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Phytochemical and pharmacological evaluation of antihyperlipidimic, antidiabetic activity of Lepidium Spinescens

Nawin Kumar[1*], Ritesh Jain[1], Naveen Gupta[1], Dharmendra singh Rajput[1]

[1]Patel College of Pharmacy, Madhyanchal Professional University, Bhopal, M.P.

Corresponding Author:

Mr. Nawin Kumar

Research Scholar

Patel College of Pharmacy,

Madhyanchal Professional University, Bhopal, M.P.

nawinkumar1968@gmail.com

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KEYWORDS

Abstract: Herbal medicines continue to be a major market in US pharmaceuticals and constitute a multi-billion dollar business. Approximately 1500 botanicals are sold as dietary supplements; formulations are not subject to Food and Drug Administration (FDA)clinical toxicity testing to assure their safety and efficacy. The Indian herbal drug market size is about $1 billion and the export of plant based crude drug is around $100 million. The current market potential of herbal medicine is estimated about $ 80-250 billion in Europe and USA. Ayurvedic preparations in relation to their use as therapeutic agents, pharmacological properties, medicinal plants being imported; medicinal plant parts being exported, endangered medicinal plants and availability of medicinal plants in different bio- geographical zones of India. The presence of sugars, flavonoids, tannins, polyphenols, saponins indicated by phytochemical examination and anti-inflammatory, Anti diabetic activity, Hepatoprotective, Anti hyperlipidemic action might be recognized these bioactive compounds. Current research regarding anti-inflammatory and analgesic activities of Lepidium Spinescens has justified its ethno medicinal use and it is recommended that further studies at cellular and molecular levels should be conducted in order to have detailed mechanistic insights. The primary action of Lepidium Spinescens in the flavonoid induced vasodilatation may be due to the protein kinases inhibition, such as myosin light chain kinase. The leaves of Lepidium Spinescens extract hold significant anti diabetic activity, anti-hyperlipidemic action. It needs further studies to determine the structure of bioactive compound responsible for studied activity and its mechanism of action.

Introduction: Human society, in particular, has a greater dependency on plant habitat. Therefore, in the biological sciences, there is a vast magnitude of findings that allow humans to grasp the nature of plant life's biodiversity. Taxonomists and botanists are conducting their exploratory expeditions to explore the natural habitat of plant life, leading to huge amounts of information on plant life in the natural habitat [1-2]. Plants fill the needs not only of a human being but also of the whole animal kingdom, in particular due to the proximity of different bioactive compounds. Ethnopharmacology is the culturally diverse study of how individuals get medicines from fungi, plants, animals or remaining different naturally occurring resources [3]. The various indigenous systems, Allopathy, Ayurveda, Unani and Siddha use a few species of plant animals to treat distinctive diseases [4]. Ayurvedais said to be India's oldest medicinal system. The word "Ayurveda" is derived from the Sanskrit, meaning "Ayur" as life, and meaning "Veda" as science or knowledge. The combination of these two words means the life knowledge or "*science of life and longevity*". Its underlying foundations can be followed back to classical India, around 5,000 years back in

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history. The Dravyaguna properties of medicinal plants have been described by various Ayurvedic classics, such as Susrutha samhita, Charaka samhita and Ashtanga samgraha etc. The theory of ayurveda rests on the tridosha, there are several conditions, which are physicochemical in nature and which are believed to result in various afflictions [5]. The origin of plant materials was primarily used for the preparation of medicines, while those of mineral and animal starting points were further used. This rich tradition in the composition of Vedic and herbal plant medicine stands evidence for the tremendous learning of our modern drug system. A decent number of restorative plants are found referenced in the old established literature, for example, Charaka Samhitha, Susrata Samhita, Ashtanga Hridaya, and so on. It is evaluated that 20,000 types of plants meds source are utilized as an in the underdeveloped nations [6]. In India, around 7000 species are utilized for drug alongside a couple of minerals, metals, and animal stuff. The utilization of herbal plant medicine is getting to be mainstream because of less toxic and worthiness than that of allopathic drugs. Nature contains a lot of knowledge about plant resources and this evidence has typically been transferred from age to age rehearsed by the indigenous collection of individuals from various regions. These individual gatherings have particular nutritional propensities, culture that is reflective of a conventional drug. Ethnomedicine might be characterized comprehensively as the utilization of plants medicine by the human [3]. Ayurvedic medicines mainly based on plants enjoy a respective position today, especially in the developing countries, where modern health services are limited. Safe effective and inexpensive indigenous remedies are gaining popularity among the people of both urban and rural areas especially in India and China. Information from ethnic groups or indigenous traditional medicines has played vital role in the discovery of novel products from plants as chemotherapeutic agents. Herbal medicines have been main source of primary healthcare in all over the world. Medicines containing plant materials combined with chemically defined active substances, including chemically defined isolated constituents of plants are not considered to be herbal medicines [7]. The authors have tried to put all these classes of plants at a common platform so that the data and information of this review could be utilized in drawing strategies for use of medicinal plants in a way that can be extended for future scientific investigation in different aspects. The Ayurvedic concept appeared and developed between 2500 and 500 BC in India. The literal meaning of Ayurveda is “science of life,” because ancient Indian system of health care focused views of man and his illness. It is pointed out that the positive health means metabolically well-balanced human beings. The practice of Ayurveda therapeutics consisted of 8 sections divided into 180 chapters and listed 314 plants, which are used as medicines in India [8]. Four thousand years ago, the medical knowledge of the Indian subcontinent was termed as Ayurveda. Ayurveda remains an important system of medicine and drug therapy in India. Plant alkaloidsare the primary active ingredients of Ayurvedic drugs. Today the pharmacologically active ingredients of many Ayurvedic medicines are being identified and their usefulness in drug therapy being determined. As mentioned in the introduction only a certain percentage of plants are used in traditional medicines. The Indian subcontinent is a vast repository of medicinal plants that are used in traditional medical treatments [9]. The plants have been the principal source of antioxidants, antioxidant is a vital molecule that is present in the cell at low concentrations and slows down the degradation process and the harmful action of the free radicals, so that the energetic action of the environment can lead to greater sustainability. The physiological role of antioxidant is to prevent the destruction of cell components because of their ability to donate electrons which neutralize the radical without forming another. Hyperlipidemia is considered one of the major risk factors causing cardiovascular diseases (CVDs). CVDs accounts for one third of total deaths around the world [10]. Hyperlipidemia is an increase in one or more of the plasma lipids, including triglycerides, cholesterol, cholesterol esters and phospholipids and or plasma lipoproteins including very low-density lipoprotein and low-density lipoprotein, and reduced high-density lipoprotein levels [11]. Diabetes mellitus is a combination of heterogeneous disorders commonly presenting withepisodes of hyperglycaemia and glucose intolerance, as a result of lack of insulin, defective insulin action, or both. Such complications arise due to derangements in the regulatory systems for storage and mobilization of metabolic fuels, including the catabolism and anabolism of carbohydrates, lipids and

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proteins emanating from defective insulin secretion, insulin action, or both. *Lepidium* spinescens sometimes referred to as garden cress (or curly cress) to distinguish it from similar plants also referred to as cress (from old Germanic *cresso* which means sharp, spicy), is a rather fast-growing, edible herb. Garden cress is genetically related to watercress and mustard, sharing their peppery, tangy flavour and aroma. In some regions, garden cress is known as mustard and cress, garden pepper cress, pepperwort, pepper grass, or poor man's pepper. *Lepidium sativum* have been widely used to treat a number of ailments in traditionalsystem of medicine throughout India.

Material and methods: All materials had been dried out in shade at room temperature. The shade dried plant material was heavily powdered by a maceration method and was subjected to petroleum ether extraction. The extraction was continued until the substance was defatted. Ethnobotanical surveys were conducted in different tribal localities of Madhya Pradesh. The method adopted for collection of data was interview with tribals, local medicine men and one to one discussion about therapeutic use of local plants in the treatment of various diseases. Fresh Leaves of *Lepidium Spinescens* was collected from area adjoining forests of Bhopal in the month of March. Leaves of *Lepidium Spinescens* was carried out in sunbut under the shade. Leaves of *Lepidium Spinescens* was preserved in plastic bags and closed tightly and powdered as per the requirements. The weight of the fresh sample and dried powder was determined, and the percentage loss was calculated due to drying and water loss.

Determination of physio-chemical parameters: Based on standard procedures, physicochemical parameters such as percentage of total ash, acid insoluble ash, water soluble ash and loss on drying were calculated.

Determination of total ash: 2 g of precisely weighed dried powder leaves were leaves of *Lepidium Spinescens* dried powder incinerated, cooled and weighed in a tarred platinum or silica dish at a temperature not exceeding 450ºC until they were free of carbon. If this could not produce a carbon-free ash, the burnt mass was drained with hot water; the dust was deposited on the ah less filter paper, incinerated along with filter paper, evaporated to dryness and burned at a temperature not exceeding 450ºC. Consequently, the ash collected was then cooled, weighed and the proportion of ash measured using the air-dried product.

Ash Value= Initial Weight – Final Weight x 100
Initial Weight

Determination of acid insoluble ash: The ash obtained from the above procedure was boiled with 25 ml of diluted hydrochloric acid for 5 minutes, and the insoluble matter was collected either on an ash less filter paper or in a Gooch crucible. The insoluble material thus obtained was washed with hot water, and the filter paper were ignited to a constant weight. The percentage of acid-insoluble ash was calculated with reference to the air-dried drug.

Determination of water soluble ash: The ash was boiled with 25 ml of water for 5 min. The insoluble matter collected in a Gooch crucible, or on an ash less filter paper, washed with hot water and ignited at a temperature not exceeding 450ºC for 15 min. The weight of the insoluble matter was removed from the weight of the ash, the difference in weight was the ash soluble in water. The percentage of water-soluble ash was calculated, with reference to the air- dried drug.

Extraction procedure: Extraction from plant materials is an important step in phytochemical processing for discovering bioactive secondary metabolite. Selection of a suitable extraction technique is also important for the standardization of herbal products. Extraction is used to remove desirable soluble constituents, with the help of the selected solvents excluding those not required. The materials collected from the plant were thoroughly washed in tap water and rinsed in distilled water. The cool, stable samples obtained from the plants were cut into small pieces and dried under shade for 3 to 4 weeks. Following the procedure for preparing extract from dried shade materialwill be adopted.

Extraction by maceration process: 100 gram of dried plant materials of *Lepidium Spinescens* was exhaustively extracted with solvent mixure of methanol and water by maceration method. Over their boiling points the extract was evaporated. Finally, the percentage yields for the dried extracts are determined.

Determination of percentage yield: The extraction yield is an evaluation of the solvent 's efficiency in

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extracting bioactive components from the selected natural plant samples and has been defined as the quantity of plant extracts recovered in mass after solvent extraction compared to the initial sample amount. After extraction, yield was calculated in grams of the plant extracts obtained, and then converted into percentage. Following formula was adopted for determination of percentage yield of selected plant materials. The percentage yield of each extract was calculated by using following formula:

Percentage Yield = $\frac{\text{Weight of Extract} \times 100}{\text{Weight of Powder drug taken}}$

Phytochemical screening: Medicinal plants are traditional medicinal resources and many of the modern medicinal products are produced indirectly from plants. Phytochemical components consist of two primary bioactive components (chlorophyll, proteins, amino acids, sugar, etc.) and secondary bioactive components (alkaloids, terpenoids, flavonoids, etc.). Phytochemical examinations were carried out for all the extracts as per the standard methods.

Preparation of extract: Plant material was subjected to hot continuous extraction with (500 ml) 80% methanol (30-40ºC) in a Soxhlet apparatus for 24 hours. The extraction procedure wasensured by pouring a few drops of extract from thimble left no residue on evaporation. After complete extraction the solvent was evaporated and concentrated to dry residue. % yield was calculated for each extract after drying under vacuum. Hydro alcoholic Extact- 100gm of extract was obtained from defatted material of Leaves of *Lepidium Spinescens* and *Aconitum heterophyllum* gave 23.38 % yield. The different extracts were subjected to quantitative phytochemical investigation to detect different phytoconstituents, and pharmacological studies.

Preliminary phytochemical investigation of the extracts: Phytochemical investigation means to investigate the plant material in terms of its active constituents.

Physical characteristics of extracts: Different physical parameters of extracts including their nature, colour, odour, taste and % yield.

Quantitative chemical test: Different methods of identification were used to investigate phytoconstituents present in the Leaves of *Lepidium Spinescens.*

Pharmacological Activity

Acute oral toxicity: Acute oral toxicity was performed according to Organization for Economic Co- operation and Development (OECD) guideline No. 420. Swiss albino rats fasted overnight, accessing water *ad libitum* were used in this study. The extract was administered orally at a dose of 2000 mg/kg body weight and the animals were observed for mortality or any abnormal behavior for first 24 h, then for next 14 days. Further behavioral responses, neurological responses as well as autonomic responses were observed.

***In vivo* Anti-hyperlipidemic activity:** Rats with an average body weight were made hyperlipidemic by giving high- fat diet (HFD) for 15 days. The HFD contained Cholesterol (2%), Cholic acid (1%), Dalda (20%), and Coconut oil (6%) as major constituents. Hyperlipidemia was confirmed by measuring the levels of serum lipids and lipoproteins in the rats.

Group –I: Normal (vehicle alone)

Group –II: Hyperlipidemic rats treated with vehicle alone

Group -III: Hyperlipidemic rats treated with hydroalcoholic extract of *Lepidium Spinescens* (250mg/kg**, p.o.)**

Group –IV: Hyperlipidemic rats treated with hydroalcoholic extract of *Lepidium Spinescens* (500mg/kg, p.o.)

Group –V: Hyperlipidemic rats treated with Orlistat (60 mg/kg/day p.o.)

Animals were divided into five groups of 6 animals each. The first group treated normal vehicle alone. The group II received hyperlipidemic rats treated with vehicle alone (positive control). The groups III, IV and V received 250 mg/kg and 500 mg/kg of hydroalcoholic leaves extract of *Lepidium Spinescens* and Orlistat (60 mg/kg/day p.o.) respectively for 15 days.

Biochemical Evaluation in Serum: Serum Triglycerides (TG), total cholesterol (TC), and HDL-cholesterol (HDL- C) were estimated by using commercial kits as per the manufacturer instructions. Blood was collected from the animals and centrifuged. The serum samples were collected in separate containers for biochemical estimations. The results were expressed in mean±standard deviation. Statistical analysis was carried out by using one way ANOVA.

***in -Vivo* anti-diabetic activity:**After fasting, diabetes

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was induced by a single intraperitoneal injection of 120 mg/kg body weight of 'Alloxan monohydrate' in distilled water. The animals were allowed to drink 5% glucose solution overnight to overcome the drug-induced hypoglycaemia. These animals were tested for diabetes after 15 days and animals with blood glucose (fasting) were selected for experimentation. Animals were divided into five groups of 6 rats each .

Group I: Rats served as normal-control and received the vehicle (0.5 ml distilledwater/day/rat)

Group II: Rats served as diabetic-control and received the vehicle (0.5 ml distilledwater/day/rat)

Group III: Rats (diabetic) were administered of hydroalcoholic extract of *Lepidium sativum* (250 mg/kg p.o.) for 15 days.

Group IV: Rats (diabetic) were administered of hydroalcoholic extract of *Lepidium sativum* (500 mg/kg p.o.) for 15 days

Group V: Rats (diabetic) were administered Glibenclamide (600µg/kg p.o.) for 15days.

Results and Discussion: Nature herbal medicines are well thought out for being successful and safe natural therapy for a variety of diseases. Our aim in this study was to show preliminary chemical screening, anti-hyperlipidemic and anti-diabetic activity of leaves of *Lepidium.* The dried Leaves material was washed carefully under running tap water and was grinded using electronic grinder. The powder was extracted by maceration method, using solvents of increasing polarity, ethanol and aqueous leaves of *Lepidium Spinescens* was tested on the different standardization criteria such as organoleptic measurement, percentage loss, percentage yield, and phytochemical screening. Results showed the percentage yield of leaves extract of *Lepidium* was 9.4%, *Lepidium Spinescens* leaves extract exhibited higher yield value. Preliminary phytochemical analysis generally helps identify and classify the plant extracts' bioactive constituents. For extracts of all samples, a small portion of the dried extracts of plant leaves underwent phytochemical screening methods for chemical testing of alkaloids, glycosides, flavonoids, saponins, phenolics, proteins and amino acids, diterpenes and tannins separately. Flavonoid was detected in hydroalcoholic extracted leaves of *Lepidium Spinescens*. The *Lepidium Spinescens* leaves, methanolic and aqueous extract showed presence of Phenols and Flavonoids. The methanolic extracts possess almost all the phytochemicals that were tested when compared other solvent. Results concluded that glycosides, flavonoids, saponins, tannins, alkaloids and phenolics were present in the hydroalcoholic extract of *Lepidium Spinescens*. The presence of phytochemicals (Phenols and Flavonoids) was quantitatively shows the overall flavonoid content of the *Lepidium Spinescens* leaves extract. The total flavonoid content of hydroalcoholic leaves extract was 3.52 respectively. In *Lepidium Spinescens* leaves extract, the quantitative analysis of the total phenolic content showed The methanol and aqueous extract quantitative analysis revealed total phenolic content (equivalent to gallic acid) of 2.37 mg/100 mg respectively.

Anti-hyperlipidemic effect: Anti hyperlipidemic effect of the hydroalcoholic extract *Lepidium Spinescens* on the high fat diet induced rats. The activity levels of serum total cholesterol (TC), triglycerides (TG) and Serum high density lipoprotein (HDL) were observed in normal and experimental animals. In group II animals, the activity levels of serum total cholesterol (TC) and triglycerides (TG) were significantly elevated when compared to that of normal groups. On the other hand the serum level of Serum high density lipoproteins (HDL) were significantly depleted in the HFD fed rat. In group III, IV and V animals, the activity levels of serum total cholesterol (TC) and triglycerides (TG) were significantly decreased when compared to that of normal groups. Also HDL level was significantly increased in the same groups. *Lepidium Spinescens* well known traditional medicinal plants possesses diverse biological activities and pharmacological function including reducing blood glucose and serum lipids. It has long been used to treat diabetes mellitus and related hyperlipidemia. Hypercholesterolemia, a high cholesterol diet and oxidative stress increase serum levels resulting in increased risk for development of atherosclerosis. Cholesterol is synthesized in all animal tissue. It is important to relate to its role in the stabilization of membrane structures because of its rigid planar structure. It also as a precursor for the synthesis of steroid hormones. In the present study, feeding rats with diets rich in cholesterol resulted in increased TC and TG levels. This model was used to study the potential of hypolipidemic effect of hydroalcoholic extract of whole plant of *Lepidium Spinescens* that contained

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significant amounts of antioxidants properties. From this study, we found that daily oral administration hydroalcoholic extract of leaves of *Lepidium Spinescens* shows significantly reducedtotal cholesterol levels in plasma after 15 days of administration. This result agrees with literature where depleted level of HFD fed hyperlipdemia. HDL is directly anti-androgenic and it is believed to remove cholesterol from the developing lesions. Theintense interest in this area results in part from the generally low toxicity of antioxidants and the hope that treatment with antioxidants might be additive with cholesterol lowering regimes. In the present study serum TG levels were significantly elevated in HFD rat. The excess of fat diet increased the TG level which is one of the causes of hardening of arteries. In conclusion, it could be said that the hydroalcoholic extract of *Lepidium Spinescens* exhibited a significant hypolipidemic activity. Administration of HFD produced a highly significant increase in weight mesenteric fat pads. A reduction in the raised weight in the fat pads as observed in the groups of animals treated with hydroalcoholic extract of *Lepidium Spinescens* may be attributed to increased thermogenesis and decreased lipogenesis.

***in-vivo* anti diabetic activity:** Alloxan-induced diabetic mice were treated with aqueous and 70% ethanol extracts of *Lepidium Spinescens*, once a day orally, for 14 days. The effect of different doses of the extracts of A.remota on fasting blood glucose level is presented. The present study was intended to examine the antidiabetic effects of the extracts of *Lepidium Spinescens* leaves. Alloxan monohydrate has been used to induce diabetes mellitus in experimental mice. A single intraperitoneal administration of 20 mg/kg body weight alloxan monohydrate solution induced effectively diabetes mellitus in mice. This was confirmed by elevated level of fasting blood glucose that can be obtained from the tail of the mice after 48 h of injection. Alloxan brings diabetes through selective destruction of insulin secreting pancreatic β-cells due to its accumulation through the glucose transporter 2 (GLUT2) and hence, minimize the glucose uptake by peripheral tissues. It is known that alloxan induces free radical formation by redox reactions that cause tissue injury and make ß-cells to degranulate and consequently degenerate. As expected in the diabetic control there was a 9.1% ± 1.5 increases in mean blood glucose level and significant difference ($p < 0.0001$) with the normal control mice. The blood glucose level of diabetic mice was estimated before and after 1st, 7th and 14th days of treatment. Both the aqueous and 70% ethanol *Lepidium Spinescens* extract treatment groups show a statistically significant difference with normal and diabetic control mice with $p < 0.0001$. There is also a statistical significant difference between each dose of aqueous extracts ($P < 0.005$) and the 70% ethanol extract (300 mg/kg) ($P < 0.0001$). However, there were no significant differences ($P > 0.05$) among the 70% ethanol extract with 500 mg/kg (AE500) and both aqueous extracts and Glibenclamide. The average percentage of decrease in blood glucose levels showed an increase in the percentage with a relative increasing dose administration of *Lepidium Spinescens* extracts. However, the aqueous extract of *Lepidium Spinescens* with dose of 500 mg/kg body weight had a greater percentage decrease (38.98 ± 0.67) than any of the extracts after 14 days of treatment administration. Glibenclamide (10 mg/kg body weight) treated diabetic mice showed a 51.10 ± 2.95 percentage reductions as positive control.

Summary and Conclusion: Human beings mainly depend on the plant kingdom which serves as a source of vital nutrients as well as caters the needs of humans by providing remedies to different ailments. This has lead to the screening of plants in treating and controlling many different diseases by trial and error. Herbal medicine is known as a utilization of plant items to treat or avert a sickness with minimal side effects. Herbal medicine is referred as a subset of larger term Complementary and alternative medicine. Before the discovery of modern medicine, herbs were the main remedies for nearly all ailments. Now a day, because of the serious toxic effects of synthetic medicine, people are using herbal medicine as both an alternative and in addition to modern synthetic drugs. Present study confirmed that the alcoholic extracts of *Lepidium Spinescens* show potential anti-hyperlipidemic and anti-diabetic activities respectively. Further the aqueous-alcoholic extracts of both plants were assessed for isolation and characterization of bioactive constituents for same activities in order to validate for the synthetic approach. The extracts may be further extended for suitable extraction of different

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phytoconstituents because the selected medicinal plants have potential in treating manyailments. Other models can be tried for similar effect.

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Table 1: Phytochemical screening of plant

S. No.	Identification	Inference
1	Mayer's test	Alkaloids are present
2	Dragendroff's Test	Alkaloids are present
3	Wagners test	Alkaliods are present
4	Hagners test	Alkaloids are present
5	Brontragers Test	Positive results showed the presence of anthraquinone Glycosides
6	Molish test	Carbohydrates Are present.
7	Fehling's Test	Carbohydrates are present
8	Bandict test	Carbohydrates Are present
9	Foam test	Saponin are Absent
10	Frothing test	Saponin are absent
11	Ammonia test	Flavonoids are present
12	Shinoda/ Pew Test	Flavonoids are present
13	Tollen's test	Positive results showed the presence of cardiac glycosides.
14	Raymond's test	Presence of cardiac glycosides
15	Keller killani test	Presence of cardiac glycosides.

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16	Xanthohydral Test	Presence of cardiac glycosides
17	Legal test	Presence of cardiac glycoside
18	Millon's test	Positive results showed the presence of amino acids
19	Xantho protein test	Positive results showed the presence of amino acids
20	Biuret test	Positive results showed the presence of amino acids
21	Ninhydrin test	Positive results showed the presence of amino acids
22	Libermann- Burchard test	Sterols are present
23	Salkowski Reaction	Sterols are present
24	Matchstick test	Tannins are present
25	Vanillin – HCl test	Tannins are present
26	Acetic acid test	Tannins are present
27	Gelatin test	Tannins are present
28	Ferric Chloride test	Phenolic compounds are present
29	Lead Acetate test	Phenolic compounds are present
30	Effervescence Test	Acidic compounds are present
31	Litmus test	Acidic compounds are present
32	Solubility test	Resins are present
33	Hydrochloric test	Resins are present

Table 2: Mean Body Weight Change

Group	Drug	Dose	Body weight (g)	
			Onset of study	End of study
I	Normal	Normal saline	180.10±7.50	210.00±7.50
II	Control	HFD	195.05±8.50	235.10±8.50
V	Extract of *Lepidium Spinescens*	250 mg/kg p.o.	200.00±7.00	192.00±7.00
VI	Extract of *Lepidium Spinescens*	500 mg/kg p.o.	200.05±8.00	185.00±8.00
IV	Orlistat	60 mg/kg p.o.	200.00±8.00	179.50±8.00

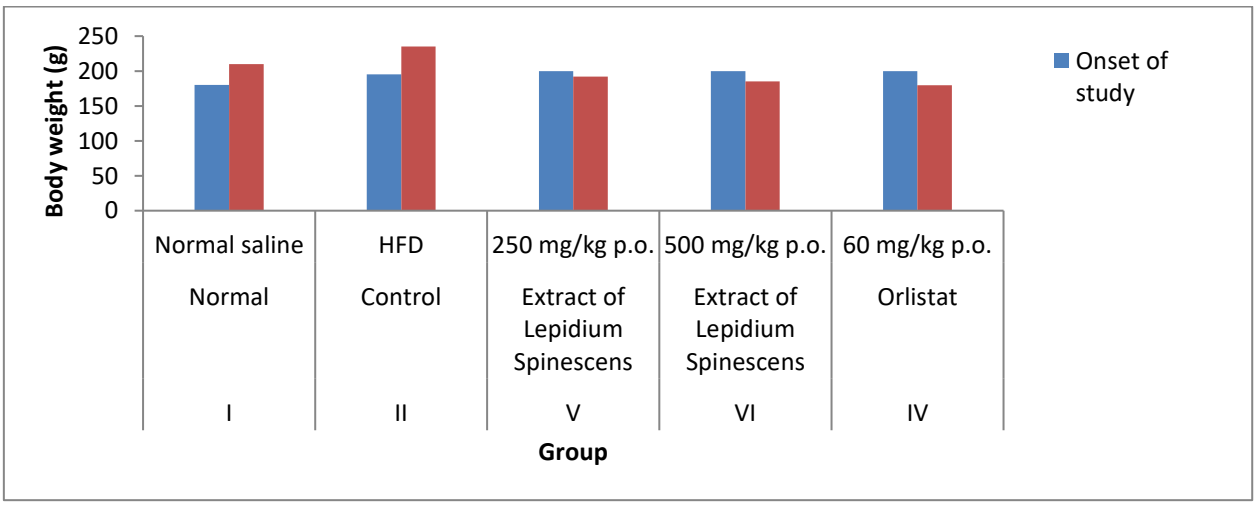

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Figure 1: Mean Body Weight Change

Table 3: Effect of the hydroalcoholic extract of Lepidium Spinescens on serum lipid profile levels (mg/dL) in HFD induced rat

Treatment	Dose	Total cholesterol (mg/dL)	Triglycerides (mg/dL)	High density lipoproteins (mg/dL)
Normal	Normal saline	85.00 ± 5.00	87.00 ± 4.50	38.00 ± 4.00
Control	HFD	143.10 ± 5.00	152.0 ± 4.22	27.00 ± 4.60
Lepidium Spinescens	250 mg/kg p.o.	92.20 ± 5.70**	93.30 ± 4.10**	29.40 ± 4.50**
Lepidium Spinescens	500 mg/kg p.o.	88.10 ± 5.10***	87.10 ± 4.50***	32.50 ± 4.60***
Orlistat	60 mg/kg p.o.	83.10 ± 5.60***	83.80 ± 4.70***	35.10 ± 4.50***

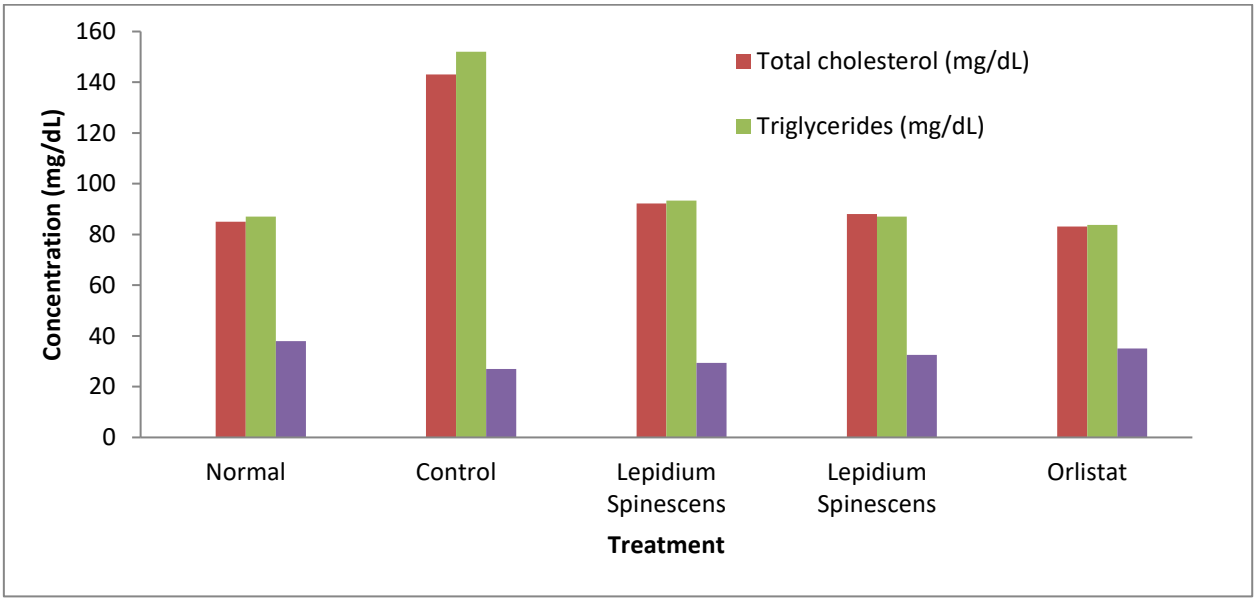

Figure 2: Effect of the hydroalcoholic extract of Lepidium Spinescens on serum lipid profile levels (mg/dL) in HFD induced rat

Table 4: Effect of hydroalcoholic extract of Lepidium Spinescens treatment on blood glucose (mg/dl) in normal and diabetic rats

Group	Treatment	Blood glucose (mg/dl)		
		Days 0	Days 8	Days 15
I	Normal	95.65± 2.50	99.00 ± 7.40	103.16 ± 2.50
II	Diabetic Control	270.50 ± 5.35	287.10± 5.35	296.50± 5.35
III	Diabetic +Hydroalcoholic extract of Lepidium Spinescens (250 mg/kg)	236.50 ± 3.50	167.50± 3.10***	131.50 ± 3.50***
IV	Diabetic + Hydroalcoholic extract of Lepidium Spinescens (500 mg/kg)	230.6± 4.00	127.82 ± 4.00***	108.27 ±4.5***
V	Diabetic + Glibenclamide (600µg/kg)	235.00 ± 4.50	121.50± 4.50***	105.77 ± 4.50***

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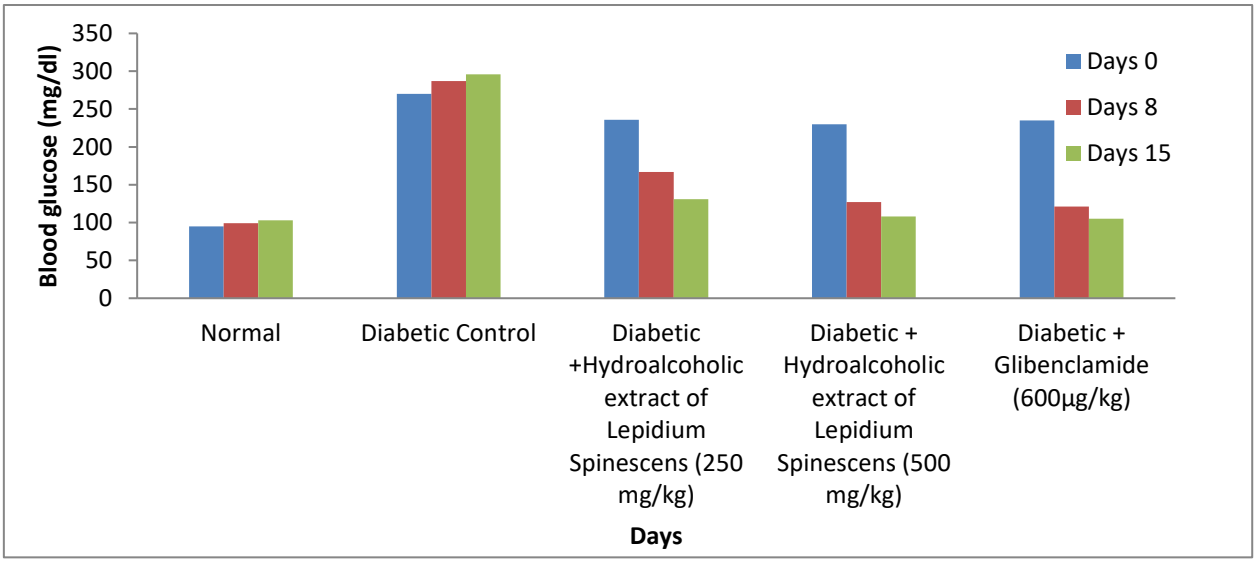

Figure 3: Effect of hydroalcoholic extract of Lepidium Spinescens treatment on blood glucose (mg/dl) in normal and diabetic rats

Table 5: Effect of hydroalcoholic extract of Lepidium Spinescens treatment on biochemical parameters in normal and diabetic rats

Group	Treatment	TC (mg/dL)	TG (mg/dL)	Total protein (g/dl)
I	Normal	91.00 ± 3.00	87.50 ± 3.00	9.10 ± 1.50
II	Diabetic Control	180.0 ± 5.00	131.0 ± 6.00	4.90 ± 1.50
III	Diabetic + Hydroalcoholic extract of Lepidium Spinescens (250 mg/kg)	119.2 ± 5.55**	90.50 ± 6.00*	7.10 ± 2.50**
IV	Diabetic + Hydroalcoholic extract of	102.8 ± 5.50**	81.50 ± 6.00*	7.90 ± 2.50**

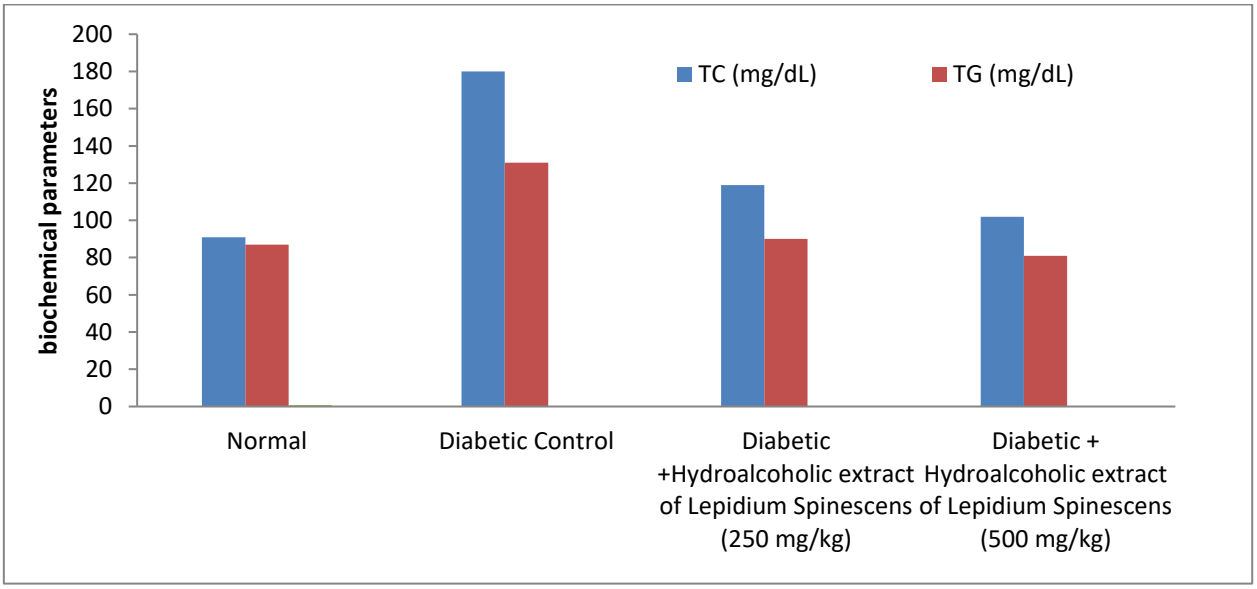

Figure 4: Effect of hydroalcoholic extract of Lepidium Spinescens treatment on biochemical parameters in normal and diabetic rats