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Effect of *Buchanania Lanzan* Bark Extract on Hyperlipidemia and Obesity Against High Fat-Diet Induced Obesity in Rats

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KEYWORDS
Hyperlipidemia, High fat diet, Buchanania Lanzan bark, Obesity.

ABSTRACT:
The present study was investigated about the hyperlipidemia and anti-obesity effect of Buchanania Lanzan bark extract on rats fed with High Fat-diet. Experimental study of high fat diet induced obesity, hyperlipidaemia, insulin insensitivity and increased atherogenic index. The control rat continued to receive either a control diet or high fat diet, and the treatment groups were fed high fat diet with methanol extract of Buchanania Lanzan bark (200 mg/kg bw) and aqueous extract of Buchanania Lanzan bark (200 mg/kg bw) and high fat diet with orlistat (standard drug). In result treatment with methanol extract of Buchanania Lanzan bark with feed material decreased the weight gain, normalized the hyperlipidaemia and reduced the serum cholesterol level and hypothyroidism. Consumption of methanol extract of Buchanania Lanzan bark supplementation can be adopted as a therapeutic strategy for the prevention of high fat diet induced obesity problems.

Introduction: Globally, obesity has emerged as a serious public health issue that is characterised by the excessive accumulation of fat in the adipose tissues [1]. According to projections made in the World Obesity Atlas 2022, one billion people throughout the world, including one in every five women and one in every seven males, would be obese by the year 2030 [2]. Predisposition to genes and an imbalance in calorie intake compared to energy expenditure are the two main contributors to obesity. It is widely regarded as the most important factor in the development of a wide variety of chronic conditions, including dyslipidaemia, non-alcoholic fatty liver disease, cardiovascular illnesses, hypertension, diabetes, and many others [3-4]. Elevated levels of triglycerides, total cholesterol, Apo B, and LDL-C are among the lipid abnormalities often identified in obese people. The effectiveness of certain previously available anti-obesity medications was hindered by several undesirable side effects, such as gastrointestinal disorders and long-term use detrimental effects on organs, such as lungs, kidney, pancreas, and liver [5-6]. Hence, there is an urgent requirement for a safe alternative treatment that is also effective in combating the disease of obesity. Therefore, numerous scientists are interested in anti-obesity and lipid lowering agents from natural products.

Buchanania lanzan is a miracle herb widely used by Indian tribes for treating various diseases. It is a member of the family Anacardiaceae, originated in the Indian sub-continent, is an excellent multipurpose tree species. Traditional indigenous knowledge reveals the immense value of almost all parts of the plant i.e. roots, leaves, fruits, seeds and gum for various medicinal uses. It is a deciduous tree which produces seeds that are edible to humans. It is known as Chironji (or Charoli). These almond-flavoured seeds are used as a cooking spice primarily in India. Traditional indigenous knowledge reveals the immense value of almost all parts of the plant i.e. roots, leaves, fruits, seeds and gum for various medicinal uses [7-8]. The gum from the tree is used against leprosy in traditional medicine.1 Charoli seeds are used in the Ayurveda and Unani systems of medicine. The roots are acrid, astringent, cooling, depurative and constipating. They are useful in the treatment of diarrhoea. The fruits are used in treating coughs and asthma. The seeds are used as expectorant and tonic. The oil extracted from kernels is applied on

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skin diseases and also used to remove spots and blemishes from the face. The juice of the leaves is digestive, expectorant, aphrodisiac, and purgative. The gum after mixing with goat milk is used as an analgesic. It is called priyala in Ayurveda. It is used as a cooking spice. It is aphrodisiac, nourishing, cardiac tonic but it may cause indigestion. The aim of the present study is to conduct scientific research into possible role of *Buchanania lanzan* bark extract on prevention of dietary deregulation induced hyperlipidemia and obesity [9-10].

Materials and methods

Plant Materials: The *Buchanania lanzan* bark, were purchased from the local market of Bhopal, M.P. Studies were conducted on the organoleptic characteristics of the *Buchanania lanzan* bark, which included color, odor, appearance, taste, and texture, among other characteristics. Dried, coarsely powdered *Buchanania lanzan* bark was subjected continuous soxhlet extraction with Petroleum ether, chloroform, ethyl acetate and methanol as solvents sequentially. Aqueous extract was obtained by using maceration method with water. The extracts were concentrated in rotary evaporator and dried in vacuum desiccator. The extractive values were calculated as percentage w/w of solvent soluble extractive with reference to the air dried drug.

Animals: Six-week-old laboratory breed wistar albino rats of either sex weighing between 200–450 g were selected for study and were acclimatized for 1 week before being randomly assigned into experimental groups. The animals were housed in individual cages with free access to water in departmental animal house kept under controlled environmental conditions with 12 hours light/dark cycle at 22-24^{0}C, relative humidity (40–50%) and allowed to take water and food ad libitum. During the acclimatization period, each animal were raised at regular diet ad libitum. The experimental protocol was conducted in accordance with the internationally accepted principles for laboratory animal use and care as described by CPCSEA guideline after approval of IAEC. Animals were divided randomly into groups containing 6 animals in each group. Initially one week Control diet to animals of all groups followed by 45 days feeding of the respective diet as per group division and drug treatment. At the start of the experiment, control groups were fed with standard pellet diet and the other groups were fed with high fat diet and water. The diets were prepared fresh every day [11]. The composition of the diet is depicted in Table 1. To avoid oxidation of unsaturated fatty acids, the diets were prepared a fresh daily.

Table 1: Composition of experimental and high fat containing diet

Ingredients	**Control diet (%)**	**High fat diet (%)**
Yellow corn	70.24	29.5
Corn gluten	5	2.1
Soybean*	8.8	3.7
Casein	5	13.84
Wheat bran	4	1.68
Sucrose	0	5.14
Vegetable oil	4.74	1.99
Animal fat	0	38.2
Cellulose	0	1.5
Methionine	0.34	0
Lysine	0.07	0.39
Ground limestone	0.82	0
Dicalcium phosphate	0.56	0.42
Common salt	1.11	1.13
Mineral mix **	0.13	0.13
Vitamin mix ***	0.3	0.3
Total	100	100

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*Soybeans were autoclaved at 110ºC for 30 min according to inactivate trypsin inhibitor, tannins, saponins, phytate, protease inhibitors, lectins and goitrogens.

**Mineral mix was composed of NaCl, 5.18 g; $MgSO_4$, 2.29 g; KCl, 32 mg; $FeSO_4.7H_2O$, 108 g; $CaHPO_4$, 70 mg; CuSO4.5H2O, 0.1 mg; $MnSO_4.H_2O$, 0.01 mg; $ZnSO_4.H_2O$, 8.7 mg; KI, 0.025 mg; $COCl_2.6H_2O$, 9 mg and MgO, 0.15 mg.

***Vitamin mix contained cholecalciferol, 400 IU; 7-hydrochloride, dehydrocholesterol, 2-nicotinamide, 45 mg; Retinol acetate, 5000 IU; ascorbic acid, 75 mg; folic acid, 1000 µg; Metablizable Energy Cal/Kg.5200 and cyanocobalamin, 5 µg).

Experimental Design: Initially one week CD to animals of all groups followed by 45 days feeding of the respective diet as per group division and drug treatment. The animals were fed diets and water for a period of 12 weeks. At the end of 12 weeks, the animals were sacrificed by cervical dislocation after collecting blood via retro-orbital puncture. The blood samples were allowed to clot for 30 min at room temperature and centrifuged at 2,000 rpm for 15 min at 4°C. The liver and abdominal fat tissues were also completely excised and cleansed with saline. Moisture was completely removed with a filter paper, and the weights were measured using an electronic balance. The tissue samples were quickly frozen with liquid nitrogen and stored at -80°C until used for further studies (Table 2).

Groups for antiobesity activity of *Buchanania lanzan* bark (Six animals per group)

Normal Control: Control diet

Negative Control: High Fat Diet (HFD)

Positive Control: HFD + (orlistat) (10 mg/kg bw)

MEBL 200 mg/kg: HFD + methanol extract of *Buchanania lanzan* bark (200 mg/kg bw)

AQBL 200 mg/kg: HFD + aqueous extract of *Buchanania lanzan* bark (200 mg/kg bw)

Parameters to Assess Obesity:

Body weight: Body weight of all animals was monitored on every week for the entire period of study and expressed as g/g. Feed intake measurements for individual rat were recorded biweekly.

Determination of food intake: Food consumption were calculated daily at the same time by subtracting the amount of food/and water left over in each cage barrier for each animal (rat) from the measured amount of food/water provided at the previous day (g/day).

Organ weights: At the end of study, the animals were sacrificed by cervical dislocation after collecting blood via retro-orbital puncture. Orangs such as liver, kidney, pancreas, and epididymal adipose tissue was dissected from the sacrificed animals and rapidly stored at -80ºC till further use. Weights of individual organs such as liver, kidney, pancreas and epidydymal adipose tissue were recorded at the time of sacrifice.

Tissue samples were taken and preserved in 10 % formalin solution for a minimum of one hour. Formalin was removed from the tissue samples with running water. Dehydration of the fixed tissue was done by giving three changes of acetone (each 100 mL). Cleaning of tissue from acetone was followed by three changes of xylene (each 500 mL) in a total duration of three hours. Incubation of processed tissue in melted paraffin was done by two changes for 3-4 hours in an incubator maintained at 58-60˚C. Embedding of the tissue in paraffin wax was then done by immersing the tissue in molten paraffin and then cooling it to harden the paraffin. Sections of the paraffin embedded tissue were done using a microtome adjusted to 1-3µ thickness. The paraffin sections were carefully taken on glass slides. The sections were then cleaned by immersing in xylene. The sections were stained with hematoxylin and eosin stain and screened to evaluate the morphology and cellular composition. Weights of individual organs were recorded at the time of sacrifice. Liver and Kidney tissues were first fixed with 10 % buffered formalin, followed by staining of histological section with hematoxylin and eosin.

Biochemical Assays: Blood samples were collected at the end of the study, from the Retro-Orbital and the serum was separated after 30 min of stabilization by 3000 rpm centrifugation. After 45 days of treatment, blood sample was collected fasting from retroorbital puncture process under very light ether anesthesia. During the blood collection, care was taken not to damage the eyeball by passing the capillary from side.

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Heparin tube was used for collecting the blood. Samples were centrifuged at 4ºC and plasma was collected for estimation of glucose, lipid profile, nephropathy parameters and insulin. For serum preparation Blood was collected in a dry test tube and allowed to coagulate at ambient temperature for 40 min. Serum was separated by centrifugation at 20,000 rpm for 10 min. Body total Cholesterol and triglyceride were measured using a kit. method based on an enzymatic colorimetric by LDL-c concentration. AI and HOMA-IR and amount of protein was estimated. Bilirubin test was determined by using the Bilirubin (D&T) reagent kit. HDL-c was determined by kit Direct HDL Cholesterol, Triiodothyronine, thyroxine, and thyroid stimulating hormone were determined using an (ELECSYS 1010 auto-analyzer Thyrocare Lab, India). Liver and kidneys were isolated and store in ice cold saline, blotted and weighted [12]. Triglycerides in the plasma and tissues were estimated using the diagnostic kit based on the enzymic method described by McGowan et al. [13]. Plasma high density lipoprotein was estimated by using commercially available kit (Biosystems, Barcelona, Spain). After precipitation of plasma lipoproteins such as VLDL and LDL, HDL fraction was removed and estimated for cholesterol levels by the enzymatic method [14]. Plasma creatinine was estimated using the diagnostic kit based on the color reaction [15]. SGOT and SGPT activity was determined by the method of Reitman and Frankel (1957) [16]. Blood urea can be estimated by the Berthelot method. Blood urea, blood plasma or serum is used. Serum bilirubin levels were estimated by the method of Dangerfield and Finlayson [17].

Histopathology study of liver: Liver was removed from experimental animals and transferred to containers with 10% formalin solution for histopathological observation. For histopathological study, three rats from each group were washed and perfused with cold physiological saline, followed by formalin (10% formaldehyde). The organs (pancreas liver and kidney) were excised immediately and fixed in 10% formalin. Then dehydrated on treatment with a series of different concentration of ethanol and embedded in paraffin wax. 3-5 µm thick sections were cut using a microtome and stained with hematoxylin and eosin. The specimens were evaluated with light microscope.

Results and discussion:

Collection and authentication of Plant material: *Buchanania lanzan* barks were dried and inspect for any foreign organic matter if present. The *Buchanania lanzan* bark were subjected to studies organoleptic characters viz., color, odour, appearance, taste, texture etc. Plant materials were dried in shade and griended and stored in air tight container till further use.

Effect of plant extract on High fat diet induced Obesity: Obesity was induced by high fat diet (HFD). In the in vivo anti-obesity study the control rat will receive either a control diet or the treated animals will get high fat diet (HFD) or plant extract along with high fat diet for a period of 45 days. As a positive control, orlistat has been administered along with high fat diet.

Effect on Body Weight: Individual body weight gains were recorded before study imitation (Day 0), and weekly thereafter from the 1st week to the end of the study, a gradual increase in body weight was recorded in normal control group, whereas the rate of increase in body weight was much higher in the HFD (Table 2 & Figure 1).

Animals fed with HFD, the weight gradually increased compared to control animals and in animals fed with experimental diet contains plant extract average weight decreased compared to the HFD diet group animals.

Table 2: Effect of High Fat diet and *Buchanania lanzan* bark extract on animal weight

Groups	Initial Body Weight (g)	Final Body Weight (g)
Normal Control	192.7±1.21	200.9±1.12
Negative control (HFD)	191.16±2.08	241.73±2.09
Positive control	190.23±1.21	168.35±1.98

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MEBL 200 mg/kg	190.12±1.57	180.45±1.34
AQBL200 mg/kg	191.89±2.09	185.56±2.06

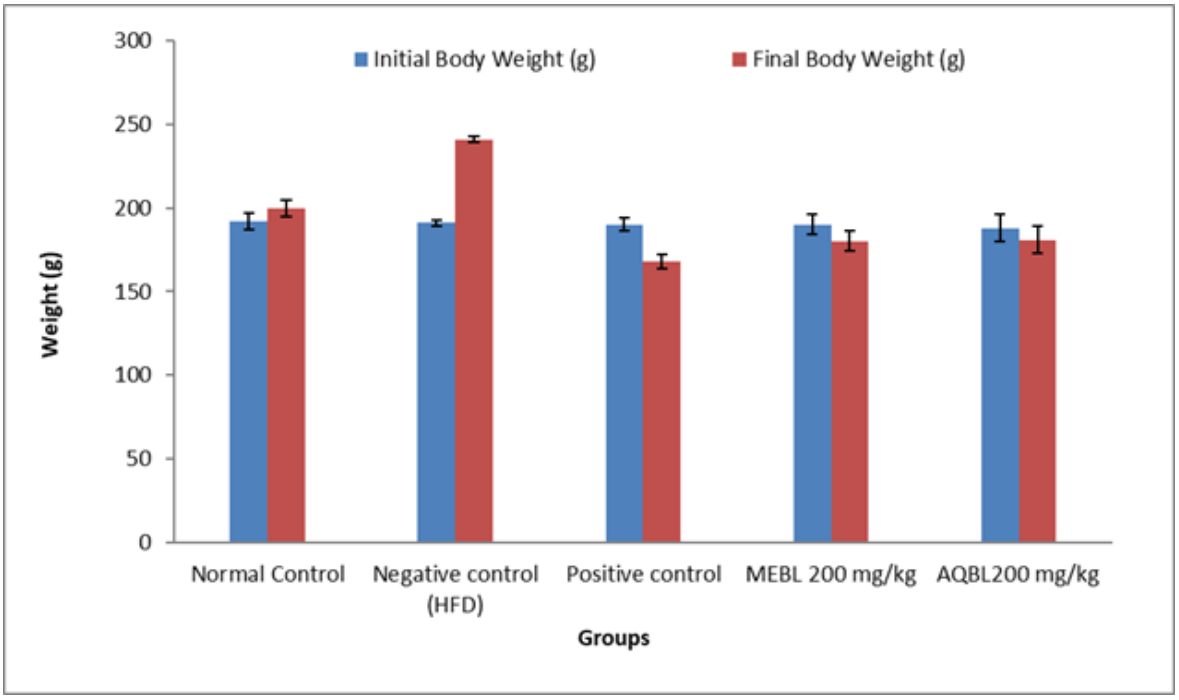

Figure 1: Effect of High Fat diet and *Buchanania lanzan* bark extract on animal weight

Determination of food intake: The food consumption calculated daily through deducting the amount of food leftover in each cage per rat (gm/rat/ day) given on the previous day. Mean for the food consumption per rat calculated by separating the amount of food in a week by seven. Rate of food consumption increased in rats fed with the high-fat diet, for 6 weeks and decreased significantly in rats feed with diet contains methanol extract of *Buchanania lanzan* bark (MEBL) compared to control group (Table 3 & Figure 2).

Table 3: Effect of *Buchanania lanzan* bark extract on the average food intake of high-fat diet induced obesity in rat

Groups	Average food intake per group in g/100 g of body wt		
	1st week	3rd week	6th week
Normal Control	11.19 ± 0.85	8.12 ± 0.86	9.01 ± 0.49
Negative control (HFD)	10.08 ± 0.05	10.38 ± 0.76	10.91 ± 0.82
Positive control	10.13 ± 0.05**	8.87 ± 0.41**	6.16 ± 0.92*
MEBL 200 mg/kg	10.23 ± 0.72**	9.38 ± 0.36*	8.76 ± 0.68**
AQBL 200 mg/kg	10.71 ± 0.46	10.24 ± 0.39	9.48 ± 0.74*

Values are mean ± SEM (n=6); *P <0.05, **P <0.01 compared to respective control group

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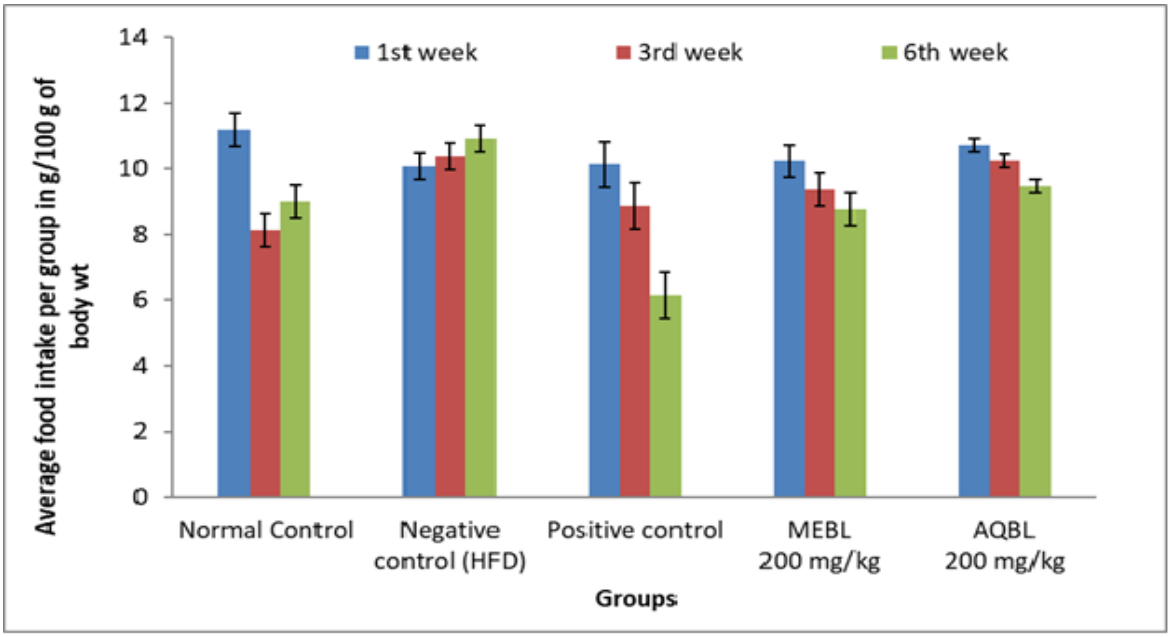

Figure 2: Effect of *Buchanania lanzan* bark extract on the average food intake of high-fat diet induced obesity in rat

Effect on Organ Weight: The animals of the High fat diet group showed a significant ($p < 0.05$) increase in weight of Liver. The results observed in the group that received the experimental diet (MEBL) significantly reduced weight of Liver ($p < 0.01$), as compared to High fat diet group; while no significant changes showing when compared to normal control group (Table 4 & Figure 3).

Table 4: Effect of *Buchanania lanzan* bark extract on Organ Weight of high-fat diet induced obesity in rat

Group	Organ Weight (g)			
	Liver	**Kidney**	**Pancreas**	**Epididymal adipose tissue**
Normal Control	5.75 ± 0.08	1.27± 0.01	8.82 ± 0.06	0.65 ± 0.008
Negative control (HFD)	8.67 ± 0.11	1.45± 0.03	10.75 ± 0.11	0.89 ± 0.011
Positive control	5.85± 0.12**	1.29 ± 0.06**	9.02 ± 0.08**	0.68 ± 0.009**
MEBL 200 mg/kg	6.05 ± 0.04**	1.32 ± 0.02**	9.78 ± 0.07*	0.72 ± 0.010*
AQBL 200 mg/kg	6.19 ± 0.13		10.02 ± 0.05	0.79 ± 0.008

Values are mean ± SEM (n=6); *P <0.05, **P <0.01 compared to respective control group

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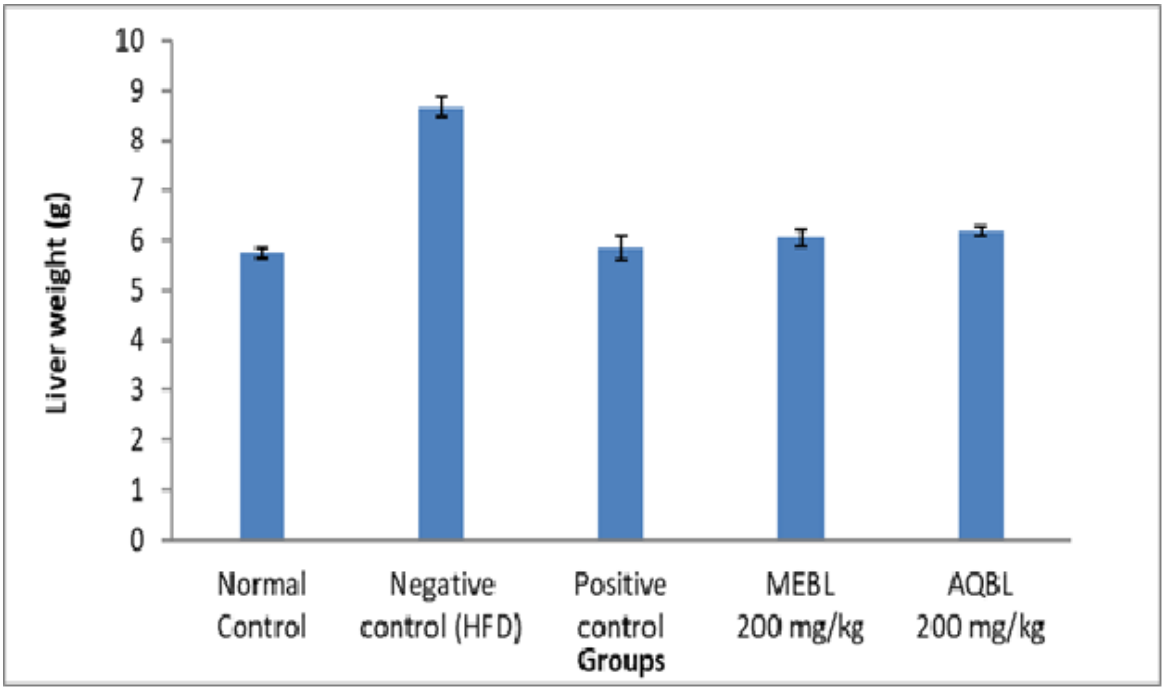

Figure 3: Effect of *Buchanania lanzan* bark extract on Liver Weight of high-fat diet induced obesity in rat

The animals of the High Fat Diet group showed a significant ($p < 0.05$) increase in weight of Kidney. The results observed in the group that received the diet containing methanol extract of *Buchanania lanzan* bark (MEBL) significantly reduced weight of kidney ($p<0.01$). Aqueous extract of both plants also exhibited activity upto some extent (Figure 4).

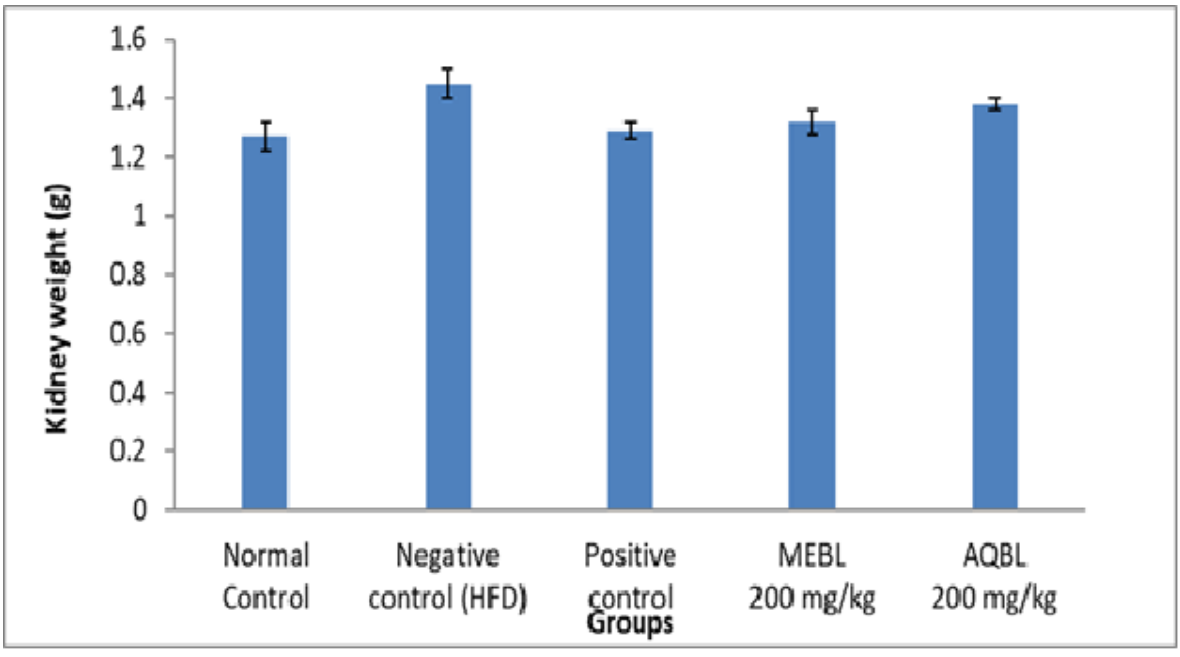

Figure 4: Effect of *Buchanania lanzan* bark extract on Kidney Weight of high-fat diet induced obesity in rat

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The animals of the High Fat Diet group showed a significant ($p < 0.05$) increase in weight of Pancreas. The results observed in the group that received the diet (MEBL 200 mg/kg) significantly reduced weight of Pancreas ($p < 0.01$), as compared to HFD group. As compared to the HFD + orlistat diet, diet contains (MEBL 200 mg/kg) treatment has moderately potent in reducing the weight of Pancreas ($p < 0.05$) (Figure 5).

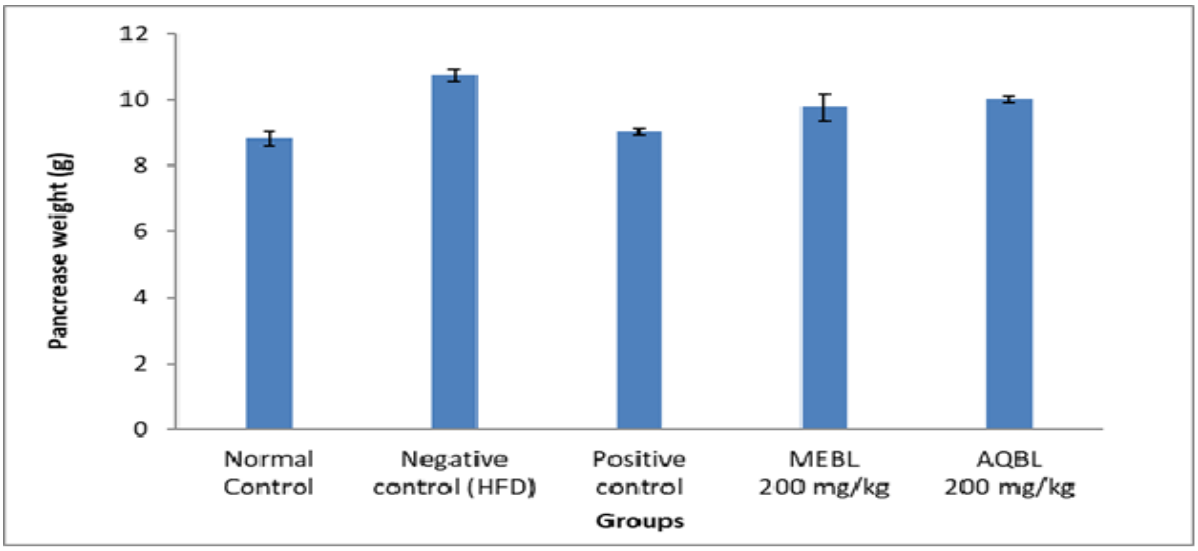

Figure 5: Effect of *Buchanania lanzan* bark extract on Pancreas weights of high-fat diet induced obesity in rat

The weight of Epididymal adipose tissue of High Fat Diet group animals group showed a significant ($p < 0.05$) increase. The results observed in the group that received the diet having (MEBL 200 mg/kg) significantly reduced weight of Epididymal adipose tissue ($p<0.01$), as compared to High Fat Diet group; while no significant changes showing when compared to positive control. Diet contains *Buchanania lanzan* bark treatment has moderately potent in reducing the weight of Epididymal adipose tissue ($p < 0.05$) (Figure 6)).

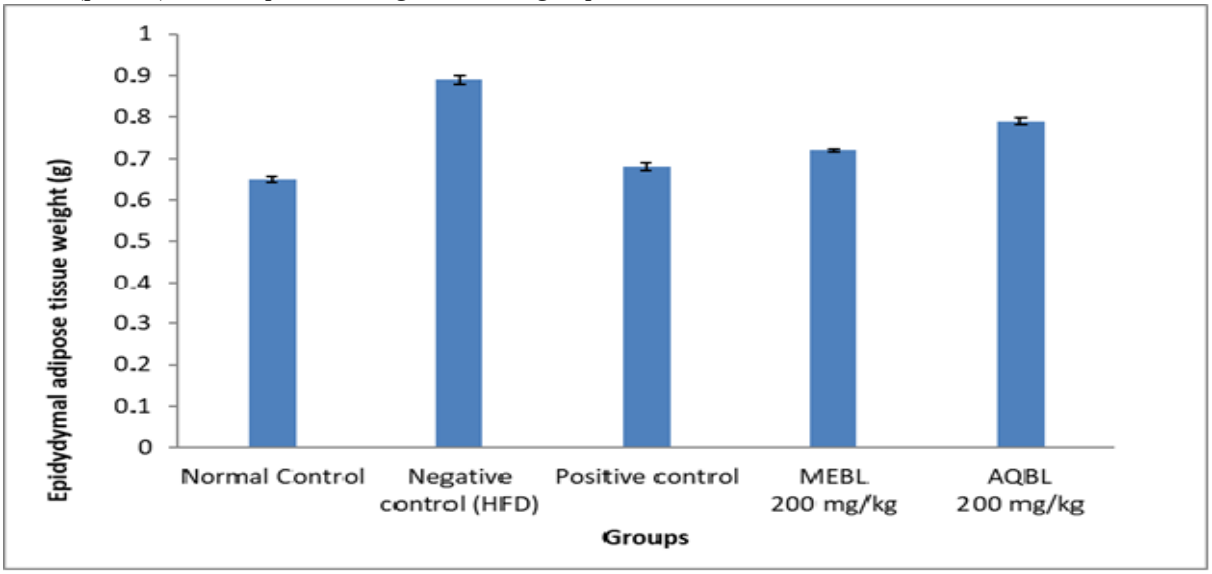

Figure 6: Effects of *Buchanania lanzan* bark extract on Epidydymal adipose tissue of high-fat diet induced obesity in rat

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Biochemical Assays:

Effect on plasma lipoproteins levels: Total cholesterol, Triglyceride (TG), Low density lipoprotein (LDL), high density lipoprotein (HDL) level and Atherogenic Index (AI) were estimated in all groups. Levels of serum cholesterol parameters elevated significantly (P<0.005) in the animals fed with high fat diet compared to the normal control group and decreased in the animals group treated with diet contained methanol extract of *Buchanania lanzan* bark.

The triglyceride levels remarkably increased in HFD diet fed animals compared to normal control group and normalize in the animals fed with MEBL 200 mg/kg extract. The animals fed with HFD diet and treated with experimental diet contained MEBL showed a reduction in HDL levels compared to normal control group animals. The LDL plasma levels elevated significantly in HFD diet-fed animals compared to normal control group animals. Experimental diet contained methanol extract of Buchanania lanzan bark was found more effective in reduction of plasma lipoprotein level in high fat induce obesity (Table 5 & Figure 7).

Table 5: Effects of *Buchanania lanzan* bark extract on the serum cholesterol parameters of high fat diet induced obese rats

Groups	Triglyceride (mg/dl)	Total Cholesterol (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	VLDL (mg/dl)
Normal Control	99.23±1.37	86.16±1.26	51.01±1.21	47.03±1.11	18.92±0.78
Negative control (HFD)	185.04±3.28	155.32±1.34	24.13±1.18	109.16±1.68	41.23±0.94
Positive control	98.05±1.67**	86.24±1.37**	46.09±1.02**	50.98±1.53**	20.02±0.75**
MEBL	104.46±1.64*	99.28±1.09**	44.27±0.98**	58.12±1.43**	26.98±1.23*
AQBL	115.37±1.39**	110.59±1.46**	42.54±1.07**	64.25±1.54**	29.73±0.76**

Values are mean ± SEM (n=6); *P <0.05, **P <0.01 compared to respective control group

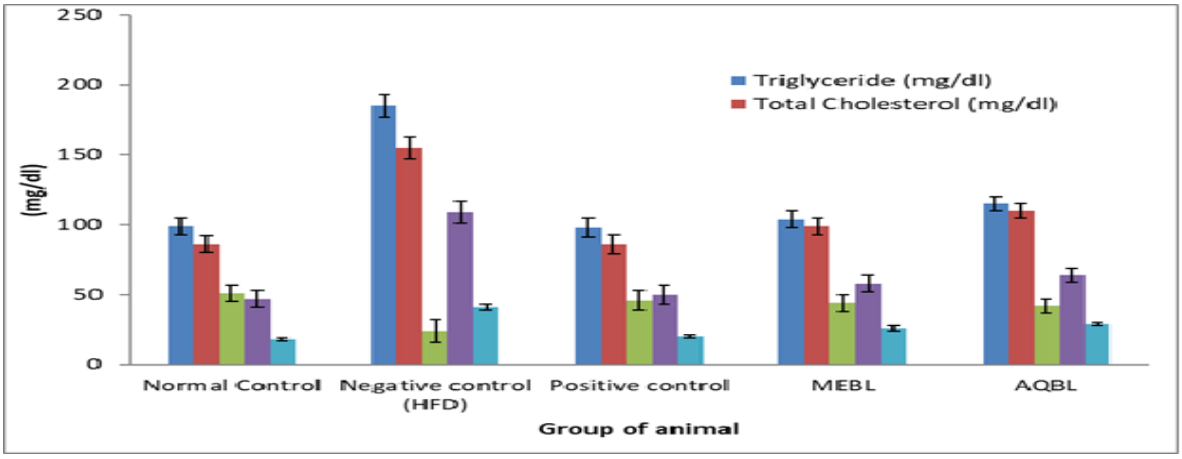

Figure 7: Effects of *Buchanania lanzan* bark extract on the serum cholesterol parameters of high fat diet induced obese rats

The atherogenic index of plasma (AIP) is calculated as log (TG/HDL) and reflects the levels of TG and HDL-C cholesterol. AIP, as a robust biomarker of dyslipidemia, has been used to quantify comprehensive lipid levels. It

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is also considered a biomarker of coronary syndrome and metabolic syndrome (Table 6 & Figure 8).

Table 6: Effects of *Buchanania lanzan* bark extract the Atherogenic Index (AI) of high fat diet induced obese rats

S No.	Group	Atherogenic Index(AI)
1	Normal Control	1.15
2	Negative control (HFD)	4.63
3	Positive control	1.18
4	MEBL 200 mg/kg	1.85
5	AQBL 200 mg/kg	2.05

Values are mean ± SEM (n=6); *P <0.05, **P <0.01 compared to respective control group

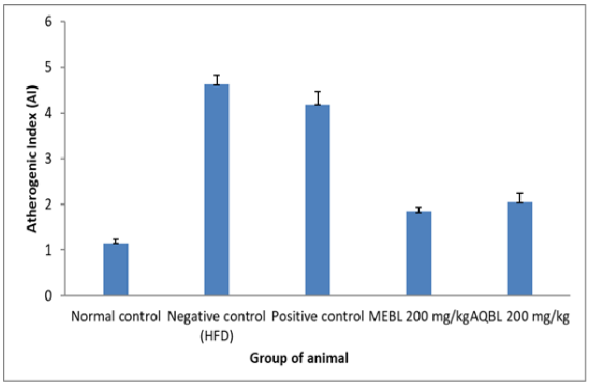

Figure 8: Effects of *Buchanania lanzan* bark extract the Atherogenic Index (AI) of high fat diet induced obese rats

Effect of plant extract on Liver Enzymes: SGPT and SGOT are certain enzymes that are produced by the liver and its cells and leak out of cells and mixes in blood when liver cells get injured. Elevated SGPT and SGOT levels are an indication of liver cell injury or damage. Bilirubin is the primary bile pigment which, when elevated causes the yellow discoloration of the skin, commonly known as jaundice and is a byproduct of the normal breakdown of red blood cells in the body. Bilirubin can be elevated in many forms of liver or biliary diseases.

The levels of Bilirubin, SGPT & SGOT remarkably elevated in high fat diet obese group compared to the control group. The levels of liver enzymes decreased significantly ($p < 0.05$) in the animals treated with diet contains methanol extract of *Buchanania lanzan* bark compared to the animals fed with high fat diet. Aqueous extract of *Buchanania lanzan* bark were decreased levels of liver enzymes less significantly (Table 7 & Figure 9 - 10).

Table 7: Effects of *Buchanania lanzan* bark extract on the liver parameters of high fat diet induced obese rats

Groups	Bilirubin (mg/dl)	SGOT (mg/dl)	SGPT (mg/dl)
Normal Control	0.011±0.001	38.16±1.13	36.01±1.42
Negative control (HFD)	0.051±0.004	115.32±2.34	109.13±1.35
Positive control	0.018±0.009**	41.24±1.07**	38.09±1.02**
MEBL 200 mg/kg	0.021±0.003*	41.28±1.09**	42.27±0.92**
AQBL 200 mg/kg	0.027±0.007**	47.59±1.46**	49.54±1.02**

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Values are mean ± SEM (n=6); *P <0.05, **P <0.01 compared to respective control group

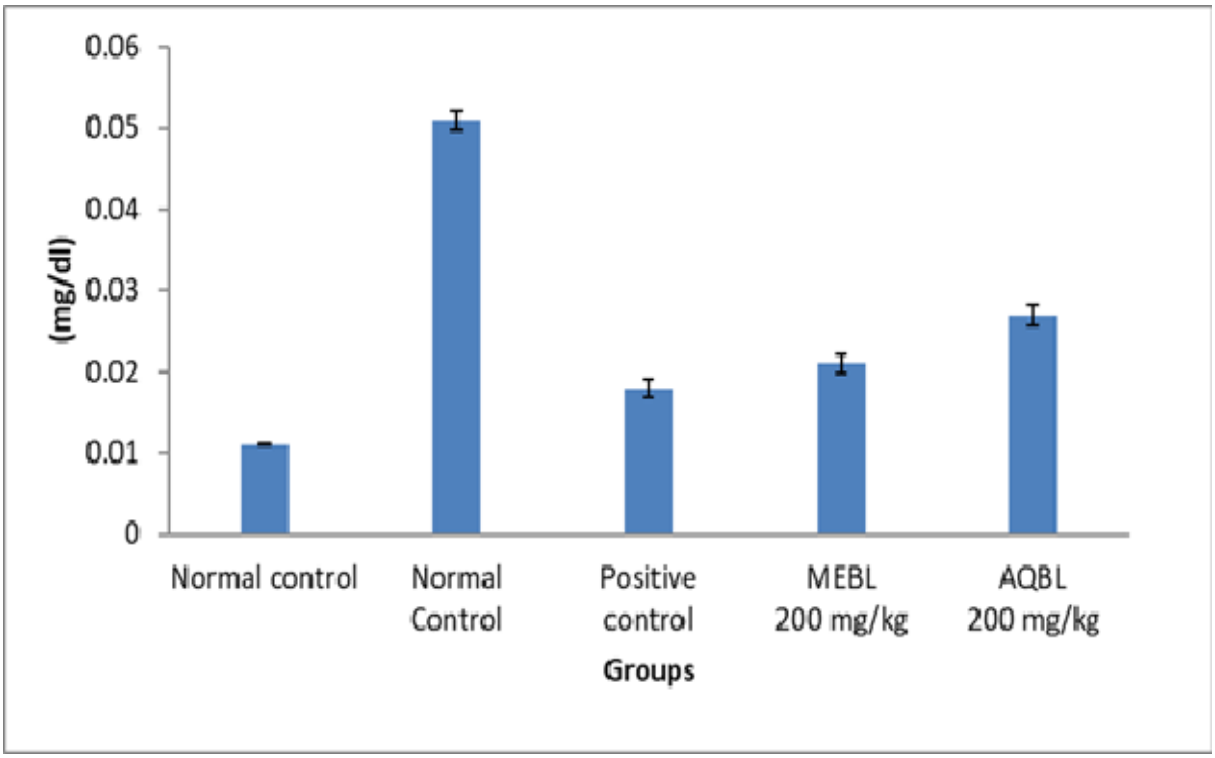

Figure 9: Effects of *Buchanania lanzan* bark extract on the liver parameters (Bilirubin) of high fat diet induced obese rats

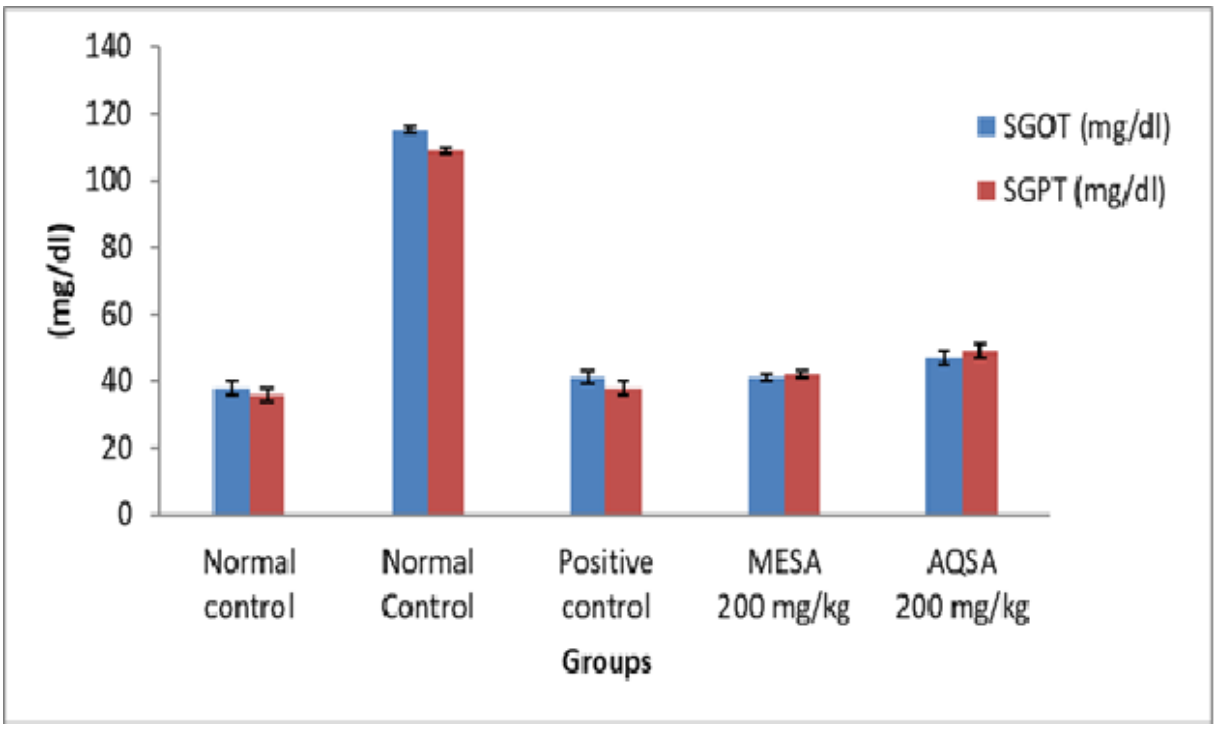

Figure 10: Effects of *Buchanania lanzan* bark extract on the liver parameters of high fat diet induced obese rats

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Effect of plant extract on kidney parameters: Elevated levels of the alkaline phosphatase (ALP) enzyme are reported among those who have obesity. Higher serum levels of alkaline phosphatase were found in in obese than in the non-obese. With elevated alkaline phosphatase (ALP) levels, there is an increase in disproportionate intracellular fat depots and thereby releasing itself into the bloodstream. The high fat diet induced obese rats had elevated levels of plasma ALP. Administration of diet contains methanol extract of *Buchanania lanzan* bark along with high fat had significantly lowered the plasma ALP towards normality, when compared to standard drug. Aqueous extract were also found effective in some extent to reduce the elevated ALP level.

Serum uric acid levels are positively correlated with body mass index (BMI) and hyperuricemia is considered to be a common lifestyle disorder related with obesity.

The high fat diet induced obese rats had elevated levels of plasma uric acid, creatinine, blood urea nitrogen and ALP. Administration of diet contains methanol extract of *Buchanania lanzan* bark along with high fat had significantly lowered the kidney parameters towards normality, when compared to standard orlistat drug (Table 8 & Figure 11 - 14).

Table 8: Effects of *Buchanania lanzan* bark extract on the kidney parameters of high fat diet induced obese rats

Groups	Uric acid (mg/dL)	Creatinine (mg/dL)	Blood urea nitrogen (BUN) (mmol/L)	ALP (IU/dL)
Normal Control	1.06 ± 0.12	0.38 ±0.01	11.08±0.92	106.23±9.06
Negative control (HFD)	2.82±0.18	0.54 ±0.01	13.26±0.97	221.8±16.24
Positive control	1.09 ±0.04**	0.41 ±0.01**	11.42 ±1.02**	112.13±10.04**
MEBL 200 mg/kg	1.14 ±0.07**	0.45 ±0.02**	12.17 ±1.06*	119.06 ± 4.34**
AQBL 200 mg/kg	1.52 ±0.09*	0.51 ±0.03*	12.58 ±1.11	129.26 ± 9.13*

Values are mean ± SEM (n=6); *P <0.05, **P <0.01 compared to respective control group

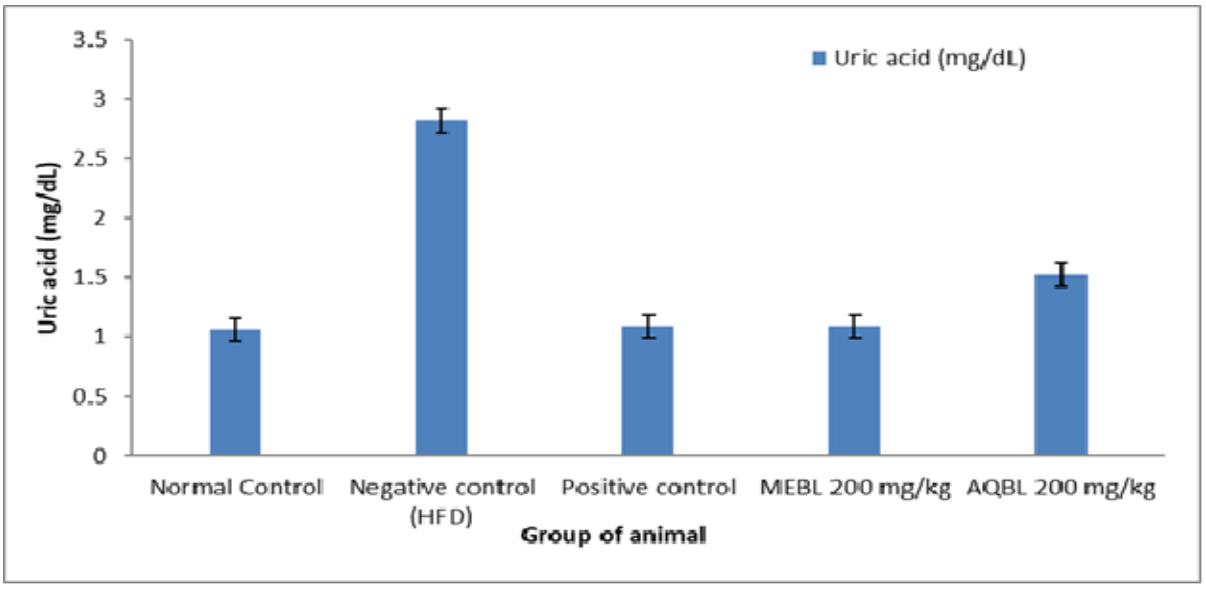

Figure 11: Effects of *Buchanania lanzan* bark extract on the Uric acid of high fat diet induced obese rats

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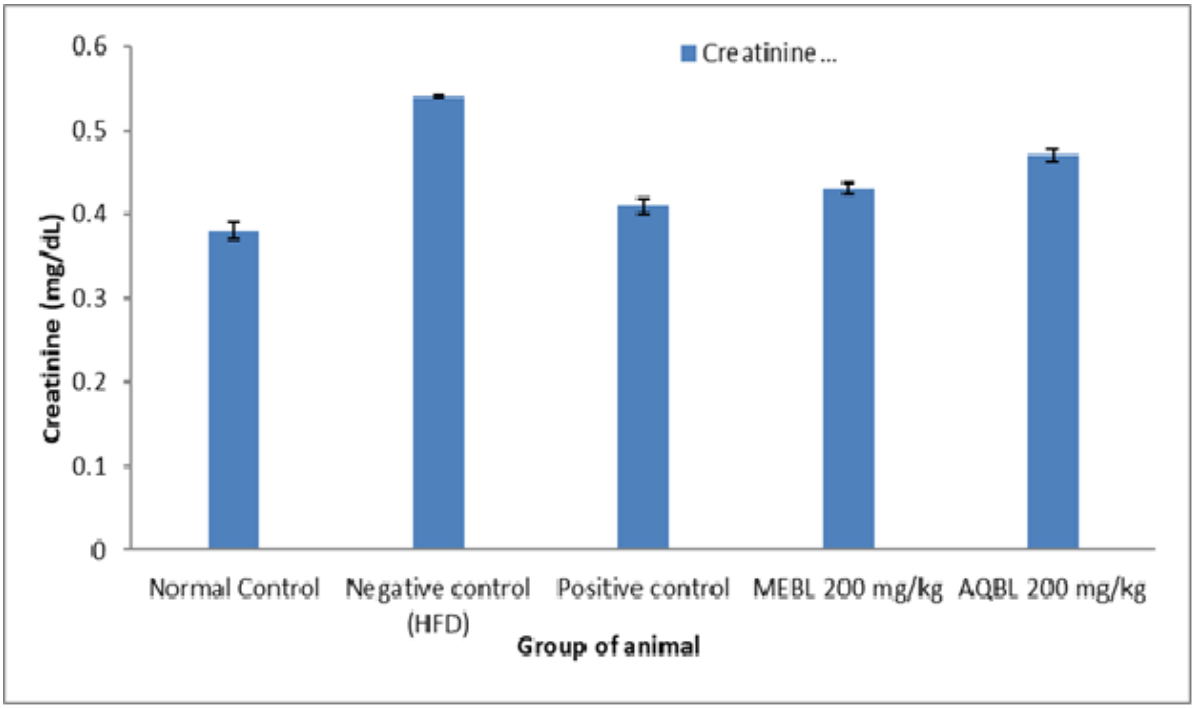

Figure 12: Effects of *Buchanania lanzan* bark extract on the Creatinine of high fat diet induced obese rats

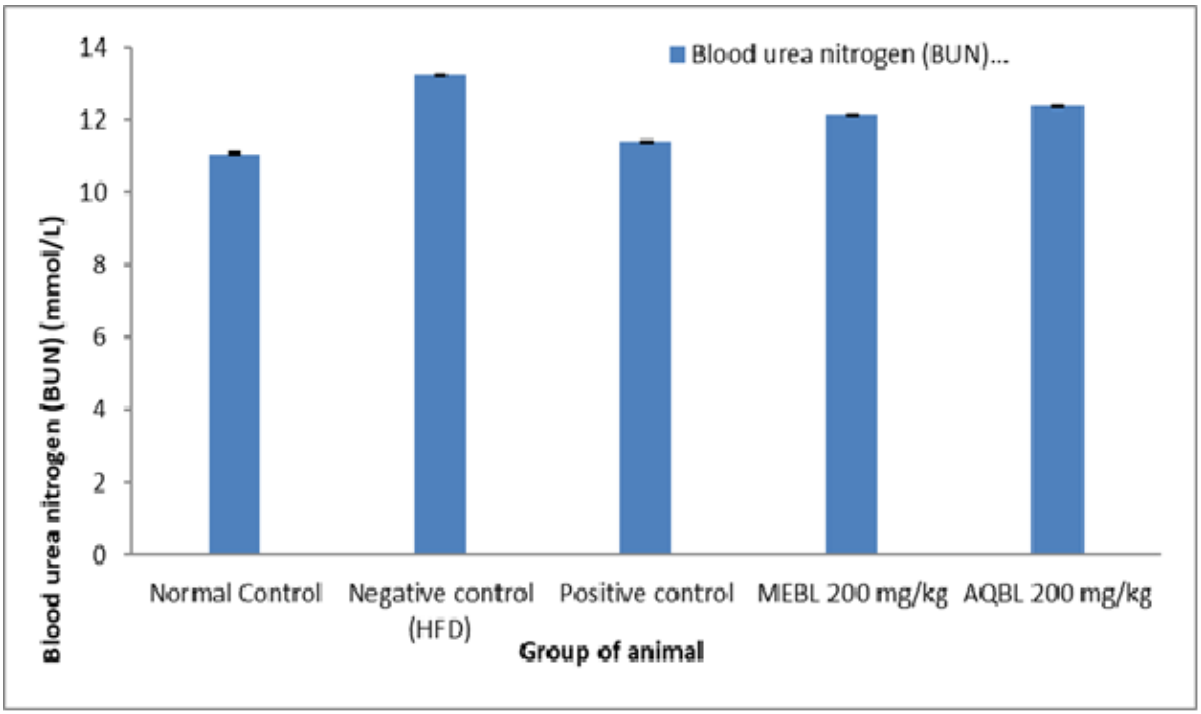

Figure 13: Effects of *Buchanania lanzan* bark extract on the Blood urea nitrogen of high fat diet induced obese rats

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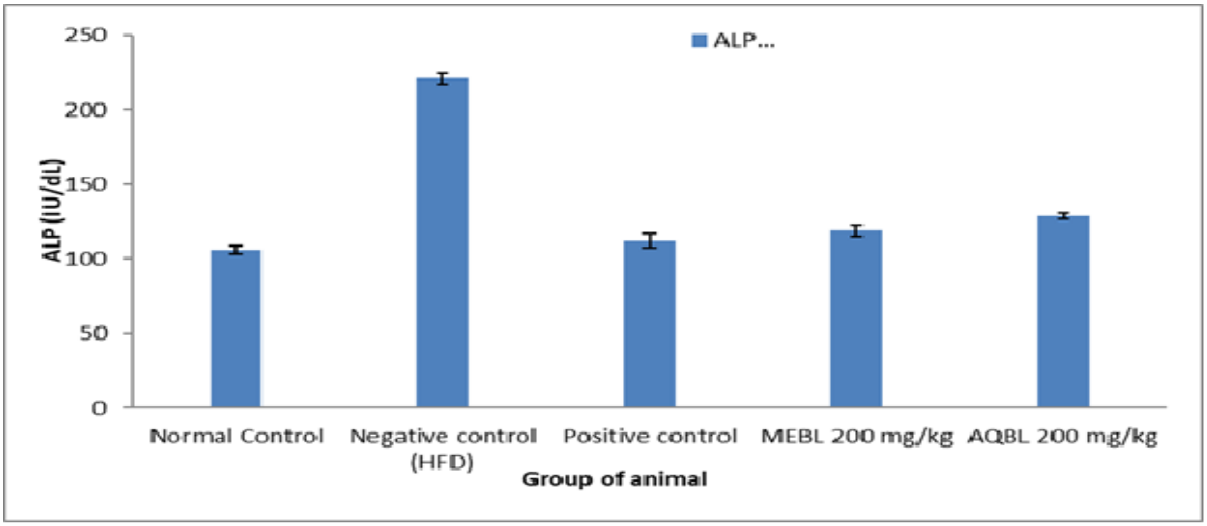

Figure 14: Effects of *Buchanania lanzan* bark extract on the ALP of high fat diet induced obese rats

Histopathology study of liver: Liver were removed from each group of animals and transferred to containers with 10% formalin solution for histopathological observation. Normal Control group showed normal liver histology fed with control diet. Rats fed with diet having MEBL showed no indication of metabolic dysfunction, no inflammation in liver. Mild hepatic morphological changes, appearing as scattered inflammation in liver in high fat diet. Hepatocytes have some visible cytoplasmic fat vacuole and reversed to normal in rat fed with plant extract with HFD diet. Administration of HFD with orlistat combinations shows normal healthy liver**.** HFD fed group rats showed higher accumulation of lipid droplets, loss of nucleus, inflammatory cells and severe swelling of hepatocytes indicating steatosis. However, diet containing MEBL along with HFD fed groups showed, decreased lipid accumulation, lesser damage and near normal hepatocytes compared to orlistat group (Figure 15).

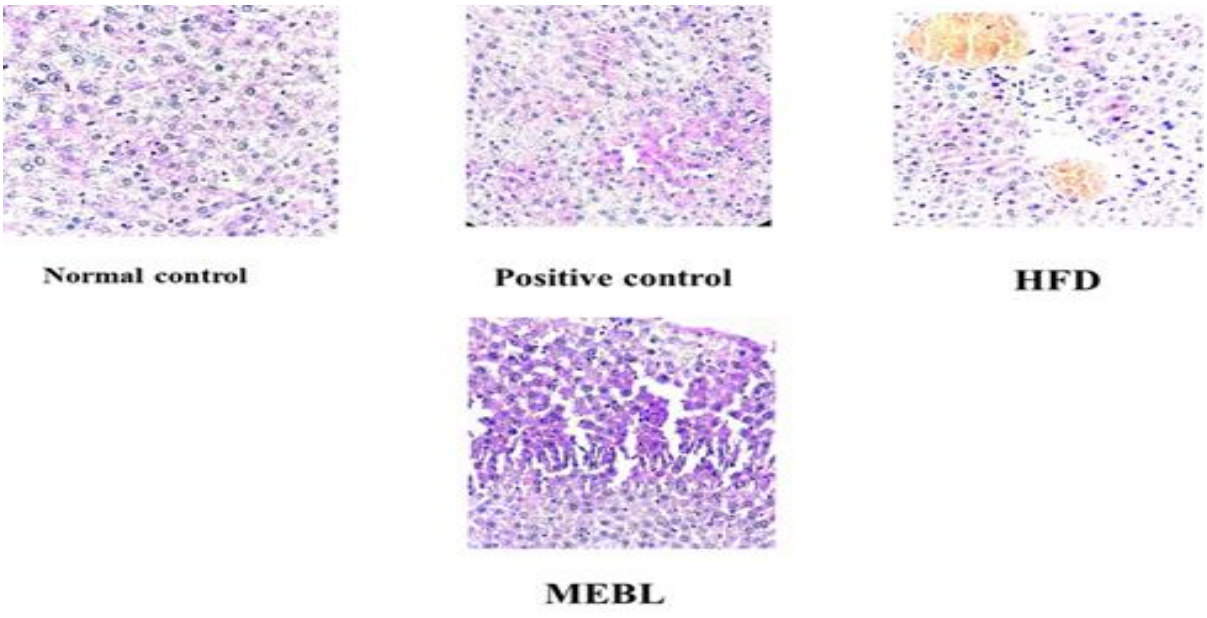

Figure 15: Histopathology of Liver

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Conclusion: The present study was investigated about the hyperlipidemia and anti-obesity effect of *Buchanania Lanzan* bark extract on rats fed with High Fat-diet. It could be conclude that high fat diet cause obesity in rat showed elevated plasma lipid parameter, and body weight. Methanol extract of *Buchanania Lanzan* bark exerts its effect by inhibiting total cholestrol levels, and may reduce weight by suppressing appetite. Experimental diet contained methanol extract of *Buchanania lanzan* bark was found more effective in reduction of plasma lipoprotein level in high fat induce obesity. The above anti-obesity activity may be due phenolic compounds and phytosterol present in extract may be beneficial as current evidence showed that Methanol extract of *Buchanania Lanzan* bark can regulate lipid profile and metabolic disorder in rat fed against high fat rich diet.

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