REVIEW ON NEPHROPROTECTIVE ACTIVITY STUDY BY DIFFERENT PLANT EXTRACT

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ABSTRACT

Kidney diseases are a major problem of worldwide proportions and renal damage is very common since kidney has the capacity to excrete toxic substances. A phyttherapeutic approach to modern drug development can provide many invaluable drugs from traditional medicinal plants. Search for pure photochemical as drugs is time consuming and expensive. Numerous plants and polyherbal formulations are used for the treatment of renal diseases. However, in most of the severe cases, the treatments are not satisfactory. Although experimental evaluations were carried out on a good number of these plants and formulations, the studies were mostly incomplete and insufficient. The therapeutic values were tested against a few chemicals-induced subclinical levels of kidney damages in rodents. In this review some of the plants with their extract studied for protective effect in renal diseases were summerised.

Keywords: Medicinal plants, nephroprotective agents, renal disorders.

INTRODUCTION

Drugs are a common source of acute kidney injury. Compared with 30 years ago, the average patient today is older, has more comorbidity, and is exposed to more diagnostic and therapeutic procedures with the potential to harm kidney function. Drugs shown to cause nephrotoxicity exert their toxic effects by one or more common pathogenic mechanisms.

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per minute per 1.73 m²), volume depletion, diabetes, heart failure, and sepsis. General preventive measures include using alternative non-nephrotoxic drugs whenever possible; correcting risk factors, if possible; assessing baseline renal function before initiation of therapy, followed by adjusting the dosage; monitoring renal function and vital signs during therapy; and avoiding nephrotoxic drug combinations. Nephrotoxicity is a poisonous effect of some substances, both toxic chemicals and medication (nephrotoxins are chemicals displaying nephrotoxicity) on the kidneys. A number of antibiotics including the penicillins, cephalosporins, tetracyclines, as well as aminoglycosides and sulfonamides, are potential nephrotoxins. Aminoglycoside nephrotoxicity is manifested functionally by decreased urine concentrating capacity, tubular proteinuria, lysosomal enzymuria, mild glucosuria, decreased ammonium excretion and lowering of glomerular filtration rate (GFR). Approximately 8% to 26% of patients who receive aminoglycosides for more than 7-10 days develop mild renal impairment which is almost always reversible.\textsuperscript{1-3}

DIFFERENT NEPHROTOXICITY MECHANISM

Gentamicin induced toxicity

Gentamicin, a typical aminoglycoside antibiotic is widely used in clinical practices for the treatment of life threatening gram-negative infections. This antibiotic generally causes drug-induced dose-dependent nephrotoxicity in 10-20% of therapeutic courses. Gentamicin induced nephrotoxicity is characterized by direct tubular necrosis, without morphological changes in glomerular structures. Gentamicin generates hydrogen peroxide in rat renal cortex mitochondria and can also enhance the generation of reactive oxygen species (ROS). Abnormal production of ROS may damage some macromolecules to induce cellular injury and necrosis via several mechanisms including peroxidation of membrane lipids, protein denaturation and DNA damage. The alteration in kidney functions induced by lipid peroxidation is a proximal event in the injury cascade of gentamicin mediated nephrotoxicity. Gentamicin also acts as an iron chelator and the iron-gentamicin complex is a potent catalyst of radical generation.\textsuperscript{4-5}

Cisplatin induced toxicity

Cisplatin (Cis diamine dichloroplatinum II) is a highly effective antineoplastic DNA alkylating agent used against a wide variety of cancers. Although higher doses of Cisplatin are more efficacious for the treatment of cancer many reversible and irreversible side effects including nephrotoxicity, neurotoxicity, bone marrow toxicity, gastrointestinal toxicity and ototoxicity often limit its utility and therapeutic profile. Primary targets of cisplatin in kidney are proximal straight and distal convoluted tubules where it accumulates and promotes cellular damage, by multiple mechanisms including oxidative stress, DNA damage and apoptosis.
Several lines of evidence suggest the role of ROS in the pathogenesis of nephrotoxicity. Cisplatin induces free radical production causing oxidative renal damage, possibly due to depletion of non-enzymatic and enzymatic antioxidant system.

**Acetaminophen induced toxicity**

Acetaminophen-induced liver necrosis has been studied extensively, but the extrahepatic manifestations of acetaminophen toxicity are currently not described well in the literature. Renal insufficiency occurs in approximately 1-2% of patients with acetaminophen overdose. The pathophysiology of renal toxicity in acetaminophen poisoning has been attributed to cytochrome P-450 mixed function oxidase isoenzymes present in the kidney, although other mechanisms have been elucidated, including the role of prostaglandin synthetase and N-deacetylase enzymes. Paradoxically, glutathione is considered an important element in the detoxification of acetaminophen and its metabolites; however, its conjugates have been implicated in the formation of nephrotoxic compounds.

Acetaminophen-induced renal failure becomes evident after hepatotoxicity in most cases, but can be differentiated from the hepatorenal syndrome, which may complicate fulminant hepatic failure. The role of N-acetylcysteine therapy in the setting of acetaminophen-induced renal failure is unclear. This review will focus on the pathophysiology, clinical features, and management of renal insufficiency in the setting of acute acetaminophen toxicity.

**AGENTS WHICH CAUSES NEPHROTOXICITY**

Drugs, diagnostic agents & chemical are well known to be nephrotoxic. The following are some of the important nephrotoxic agents.

A) **Heavy metal:** Mercury, arsenic, lead, bismuth

B) **Antineoplastic agents**

Alkylating agents: Cisplatin, cyclophosphamide

Nitrosoureas: Streptozotocin, Carmustine, Lomustine & Semustine.

Antimetabolites: High dose Methotrexate, Cytosine Arabinose, high dose 6-thioguanine, 5-flourouracil.

Antitumor antibiotics: Mitomycin, Mithramycin, Doxorubicin

Biologic agents: Recombinant leukocyte and interferon

C) **Antimicrobial agents:** Tetracycline, Acyclovir, Pentamidine, Sulphadiazine, Trimethoprin, Rifampicin, Amphotericin B

D) **Aminoglycosides:** Gentamycin, Amikacin, Kanamycin, Streptomycin

E) **Miscellaneous**

Radiocontrast agents: Non-steroidal anti-inflammatory agents (NSAID’s): Ibuprofen, Indomethacin, Aspirin etc.

**DIFFERENT PLANT SHOWING NEPHROPROTECTIVE ACTIVITY**
**Aloe barbadensis**

Aloe vera has been used for medicinal purposes in several cultures for millennia: Greece, Egypt, India, Mexico, Japan, and China. The therapeutic claims made for Aloe vera range over a broad list of conditions, as do the pharmacological activities associated with it. Here the protective effects of the aqueous leaf extract of Aloe barbadensis (AEAB) has studied on gentamicin and Cisplatin-induced nephrotoxic Wistar rats. In each model of nephrotoxicity, thirty adult male Wistar rats were evenly divided into 5 groups. Groups I and II served as untreated and model controls, respectively while groups III-V were the treatment groups which were pretreated with 100-200 mg/kg bodyweight per day of AEAB 1 h before each dose of the nephrotoxicants. On the 8th day (in case of gentamicin) and on 6th day (in case of Cisplatin), blood samples for serum urea, total protein and creatinine as well as some ions like sodium, potassium, chloride and uric acid while the rat kidneys for histology were obtained under inhaled diethyl ether anesthesia. In the gentamicin nephrotoxic rats, 100-200 mg/kg bodyweight per day significantly attenuated elevations in the serum creatinine, total protein and blood urea nitrogen levels in dose related fashion and no treatment related effect on uric acid and ions, and attenuated the gentamicin-induced tubulonephrosis. Similar effects were also recorded in the Cisplatin model of acute renal injury.

The nephroprotective effect of AEAB could be due to the inherent antioxidant and free-radical-scavenging principle(s) contained in the extract. [Figure 1]

![Figure 1: Showing Aloe barbadensis Plant](image)

**Vernonia cinerea**

*Vernonia cinerea* less belonging to family Asteraceae. Mainly it consists of 38% fatty oil. plant contains β-amyrin acetate, β-amyrinbenzoate; lupeol and its acetate, β-sitosterol, stigmasterol, a-spinasterol, kcl and also contains flavonoids, glycosides, tannins and carbohydrates.

The different parts of vernonia cinerea less has been possess Hypoglycemic and anti-diabetic activity, anti-pyretic activity, anti-bacterial activity, diuretic and anti-diuretic activity, anti-inflammatory activity, free radicals and No scavenging activity, Analgesic activity. The alcoholic extracts of aerial parts of vernonia cinerea has been examined for the effect of petroleum ether, ethyl acetate on cisplatin-induced nephrotoxicity at a dose of 6mg/kg, i.p. in albino rats. The alcoholic extract showed pronounced curative activity and the ethyl acetate extract has exhibited...
good prophylactic activity and petroleum ether extract showed moderate protection for both curative and prophylactic models against cisplatin-induced toxicity\textsuperscript{10}. [Figure 2].

**Figure 2: Showing Vernonia cinerea Plant**

**Boerhaavia diffusa**

The current study designed to investigate the effects of pre-treatment of aqueous extract of *B. diffusa* root (200 – 400 mg/kg/day) in repeated dose acetaminophen nephrotoxic rats for 14 days. Administration of acetaminophen to rats induced marked detriments of renal function, characterized by a significant increase in blood urea nitrogen (BUN), serum creatinine (p < 0.01) and injured the renal cells evident from increased level of kidney malondialdehyde (MDA), protein thiol (p < 0.01) along with depletion of super oxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx) activities and reduced glutathione (GSH) levels (p < 0.01), however pre-treatment with *B. diffusa* extract protected against these changes. Histopathological changes showed that acetaminophen caused significant structural damages to kidneys like tubular necrosis, degeneration of epithelial cells, glomerular damage and congestion which was reversed with *B. diffusa*. The results suggest that *B. diffusa* has the potential in preventing the acetaminophen-induced nephrotoxicity\textsuperscript{11}. [Figure 3].

**Figure 3: Showing Boerhaavia diffusa Plant**

**Indigofera barberi**

The entire plants including the flowers of *Indigofera barberi* has been well-known in treating jaundice and renal diseases. The present study designed to evaluate the nephroprotective effect of ethanol extract of whole plant of *I. barberi* (Linn) in paracetamol induced nephrotoxicity of albino rats. The ethanol extract of *I.barberi* (250 mg and 500 mg/ kg body weight) was administered orally ones for 14 days.

Nephrotoxicity was induced in rat by administering single dose of paracetamol (750 mg/kg). The degree of nephroprotective activity was measured by renal functional parameters such as serum urea (UR), uric acid (UA) and creatinine (CR).and hematological profile was concluded that the ethanol extract
of *I-barberi* is an effective nephroprotective agent [12]. [Figure 4].

![Figure 4: Showing *Indigofera barberi* Plant](image)

**Pimpinella tirupatiensis**

*Pimpinella tirupatiensis* (Apiaceae) is a herbaceous medicinal plant used to treat cough, stomach, liver problems, asthma, ulcer and tooth ache in India and other Asian countries. The aim of the present study is to investigate the nephroprotective and antioxidant activities of the ethanol extract of *P.tirupatiensis* in two dose levels of 500mg/kg & 750 mg/kg B/W respectively on APAP induced toxicity in rats. Biochemical studies show that there is an increase in the levels of serum urea and creatinine along with an increase in the body weight and reduction in the levels of uric acid in APAP induced groups. These values are retrieved significantly by treatment with *P.tirupatiensis* extracts at two different doses.. Apart from these, histopathological changes also reveal the protective nature of the *P.tirupatiensis* extract against acetaminophen induced necrotic damage of renal tissues. In conclusion, these data suggest that the ethanol extract of *P.tirupatiensis* can prevent renal damage from APAP induced nephrotoxicity in rats [13]. [Figure 5].

![Figure 5: Showing *Pimpinella tirupatiensis* Plant](image)

**Curcumin**

We report the role of mitochondria in the protective effects of curcumin, a well-known direct and indirect antioxidant, against the renal oxidant damage induced by the hexavalent chromium [Cr(VI)] compound potassium dichromate K$_2$Cr$_2$O$_7$ in rats. Curcumin was given daily by gavage using three different schemes: (1) complete treatment (100, 200, and 400 mg/kg bw 10 days before and 2 days after K$_2$Cr$_2$O$_7$ injection), (2) pretreatment (400 mg/kg bw for 10 days before K$_2$Cr$_2$O$_7$ injection), and (3) posttreatment (400 mg/kg body weight 2 days after K$_2$Cr$_2$O$_7$ injection). Rats were sacrificed 48 h later after a single K$_2$Cr$_2$O$_7$ injection (15 mg/kg, sc) to evaluate renal and mitochondrial function and oxidant stress.

Curcumin treatment (schemes 1 and 2) attenuated K$_2$Cr$_2$O$_7$-induced renal dysfunction, histological damage, oxidant
stress, and the decrease in antioxidant enzyme activity both in kidney tissue and in mitochondria. Curcumin pretreatment attenuated \( K_2Cr_2O_7 \) induced mitochondrial dysfunction (alterations in oxygen consumption, ATP content, calcium retention, and mitochondrial membrane potential and decreased activity of complexes I, II, II-III, and V) but was unable to modify renal and mitochondrial Cr(VI) content or to chelate chromium. Curcumin posttreatment was unable to prevent \( K_2Cr_2O_7 \) induced renal dysfunction.\(^{14}\).

**Aegle marmelos**

Present investigation was carried out to evaluate the Nephroprotective activity of an aqueous extract of Leaves of Aegle marmelos in Wistar rats. The aqueous extract of Aegle marmelos leaves (AEAM) was administered at three doses (250, 500, and 750 mg/kg.) to wistar rats in Gentamicin (GM)-induced nephrotoxicity model. The rats were pre-fed experimental diets for 8 days and then received GM (100 mg/kg body weight/day) treatment for 8 days while still on diet. Serum parameters, oxidative stress in rat kidney were analyzed.

GM nephrotoxicity was recorded by increased serum creatinine and blood urea nitrogen level. GM increased MDA level whereas decreased catalase, reduced glutathione level, while AEAM significantly reduced the elevated MDA levels and increased GSH and catalase concentration. GM increased serum creatinine, urea and blood urea nitrogen level, while AEAM reduced serum creatinine, urea and blood urea nitrogen level in gentamicin toxicity indicating a nephroprotective effect.\(^{15}\) [Figure 6].

![Figure 6: Showing Aegle marmelos Plant Erucasati va](image)

Mercuric chloride (HgCl\(_2\)) is a well-known nephrotoxic agent. Increasing number of evidences suggest the role of oxidative stress in HgCl\(_2\) induced nephrotoxicity.

Eruca sativa is widely used in folklore medicines and has a good reputation as a remedy of renal ailments. In the present study, the antioxidant potential of ethanolic extract of E. sativa seeds was determined and its protective effect on HgCl\(_2\) induced renal toxicity was investigated. The extract was found to possess a potent antioxidant effect, with a large amount of polyphenols and a high reducing ability. HPLC analysis of the extract revealed glucoerucin and flavonoids to be the major antioxidants present in it. E. sativa extract significantly scavenged several reactive oxygen species (ROS) and reactive nitrogen species (RNS). Feeding of the extract to rats afforded a significant protection against HgCl\(_2\) induced renal toxicity. Subcutaneous
administration of 4 mg/kg body weight HgCl$_2$ induced renal injury evident as a marked elevation in serum creatinine and blood urea nitrogen levels, and histopathological changes such as necrosis, oedema and congestion of stroma and glomeruli.\textsuperscript{16} \[Figure 7\].

**Figure 7: Showing Erucasati va Plant**

**Tectona grandis**

In the present study, effect of ethanolic extract of bark of Tectona grandis Linn. (TG) was evaluated using alloxan induced diabetes and associated renal complication. The diabetes was induced by administration of alloxan to the rats at the dose of 140 mg/kg, i.p. TG was administered to diabetic animals for six weeks and various biochemical parameters in blood and urine (plasma glucose, serum albumin, total protein, and creatinine, urine total protein, urine albumin), tissue parameters (cholesterol and triglyceride in kidney homogenate) and % change in body weight were evaluated along with histopathological study.

In present study diabetic animals treated with TG showed significant reduction in the elevated level of plasma glucose (p<0.01) when compared with diabetic control. While considering renal parameters, diabetic animals treated with TG showed significant decrease in serum creatinine (p<0.05), urine albumin and urine total protein levels (p<0.01) and significant increase in serum albumin, total protein and % change in body weight (p<0.01) when compared with diabetic control. Diabetic control showed significant increase in total cholesterol and triglyceride accumulation in kidney, while diabetic animals treated with TG showed significant decrease in levels of total cholesterol (p<0.01) and triglyceride (p<0.05) in the kidney when compared with diabetic control.

Diabetic control showed significant mark of glomerulosclerosis and hyalinization which occurs because of severe diabetic condition (diabetic nephropathy). Diabetic groups treated with TG showed absence of the sclerotic lesions produced by diabetic condition.\textsuperscript{17} \[Figure 8\].

**Figure 8: Showing Tectona grandis Plant**

**Ginkgo biloba**

Extract EGb 761 was studied for its nephroprotective effects in experimentally
diabetic and hypoxic rats. Duration of streptozotocin-induced diabetes was 4 months, that of respiratory hypoxia of the diabetic group 20 min. The daily dose of 100 mg EG b/kg body weight started 1 month after induction of the diabetes. EG b reduced diabetes-induced morphological alterations of the kidney such as increase in volume of glomeruli, capillary tufts, urinary space, and thickening of Bowman's capsule basement membrane. Diabetically increased immunostaining of interstitial collagens of types I, III, and VI was diminished by the EGB extract. EGB reduced the relative total SOD activity from 163% in diabetic kidney to 46%. Additional hypoxia-induced ultrastructural damage was also diminished. [Figure 9].

**Figure 9: Showing Ginkgo biloba Plant**

*Abutilon indicum*

The present study reported that the etanolic extract of Abutilon indicum scavenge superoxide and hydroxyl radicals, resulting in a reduction of lipid peroxidation. The purpose of the present study was to evaluate EEAI's efficacy as a protective agent against cisplatin-induced ototoxicity. Albino wistar rats were used in this study and were divided into five treatment groups: (1) animals administered 2% v/v aqueous tween 80 solution (5ml/kg, p.o) – control group (Group I), (2) animals administered 2% v/v aqueous tween 80 solution (5ml/kg, p.o) + 6 mg/kg via the i.p route of Cisplatin (Group II), (3) animals received Cystone (5ml/kg, p.o) [Standard] (Group III), (4) animals received 200 mg/kg EEAI suspended in 2% v/v aqueous tween 80 solution, p.o + 6 mg/kg, i.p of cisplatin (Group IV), (5) animals received 400 mg/kg EEAI suspended in 2% v/v aqueous tween 80 solution, p.o 6 mg/kg, i.p of cisplatin (Group V).

The protective effect of EEAI on CDDP-induced nephrotoxicity was evaluated. Nephrotoxicity was evaluated by means of measurement of serum BUN and creatinine and histopathological examination of the kidney.

There were significant differences in serum BUN and creatinine levels between control Group and cisplatin treated Groups. The result suggested that EEAI at 200 and 400mg/kg administered 7 days before cisplatin treatment significantly prevented the increase of serum creatinine, blood urea nitrogen, uric acid, total proteins, total cholesterol, alkaline phosphatase, and albumin concentrations and markedly decreased cisplatin-induced renal damage as confirmed by biochemical assays and histopathological studies. [Figure 10].
The present study was conducted to investigate the chemopreventive effects of hydro-ethanolic extract of Euphorbia neriifolia (EN) on N-nitrosodiethylamine (DENA) induced renal cancer in male Swiss albino mice. Animals were pretreated with EN extract (150 and 400 mg/kg body weight; p.o) and butylated hydroxyanisole (BHA) as a standard (0.5% and 1% BHA p.o) both for two week prior to the administration of single dose of DENA (50 mg/kg body weight; p.o). Various in vivo antioxidant biochemical parameters like lipid peroxidation (LPO), superoxide dismutase (SOD), and Catalase (CAT) were evaluated to determine the reno-protective and antioxidant activity of EN. DENA increased oxidative stress through increase in LPO and decrease in antioxidant enzymes (SOD, and CAT).

The EN extract significantly restored the antioxidant enzyme level in the kidney and exhibited significant dose dependant protective effect against DENA induced nephrotoxicity, which can be mainly attributed to the antioxidant property of the extract. This study rationalized the ethno-medicinal use of EN for protection against renal cancer. 

Rubia cordifolia

This study investigated the protective effect of the hydro-alcoholic extract of roots of Rubia cordifolia Linn. (HARC) against ethylene glycol induced urolithiasis and its possible underlying mechanisms using male Wistar albino rats.

Ethylene glycol feeding resulted in hyperoxaluria, hypocalciuria as well as increased renal excretion of phosphate. Supplementation with HARC significantly prevented change in urinary calcium, oxalate and phosphate excretion dose-dependently. The increased calcium and oxalate levels and number of calcium oxalate crystals deposits in the kidney tissue of calculogenic rats were significantly reverted by HARC treatment. The HARC supplementation also prevents the impairment of renal functions.

Euphorbia neriifolia

Figure 10: Showing Abutilon indicum Plant

Figure 11: Showing Euphorbia neriifolia Plant

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Results indicate that the HARC can protect against ethylene glycol induced urolithiasis as it reduced and prevented the growth of urinary stones. Therefore, HARC is helpful to prevent the recurrence of the disease as it showed its effect on early stages of stone development. The mechanism underlying this effect is mediated possibly through an antioxidant, nephroprotection and its effect on the urinary concentration of stone-forming constituents and risk factors.[21]. [Figure 12].

![Figure 12: Showing Rubia cordifolia Plant](image)

### Aerva lanata

Aerva lanata is also called as Pasanabheda, Chaya, Gorakhganja belongs to the family Amaranthaceae. The Aerva lanata plant is reported to have α-amyrin, campesterol, β-sitosterol, its palmitate, chrysin and flavonoid glucosides.[63] Canthin-6-one and β-carboline alkaloids were isolated. The plant was reported for various activities such as diuretic, hepatoprotective, antidiabetic, antimicrobial, anthelmintic and demulcent activity. Aerva lanata also shows its effect on cisplatin and gentamycin model of acute renal failure.

The ethanolic extract of the entire plant of Aerva lanata was studied for its nephroprotective activity in cisplatin and gentamicin induced acute renal injury in albino rats of either sex. In the curative regimen, the extract at dose levels of 75, 150 and 300 mg/kg showed dose-dependent reduction in the elevated blood urea and serum creatinine and normalized the histopathological changes in the cisplatin model. In the gentamicin model the rats in the preventive regimen also showed good response to the ethanol extract at 300 mg/kg. The results suggest that the ethanolic extract of Aerva lanata possesses marked nephroprotective activity with minimal toxicity and could offer a promising role in the treatment of acute renal failure caused by nephrotoxins like cisplatin and gentamicin.[22, 23]. [Figure 13].

![Figure 13: Showing Aerva lanata Plant](image)
Crataeva nurvala

Crataeva nurvala Buch-Ham belongs to the Family Capparidaceae commonly known as Varuna, is an evergreen tree indigenous to India. Moreover, pharmacological study reveals the potentiality of Crataeva nurvala extract and its active principle, particularly lupeol as diuretic, anti-inflammatory, antioxidant, cardio-protective, hepatoprotective, lithonotriptic, anti-rheumatic, anti-periodic, contraceptive, anti-protozoal, rubifacient and vesicant.

The alcoholic extract of Crataeva nurvala 250 and 500 mg/kg for 10 days showed protective activity against cisplatin 5 mg/kg induced nephrotoxicity. The results suggested, that the alcoholic extract has significantly altered the dysfunction of renal proximal tubule cells by decreasing the concentration of blood urea nitrogen, creatinine, lipid peroxidation, glutathione and catalase 24, 25. [Figure 14].

Figure 14: Showing Crataeva nurvala Plant

Orthosiphon stamineus

Orthosiphon stamineus Benth. is a medicinal herb belonging to the family Lamiaceae.

The methanolic extract of Orthosiphon stamineus benth was evaluated for its nephroprotective activity using rat model. Gentamycin is an extensively used aminoglycoside antibiotic. It has been reported to produce nephrotoxicity even at normal therapeutic dose level. The drug was administered intra peritonialy at a dose of 80mg/kg weight for 9 days. Histopathological sections showed marked glomerular, peritubular and blood vessel congestion. These increased levels of serum creatinine, blood urea, urinary protein and extent of renal damage were decreased by the methanolic extract of Orthosiphon stamineus at both dose levels that is 100 and 200 mg/kg body weight in rats 26. [Figure 15].

Figure 15: Showing Orthosiphon stamineus Plant

Strychnos potatorum

Strychnos potatorum Linn commonly referred to as clearing nut belongs to the family Loganiaceae. The ethanolic extract of Strychnos potatorum seeds was evaluated for its nephroprotective effect by using rat models. Hence, the study concludes that the seeds of Strychnos potatorum possess marked
nephroprotective activity and could have a promising role in the treatment of acute renal injury induced by nephrotoxins, especially gentamicin \(^{27, 28}\). [Figure 16].

![Image of Strychnos potatorum](image1.png)

**Figure 16: Showing *Strychnos potatorum* Plant**

*Aerva javanica*

*Aerva javanica* Juss. ex Schult is medicinal plant belonging to the family Amaranthaceae. The aqueous extracts of *Aerva javanica* roots were studied for the scientific evaluation of nephroprotective activity. Various parameters like body weight, blood urea, serum creatinine, serum protein, total protein, serum albumin, urine volume and pH, tissue protein, GSH and TBARS level were compared with controls on 16th day after treatment.

The study concludes that cisplatin injury was evidenced by the elevated biochemical markers and histopathological features of acute tubular necrosis. The aqueous extract at the dose level of 400 mg/kg body weight was found to normalize the elevated biochemical markers and bring about a marked recovery in kidneys as evidenced by using microscopy \(^{29}\). [Figure 17].

![Image of Aerva javanica](image2.png)

**Figure 17: Showing *Aerva javanica* Plant**

*Ficus religiosa*

*Ficus religiosa* (L.), commonly known as pepal belonging to the family Moraceae. plants have been used in traditional Indian medicine for various range of ailments. To evaluate the possible potential, nephroprotective and curative role of the methanolic extract of *Ficus religiosa* L. Latex was used against cisplatin (5mg/kg, i.p.) induced Nephrotoxicity.

The blood was collected from the retro-orbital sinus of rats and determined for urea and creatinine levels in serum of each group after then rats were sacrificed for quantitative estimation of various enzymes and ATPases content in kidney tissue. A single dose of cisplatin induced shows the increased levels of urea & creatinine in serum and it was significantly recovered by 400mg/kg in curative and protective groups. The enzyme estimation in kidney tissue has found that increased malondialdehyde and decreased reduced glutathione (GSH).
The results conclude that the study data confirmed nephrotoxicity induced by cisplatin due to oxidative stress and methanolic extract of Ficus religiosa L. latex may have nephroprotective and curative activity. The ethanolic extract of dried fruits of *Pedalium murex* Linn was evaluated for its nephroprotective activity. Nephrotoxicity was induced in Wistar rats by intraperitoneal administration of Cisplatin 5mg/kg. Effect of concurrent administration of *Pedalium murex* ethanolic extract at a dose of 250 mg/kg given by oral route was determined using serum creatinine and blood urea and change in body weight as indicators of kidney damage. Cystone was used as standard drug. The extract significantly decreased the cisplatin induced nephrotoxicity. The results showed that the ethanolic extract of dried fruits of *Pedalium murex* has an excellent nephroprotective activity as compared to cystone. [Figure 19].

**CONCLUSION**

From this study, it is clear that the medicinal plants play a vital role against various diseases. Various herbal plants and plants extracts have significant nephroprotective activity in animal models. The nephroprotective activity is probably due to the presence of flavonoids in all few herbal plants. The results of this study indicate that extracts of leaves and plants extracts of some medicinal plant have good potentials for use in renal disease. The present review study give evidential explore mechanism of action of medicinal plants against experimentally induced nephrotoxicity.

Hence the review study is concluded that the herbal drug possesses nephroprotective activity and it has been proved by different animal models give many links to develop the future trials.
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