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ANTI - HYPERLIPIDEMIC ACTIVITY OF *GOMPHRENA CELOSOIDES LEAF* EXTRACT AGAINST HIGH FAT DIET INDUCED HYPERLIPIDEMIA IN ALBINO RATS

Jegathishan E*, Ganeshkumar T., Hemadharshini P., Kannan S., Sangameswaran B.

SSM College of Pharmacy, Jambai, Erode, The Tamilnadu Dr. M. G. R. Medical University, Chennai.

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***Corresponding Author: Jegathishan E**
SSM College of Pharmacy, Jambai, Erode, The Tamilnadu Dr. M. G. R. Medical University, Chennai.
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ABSTRACT

Hyperlipidemia, a major risk factor for cardiovascular diseases, is characterized by elevated blood lipid levels. Preliminary phytochemical investigation of Gomphrena celosioides leaf reveals the presence of resin, carboxylic acid, steroids, saponin, and alkaloids, which may contribute to its anti-hyperlipidemic activity. The evaluation of Gomphrena celosioides leaf extract's anti-hyperlipidemic activity against high-fat diet-induced hyperlipidemia showed promising results Gomphrena celosioides, a plant with potential bioactive compounds, was evaluated in a study involving five groups of animals: Group-1 Control (normal diet), Group-2 Negative Control (high-fat diet), Group-3 Positive Control (high-fat diet + Orlistat 10mg/kg), Group-4 (high-fat diet + Gomphrena celosioides leaf extract 100mg/kg), and Group-5 (high-fat diet + Gomphrena celosioides leaf extract 200mg/kg). The high-fat diet significantly elevated lipid parameters in the Group-2 (Negative Control). However, treatment with Gomphrena celosioides leaf extract (100mg/kg and 200mg/kg) significantly reduced total cholesterol, triglycerides, LDL and VLDL cholesterol, while increasing HDL cholesterol levels in a dose-dependent manner. The extract's efficacy was comparable to the standard anti-hyperlipidemic drug Orlistat (10mg/kg). Possible mechanisms of action include the inhibition of cholesterol absorption, suppression of hepatic lipid synthesis, enhancement of lipoprotein lipase activity, and antioxidant effects that reduce oxidative stress and inflammation, suggesting its potential as a natural therapeutic agent for managing lipid profiles. Biochemical analysis of serum samples suggests that the ethanolic extract of Gomphrena celosoides has a dose-dependent protective effect on liver function, as reflected in the significant changes in the levels of Alkaline Phosphatase (ALP) and Aspartate Aminotransferase (AST). The histological results indicate that the ethanolic extract of Gomphrena celosoides can also possess hepatoprotective properties, particularly in the context of high-fat diet-induced liver damage. The study's findings indicate that Gomphrena celosioides leaf extract could be a valuable adjunct in managing hyperlipidemia.

KEYWORDS: *Gomphrena celosoides,* anti-hyperlipidemic, high-fat diet, Lipid profile, Orlistat.

1. INTRODUCTION

Hyperlipidemia is a medical condition characterized by an elevation of one or more of the following: cholesterol, cholesterol esters, phospholipids, or triglycerides. Abnormalities of plasma lipids can lead to a predisposition to coronary, cerebrovascular, and peripheral vascular arterial diseases. Hyperlipidemia is considered one of the major risk factors contributing to cardiovascular diseases (CVDs).[1] On the basis of the Causing Factor, hyperlipidemia is classified as Primary (Familial: hyperlipidemia) and Secondary (Acquired hyperlipidemia).[2] The main causes of hyperlipidemia include changes in lifestyle habits, with the main risk factor is mainly poor diet. The abnormal cholesterol levels are the result of an unhealthy lifestyle, including taking a high-fat diet and other lifestyle factors like being overweight, smoking, heavy alcohol use, and lack of exercise. Other factors include diabetes, kidney disease, pregnancy, and an underactive thyroid gland. Other illnesses that may elevate cholesterol levels include polycystic ovarian syndrome and kidney disease. The higher levels of female hormones like estrogen have been noted to increase or change cholesterol levels. In addition, drugs like diuretics, beta-blockers, and Ciclosporin. Glucocorticoids and medicines used to treat depression have also been reported to raise cholesterol levels.[3]

Generally, hyperlipidemia does not have any obvious symptoms but they are usually discovered during routine examination or until it reaches the danger stage of a stroke or heart attack. Patients with high blood cholesterol level or patients with the familial forms of the disorder can develop xanthomas which are deposits of cholesterol may form under the skin, especially under the eyes. At the same time, patients with elevated levels of triglycerides may develop numerous pimple-like lesions at different sites in their body. Liver and pancreas may get swollen. Vessels of brain and heart may be blocked.[4] Hyperlipidemia is the most important risk factor for atherosclerosis, of coronary artery disease (CAD), Myocardial Infarction (MI), Ischemic stroke.[5]

Currently many of the hypolipidemic synthetic drugs are available in the market for the treatment of hyperlipidemia includes HMG-CoA reductase inhibitors (Atorvastatin), Bile acid sequestrants (Cholestyramine), Fibrates (Gemfibrozil), Nicotinic acid (Niacin) and PCSK9 inhibitor (Alirocumab).[6] Prolonged use of anti-hyperlipidemic agent produces many risks includes muscle damage, Liver enzyme elevation (potential liver damage), Gastrointestinal problems and increased risk of diabetes (in certain cases) and Pancreatitis in rare case.

Natural products have proven to be the richest source of medicinal compounds. Screening the marine flora and fauna, soil samples, fungi and microbes is conducted either to discover a new drug or a lead structure. A lead is a prototype compound for a given biological activity. For example, for anti-tumour activity, a natural product lead structure is subjected to chemical modification or scaffolds to arrive at the therapeutically important molecular fragment, the pharmacophore. Only a few natural products are directly used as drugs, but in many cases the chemical scaffolds of the lead structure provide a more potent synthetic or semi-synthetic analogues. Many drugs listed as conventional medications were originally derived from plants. Salicylic acid, a precursor of aspirin, was originally derived from white willow bark and the meadowsweet plant. Cinchona bark is the source of malaria-fighting quinine. The opium poppy yields morphine, codeine and paregoric, a remedy for diarrhoea. Laudanum, a tincture of the opium poppy, was the favored tranquilizer in Victorian times.[7]

Gomphrena celosioides belongs to the Amaranthaceae family, which is geographically distributed in tropical and temperate regions. Moreover, the previous study shows that G. celosioides possesses a number of pharmacological important activities such as antimalarial, anti-inflammatory and antimicrobial activities.[8]

In the present study is aims to evaluate the anti-hypelipidemic activity by using anti- oxidant property of ethanolic extract of Gomphrena celosoides Leaf on evaluating the hydrogen peroxide scavenging method and DPPH scavenging methods. In this study inhibition of extract is compared with the standard inhibition, here Ascorbic acid taken as a standard. The activity is based on the ability of plant extracts to scavenge hydrogen peroxide or free radical.[9]

2. PLANT PROFILE

2.1. Taxonomical Classification

Kingdom: Plantae

Super-division: Spermatophyta

Division: Magnoliophyta

Family: Amaranthaceae

Species: *Gomphrena celosioides Mart.*

Synonyms: Gomphrena decumbens Jacq. (Bayer, 1982), Gomphrena decumbens auct afr.non Jacq.[10]

Fig. No 1: *Gomphrena celosioides Mart.* Whole plant.

2.2. Global description & Habit

Gomphrena celisioides is a perennial herb, decumbent, branched from the base. Leaves are elliptic to lanceolate shaped, hairy especially towards the apex. Roots are thickened over time. Stem is white and short. Inflorescence are spike arranged. *Gomphrena celosioides* is a perennial herb, multi branched prostrate. It grows up to 20 cm height. Flowering from October to June.[11]

2.3. Botanical description:

Gomphrena celosioides phyllotaxy is opposite, leaves are simple, margin-entire, venation-reticulate, shape-oblanceolate, surface-hairy, stipule-exstipulate, length- 3-5 cm and width- 1-2 cm with very short petiole of 0.3 – 0.7cm long. The inflorescence of *Gomphrena celosioides* is whitish and short consisting of many bisexual flowers. Each flower had five perianth, five stamens and a yellowish stigma. The inside is covered with wool-like structure. The entire stem of *Gomphrena celosioides* is pinkish-green in colour with hairs and somehow rounded and slender with

contracted nodes. The fruit of *Gomphrena celosioides* is covered by a wool-like structure and fruit wall is hard which bears the brown coloured seed of 1mm in sizes.[12] The roots of *Gomphrena celosioides* are whitish. Roots are thickened over time, Taproot system.

3. MATERIALS AND METHODS

3.1 Collection, authentication, and preparation of extract

The fresh plant of *Gomphrena celosoides* were collected from their natural habitat, ensuring they were free from disease or damage. The plant material was authenticated by a Dr. P Radha, Research Office (Botany), Sci II i/c, Siddha Medicinal Plants Garden, CCRS, Ministry of Ayush, Tamilnadu, and a voucher specimen was deposited for future reference G260525013C. The collected Leafs were washed to remove dust and shade-dried at room temperature (25–30°C) for 10–15 days.

The dried parts are needs to be crushed, using a pestle and mortar, to provide a greater surface area. The test sample should be sufficient to fill the porous cellulose thimble (in our experiments we use an average of 14 g of thyme in a 25- x 80-mm thimble). All equipment should be too assembled. Build a rig using stands and clamps to support the extraction apparatus. Following this, the Ethanol is added to a round bottom flask, which is attached to a Soxhlet extractor and condenser on an isomantle. The crushed plant material is loaded into the thimble, which is placed inside the Soxhlet extractor.[13] The side arm is lagged with glass wool. The solvent is heated using the isomantle and will begin to evaporate, moving through the apparatus to the condenser. The condensate then drips into the reservoir containing the thimble. Once the level of solvent reaches the siphon it pours back into the flask and the cycle begins again. The process should run for a total of 4 hours. Once the extraction set up, it can be left to run without direct supervision. It is not advised to leave the equipment completely alone due to the mix of running water and an electrical appliance, so a technician or other lab user should be made aware. The equipment can be turned off. The resulting extract (EEGC) was further dried in a vacuum desiccator and stored in an air-tight container at 4°C for future use. The percentage yield of the extract was calculated based on the initial weight of the plant material and the final weight of the dried extract.[14]

3.2 Qualitative Phytochemical Screening

Phytochemicals (Greek: phyton = plant) are chemical compounds naturally present in the plants attributing to positive or negative health effects.[15] Medicinal plants used in different diseases and ailments are the richest bio reservoirs of various phytochemicals. The medicinal properties of the plants are determined by the phytochemical constituents.[16] Some of the important phytochemicals include alkaloids, flavonoids, phenolics, tannins, saponins, steroids, glycosides, terpenes, etc. which are distributed in various parts of the plants. Identification of phytoconstituents in the plant material helps to predict the potential pharmacological activity of that plant.[17] The phytochemical screening test were conducted for resins, carboxylic acids, steroids, saponins, alkaloids, flavonoids, tannins, carbohydrates, glycosides, phenols, and gum.

3.3 In-vivo ANTI-HYPERLIPIDEMIC STUDY

Animals

For the in-vivo antihyperlipidemic study the albino rats at the weight of 180-250g were used. The rats were kept in 5 distinct groups, each with six animals and maintained at the standard balanced diet and water on demand. Temperature and humidity were also kept under control at 25 to 27 C and 60-80 % relative humidity, respectively. Before being used

in experiment the animals were properly cared and allowed to adopt to the laboratory environment for the period of 14 days. The institutional animal ethical committee (SSMCOP/IAEC/M.Pharm/03/06/2025) evaluated the experimental protocol and techniques used in the research work and the experiment were conducted in compliance with institutional ethical committee protocols.

Procedure

Albino rats (180–220 g) will be housed under standard laboratory conditions (22 ± 2°C, 12-hour light/dark cycle) with ad libitum access to food and water and acclimatized for one week. Hyperlipidemia will be induced by the administration high fat diet (Corn oil) through oral route. Orlistat taken as a standard drug at the concentration of 10mg/kg (Group III) administered through the oral route. The test-ethanolic extract were taken at two different concentrations 100 mg/kg (Group IV) and 200 mg/kg (Group V) administered through oral route.[18] The studies were conducted in the following groups of animals.

Group I: Normal rats: rats received normal pellet diet, and they were treated with vehicle (distilled water)
Group II: HFD control: rats received high fat diet, and they were treated with vehicle (distilled water)
Group III: Orlistat (10mg/kg): rats received high-fat diet, and they were treated with Orlistat (10 mg/kg)
Group IV: Extract (100 mg/kg): rats received high-fat diet, and they were treated with Gomphrena celosoides Leaf extract-I (100 mg/kg).
Group V: Extract (200 mg/kg): rats received high-fat diet, and they were treated with Gomphrena celosoides Leaf extract-II (200 mg/kg).[19]

Parameters observed

3.3.1 Lipid profile test

Total cholesterol (TC),
Triglycerides (TG),
Low-Density Lipoprotein (LDL),
Very Low-Density Lipoprotein (VLDL),
High-Density Lipoproteins (HDL)

3.3.2 Biochemical Analysis (Serum Samples)

Alkaline Phosphate (mg/dL),
Aspartate Aminotransferase (AST) (mg/dL)

3.3.3 Histopathology of liver by H&E staining

Intact and continuous sections were collected and stained by H&E. The slides with sections were placed in a metal staining rack. The sections were immersed in the filtered Harris Hematoxylin for 10 seconds. The slides were removed from the rack and transferred into a beaker with tap water. The water in the beaker was repeatedly exchanged with tap water until the water is clear. Then the slides were immersed sections in EOSIN stain for ~30 seconds. Then rinsed in a beaker with a tap water until the water is clear. The sections in the slides were dehydrated in ascending alcohol solutions (50%, 70%, 80%, 95% x 2, 100% x 2) in Columbia staining dish (jar)s. Cleared the sections with xylene treatment (3 - 4 x) in Columbia staining dish (jar)s. Mounted coverslip onto the section on glass slides with Permount mounting medium. The stained sections were viewed in the Magnus Trinocular microscope at 10X and 100X

magnification.[20] The structural morphology of tissues and the distribution of cells was analyzed. The contrast between the blue-purple nucleus and the pink background was sharp, and the cell bodies contour were well defined.

4. RESULTS AND DICUSSION

4.1 Qualitative Analysis of Phytochemicals:

The phytochemical analysis of *Gomphrena celosoides* leaf extract revealed a specific set of bioactive compounds, some of which are known for their medicinal properties. The presence of resins, carboxylic acids, steroids, saponins, and alkaloids suggests that *Gomphrena celosoides* may possess therapeutic potential in various health-related areas.

Table No 1: Qualitative Phytochemical screening of Gomphrena celosoides leaf.

S.No.	Name of the Sample	Phytochemical compound	Result
1.	Ethanolic extract of Gomphrena celosoides leaf	Resins	+
2.		Carboxylic acid	+
3.		Tanins	-
4.		Steroids	+
5.		Flavonoid	-
6.		Carbohydrates	-
7.		Glycosides	-
8.		Saponification	-
9.		Protein	-
10.		Phenol	-
11.		Saponin	+
12.		Gum	-
13.		Flavanoglycosides	-
14.		Alkaloids	+

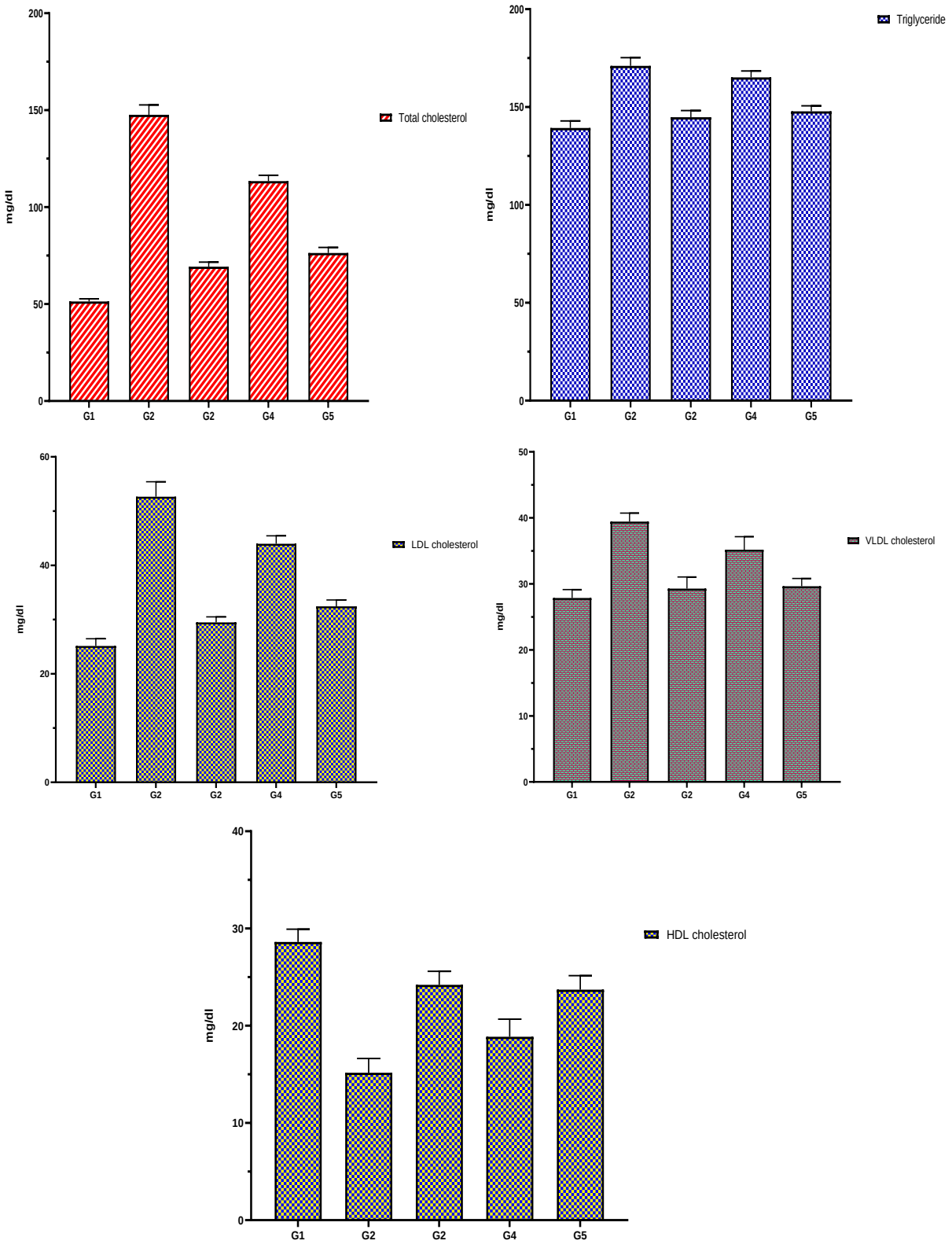
4.2 In-vivo ANTI- HYPERLIPIDEMIC ACTIVITY

4.2.1 Lipid profile test

Table No 2 shows the changes in the Total cholesterol, Triglycerides, Low density lipoprotein, High density lipoprotein and High-density lipoprotein. The Lipid profile of vehicle control group were compared with the Orlistat and ethanolic extract of Gomphrena celosoides treated group.

Table No 2: Effect of ethanolic extract Gomphrena celosoides leaf extract on lipid profile.

Groups	Total cholesterol (mg/dL)	Triglycerides (mg/dL)	Low-density lipoprotein (LDL) (mg/dL)	Very low-density lipoprotein (VLDL) (mg/dL)	High-density lipoprotein (HDL) (mg/dL)
G1-Control	51.34 ± 1.39	139.28 ± 3.64	25.14 ± 1.33	27.86 ± 1.28	28.61 ± 1.32
G2- High fat induced by corn oil	147.61 ± 5.07	171.04 ± 4.19	52.64 ± 2.76	39.44 ± 1.29	15.17 ± 1.46
G3- High fat induced by corn oil + Orlistat (10mg/kg)	69.26 ± 2.37	144.81 ± 3.37	29.49 ± 1.01	29.29 ± 1.76	24.21 ± 1.39
G4- High fat induced by corn oil+ Test sample (100 mg/kg)	113.41 ± 3.01	165.16 ± 3.29	43.97 ± 1.47	35.17 ± 1.98	18.86 ± 1.82
G5- High fat induced by corn oil+ Test sample (200 mg/kg)	76.34 ± 2.88	147.84 ± 2.77	32.44 ± 1.17	29.64 ± 1.18	23.71 ± 1.44



Graph No 1, 2, 3, 4, 5: Effect of ethanolic extract Gomphrena celosoides leaf extract on lipid profile.

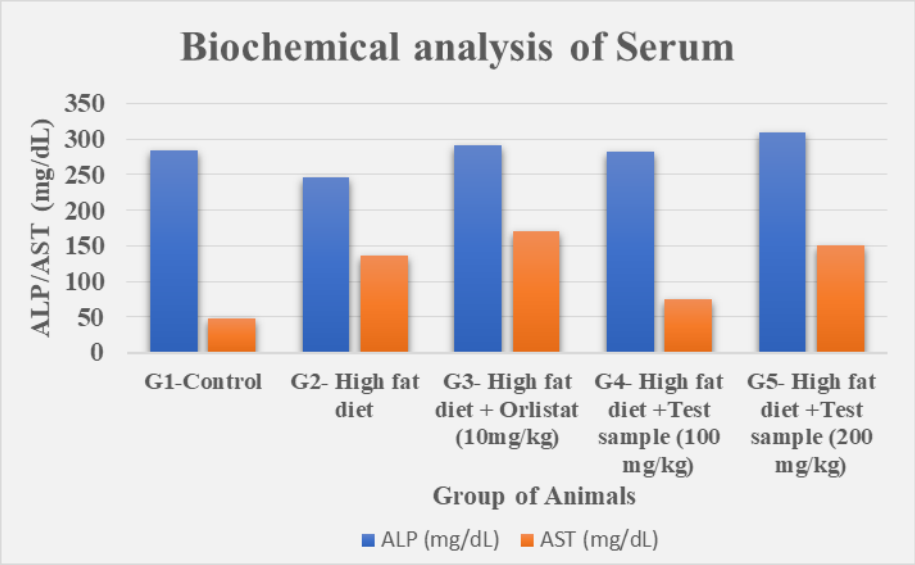
4.2.2 Biochemical Analysis

The Mean Biochemical analysis values in vehicle control were compared with negative control, Standard Orlistat (10mg/kg), Ethanolic extract of Gomphrena celosoides leaf 100mg/kg and 200mg/kg.

The results suggest that the ethanolic extract of *Gomphrena celosoides* has a dose-dependent protective effect on liver function, as reflected in the significant changes in the levels of **Alkaline Phosphatase (ALP)** and **Aspartate Aminotransferase (AST)**. ALP and AST are liver enzymes commonly used to assess liver health; elevated levels indicate liver cell damage, inflammation, or dysfunction.

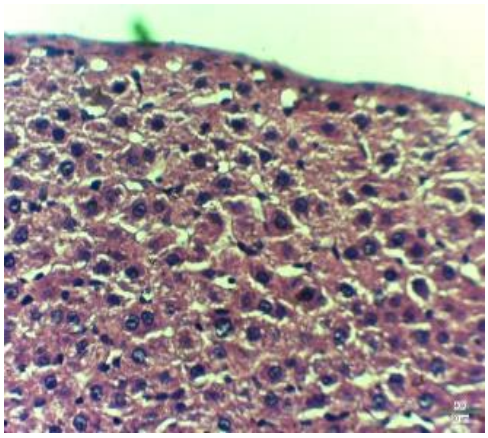
Table No 3: Biochemical analysis of serum.

Groups	Test of Analysis	
	ALP (mg/dL)	AST (mg/dL)
G1-Control	283.4	48.0
G2- High fat induced by corn oil	245.6	137.0
G3- High fat induced by corn oil + Orlistat (10mg/kg)	291.0	170.0
G4- High fat induced by corn oil + Test sample (100 mg/kg)	282.1	75.0
G5- High fat induced by corn oil + Test sample (200 mg/kg)	309.3	150.0

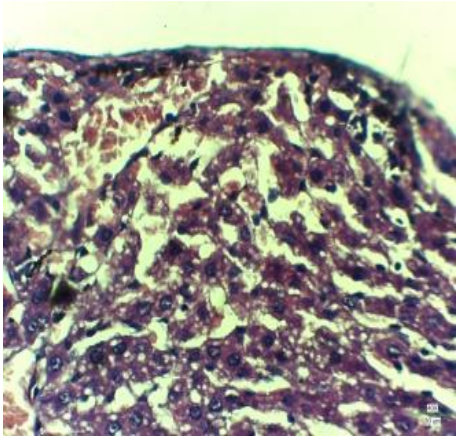


Graph No 6: Biochemical analysis of serum.

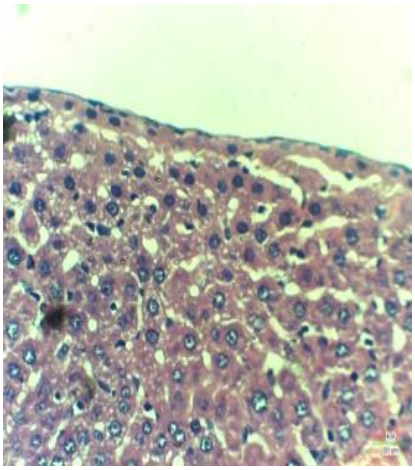
4.2.3 Histopathology of Liver



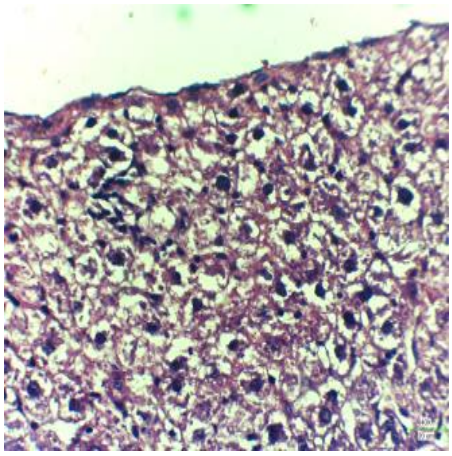
GI – Control



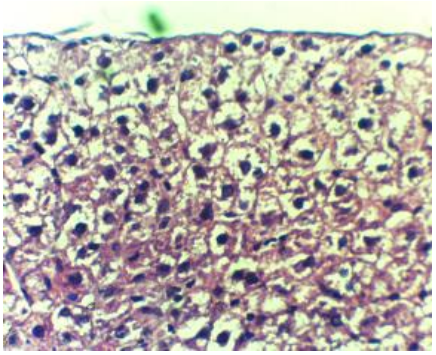
GII - High fat induced by corn oil



GIII- High fat induced by corn oil + Orlistat (10mg/ kg)



GIV High fat induced by corn oil + Test sample (100 mg/kg)



GV- High fat induced by corn oil +Test sample (200 mg/kg)

5. DISCUSSION

The high-fat diet led to significant lipid accumulation, increased liver enzymes, and structural changes in liver tissue, reflecting hyperlipidemia and liver stress. Orlistat treatment reduced fat absorption and lipid levels but resulted in mild liver enzyme elevation, indicating potential hepatotoxicity despite its lipid-lowering effects. At **100 mg/kg**, the ethanolic extract showed moderate improvement in lipid profiles and liver enzyme levels, with some hepatoprotective effects. At **200 mg/kg**, the extract significantly reduced fat accumulation, improved liver function, and restored liver architecture, suggesting stronger hepatoprotective effects. The higher dose of the extract (**200 mg/kg**) showed a marked improvement in liver tissue architecture, reducing fatty infiltration and improving hepatocyte structure. While Orlistat reduced fat absorption, it did not completely normalize liver structure or enzyme levels, indicating that the extract may offer additional protective effects.

The extract's antioxidant properties likely played a role in reducing oxidative stress, protecting the liver from damage and helping to normalize liver enzyme levels. The extract's anti-inflammatory effects likely reduced liver inflammation, which helped to reduce the release of liver enzymes (AST and ALP). The ethanolic extract helped regulate lipid metabolism, reducing lipid accumulation in liver cells and enhancing fat oxidation, which improved liver health. The extract may stimulate hepatic regeneration, promoting the repair of liver cells damaged by the high-fat diet, leading to better liver architecture and function. The extract may stabilize liver cell membranes, reducing the leakage of liver enzymes into the bloodstream and contributing to the improvement in liver function.

6. CONCLUSION

The ethanolic extract significantly reduced total cholesterol, triglycerides, LDL, and VLDL levels, while increasing HDL levels, suggesting its potential for improving lipid metabolism. The extract reduced liver enzyme levels (ALP and AST) in treated rats, indicating hepatoprotective effects and a reduction in liver damage caused by the high-fat diet. Histological examination of liver tissue revealed that the extract improved liver architecture, with reduced fatty infiltration and better-preserved hepatocytes, especially at higher doses. The extract's effects were dose-dependent, with **200 mg/kg** showing a stronger lipid-regulating and hepatoprotective effect compared to **100 mg/kg**. The control group exhibited healthy liver function, with normal lipid levels and enzyme activities, providing a baseline for comparison.

The study supports the potential of *Gomphrena celosoides* leaf extract as a natural remedy for managing **hyperlipidemia** and protecting against **liver damage** caused by high-fat diets. Further studies, including clinical trials, are necessary to confirm the extract's efficacy in humans, optimize its dosage, and evaluate its long-term safety and therapeutic potential.

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