**Evaluation of In vitro Antioxidant and In vivo Antihyperlipidemic Activities of ethanol Extract of ipomea carnea leaf**

Laxmi Athbhaiya, Bhumika Chandrakar\*

Corresponding author\*-

**Abstract-**

Reactive oxygen species (ROS) in the human body are abundant due to the univalence reduction of oxygen (O2) inhalation. These free radicals can cause diseases like diabetes, cancer, cirrhosis, obesity, and cardiovascular disorders. Enzymatic antioxidant barriers like SOD, GPx, and CAT help neutralize ROS. Factors like ultraviolet rays, NADPH stimulation, cigarette smoke, environmental contaminants, and toxic chemicals contribute to ROS overproduction, causing harm to DNA and lipids. Reactive oxygen species (ROS) are linked to various pathological conditions, and synthetic antioxidants can cause adverse health effects, while medicinal plants contain antioxidant components that prevent ROS-related harm.

 **Aim**-

The study aims to evaluate and compare the free radical scavenging activity of various medicinal plants using spectrophotometers. Plants possess a diverse array of antioxidant components, including phenols, vitamins, terpenoids, and flavonoids, which have high antioxidant potentials. These plant-derived polyphenolic constituents are more effective in vivo than vitro.

**Conclusion-**

Medicinal plants have been effectively used to treat ROS due to their antioxidant potential, which is primarily due to their rich source of phyto-nutrients and ingredients like phenols, flavonoids, and terpenoids. The antioxidant potentials of many medicinal plants have been studied for their anti-cancer, immunomodulator, hepato-protective, and hypolipidemic properties. Significant antioxidant activity was demonstrated by the plant extract in a dose-dependent manner. The extract considerably raised (p < 0.05) serum HDL-c levels while significantly decreasing (p < 0.01 or 0.001) serum TC, TG, LDL-c, and VLDL-c levels in hyperlipemic rats fed a high-fat diet. The extract considerably raised (p < 0.05) blood HDL-c levels while significantly decreasing (p < 0.05, p < 0.01, p < 0.001) serum TC, TG, LDLc, and VLDL-c levels in rats with triton-induced hyperlipidemia. At a dose of 300 mg/kg/day, the extract significantly (p < 0.01) reduced AI in both high fat-induced (1.70 ± 0.25)) hyperlipidemic albino rats.

**Introduction-**

**-**Hyperlipidemia, a medical condition involving high blood lipid levels, is a significant risk factor for cardiovascular diseases. It can be genetic or lifestyle-related, and early detection and management through lifestyle modifications and medication can reduce complications.Hyperlipidemia assessment is crucial for identifying individuals at risk of cardiovascular diseases, as it helps in early detection, intervention, and monitoring of lifestyle changes, dietary modifications, and medications to prevent long-term health complications.

Coronary arterial diseases, including atherosclerosis and coronary heart disease, are largely caused by elevated cholesterol levels. To reduce these risks, medical chemists are developing new bioactive molecules to lower lipid levels. This review highlights potential biological targets, treatments, and ongoing research in lipid lowering agents.[1]**.**High blood lipids are risk factors for cardiovascular disease. Current treatment for hyperlipidemia is based on NCEP's ATP-III guidelines, with statins being the preferred class. However, research raises questions about the effectiveness of these guidelines. New ATP-IV guidelines are expected, raising uncertainty about target levels and treatment strategies.[2]

 Antioxidant activity is attributed to various mechanisms such as chain initiation prevention, transition metal ion catalyst binding, peroxide decomposition, reductive capacity, and radical scavenging activity.[3]**.**Hyperlipidemia is a significant risk factor for cardiovascular diseases, including atherosclerosis, ischemic heart disease, and myocardial infarction, due to disorders in lipid metabolism and plasma lipoproteins. [4]

 Macrophages in atherosclerotic lesions express myeloperoxidase that yields a unique pattern of protein oxidation products. Myeloperoxidase is also pinpointed as a pathway that promotes LDL oxidation[5]Oxidized LDL can damage endothelial cells and trigger the expression of adhesion molecules like Pselectin andchemotactic factors like monocyte chemoattractant protein-1 and macrophage colony stimulating factor, leading to the tethering, activation, and attachment of monocytes and T-lymphocytes to the endothelial cells.[6]

Ipomoea carnea, a tropical shrub with numerous medicinal properties, has been found to have toxicological effects. Its leaves, flowers, and seeds have been used to isolate polyhydroxylated alkaloids, which could be beneficial for phytotherapy research and drug development. Ipomea carnea leaf extract contains compounds like Swainsonine, 2-epi-lentiginosine, calystegines B1, B2, B3, and C1, used in Ayurvedic, Siddha, and Unani medical systems as a folk remedy. It contains chemical components like 2-ethyl-1,3-dimethylbenzene.[7] The exposure to higher doses of Ipomoea carnea in rat pups and adult offspring resulted in higher postnatal mortality, smaller size , reversible hyperflexion of carpal joints, delay in opening ears, and negative geotaxis**.** [8]

Ipomoea carnea leaf extracts in mice and rats reduced phenobarbitone-induced sleep time, decreased exploratory activity, prolonged maze time, and increased convulsion onset. The acute toxicity showed a LD50 of 3000 mg/kg, supporting its use in traditional medicine for convulsion and psychosis management**.[9].** The cardiac effect of I. carnea's fresh leaves on mouse and frog hearts. The extract blocks the isolated frog heart by a dose-dependent increase in cardiac contractility Atropine blocks the initial depressant phase and potentiates the stimulant effect extract produces a positive inotropic effect on the isolated frog heart, possibly due to sodium extrusion or intracellular calcium release[10]

Cardiovascular function and chemically-induced toxicity[11]Cardiac effect of Ipomoea carnea leaf extract on frog and mouse hearts. It shows that the extract blocks the heart for then increases cardiac contractility. Atropine blocks the initial depressant phase and intensifies the stimulant effect. The extract's effects aren't affected by propranolol or calcium channel blockers[12] Antioxidants are crucial in lipid studies due to their role in preventing lipid peroxidation, influencing lipid metabolism, evaluating oxidative damage, and assessing therapeutic potential. They help prevent oxidized LDL, which contributes to atherosclerosis and hyperlipidemia. Antioxidants also modulate enzyme activities involved in cholesterol synthesis, transport, and breakdown, helping maintain healthy lipid level.

**EXPERIMENTAL**

**Plant material**

The Medicinal plant samples were collected from Durg Chattisgarh and were identified by Professor Dr. Satyendra Sen , VYT. College Durg . The dried samples were carried out to Department of Biology, Durg where the evaluation antioxidant properties of the medicinal plant samples was achieved under the supervision of Professor Dr Bhumika Chandrakar . The chemicals, solvents and reagents used in the preparation of plant extracts were Distilled water, Ascorbic acid, DPPH (1, 1-diphenyl, 2-picryl hydrazyl), Methanol and Ethanol. The required materials include Hydrogen Peroxide 40 mm, Phosphate Buffer pH 7.4 a sample (antioxidant extract, compound, or standard), and a spectrophotometer set to 230 nm.

**Preparation of extracts**

The plant was washed, shade dried and powdered in a heavy-duty Willy mill (Bells India Ltd.), and then 500 g of dried powder was soaked in 2500 mL of ethanol. After 15 days, the whole mixture was filtered through cotton wool and the filtrate was concentrated under reduced pressure using a rotatory evaporator method. The yield of extract was 43 %. The extract was stored in the refrigerator at 4 oC until further use. The extract was dissolved in 1 % carboxyl-methyl cellulose used for the animal studies [13]

**Preliminary phytochemical screening of ethanolic plant extract**

The ethanol extract of Ipomea carnea underwent preliminary phytochemical screening for alkaloids, glycosides, steroids, coumarin, tannins, flavonoids, saponins, and reducing sugar, using color intensity or precipitate formation as analytical responses.[14]

**Experimental animal**

The study involved Wistar albino rats aged 8-10 weeks, weighing 120-250 g each, from Rungta Institute of Pharmaceutical Sciences, Bhilai animal house. The rats were kept in clean and dry polypropylene cages with a 12-hour light, dark cycle, and a standard laboratory diet. They were fed water ad libitum and were kept in the environment for at least 3-4 days before the experiment.[15] The protocol used for diabetic and antihyperlipidemic research was based on the guidelines of the Institutional Animal Ethics Committee (IAEC). The rats were sensitive to environmental changes and were kept in the same environment for at least 3-4 days before the experiment.

Five rats per group received oral administration of Ipomea carnea dissolved in 1% carboxyl-methyl cellulose at doses ranging from 100 to 2500 mg/kg. Mortality was noted 72 hours later. The Litchfield and Wilcoxon method [was used to determine acute toxicity**.[16]**

**Determination of DPPH scavenging activity**

The DPPH assay is a widely used method to measure antioxidant capacity, but its measurement requires careful consideration due to the non-linear relationship between antioxidant concentration and antiradical activity.[17]**.**The increasing use of antioxidants to minimize oxidative stress effects is a growing concern. The 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay is used to assess the antiradical properties of various compounds.[18]**.**Three milliliters of a 0.1 mmol/L ethanol solution of DPPH were added to one milliliter of the sample ( 20,40,60,80,100,120,140μg/mL). Following a 30-minute incubation period, the absorbance of each sample was measured at 517 nm (Shimmadzu-1800, Japan). .

Inhibition of DPPH (D) was determined according to Eq 1.

**D (%) = {(Ac – As)/Ac}100 …………………. (1)**

where Ac and As are the absorbance of control and test samples, respectively**.**

**Determination of h2o2 scavenging activity**

The h2o2 assay is a widely used method to measure antioxidant capacity, but its measurement requires careful consideration due to the non-linear relationship between antioxidant concentration and antiradical activityHydrogen peroxide is a key redox metabolite involved in redox sensing, signaling, and regulation. Recent research explores its metabolic sources and sinks, its role in redox signaling under physiological conditions, and its potential for assaying in biological settings. It also explores its role in oxidative stress..[19] The assay involves introducing plant extracts to a reaction system involving H2O2, phenol, and 4-aminoantipyrine in the presence of horseradish peroxidase. The assay has been found to be convenient and precise, making it suitable for rapid quantification of the H2O2 scavenging ability of standard and natural antioxidants present in plant extracts. [20]]**.**The increasing use of antioxidants to minimize oxidative stress effects is a growing concern Three milliliters of a 0.1 mmol/L ethanol solution of h2o2 were added to one milliliter of the sample ( 20,40,60,80,100,120,140μg/mL). Following a 30-minute incubation period, the absorbance of each sample was measured at 250 nm (Shimmadzu-1800, Japan). .

**H2o2 (%) = {(Ac – As)/Ac}100 …………………. (2)**

**Assessment of total flavonoid content**

The aluminum chloride method was used to determine the total flavonoid content of sample extracts. Aliquots were mixed with methanol, AlCl3 (10%), Na-K tartarate, and distilled water, and shaken for 30 minutes. Absorbance at 415 nm was recorded, and a calibration plot was generated using known quercetin concentrations. The concentrations of flavonoid in the samples were calculated from the plot and expressed as mg quercetin equivalent /g of sample.[21]

**High fat induced hyperlipidemia model**

 The modified method to produce a high fat diet induced hyperlipidemia. Normal food pellets were crushed and ground into a fine powder, along with cholesterol, cholic acid, sucrose, and coconut oil. These ingredients were then added to the grinder to create feed balls, which were stored in a refrigerator at 2-8°C. The normal group's feed was prepared by grinding normal food pellets and mixing with water, once every three days. The animals were fed a high fat diet for 30 days, and their serum blood cholesterol levels were regularly monitored**.[22]**The animals were fed a high fat diet for 30 days, and their serum blood cholesterol levels were regularly monitored**.[23]**

**Experimental design for high fat induced hyperlipidemic rats**

Wistar rats were divided into five groups: normal control, high fat diet, atorvastatin, plant extract, and 300 mg/kg/day plant extract.

**Table 1 high fat induced hyperlipidemic rats**

|  |  |  |
| --- | --- | --- |
| **Group** | **Experiment** | **Received** |
| Group1 | Normal | Only vehicles |
| Group 2 | HFD | HFD |
| Group 3 | Atrovastatin | 10mg Atrovastatin |
| Group 4 | Plant extract | ICEA 150mg/kg |
| Group 5 | Plant extract | ICEA 300mg/kg |

 Group 1: Served as normal control and were given only vehicle (distilled water)

Group 2: Received high fat diet served as hyperlipidemic control (positive control)

Group 3: Received 10 mg/kg/day atorvastatin served as standard

Group 4: Received 150 mg/kg/day plant extract

Group 5: Received 300 mg/kg/day plant extract

**Table 2 HFD composition**

|  |  |  |  |
| --- | --- | --- | --- |
| **S.no** | **Nutrient** | **Standard diet** | **High fat diet** |
| **1** | Fat | 10-15% | 40-60% |
| **2** | Protein | 15-20% | 15-20% |
| **3** | Carbohydrate | 55-65% | 20-40% |
| **4** | Cholestrol | 0.02% | 0.2-2% |

 After 14 days of treatment, rats were fasted for 15 days, and blood samples were collected by retro orbital sinus puncture under mild anesthesia. The collected samples were centrifuged for 30 minutes at 2000 rpm, and the serum samples were used for various biochemical tests. The study aimed to understand the effects of different treatments on rats' health.

On the 8th day, blood samples were collected through retro-orbital sinus puncture under ether anesthesia and centrifuged for 15 minutes at 2500 rpm. Serum samples were then collected and analyzed for TC, TG, and HDL-c using appropriate kits, and VLDL-c and LDL-c were calculated using Friedewald's relationships.[24]

**.**

**VLDL-c = (TG)/5 ………….…………………. (2)**

**LDL-c = TC-(HDL-c+VLDL-c) ……………… (3)**

Atherogenic index was calculated as in Eq 4 (Schulpis’ equation)

**Atherogenic index (AI) = (TC – HDL-c)/HDL-c …… (4)[25]**

**Statistical data analysis**

The data was analyzed using one-way ANOVA and Dunnett's test using SPSS software, with a significance level of p < 0.05.

**RESULTS**

**Phytochemical profile**

The extract's phytochemical profile reveals the presence of alkaloids, glycosides, flavonoids, phenol , and amino acid. (Table 3).

**Table Qualitative phytochemical profile of ethanol extract of Ipomea carnea**

|  |  |  |  |
| --- | --- | --- | --- |
| **S.no** | **Test** | **Observation** | **Result** |
| 1 | Alkaloid |  |  |
|  | Mayers test  | Cream ppt. | +ve |
|  | Wagner test  | Reddish brown | +ve |
| 2 | Falavonoids |  |  |
|  | Shinoda  | Yellow | +ve |
|  | Ferric chloride | Green black ppt | +ve |
| 3 | Glycoside |  |  |
|  | Molisch test | Violet ring formed in between 2 layers | +ve |
|  | Benedict  | Light green | +ve |
| 4 | Phenol |  |  |
|  | Ferric chloride  | Greenish black | +ve |
|  | Lead acetate  | Yellow | +ve |
| 5 | Amino acid |  |  |
|  | Ninhydrin  | No change  | -ve |

**Acute toxicity**

The plant extract was found to be safe up to a dose of 2500 mg/kg of body weight, and the animals' behavior was observed for 8 hours, followed by 8 hours every 8 hours for 72 hours.

**DPPH scavenging activity**

The ethanol extract of I.carnea showed an increase in DPPH radical scavenging activity with increasing extract concentration, resulting in an odd electron-containing DPPH radical with an absorbance at 515-517 nm and a visible deep purple color.The ethanol extract of I.carnea showed significant antioxidant activity, with an IC50 value of 130.320 µg/mL and 11.24 µg/mL compared to ascorbic acid.

**%RSA = (Abs of Control) - (Abs of Sample)/(Abs of Control)\*100**



**H2o2 scavenging activity**

The H₂O₂ scavenging assay measures antioxidants' ability to neutralize hydrogen peroxide, a reactive oxygen species that can cause oxidative stress and cell damage. Antioxidants prevent damage to DNA, proteins, and lipids, complementing DPPH for detoxification. The study measures the scavenging activity of a sample by reducing H₂O₂ absorbance at 230 nm using a UV-Vis spectrophotometer.

**% radical scavenging and IC50 from H2O2 Assay**

**%RSA = (Abs of Control) - (Abs of Sample)/(Abs of Control)\*100**

|  |  |
| --- | --- |
| **Total phenol and flavonoid content**The study investigated the total phenol and flavonoid content of the I.carnea expressed in gallic acid quercetin equivalents. The phenolic content was found to correlate with antioxidant activity investigation correlates with their antioxidant activity (128.016 ± 0.056 mg GAE/g), while the flavonoid content was significant compared to the standard (168.33 ± 0.061 mg QE/g).  **Effect of extract I.carnea on lipid profile**  |  |

oral administration of ethanol extract I.carnea on lipid profile (150 mg/kg and 300 mg/kg, p.o.)significantly reduced serum TC, TG, LDL-c, and VLDL-c levels in a high fat diet-induced hyperlipidemia model, but increasedHDL-c levels is observed.







Fig graphical representation of TC, HDL,TG,VLDL,LDL,AI determines the spike in hdl and ldl

**DISCUSSION**-Lipids, including cholesterol, triglycerides, and phospholipids, are transported in the blood as lipoproteins, composed of enzymes and apolipoproteins.[26] Antioxidant activity mechanisms like prevention of chain initiation, binding of transition metal ion catalysts, decomposition of peroxides, reductive capacity, and radical scavenging activity

Ipomoea carnea, a traditional plant highlights its anti-bacterial, anti-fungal, antioxidant, anti-cancer, immunomodulatory, anti-diabetic, hepatoprotective, anti-inflammatory, anxiolytic, sedative, and wound healing activities. The study also discusses major phytochemicals associated with its bioactivity, potentially benefiting phytotherapy research.[27] I. carnea extracts significantly prevented drug-induced hepatic enzyme increase, reduced lipid peroxidation in liver tissue, restored antioxidant enzyme activities, and attenuated hepatocellular necrosis and inflammatory cell infiltration. This supports the traditional use of I. carnea extracts for liver injury protection.[28]

Statin-ezetimibe combinations, a fixed-dose combination with atorvastatin, have been approved in several countries for high-risk patients seeking cholesterol reduction. Studies show that combination therapy leads to greater LDL-C reduction and a higher proportion of patients achieving lipid goals, and atorvastatin-ezetimibe combinations are generally well-tolerated.[29] Antioxidant studies show that hyperlipidemic individuals often have high levels of oxidative stress, leading to lipid peroxidation, endothelial dysfunction, and an increased risk of atherosclerosis. High cholesterol levels contribute to oxidized LDL, promoting inflammation and cardiovascular diseases. Antioxidants like vitamin C, vitamin E, polyphenols, flavonoids, and carotenoids can reduce oxidative stress, improve lipid profiles, and protect against atherosclerosis. Supplementation can lower total cholesterol, LDL cholesterol, and triglycerides while increasing HDL cholesterol, contributing to better cardiovascular health. Antioxidant-rich diets and natural compounds show promise in managing hyperlipidemia and reducing cardiovascular complications.

**CONCLUSION-**

The ethanol extract of Ipomea carnea exhibits potent antioxidant and antihyperlipidemic properties. Medicinal plants have been effectively used to treat ROS due to their antioxidant potential, which is primarily due to their rich source of phyto-nutrients and ingredients like phenols, flavonoids, and terpenoids. The antioxidant potentials of many medicinal plants have been studied for their anti-cancer, immunomodulator, hepato-protective, and hypolipidemic properties. Significant antioxidant activity was demonstrated by the plant extract in a dose-dependent manner. The extract considerably raised (p < 0.05) serum HDL-c levels while significantly decreasing (p < 0.01 or 0.001) serum TC, TG, LDL-c, and VLDL-c levels in hyperlipemic rats fed a high-fat diet. The extract considerably raised (p < 0.05) blood HDL-c levels while significantly decreasing (p < 0.05, p < 0.01, p < 0.001) serum TC, TG, LDLc, and VLDL-c levels in rats with triton-induced hyperlipidemia. At a dose of 300 mg/kg/day, the extract significantly (p < 0.01) reduced AI in both high fat-induced (1.70 ± 0.25)) hyperlipidemic albino rats. Low-density lipoprotein (LDL) is a type of cholesterol that can block arteries, causing artery plaque. It ranges from 130 mg/dL to 159 mg/dL, with high numbers reaching 160 to 189 mg/dL. Very low-density lipoprotein (VLDL) is also considered bad due to its triglyceride content. High-density lipoprotein (HDL) is considered good cholesterol as it transports cholesterol to the liver, which removes it, like a tow truck removing broken down vehicles from traffic lanes. HDL levels should not be lower than 40 mg/dL.Dysfunctional and dysregulated cholesterol are terms used interchangeably to describe abnormalities in cholesterol levels, such as high or imbalanced levels. High cholesterol and inflammation in normal cholesterol levels increase the risk of heart disease.

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