/L form Sigma, Bangalore.All reagents are ready for use and stable up to the expiry date given on label when stored at 2–800 C.

2.2 Preparation of Extracts

Each plant powder was successively extracted with different organic solvents in increasing polarity order according to by Soxhlet extraction method (Kemal Duricet al., 2015).By using Soxhlet extractor exhaustive extraction with a series of solvents of increasing polarity was done. Solvents used with increasing polarity are n-Hexane, Chloroform, Ethyl acetate, Acetone and Methanol. For each extraction, 500gr of powdered material was weighed accurately and placed in Soxhlet extraction chamber which was suspended above the flask containing 1000 ml of

80% solvent and below a condenser. The flask was heated and the solvent evaporated and moved into the condenser where it was converted into a liquid that trickled into the extraction chamber containing the plant material. The extraction chamber was designed so that when the solvent surrounding the sample exceeded at certain level it overflowed and trickled back down into the boiling flask. At the end of the extraction process, the flask containing the solvent extract was removed and excess solvent was evaporated by using rotary evaporator. The weight of the residual extract was measured and percent yield was calculated. The residue of the extract was dissolved in 25 ml of pure methanol and stored in air tight glass vials at 400C until further use.

Extract yield % = $W1/W2 \times 100$;

Where, W1 = Net Weight of powder in grams after extraction, W2 = total Weight of powder in grams taken for extraction

2.3 Test Animals:

Adult albino Wistar rats (150–155 g), aged 8–14 weeks, were obtained from the Animal House, Jeeva Life Sciences, Hyderabad, and used in the study. The experimental protocol was reviewed and approved by the Institutional Animal Ethics Committee (IAEC) of Jeeva Life Sciences, Hyderabad, in accordance with the guidelines of the Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA), Government of India. The rats were acclimatized for a period of 7 days before experimentation and housed in groups of seven in polypropylene cages lined with soft wood shavings as bedding, which was renewed every 24 h. Animals were maintained under controlled environmental conditions of a 12 h light/12 h dark cycle, relative humidity of 50–60%, and temperature of $22 \pm 3^\circ\text{C}$. They were provided with standard rat pellet diet (Gold Mohur, Lipton India Ltd., India) and water ad libitum throughout the experimental period.

2.4 Experimental design

Animals selected were fasted over night and then divided into seven groups (n=6) as follows:

- Group-I: Normal Control rats (non-alloxanized) that was administered with standard feed and water.
- Group-II: Diabetic control rats (Untreated, alloxanized).
- Group III: Diabetic rats administered with Glybenclamide drug (600µg/kg/bw) as reference standard drug while.
- Group-IV: Diabetic rats administered with Hemedesmus indicus leaf extract (11 mg/bw)
- Group-V: Diabetic rats administered with *Cassia auriculata* leaf extract (7 mg/bw)
- Group-VI: Diabetic rats administered with *Chloroxylon swietenia* bark extract (8 mg/bw)
- Group-VII: Diabetic rats administered with *Tinospora cordifolia* leaf extract (10 mg/bw)

2.5 Induction of experimental diabetes

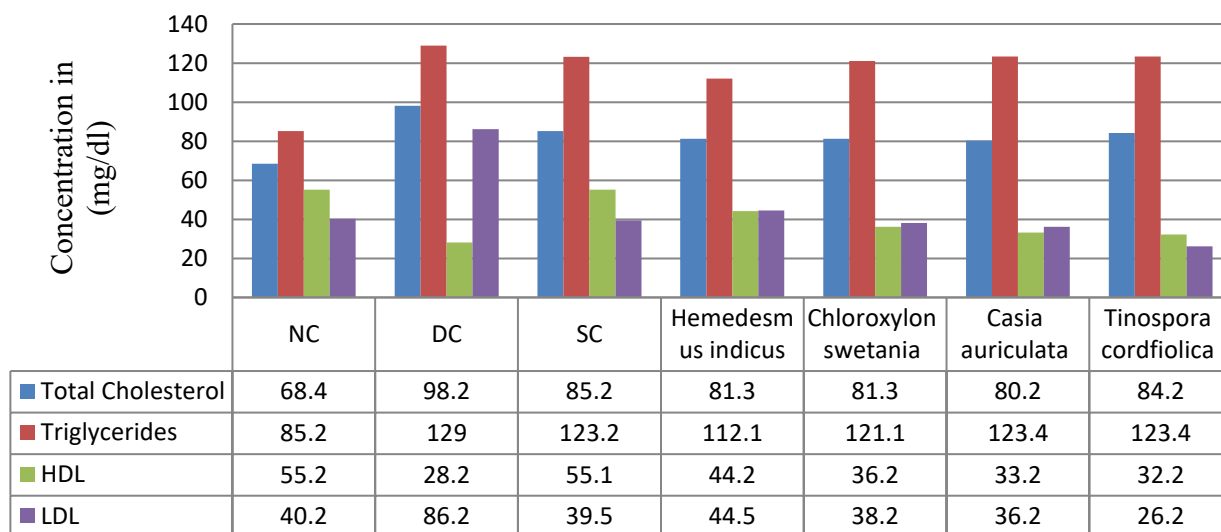
Diabetes was induced by intra peritoneal injection (single dose) of alloxan monohydrate (120 mg kg⁻¹b.w.) in 0.9% w/v NaCl solution (normal saline) to overnight fasted normal rats. Blood glucose level was checked by using one-touch glucometer and diabetes was confirmed after 72 hr of alloxanisation. Rats shown FBG > 250 mg/dl were considered to be diabetic and were selected for studies.Treatment was continued for a period

of 7 days following oral administration to the experimental animals by gastric intubation, using a force-feeding needle.

2.6 Specimen Collection and Preparation

have 55.1mg/dl, *Hemedesmus indicus* leaf extract treated group rats have 42.2 mg/dl, Chloroxylon swietenia bark extract treated group rats have 36.2 mg/dl, Cassia auriculata flower extract treated group rats have 33.2 mg/dl and *Tinospora*

Fig 1. Lipid Profile comparison in diabetic induced rats treated with plant extract and controls



Serum samples and EDTA, free from hemolysis, are the specimens. Serum from blood cells were Separated. Sample Storage and Stability of Total cholesterol in serum stable for at least 7 days when stored at 2 - 8°C, up to 3 months when stored at ≤ -20°C and at -70°C (Tietz et al., 1990). The estimation of cholesterol, Triglyceride, HDL, LDL in serum was performed at 0 day and at 7th day after completes of the treatment respectively all groups of animals.

Estimation of Serum Lipids by CHOD-PAP-Phosphotungstate method: In-vitro quantitative determination of the activity of cholesterol, Triglyceride, HDL, LDL in serum was estimated by CHOD-PAP method (Richmond et al., 1973, Henry et al., 1974, Charles et al., 1974).

3. Results and Discussion

This shows the Lipid profile comparison in Diabetic induced rats treated with Plant extract and Controls.

Total Cholesterol: The Normal control group rats have 68.4mg/dl, Diabetic control group rats have 98.2mg/dl, standard control group rats have 85.2mg/dl and *Hemedesmus indicus* leaf extract treated group rats have 81.3mg/dl, *Chloroxylon swietenia* bark extract treated group rats have 81.3mg/dl, *Cassia auriculata* flower extract treated group rats have 80.2mg/dl and *Tinospora cordifolia* leaf extract treated group rats have 84.2mg/dl.

Triglycerides: The Normal control group rats have 85.2mg/dl, Diabetic control group rats have 129mg/dl, standard control group rats have 123.2mg/dl, *Hemedesmus indicus* leaf extract treated group rats have 121.1mg/dl, *Chloroxylon swietenia* bark extract treated group rats have 121.1mg/dl, *Cassia auriculata* flower extract treated group rats have 123.4mg/dl and *Tinospora cordifolia* leaf extract treated group rats have 113.4 mg/dl.

HDL: The Normal control group rats have 55.2mg/dl, Diabetic control group rats have 28.2mg/dl, standard control group rats

cordifolia leaf extract treated group rats have 32.2mg/dl.

LDH: The Normal Control group rats have 40.2mg/dl, Diabetic control group rats have 86.2mg/dl, Standard control group rats have 39.4 mg/dl, *Hemedesmus indicus* leaf extract treated group rats have 44.2 mg/dl, *Chloroxylon swietenia* bark extract treated group rats have 38.2 mg/dl, *Cassia auriculata* flower extract treated group rats have 36.2mg/dl and *Tinospora cordifolia* leaf extract treated group rats have 26.2 mg/dl.

Table 1. Effect of *Hemedesmus indicus* leaf extract on Lipid profile of Wistar rats

	Total cholesterol (mg/dl)	TGL (mg/dl)	HDL (mg/dl)	LDL (mg/dl)
Group I (NC)	68.4±4.02	85.2±6.02	55.2±0.48	40.2±1.01
Group II (DC)	98.2±1.6	129±1.58	28.2±0.78	86.2±2.0
Group III(sc)	85.2±1.12	123.2±1.52	55.1±1.67	39.4±3.12
Group IV <i>Hemedesmus indicus</i> (11 mg/bw)	81.3±1.18	112.1±2.01	44.2±1.31	44.2±2.12

Table 2. Effect of *Chloroxylon swietenia* bark extract on lipid profile of Wistar rats

	Total cholesterol (mg/dl)	TRG (mg/dl)	HDL (mg/dl)	LDL (mg/dl)
Group I (NC)	68.4±4.02	85.2±6.02	55.2±0.48	40.2±1.01
Group II(DC)	98.2±1.6	129±1.58	28.2±0.78	86.2±2.0

Group III (Sc)	85.2±1.12	123.2±1.5 2	55.1±1.6 7	39.4±3.1 2
Group V <i>Chloroxylo n swetania</i> (8mg/bw)	81.3±1.14	121.1±1.4 8	36.2±0.4 1	38.2±0.1 5

17.21% was decreased when compare to the diabetic control group rats. The triglycerides 6.13% was decreased with compare to the diabetic control group rats. HDL 28.36% was increased when compare to the diabetic control group rats and LDL 44.31% was decreased when compare to the diabetic control group rats.

Figure-4 shows the effect of *Cassia auriculata* flower extract

Fig 2. Effect of *Hemedesmus indicus* leaf extract on Lipid profile of Wistar rats

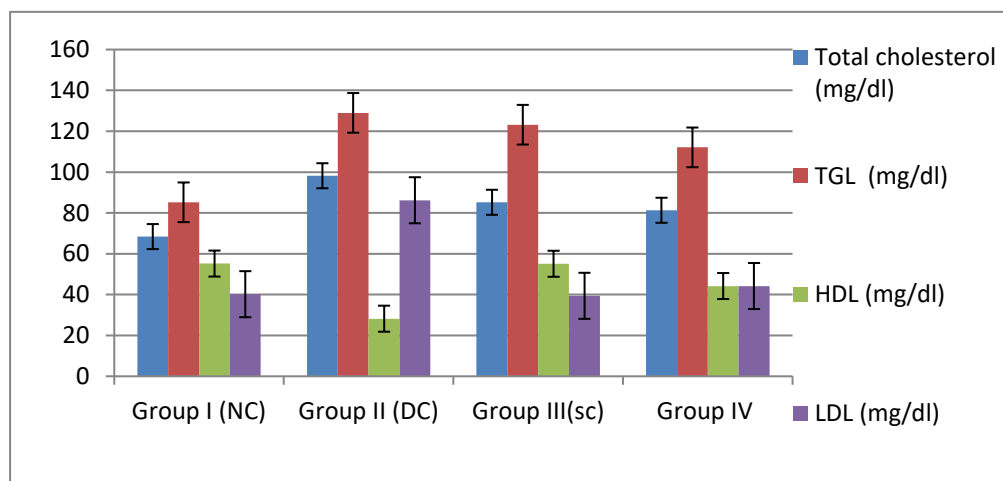


Fig 3. Effect of *Chloroxylon swetania* bark extract on lipid profile of wistar rats

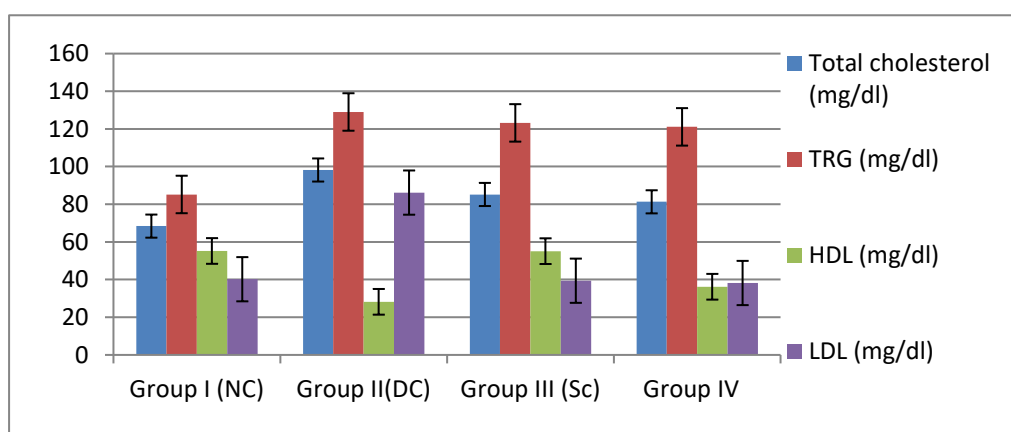


Fig 4. Effect of *Casia auriculata* flower extract on lipid profile of wistar rats

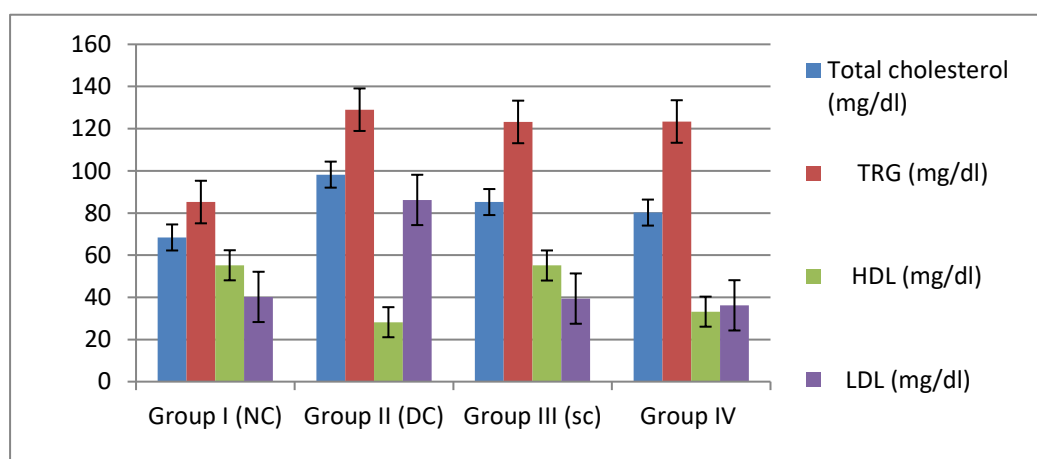


Figure-3 shown the effect of *Chloroxylon swietenia* bark extract on lipid profile of Wistar rats. Here the Total cholesterol

18.33% was decreased with compare to the diabetic control group rats.

The triglycerides 4.35% was decreased with compare to the diabetic control group rats. HDL 17.73% was increased with compare to the diabetic control group rats and LDL 41.99% was decreased with compare to the diabetic control group rats.

Group III(sc)	85.2±1.12	123.2±1.5 2	55.1±1.67	39.4±3.12
Group IV <i>Tinospora cordifolia</i> 10mg/bw))	84.2±1.13	123.4±1.5 1	32.2±1.01	26.2±2.02

Fig 5. Effect of *Tinospora cordifolia* leaf extract on lipid profile of Wistar rats

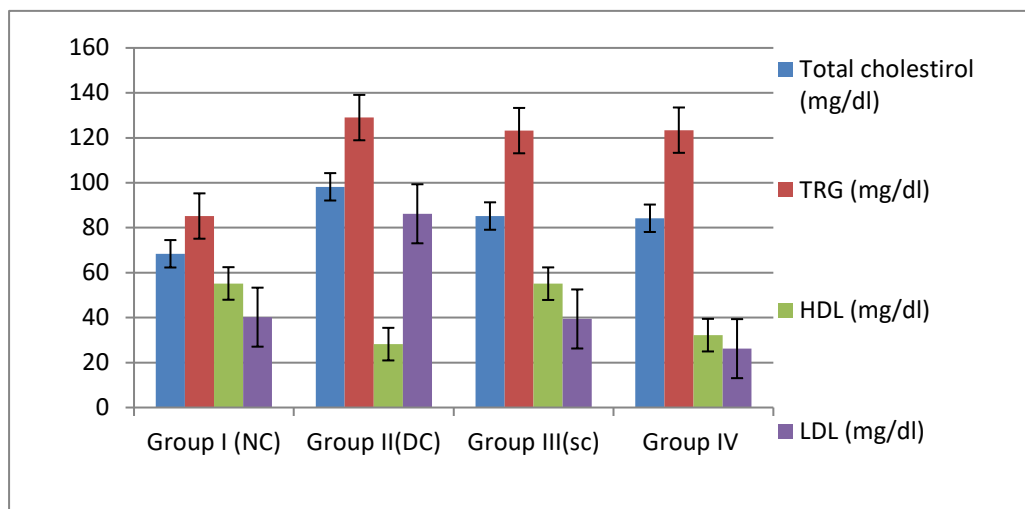


Figure-5 shows the effect of *Tinospora cordifolia* leaf extract on lipid profile of wistar rats. Here the Total cholesterol 14.26% was decreased with compare to the diabetic control group rats. The triglycerides 4.35% was decreased with compare to the diabetic control group rats. HDL 14.18% was increased with compare to the diabetic control group rats and LDL 30.16% was decreased with compare to the diabetic control group rats. The induction of diabetes is confirmed by elevated levels of fasting blood glucose levels in selected rats.

Table 3. Effect of *Casia auriculata* flower extract on lipid profile of wistar rats

	Total cholesterol I (mg/dl)	TGL (mg/dl)	HDL (mg/dl)	LDL (mg/dl)
Group I (NC)	68.4±4.02	85.2±6.02	55.2±0.48	40.2±1.01
Group II (DC)	98.2±1.6	129±1.58	28.2±0.78	86.2±2.0
Group III(sc)	85.2±1.12	123.2±1.5 2	55.1±1.67	39.4±3.12
Group IV <i>Casia auriculata</i> (7mg/bw)	80.2±1.2	123.4±1.5 1	33.2±1.42	36.2±2.98

Table 4. Effect of *Tinospora cordifolia* leaf extract on lipid profile of wistar rats

	Total cholesterol (mg/dl)	TGL (mg/dl)	HDL (mg/dl)	LDL (mg/dl)
Group I (NC)	68.4±4.02	85.2±6.02	55.2±0.48	40.2±1.01
Group II (DC)	98.2±1.6	129±1.58	28.2±0.78	86.2±2.0

The present study was focused to explore the selected plant extracts *Hemedesmus indicus*, *Cassia auriculata*, *Chloroxylon swietenia*, *Tinospora cordifolia*. The results of present study indicate that decreasing fasting blood glucose levels achieved by multiple dose study in different groups in sub-acute studies indicates the effectiveness of extract in Alloxan induced diabetic rats.

The precise mechanism of alloxan-induced diabetes remains unclear, there is increasing evidence that it involves the degeneration of islet-cells by accumulation of cytotoxic free radicals (Halliwell et al.,1989). Considering this, plant extracts was administered daily for 7 days, the period which may be produced a significant reduction in all the diabetic markers, and this effect was more potent as compared to acute dosing. The elevated levels of blood glucose are accompanied with the increases in TC, TG, LDL and fall of HDL levels. Considerable research has been shown that abnormal lipid metabolism is an important predictor for diabetes mellitus (Shukla et al., 1995). The administration of plant extracts showed significant reduction in serum levels of TC, LDL, TG, whereas a significant elevation in HDL levels. The 7-day treatment with extract restored all the above-mentioned parameters towards the normal levels. The administration of plant extracts to diabetic rats showed significant decrease in the levels of blood glucose and an increase in serum insulin levels. Treatment with plant extracts for 7 days significantly augmented the activity of catalase in diabetic rats which could be attributed to the strong antidiabetic property of plant extracts.

4. Conclusion

In the present study the administration selected plant extracts *Hemedesmus indicus*, *Cassia auriculata*, *Chloroxylon swietenia*, *Tinospora cordifolia* showed permanent reduction in blood glucose level, normalization of lipid profile compared with diabetic control therefore it can be concluded that selected plant extract *Hemedesmus indicus*, *Cassia auriculata*, *Chloroxylon*

swietenia, *Tinospora cordifolia* shows remarkable effects against Alloxan induced diabetes in Wistar rats.

Competing interests:

The authors declare that they have no competing interests

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