



Smilax zeylanica: A Promising Antilipidemix and Antiobesity Agent

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: It is well established fact that obesity has now said to be a disease status. The phytochemicals have always been looked for their enormous stored potential. *Smilax zeylanica* is a naturally occurring flavonoid known for its pharmacological potential. In this study it was aimed to determine the antiobesity and antilipidemic effect of various *Smilax zeylanica* extract.

Materials and Methods: The pharmacological screening of Cyclohexane extract of *Smilax zeylanica* (SZH), ethyl acetate extract *Smilax zeylanica* (SZE) and methanolic extract of *Smilax zeylanica* (SZM) was performed. The acute toxicity studies were performed on various animal groups. Obesity was diet induced. The plasma samples were investigated for various biochemical parameters such as glucose, lipid profile (Cholesterol, TG, HDL, LDL and VLDL), Liver function test (SGPT, SGOT).

Results and Conclusion: The various parameters studied showed that the methanolic extracts of *Smilax zeylanica* showed enormous antiobesity potential and concluded for the supplementation for antilipidemic effect.

Keywords: *Smilax zeylanica*; antiobesity; antilipidemic effect; LDL; SGPT; SGOT.

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1. INTRODUCTION

Heftiness is a constant metabolic problem brought about by awkwardness between energy admission and use. Overweight and heftiness are characterized as strange or exorbitant fat collection that presents a danger to wellbeing [1]. Numerous mainstream researchers have gotten progressively keen on the sub-atomic guideline of fatty oil combination and in drug ways to deal with lessen fat assimilation and capacity because of phytochemicals, introducing an energizing open door for the revelation of more up to date hostile to weight specialists. The guideline of unsaturated fat and fatty substance accessibility in natural reactions relies upon the movement of lipolytic chemicals present in unsaturated fat digestion in fat tissue. The portrayal and ID of a few qualities associated with lipid digestion have yielded a rich pool of possible focuses for medications to treat weight and other metabolic conditions [2]. Pancreatic lipase, the principle lipid processing chemical, eliminates unsaturated fats from the α and α' places of dietary fatty oils, which yield the lipolytic item β -monoglyceride and long chain soaked and polyunsaturated unsaturated fats. Restraint of pancreatic lipase is an alluring focused on methodology for the revelation of powerful enemy of stoutness specialists for weight treatment [3]. One of the screening techniques utilized in the disclosure of against heftiness drugs is to look for powerful lipase inhibitors from plant removes. Plants have been utilized as customary regular meds for mending numerous infections. Specifically, different oriental therapeutic plants are accounted for to have natural movement. *Smilax zeylanica* Linn. (*Smilacaceae*) regularly known as Jangliashbha (Hindi) is broadly disseminated in Indian woods. It is a brambled, woody plant that grows up to 50 m long [4]. It creates little blossoms and dark, blue or red berry-like natural products which are eaten regularly by bird. Plants bloom in May and June with white/green grouped blossoms. On the off chance that fertilization happens, the plant will deliver a splendid red to blue-dark circular berry organic product around 5-10 mm in width that develops in the fall [5]. The writing overview uncovers that different pieces of *Smilax zeylanica* have been utilized as a fables medication for relieving Investigation on Phytochemicals, antiobesity and antilipidemic activities of *Smilax zeylanica* Linn. Verdant Extracts [6,7]. The current examination includes the starter examination of phytochemical constituents, intense harmfulness study and the antiobesity effect of various

concentrates of leaves of *S. zeylanica* utilizing oil ether, diethyl ether, chloroform and methanol as solvents.

2. MATERIALS AND METHODS

The pharmacological screening of cyclohexane extract of *Smilax zeylanica*(SZH), ethyl acetate extract *Smilax zeylanica*(SZE) and methanolic extract of *Smilax zeylanica*(SZM) was performed.

2.1 Collection, Identification and Authentication of Plant Material

The plant *Smilax zeylanica* was collected in June from Yamuna biodiversity park, New Delhi.

The formal authentication and identification was done by Dr. Bhawana.S .Bajpai Department of Botany Ch.Charan Singh University, Meerut voucher specimen number B01-PB565/1/2/2017. The roots were allowed to air dry, away from sunlight. The dried material was grounded coarsely to a powder and transferred to labelled brown bottles until required.

The dried, powdered plant material (500 g) was defatted with petroleum ether and was then extracted consecutively with solvents of increasing polarity Cyclohexane, Ethyl acetate and methanol for 72 hrs each with intermittent stirring. The collected mass was subjected to drying to evaporate the excess of solvent in a rotary evaporator; this procedure was as per protocol. The collected dark coloured material were stored at 4 o C and were termed as *Smilax zeylanica* cyclohexane extract(SZH), *Smilax zeylanica*(SZE), *Smilax zeylanica* (SZM).

2.2 Acute Toxicity Study

The acute toxicity was performed according to OECD guidelines (OECD 423, 2001). The selected Wistar rats were used for toxicity studies. The animals were divided into three groups of three in each. The animals were fasted overnight prior to the experimental procedure. The acute toxicity study was performed for deciding safe doses for further pharmacological studies along with this any behavioural or physiological changes due to extract administration was also observed. Extracts were given orally to rats at the graded dose of 1000, 2000, 4000 mg/kg body wt. Immediately, after dosing, the animals were observed continuously for first four hours for behavioural changes and

for mortality at the end of 24 h and daily up to 14 days for any behavioural change or mortality. Since no mortality was reported even after 14 days. This indicated that the extracts are safe up to a single dose of 4000 mg/kg body weight. Hence the selected doses for the administration in experimental animals were considered 1/10th and 1/5th of maximum safe dose (Table 1). Since no mortality was observed the animals were then kept in a washing period for 20 days, the same animals were then used for the anti-obesity activity [8].

2.3 Anti-obesity Activity

In order to screen the phytoextracts for anti-obesity activity Wistar albino rats were used. Obtained the approval from CPCSEA Committee at ITS College of Pharmacy, Ghaziabad. Registration number 1044/PO/Re/S/07/CPCSE. Anti-obesity study was carried out on 36 animals which were divided into 6 groups with six animals in each group. Except the normal diet rats all other groups were fed with Cafeteria diet for a period of 8 weeks [9], pre-weighed food pellet/s was presented to rats in the home cage every day. Food intake was measured daily as the in the weight of left over feed from the weight of total feed presented to each animal daily. Orlistat drug (10 mg/kg) was used as standard drug, during the course of the study each group was then dosed accordingly. Table 2 gives the

summary of treatment groups, dosage and duration of activity.

2.4 Diet Induced Obesity

The obesity in rats was induced by feeding them cafeteria diet for a period of 8 weeks. Three different cafeteria diets were given every day.

The diets were prepared and calculated according to per kg b w and given to all the groups of rats (except ND) any three of this snack food were given daily along with chow diet [10].

Preparation of Cafeteria diet (CD): The CD pellets were prepared fresh daily in combination of 70% Cafeteria diet with 30% of normal rat pellet.

Anthropometric measurements of each rat were monitored every week, during the course of the 8 weeks experiment (Table 3).

Animals were euthanized at the end of 8th week and the weight of the liver of each Rat and white adipose tissues in all the nine groups were measured at the end of the experiment. Each tissue was then rinsed with phosphate-buffered saline, and stored at -40°C until histopathological analysis.

Table 1. Grouping of animals for acute toxicity studies

Groups	Number of animals	Treatment	Route	Dosage	Duration
AI	3	Cyclohexane extract of <i>Smilax zeylanica</i>	Oral	1000 mg/kg bodyweight	14 Days
AII	3	Cyclohexane extract of <i>Smilax zeylanica</i>	Oral	2000 mg/kg bodyweight	14 Days
AIII	3	Cyclohexane extract of <i>Smilax zeylanica</i>	Oral	4000 mg/kg bodyweight	14 Days
BI	3	Ethyl acetate extract of <i>Smilax zeylanica</i>	Oral	1000 mg/kg bodyweight	14 Days
BII	3	Ethyl acetate extract of <i>Smilaxzeylanica</i>	Oral	2000 mg/kg bodyweight	14 Days
BIII	3	Ethyl acetate extract of <i>Smilax zeylanica</i>	Oral	4000 mg/kg bodyweight	14 Days
CI	3	Methanolic extract of <i>Smilax zeylanica</i>	Oral	1000 mg/kg bodyweight	14 Days
CII	3	Methanolicextract of <i>Smilax zeylanica</i>	Oral	2000 mg/kg bodyweight	14 Days
CIII	3	Methanolicextract of <i>Smilax zeylanica</i>	Oral	4000 mg/kg bodyweight	14 Days

Table 2. Diet induced obesity

Cafeteria Diet Composition.										
Values are per 1g of food item	Total kcal	Fat kcal	Total fat g	Total Carb g	Protein g	Dietary fiber g	Sugars g	Saturated fat g	Cholesterol mg	Sodium mg
Boiled potatoes	0.87	0.0	0.01	0.2	0.019	0.018	0.09	0	0	0
Amul butter	7.2	7.2	8	0	0.5	0	0	0.5	1.8	8.36
Chocolate Cookies	5.00	2.50	0.28	0.56	0.06	0.06	0.06	0.06	0.00	8.75
Sugar Wafers	5.16	2.58	0.29	0.65	0.03	0.00	0.48	0.06	0.00	0.65
Chow diet	3.82	0.38	0.04	0.54	0.25	0.05	0.00	0.00	0.00	4.40
Fruit Loops Kelloggs	4.00	0.33	0.03	0.87	0.03	0.03	0.43	0.00	0.00	4.70
Peanut butter Cookies	5.00	1.88	0.22	0.63	0.06	0.00	0.31	0.06	0.00	3.13
Chocolates	5.13	2.05	0.23	0.62	0.13	0.03	0.54	0.18	0.00	2.05
Cakes/muffins	4.74	2.28	0.26	0.56	0.05	0.02	0.33	0.04	0.70	3.16
Dried coconut	4.39	2.46	0.28	0.44	0.05	0.02	0.26	0.04	0.53	2.46
Doritos Nacho Cheese (Frito-Lay)	5.36	2.50	0.29	0.61	0.07	0.04	0.04	0.05	0.00	6.43
Cheese	3.93	2.86	0.32	0.04	0.25	0.00	0.00	0.18	1.07	6.43

Table 3. Summary of treatment groups, dosage and duration of activity

Groups	Treatment	Dosage (mg/kg)*	Duration
NORMAL	Normal diet		
POSITIVE CONTROL	Treatment	10 mg/Kg	Once daily for 8 weeks
CD	Cafeteria diet		
GP 1	<i>Smilax zeylanica</i> cyclohexane extract	400 mg/Kg	Once daily for 8 weeks
GP 2	<i>Smilax zeylanica</i> EtoAc extract(SZE)	400 mg/Kg	Once daily for 8 weeks
GP 3	<i>Smilax zeylanica</i> methanolic extract(SZM)	400 mg/Kg	Once daily for 8 weeks

2.5 Statistical Analysis

The factual investigation of the considerable number of results was completed utilizing one-way ANOVA took after by Dunnet's numerous correlations test and Bonferroni post-Hoc test. Blood collection and biochemical assays: A 12-h fasting blood difference samples was drawn at the end of 8 weeks from the retro-orbital plexus into an anti-coagulant containing tube. Plasma was obtained by centrifuging the blood at 3000 rpm for 15 min at 4°C.

Biochemical parameters viz., Plasma glucose, TC, TG and Plasma SGOT, SGPT were estimated using commercially available kits as per manufacturer's instructions.

2.6 Anthropometric Measurements

The various Anthropometric measurements like weight, and thenasal length were Documented for each rat according to standard techniques [11]. Weightwas measured using scales.

Body Weight: Weight was recorded every week using weighing scale.

Body Mass Index: BMI was calculated as weight (g) divided by height squared (cm²).

Lee Index: Lee index is given by

$$[(\text{Body Wt})^{1/3} / \text{ano-nasal length (cm)} \times 1000]$$

was calculated before and after the treatment as an index of obesity.Body weight for all groups was recorded weekly. The plasma samples were investigated for various biochemical parameters such as glucose, lipidprofile (Cholesterol, TG, HDL, LDL and VLDL), Liver function test (SGPT, SGOT).

2.7 Plasma Glucose Levels

The glucose levels in plasma were measured using a commercially available kit (AutoZyme)

Plasma Glucose, Accurex Biomedical Pvt. Ltd. The set of tests were performed in duplicate as per the manufacturer's instructions using a UV spectrophotometer and absorbance were measuredat 505 nm.

2.8 Plasma Cholesterol Levels

Plasma cholesterol levels were measured using commercially available kit by Sigma code no. 120194.Tests were performed induplicate as per the manufacturer's instructions using a UV spectrophotometerand absorbance was measured at 510 nm upon scanning from 505 - 530 nmrange.

2.9 Plasma Triglyceride Levels

Plasma triglyceride levels were measured using commercially available kitby Sigma code: 120211). This kit contains areagent set for determination of triglycerides, based on enzymatic method usingLipoprotein lipase, Glycerol kinase, Glycerol phosphate oxidase and Peroxidase.Tests were performed in duplicate as per the manufacturer's instructions using UV spectrophotometer and absorbance was measured at 510 nm uponscanning from 505- 530 nm range.

2.10 Plasma High Density Lipoprotein Cholesterol (HDL Chol.) Levels

Plasma HDL-Cholesterol levels were measured using commercially available kit.HDL-Cholesterol precipitating reagent method (PTA) is intended for theseparation and quantitative determination of HDL cholesterol and utilizes the well-established precipitating properties of phosphotungstic acid to precipitate non HDL-Chol. The remaining cholesterol in the supernatant, HDL-Chol was then measured using commercially available kit for the

estimation of Cholesterol by Erba code no. 120194.

2.11 Plasma Low Density Lipoprotein (LDL) and Very Low Density

Lipoprotein (VLDL) levels. The plasma LDL and VLDL levels were calculated from the Friedewald equation [12].

$$\text{LDL Level Serum LDL levels (mg/dl)} = \text{Total cholesterol} - (\text{HDL level} + \text{VLDL level})$$

2.12 VLDL Level

$$\text{Serum VLDL levels (mg/dl)} = \text{Triglyceride level} / 5$$

Plasma SGPT (ALT) levels

Serum SGPT levels (ALT) were estimated using commercially available kit ALT Activity Assay kit: SIGMA (MAK052) SGPT (ALT), catalyses the transfer of amino group from L-alanine to 2-Oxoglutarate to form pyruvate and L-Glutamate. The pyruvate thus formed reacts with 2, 4-dinitrophenyl hydrazine to form a corresponding hydrazone, a brownish red colored complex in an alkaline medium. The absorbance was measured at 505 nm using a UV spectrophotometer.

2.13 Plasma SGOT (AST) Levels

Serum SGOT levels were estimated using commercially available kit (AST Activity Assay Kit: SIGMA (MAK055), SGOT (AST), catalyses the transfer of amino group from aspartic acid to 2-Oxoglutarate to form oxaloacetate and L-

Glutamate. The oxaloacetate thus formed reacts with 2, 4-dinitrophenylhydrazine to form a corresponding hydrazone, a brownish red colored complex in an alkaline medium. The absorbance was measured at 505 nm using a semi-auto biochemistry analyzer.

2.14 Histological Analysis

At the end of the experimental period, animals were sacrificed. Adipose tissue (fat pads) from each rat was removed, weighed and stored at -40°C. For histological examination, adipose tissue was fixed in 10% formalin solution and embedded in paraffin. Standard sections of 5µm thickness were cut, stained using haematoxylin and eosin, viewed under an optical microscope (40X). Histological analysis was carried out at the oral pathology department, I.T.S Dental college Muradnagar.

3. RESULTS

3.1 Effects of High-Fat Diet and Treatment on Body Weight

There was no momentous difference in all of the treatment groups at the commencement of the study. However, animals feed with high-fat diet showed significant increase in body weight compared to those fed with normal pellet diet (NPD). There was no significant difference in body weight of Positive Control group and normal but there was a significant difference in the body weight of Normal group and other treatment groups ($p < 0.05$). The group treated with SZM Which is GP III showed no significant difference with POSITIVE CONTROL (Figs. 1, 2).

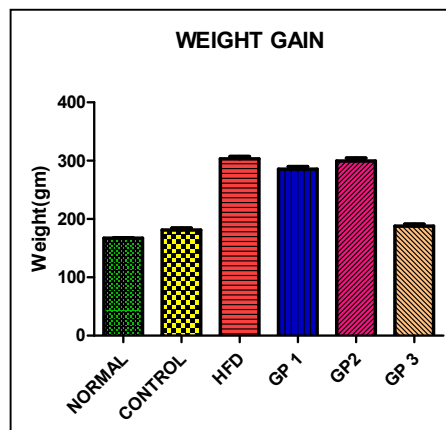


Fig. 1. The body weight of ND group compared with other treatment group

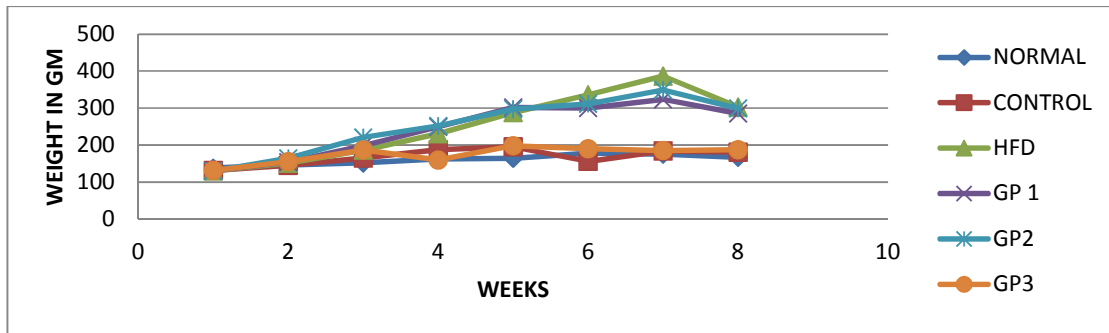


Fig. 2. Effects of high-fat diet on food intake

The average daily feed intake of all the groups was the same at the start of the study; however, 8 weeks treatment with CD resulted in an increase in food intake (Fig. 3). The intake of food was calculated as gm/day/animal. Using the weighing scale the food intake was calculated every day.

CDgroup fed with high fat diet showed significant ($p < 0.001$) increase in daily food intake when compared with Normal group and POSITIVE CONTROL group Treatment with TOM (400 mg/kg/p.o) and SZM showed significant ($p < 0.001$) decrease in daily food intake as compared with CD group animals. Results are shown in (Fig. 3). Fig. 4 shows weekly comparison of Food intake ND group and other treatment groups.

3.2 Weekly Food Intake

There was a significant increase in the food intake in rats fed with CD but after the treatment of 3-4 weeksthere was a decrease in food intake.

3.3 BMI and Lee index

Body weight for all groups was recorded every week. The mean BMI and Lee Index were calculated at the end of the entire experimental duration.

Body Mass Index of Rats Fed on the Experimental Diets for 8weeks. Values are mean + SEM; n=6. Means are statistically significantly different ($p < 0.05$)(Fig. 5).

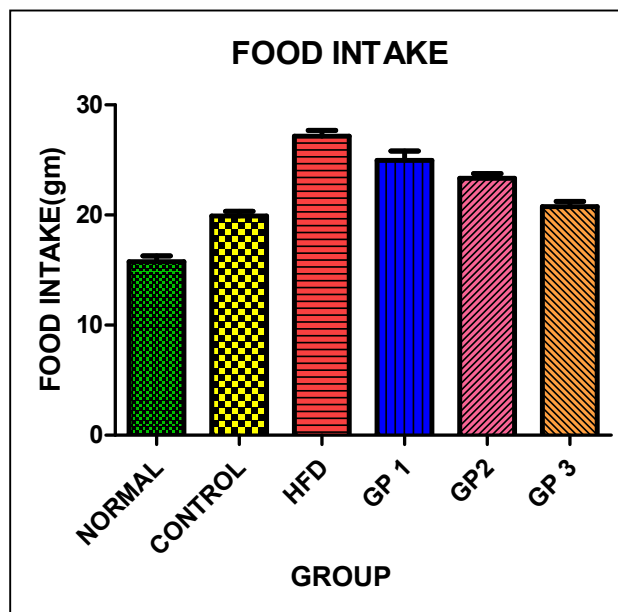


Fig. 3. Food intake in ND group compared with other treatment group

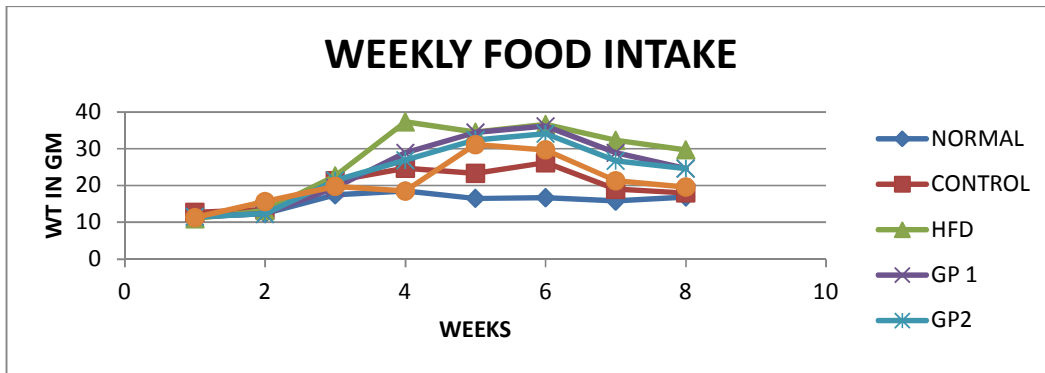


Fig. 4. Weekly comparison of Food intake ND group and other treatment groups

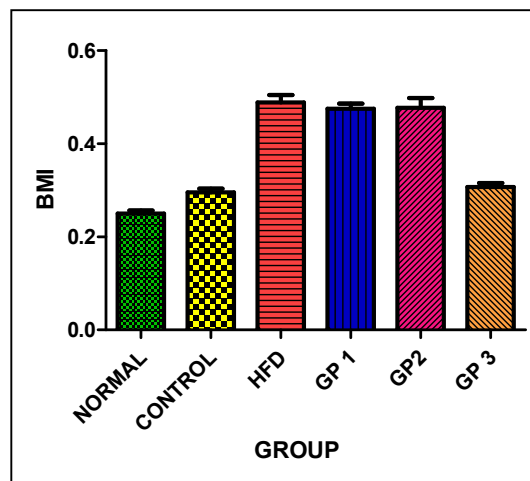


Fig. 5. BMI of normal groups and other treatment groups

3.4 Lee Index

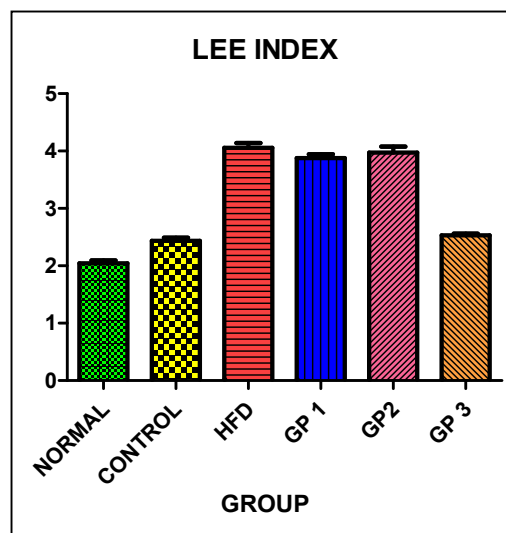


Fig. 6. Lee index of normal groups and other treatment groups

3.5 Locomotor Activity

Locomotion or physical activity is found reduced in obese animals hence this parameter can be used for determining the extent of obesity. This experiment was carried out using anactophotometer(Fig. 7),Dunnets multiple comparison test between Negative control CD and Other groups.

3.6 Adiposity Index

Adipose tissue weight

Adipose tissue (fat pad) weight was taken at the end of the experiment after euthanisation of animals from all the groups. The fat pads were separated, washed in saline and weighed for all the rats (Figs. 8, 9).

It was observed that there was a significant increase in adipose tissue weight in rats fed with Cafeteria diet ($p<0.05$). Whereas the POSITIVE CONTROL group and the group treated with SZM did not show any significant increase in weight of fat pads when compared to the normal group, there was significant increase in weight of

fat pads in all other treatment groups ($p<0.001$) in comparison with normal group.

3.7 Plasma Glucose

The plasma Glucose levels were measured in each group. There was no significant difference between the normal group and POSITIVE CONTROL group, and similarly there was no significant difference between the SZM treated group i.e. GP III and Normal group. Whereas other treatment groups showed significant difference from the normal group ($p<0.001$)(Fig. 10).

3.8 Total Cholesterol, Triglycerides, LDL, HDL, VLDL

Rats fed with CD showed increased levels of serum Triglycerides, Total cholesterol, Fig. 11 LDL, VLDL Fig. 12, Fig. 13 and decreased HDL levels Fig. 14, However oral administration of SZM extract significantly suppressed the rise of Lipid profile and led to raise in the HDL levels. When compared to Normal group and POSITIVE CONTROL group. Below given are the charts representing the same.

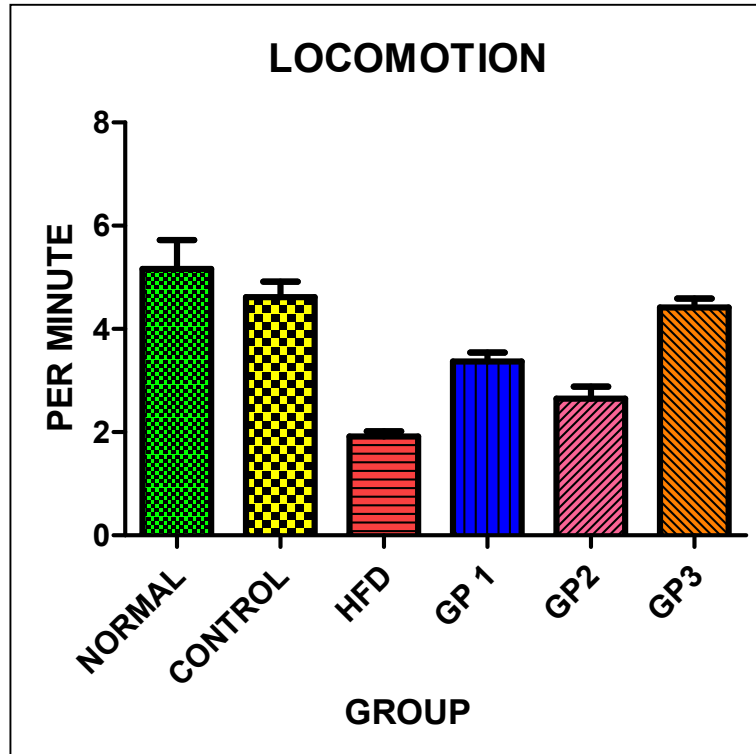


Fig. 7. Comparative aspect of locomotive activity of normal groups and other treatment groups

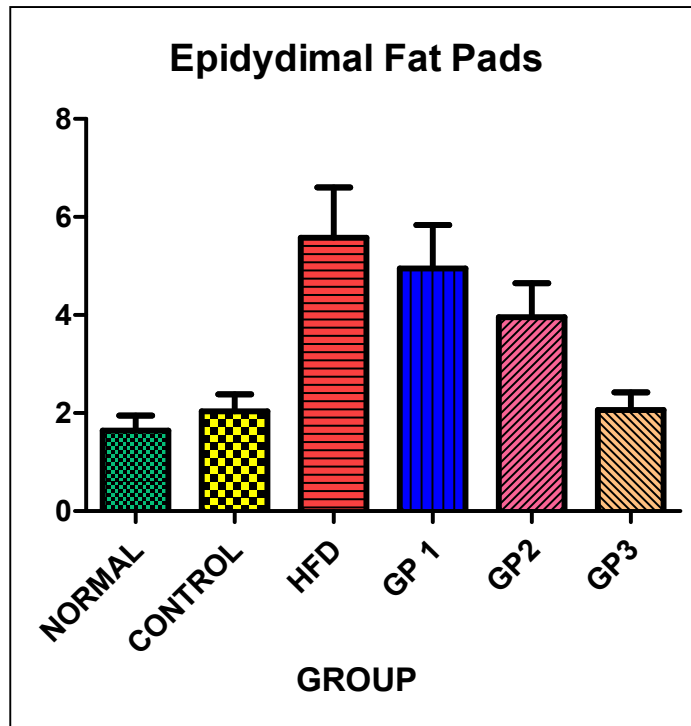


Fig. 8. Comparative aspect of adipose tissue weight of normal groups and other treatment groups

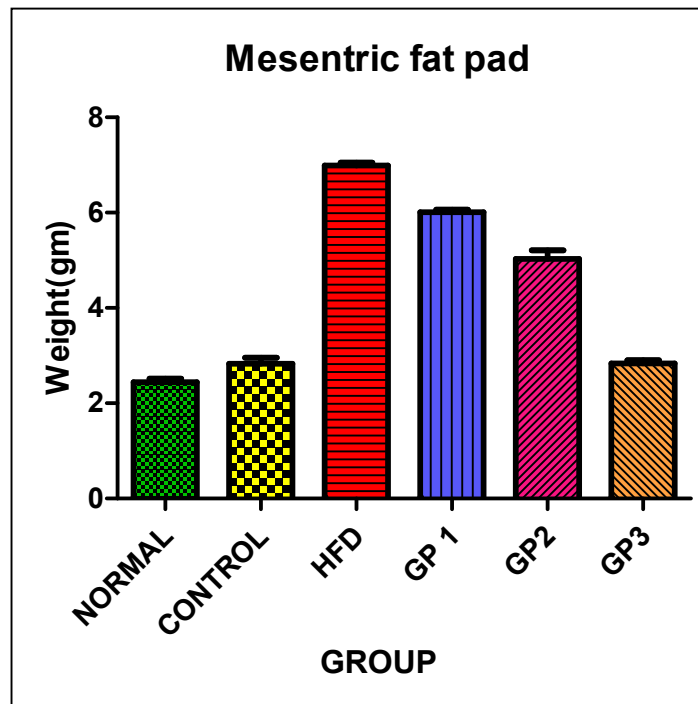


Fig. 9. Comparative aspect of adipose tissue weight (Mesentric fat Pad) of normal groups and other treatment groups

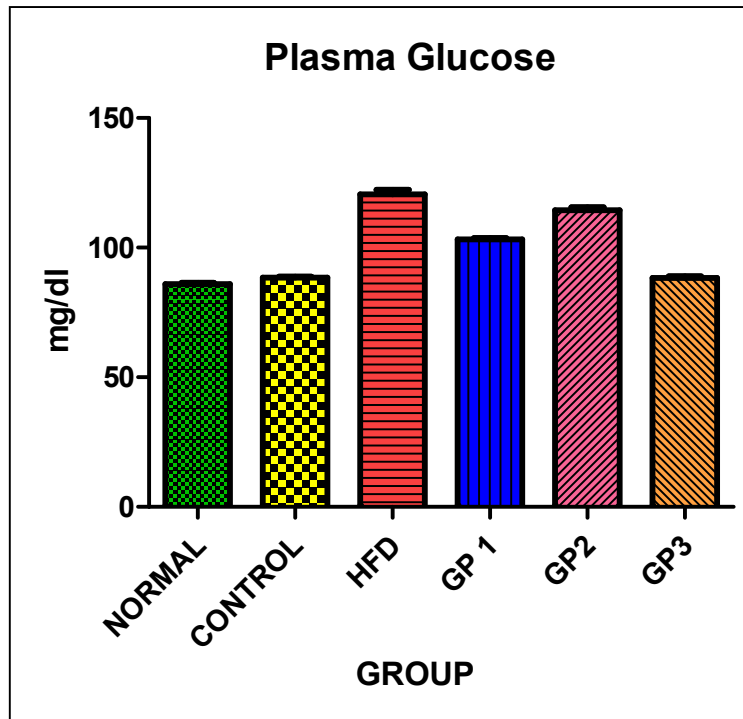


Fig. 10. Comparative aspect of plasma glucose of normal groups and other treatment groups

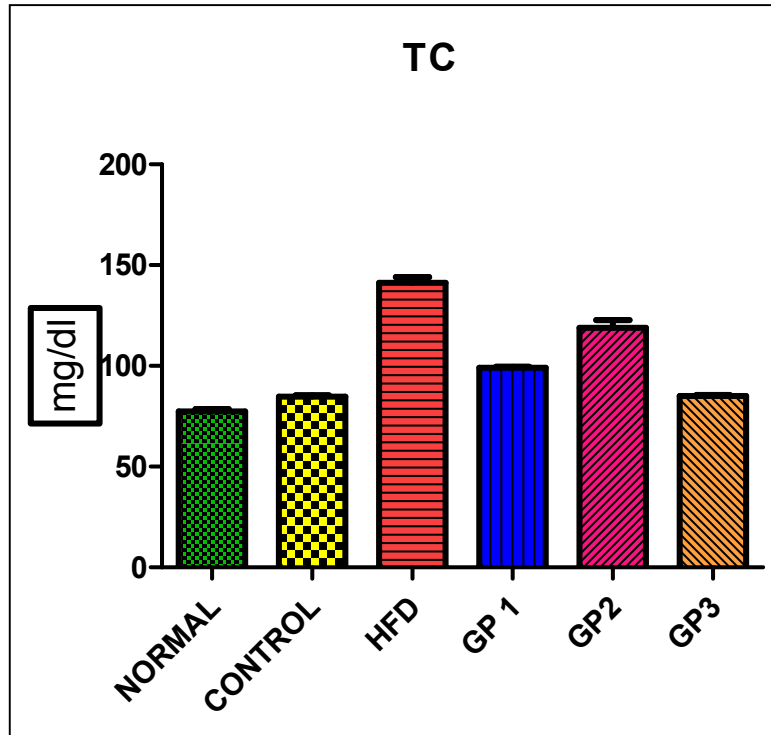


Fig. 11. Comparative aspect of (TC) total cholesterol of normal groups and other treatment groups

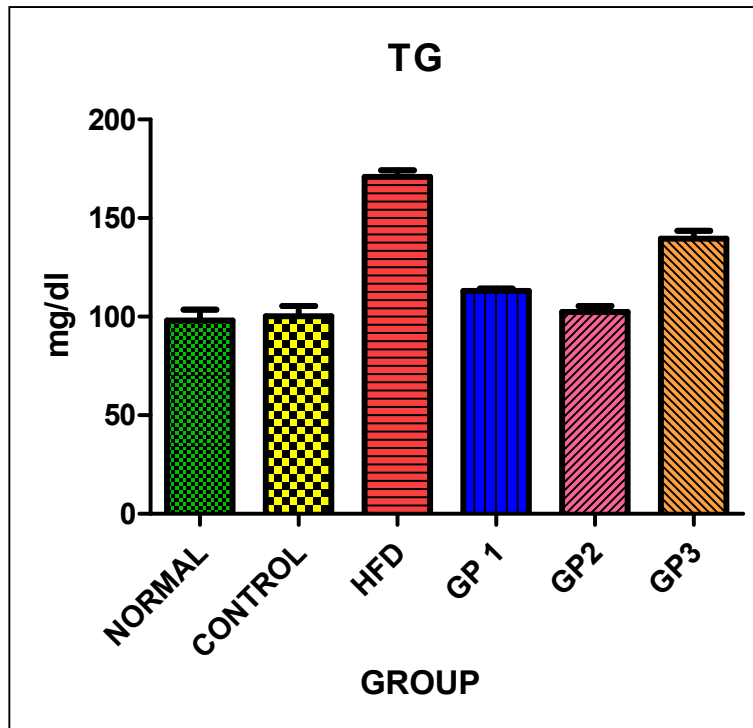


Fig. 12. Comparative aspect of (TG) triglycerides of normal groups and other treatment groups

VLDL

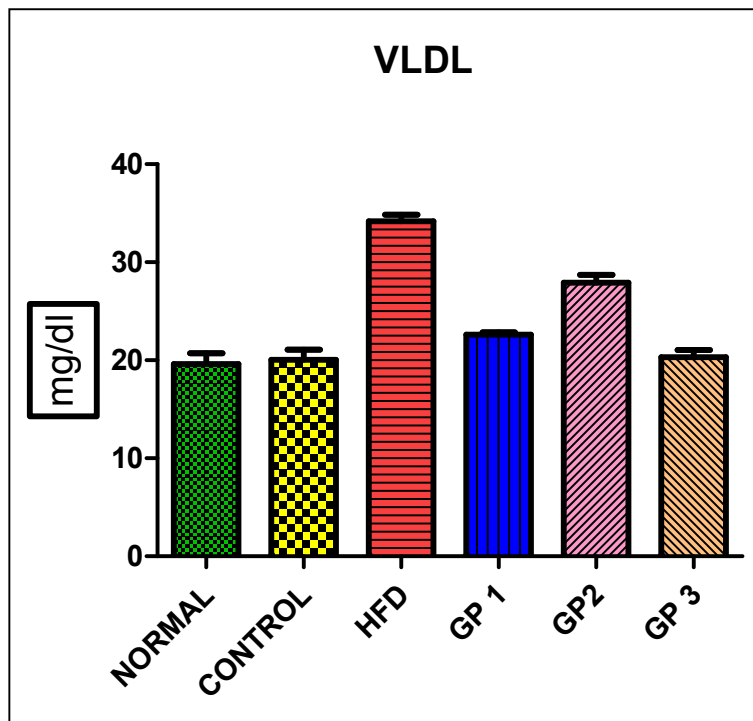


Fig. 13. Comparative aspect of total VLDL of normal groups and other treatment groups

HDL

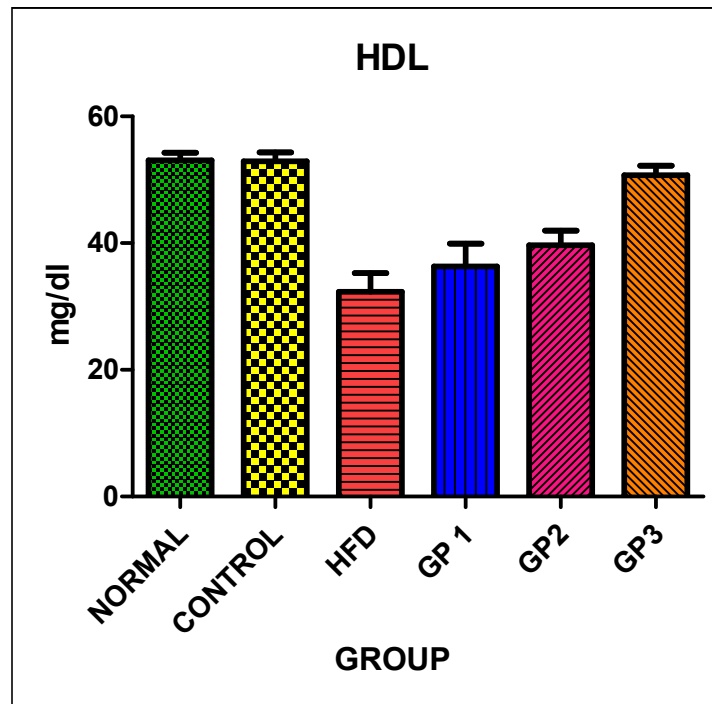


Fig. 14. Comparative aspect of total HDL (high-density lipoprotein) of normal groups and other treatment groups

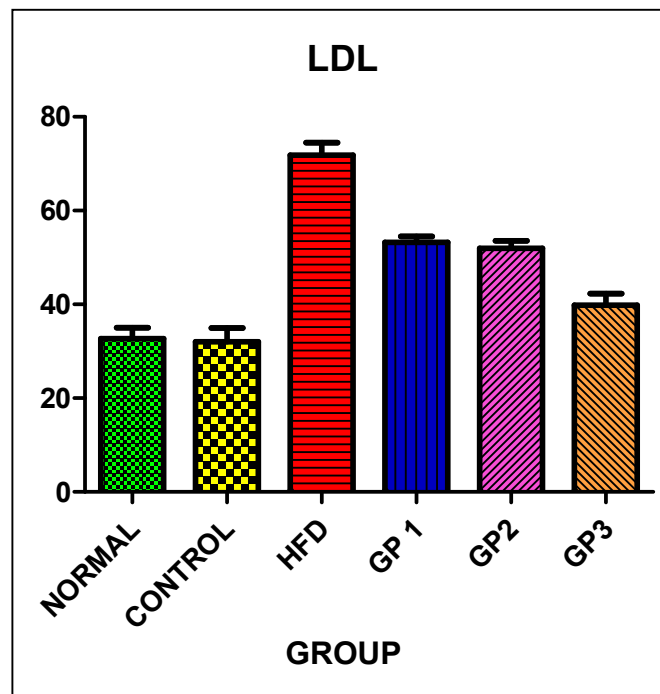


Fig. 15. Comparative aspect of total LDL (high-density lipoprotein) of normal groups and other treatment groups

Atherogenic Index

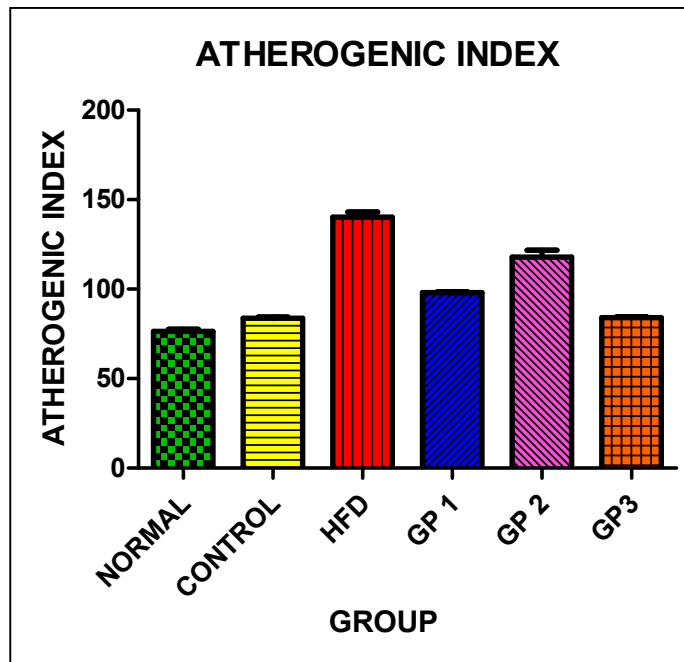


Fig. 16. Comparative aspect of atherogenic index of normal groups and other treatment groups

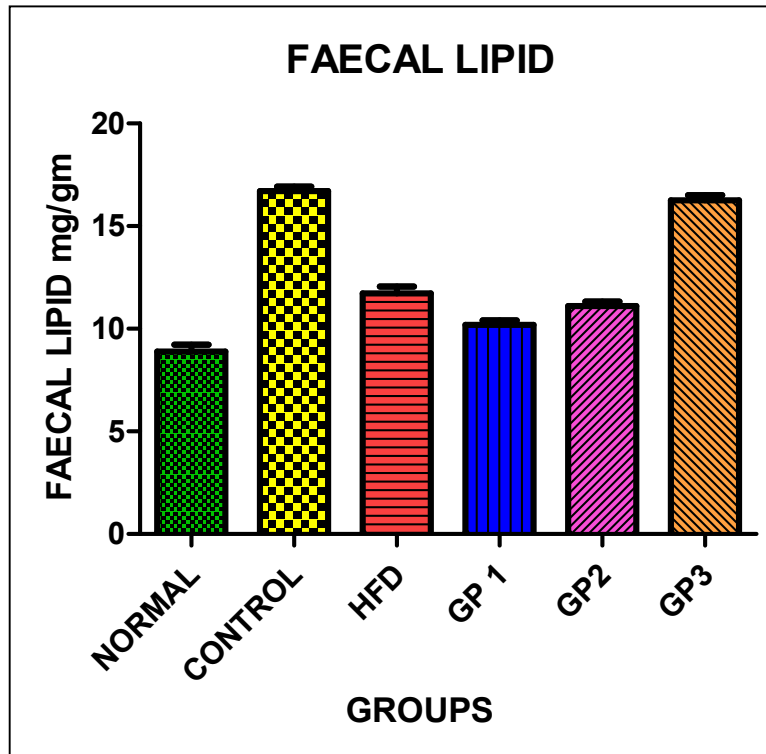


Fig. 17. Comparative aspect of amount of faecal lipids in normal groups and other treatment groups

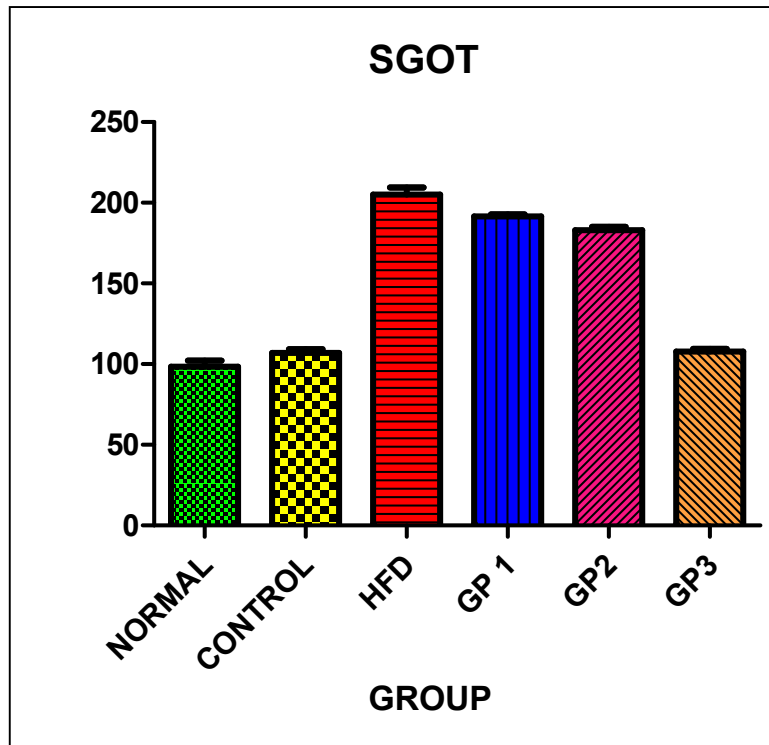


Fig. 18. Comparative aspect of SGOT (serum glutamic-oxaloacetic transaminases), in normal groups and other treatment groups

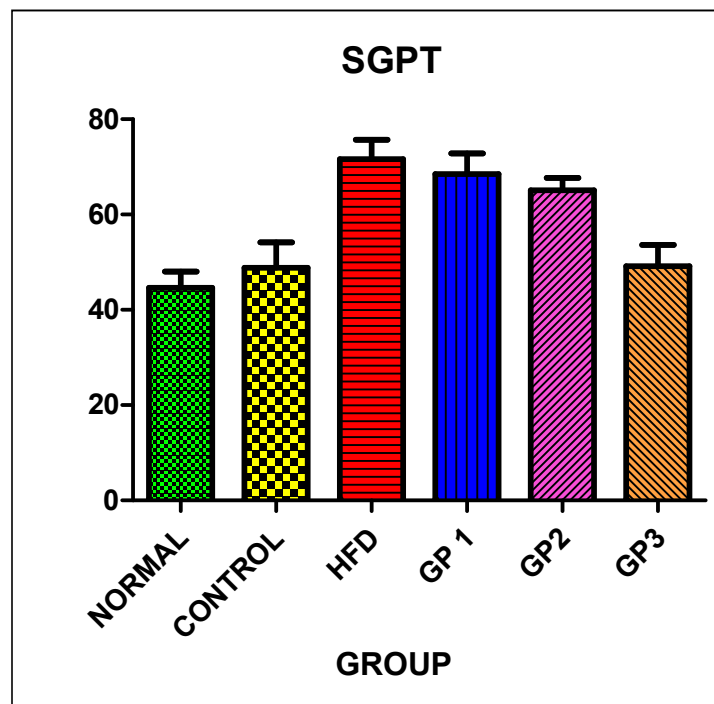


Fig. 19. Comparative aspect of levels of SGPT(serum glutamic-pyruvic transaminases) in normal groups and other treatment groups

3.9 Faecal Lipids

Faecal matter was collected from the experimental rats at the end of 9th week and 15th week, dried and powdered. Faecal lipids were extracted with chloroform and methanol (2:1), then dissolved in 1% triton × 100 and estimated by standard kit method.

Increased excretion of faecal tri glycerides was observed in Orlistat and TOM treated CD groups, indicating that TOM might reduce lipid digestion and absorption. Similarly slightly significant TG in the faeces was observed in rats treated with SZM.

3.10 Liver Biochemical Parameters

Liver function tests are important indicators to reveal the functional status of liver since it is the vital organ involved in detoxification of compounds and in general metabolism. During diet induced obesity, the liver of obese rats displayed characteristic features of hepatic steatosis such as fat accumulation and swelling of roughendoplasmic reticulum and mitochondria in hepatocytes. Increased levels of SGOT (Fig. 19), SGPT (Tables 2, 3, Fig. 20), ALP in CD group, as shown in the present study indicate alterations in liver metabolic function. SZM extract administration has effectively lowered the CD-induced elevated levels of these hepatic enzymes and lipid profiles demonstrating its protective activity.

Liver weight

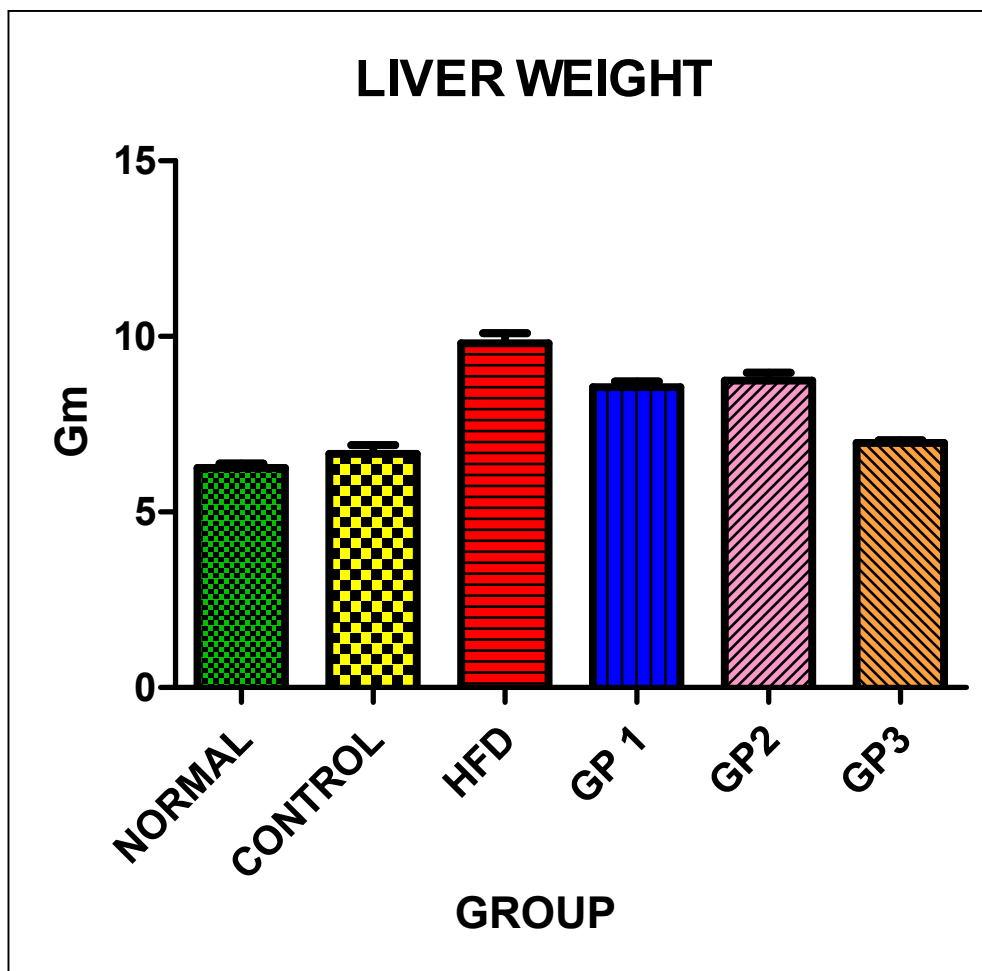


Fig. 20. Comparative aspect of liver wt in normal groups and other treatment groups

Assay for estimating oxidative stress levels

MDA

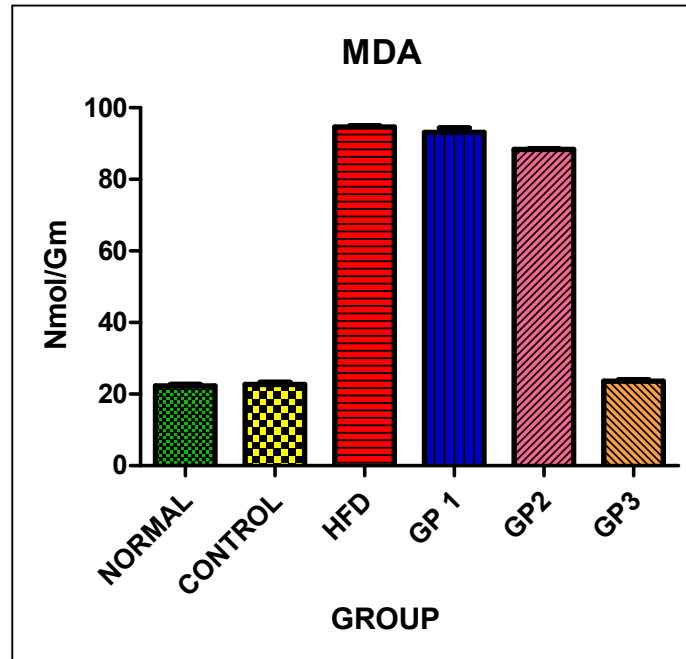


Fig. 21. Comparative levels of MDA in normal groups and other treatment groups

GSH

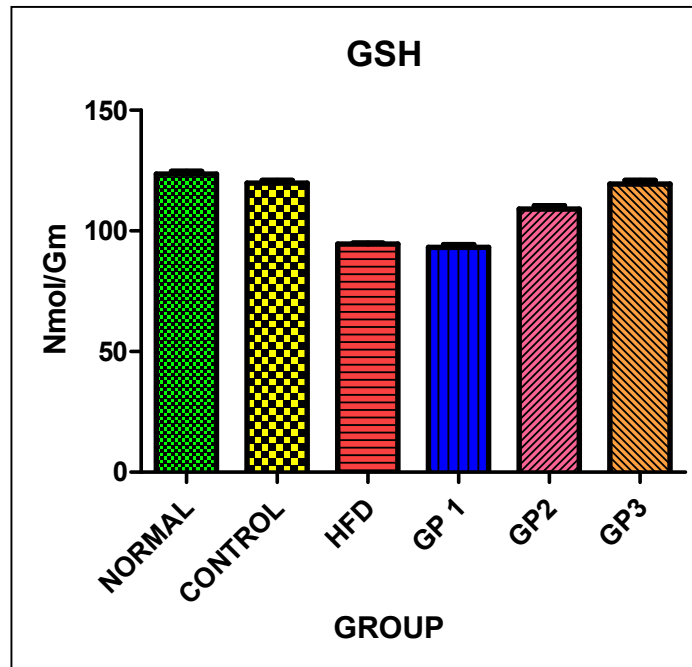


Fig. 22. Comparative levels of GSH in normal groups and other treatment groups

Our results showed a statistically significant increase in the hepatic tissues levels of MDA in obese rats when compared to the POSITIVE CONTROL group, ($p < 0.001$) (Fig. 22) Concerning the antioxidant enzymes activities in obese animals, the present study showed a statistical significant decrease in the activities of hepatic GSH level in obese rats compared to positive control (Fig. 23).

3.11 Abdominal Fat Depots and Fatty Liver: Dissected Figures of ND and CD Fed Rats

The increase in accumulation of abdominal fat on feeding rats with high fat diet became further evident on dissecting the animals (Fig. 23). The increase in the fat deposit was evident even through the naked eyes. The differentiation between the fatty liver and normal liver could also be made through naked eyes. The liver in all animals of the CD group were enlarged and yellowish in colour, indicative of liver

steatosis. On administration of treatment Orlistat, and SZM the liver remained reddish brown in colour and appeared normal in texture and colour with no abdominal or extra-hepatic fat deposition.

4. DISCUSSION

The deadly dose (LD50) value of the *Smilax zeylanica* indicated that the concentrate (methanol) was protected and nontoxic up to 5 g/kg [13]. Past examinations have announced the antiulcer, diuretic, calming, antifertility, CNS depressant, and wound healing properties of leaves of *Smilax zeylanica*. None theless, the after effects of the past lab creature study demonstrated that unrefined concentrate of *Smilax zeylanica* has hypocholesterolemic movement in rodents. Still no confirmations are accessible for antiobesity capability of methanolic remove of *Smilax zeylanica*. Hence, the study has been designed to demonstrate the effect of

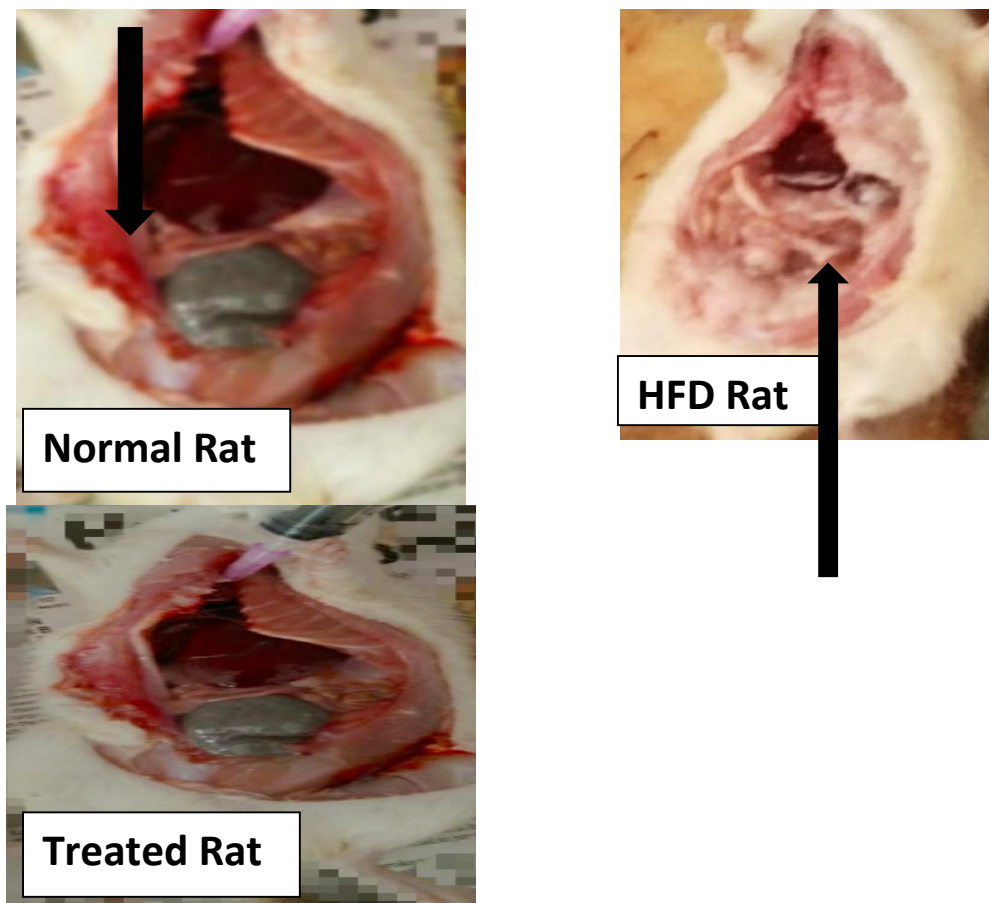


Fig. 23. Visible adipose tissue

Smilax zeylanica in high fat diet-induced obesity. Weight is a significant danger factor for increased bleakness and mortality and is associated with various medical ailments [14]. High fat eating regimen actuated stoutness has been considered as the most mainstream model among scientists because of its high closeness of imitating the typical course of heftiness scenes in human thus why it is considered as a dependable instrument for examining corpulence as they will promptly put on weight when feed high-fat weight control plans. Human examinations have uncovered that expanded fat admission is related with body weight acquire, which can prompt corpulence and other related metabolic illnesses. This examination hence demonstrated that rodents presented to highfat diet for about fourteen days cause a critical increment of creatures' body weight, along these lines confirming the stout status [15]. Despite the fact that there was a significant difference in the body weights between the high-fat and normal diet groups, no significant difference was seen in the everyday food admission of creatures. This perception furnishes us with the way that an expansion in body weight is independent of the amount of food consumed by the creatures. Treatment of HFD rodents with *Smilax zeylanica* at 200 mg/kg and 400 mg/kg p.o. conversely causes a remarkable decrease of body loads when contrasted with the high-fat diet administered rats. The result also suggests that *Smilax zeylanica* supplementation at 200 mg/kg and 400 mg/kg are fit for forestalling body weight acquire, correspondingly helping in keeping up the current body weight. This outcome was in accordance with the results reported from the previous study where a portion subordinate diminishing in the body weight was observed. Further, treatment with *Smilax zeylanica* markedly decreases the organ weight of rats feed on high-fat diet. Thus it proved the weight reducing potential of *Smilax zeylanica*. Further, dyslipidemia is another significant trademark in the pathogenesis of heftiness described by hypertriglyceridemia with diminished degree of LDL and VLDL [16]. Chronic dyslipidemia has been characterized as a major risk factor for cardiovascular danger, including atherosclerosis. In the current examination separated from decrease in weight, supplementation with *Smilax zeylanica* was seen to lessen altogether the degrees of complete cholesterol and LDL and expanded the degree of HDL level in rodents feed with HFD. The expansion in the degree of HDL was discovered to be in a portion subordinate way; that is, supplementation with

Smilax zeylanica at a portion of 400 mg/kg shows a superior impact in contrast with 200 mg/kg. where treatment with crude extract of *Smilax zeylanica* led to an expanded serum HDL level and diminished degrees of complete cholesterol, LDL, and triglyceride. Thus, it can be concluded that leaves of *Smilax zeylanica* have cardioprotective potential [17]. Further, atherogenic is viewed as a marker for different cardiovascular problems; the higher the worth, the higher the risk of developing cardiovascular disease and the other way around. High-fat eating regimen openness brought about the increased atherogenic index. Treatment with 200 mg/kg and 400 mg/kg significantly attenuated the atherogenic index and thus gives cardioprotection. The diminished atherogenic index by *Smilax zeylanica* thus supports the cardioprotective nature of *Smilax zeylanica*. To enhance the outcomes, the histopathological studies were likewise performed. The writing audit revealed that high fat diet-induced obesity and abnormal lipid metabolic small collectively are associated with inflammation, clog, and non alcoholic greasy liver sickness (NAFLD) prompting hepatic disappointment causing a lift in SGOT, SGPT, and complete bilirubin level in the serum [18]. Our outcomes showed that consumption of high-fat diet may play a crucial part in the pathogenesis of greasy liver or hepatic steatosis associated with obesity depicted via ballooning degeneration. Raised degrees of liver chemicals are a screen of hepatocellular harm and connect with expanded liver weight [19]. The results acquired in the current examination set up that high-fat diet causes hepatocellular damage, as clearly seen by the stamped height of serum proteins (SGOT, SGPT, and total bilirubin) activities and histopathological studies of liver misrepresented with hepatic steatosis. Nonetheless, treatment with *Smilax zeylanica* causes a momentary reduction in these enzyme levels, meaning the job of *Smilax zeylanica* in forestalling liver harm caused by high-fat diet. Insulin resistance is associated with a number of metabolic problems, for example, corpulence, hyperlipidemia, and hypertension. HFD admissions were appeared to add to conditions, for example, hyperlipidemia, glucose narrow mindedness, hypertension, and atherosclerosis. Various confirmations showed that in exploratory creatures, high-fat eating regimens brought about unsettling influence in glucose digestion and disabled glucose resilience, and the current investigation likewise exhibit the decrease in blood glucose level those treated with *Smilax zeylanica* (200 and 400 mg/kg). The hypolipidemic

potential is related with the presence of β -sitosterol²⁰ in unrefined concentrate of *Smilax zeylanica*. Accordingly, further investigation should be done for distinguishing proof of explicit constituents present in *Smilax zeylanica* for its observed effects. The current examination consequently reasons that the concentrate of leaves of *Smilax zeylanica* have hypolipemic and antiobesity potential that secures the body against unfriendly impacts of high fat diet-induced obesity. Further, we demonstrated that the day by day supplementation of *Smilax zeylanica* leaves concentrate may switch the arrangement of hepatic steatosis and nonalcoholic fatty liver disorder. The results in the present study established that high-fat diet causes elevation in body weight and reduces lipid digestion as obviously seen by the checked rise of liver proteins and lipid level. Nonetheless, supplementation with *Smilax* reversal the parameters thus suggesting its weight-reducing potential.

5. CONCLUSION

Hence, from the current examination it tends to be inferred that the methanolic concentrate of *Smilax zeylanica* is valuable to the weight board, which underpins its customary case. Further, contemplations are done to decide the dynamic guideline of this plant, trailed by the distinguishing proof of the unthinking methodology of *Smilax zeylanica* that helps in weight the executives.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

It is not applicable.

ETHICAL APPROVAL

Animal Ethic committee approval has been taken to carry out this study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Chooi YC, Ding C, Magkos F. The epidemiology of obesity. *Metabolism*. 2019;1(92):6-10.
2. GBD 2015 Obesity Collaborators. Health effects of overweight and obesity in 195 countries over 25 years. *New England Journal of Medicine*. 2017;6;377(1):13-27.
3. Rajan L, Palaniswamy D, Mohankumar SK. Targeting obesity with plant-derived pancreatic lipase inhibitors: A comprehensive review. *Pharmacological research*. 2020;1(155):104681.
4. Rajesh V, Perumal P, Sundarajan T. Antidiabetic activity of methanolic extract of *Smilax zeylanica* Linn. instreptozotocin induced diabetic rats. *Internet J Endocrinol*. 2010;9.
5. Murali A, Ashok P, Madhavan V. Screening of methanol extract of roots and rhizomes of *Smilax zeylanica* L for hepatoprotective effect against carbontetrachloride induced hepatic damage. *J Expl Integr Med*. 2012;(2):237-44.
6. Hiraki E, Furuta S, Kuwahara R, Takemoto N, Nagata T, Akasaka T, Shirouchi B, Sato M, Ohnuki K, Shimizu K. Anti-obesity activity of *Yamabushitake* (*Hericium erinaceus*) powder in ovariectomized mice, and its potentially active compounds. *Journal of natural medicines*. 2017;71(3):482-91.
7. Thirugnanasampandan R, Mutharajan V, Bai VN. *In vitro* propagation and free radical studies of *Smilax zeylanica* Vent. *Afr J Biotechnol*. 2009;(8):395-400.
8. Liu JS, Dong C, Vo AX, Dickmeyer LJ, Leung CL, Huang RA, Kielb SJ, Mukherjee S. Obesity and anthropometry in spina bifida: What is the best measure. *The journal of spinal cord medicine*. 2018;41(1):55-62.
9. Sabarisenhil B, Kalaichelvan VK. A review on pharmacological activities of *Smilax* China and *Smilax zeylanica*. *International Journal of Chemical and Pharmaceutical Sciences*. 2017;8(1).
10. Abhilash G, Naveen B. Hypolipemic activity of parts of *Luffa aegyptiaca* in poloxamer induced hyperlipidemia.

- International Journal of Review in Life Sciences. 2018;8(1):1-4.
11. Tencerova M, Figeac F, Ditzel N, Taipaleenmäki H, Nielsen TK, Kassem M. High-fat diet-induced obesity promotes expansion of bone marrow adipose tissue and impairs skeletal stem cell functions in mice. *Journal of Bone and Mineral Research*. 2018;33(6):1154-65.
 12. Hong SJ, Lee JH, Kim EJ, Yang HJ, Park JS, Hong SK. Anti-obesity and anti-diabetic effect of neogargarooligosaccharides on high-fat diet-induced obesity in mice. *Marine drugs*. 2017;15(4):90.
 13. Fenni S, Hammou H, Astier J, Bonnet L, Karkeni E, Couturier C, Tourniaire F, Landrier JF. Lycopene and tomato powder supplementation similarly inhibit high-fat diet induced obesity, inflammatory response, and associated metabolic disorders. *Molecular nutrition & food research*. 2017;61(9):1601083.
 14. Blüher M. Obesity: Global epidemiology and pathogenesis. *Nature Reviews Endocrinology*. 2019;15(5):288-98.
 15. Borkar S, Jaiswal SK. Classification of enlisted ayurvedic lipid lowering herbs according to principle of ayurveda. *International Journal of Ayurveda and Pharma Research*. 2019;9:63-8.
 16. Soujanya H, Purushothaman M, Jagadeeshwari S, Kumar S. Evaluation of antihyperlipidemic activity of polyherbal capsules. *International Research Journal of Pharmaceutical and Applied Sciences*. 2018;28;8(1):1-4.
 17. Sembiring D, Levita J. Hepatotoksitasdanaktivitashepatoprotekti ftanamanmalvaviscus. *Farmaka*. 2019;17(3):142-50.
 18. Patel S, Biswas B, Rambabu K, Sundaram EN, Arya R. Pharmacognostical studies of *Smilax aspera*Linn.–A herbal drug. *Indian Journal of Research in Homoeopathy*. 2020;1;14(4):260.
 19. Sharma S, and Sagarika Majhi NT. *Smilax zeylanica*: An overview. *International Journal of Research and Development in Pharmacy & Life Sciences (IJRDPL)*. 2008;7:2893-5.
 20. Malge HMNR, Dannushika N, Peiris LD. Antioxidant, cytotoxic and antibacterial activities of methanol extracts from *Smilax zeylanica* L. Root and Rhi zome; 2017.

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