



A review on potential nephroprotective herbs

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Abstract

Medicinal plants could be a valuable source of novel chemicals for the development of successful treatment for a variety of renal problems. Variety of herbs have been proven to be effectual as nephroprotective agents while many others are claimed to be nephroprotective but there is no scientific evidence to support such claims. Developing a satisfactory herbal therapy to treat severe kidney disorders requires systematic investigation of properties like acute renal failure, nephritic syndrome and Chronic Interstitial Nephritis. The aim of the current review is to enlist the nephroprotective medicinal plants, which are scientifically proved in treating renal (kidney) disorders.

Keywords: nephroprotective, medicinal plants, kidney, pharmacology, toxicology

Introduction

The kidney disorders are now a days very commonly observed in nearly all age groups. About 80% of population is depend upon traditional medicine for their primary essential health care needs. Now a day's exploration of traditional medicines or herbs are mysteriously increasing, scientifically significant and economically important task of ethnobotanists. Nephrotoxicity is the most commonly remarkable kidney problem and occurs when body is exposed to a causative drug or toxin. A number of therapeutic agents can adversely affect the kidney causing ARF (acute renal failure), chronic interstitial nephritis and nephritic syndrome since there is an expanding number of potent therapeutic drugs like aminoglycoside antibiotics, NSAID's, chemotherapeutic agents combined to the therapeutic arsenal in recent years [1]. Exposure to chemical reagents like carbon tetrachloride, ethylene glycol, sodium oxalate and heavy metals such as lead, cadmium, mercury and arsenic also induces nephrotoxicity. Prompt recognition of the disease and termination of responsible drugs are usually the crucial challenges [2]. Nephroprotective agents are the substances which are known to improve symptoms of Nephrotoxicity. Medicinal plants are the reservoirs of various phytochemicals which may have healing properties therefore selective phytochemicals are used as nephroprotective based on their characteristics.

Earlier there is huge number of literatures available for the herbs acting on the renal disorder. Concurrent use of various medicinal plants possessing nephroprotective activity together with different nephrotoxic agents which may reduce its toxicity. The term renal failure primarily indicates failure of the excretory function of kidney, leading to retention of nitrogenous waste products of metabolism in the blood [3]. In addition to this, there is imbalance in fluid and electrolyte regulation along with endocrine dysfunction. The renal failure is fundamentally categorized into acute and chronic renal failure [4]. In case of Nephrotoxicity there

will be a severe damage to kidney because of this kidney is unable to get rid of excess urine and wastes from the blood. Nephrotoxicity has a great impact on formation of urine and excretion along with the elevated levels of various nitrogenous waste products in the blood (such as urea, uric acid, creatinine) and along with this there are increased values of some blood electrolytes such as potassium and magnesium. A number of therapeutic agents can adversely affect the kidney which results in acute renal failure (ARF), chronic interstitial nephritis and nephritic syndrome because increasing number of potent therapeutic drugs like chemotherapeutic agents, aminoglycoside antibiotics, and NSAIDs have been added to the therapeutic arsenal in recent years. Exposure to chemical reagents like carbon tetra chloride, ethylene glycol, sodium oxalate and heavy metals like lead, arsenic, mercury and cadmium also induces nephrotoxicity [5, 6, 7, 8]. Many plants have been used for the treatment of renal failure in traditional system of medicine throughout the world. Plant preparations, associated with dietary guidelines, provided, the basis of disease therapy until the emergence of allopathic medicine. Traditional knowledge will greatly facilitate intentional, focused and safe natural products research to enlighten the drug discovery process (DDP). Therefore, search of nephroprotective herbs from medicinal plants has become important and the need of the time.

Acute renal failure (ARF) refers to the sudden and usually reversible loss of function of the kidney. In this which develops over a period of days or weeks. There are many causes for acute renal failure which mainly includes acute tubular necrosis that commonly accounts for 85% of incidence. Mostly acute tubular necrosis is occurring due to ischemia or due to toxins. The toxins may be endogenous or exogenous. The exogenous agents are radio contrast agents, cyclosporine, antibiotics, chemotherapeutic agents, organic solvents, acetaminophen and illegal abortifacients [9]. Chronic renal failure (CRF) is an irreversible deterioration

in the function of the kidney. This type of kidney failure develops over a period of years, leading to loss of excretory, metabolic and endocrine functions. Various causes of renal failure have been recognized like hypertension, diabetes mellitus, antineoplastic agents like cyclophosphamide, vincristine and cisplatin etc. [10].

In General Mechanism of Nephroprotection

Generally, the nephroprotective herbs show the activity by common mechanisms like Antioxidant activity, Immunomodulatory action, Anti-inflammatory action. An

antioxidant is a substance which is at low concentrations delays or prevents oxidation of a substrate. Antioxidant compounds act through chemical mechanisms: single electron transfer (SET), hydrogen atom transfer (HAT) and the ability to chelate transition metals. In the activity of nephroprotection the Glutathione level, serum SOD level and CAT levels of the body get increased. Also, the nitric oxide and Malondialdehyde (MDA) levels get decreased as well as the lipid peroxidation lowers, therefore it shows nephroprotective action.

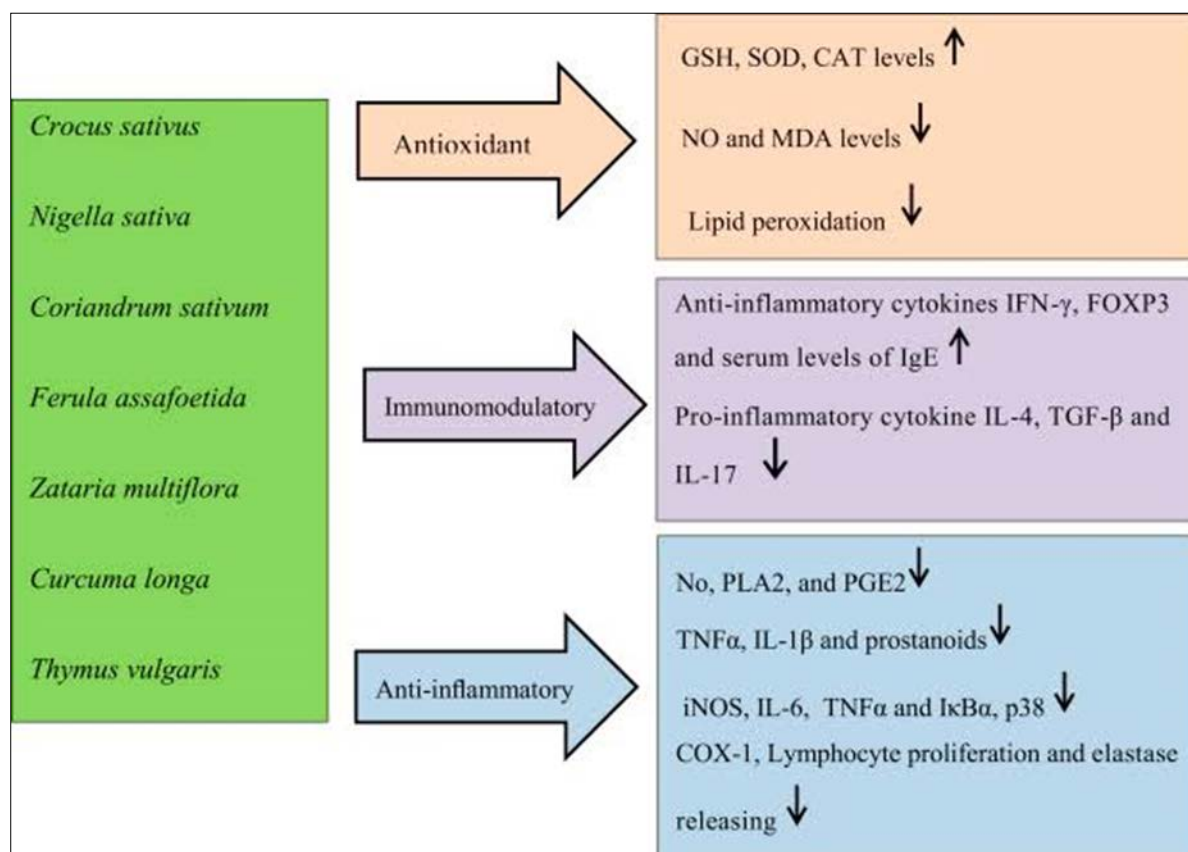


Fig 1: General mechanism of Nephroprotection

Pleiotropic mechanism of action of immunomodulatory drugs. IMiDs increase T-cell activation and T-cell clonal proliferation by co-stimulating CD4⁺ and CD8⁺ T cells by CD28 phosphorylation. In this mechanism the Anti-inflammatory cytokines IFN- γ , FOXP3 and serum level of IgE increases, Pro-inflammatory cytokine IL-4, TGF- β and IL-17 decreases and shows pharmacological actions. They

exert direct cytotoxicity by induction of apoptosis and inhibition of cell adhesion molecules.

Anti-inflammatory drugs produce their pharmacological actions through inhibition of cyclooxygenase (COX), the enzyme that makes prostaglandins (PGs). They all have the same adverse effects, including gastrointestinal toxicity, to a greater or lesser extent.

Table 1: List of Nephroprotective plants

Sr. No.	Name of plant and its family	Dose	Extract & Part of plant used	Mechanism	Chemical constituents	Reference
1	<i>Abelmoschus esculentus</i> Malvaceae	500 mg/kg	Alcoholic extract of Fruit, seed, Root	Okra pods succeeded in stimulating the histology of kidney like, diameter of the proximal tubule, percentage of necrotic cells, thickness of the epithelial proximal tubule, and ratio diameter of glomerular Bowman's capsule toward the normal.	Carotene, folic acid, thiamine riboflavin, tocopherol palmitic acid	11
2	<i>Abrus precatorious</i> Leguminosae	100 mg/kg	Methanolic extract of Roots, leaves	The methanol extract of <i>Abrus precatorious</i> plays an important role against gentamicin induced kidney damage by lowering levels of renal markers of oxidative stress, apoptosis and inflammation, enhancing enzymatic	Glucoside, Alkaloid,	12

				and non-enzymatic renal antioxidant system, alongside an increase in Bcl-2 and a decrease in NF-κB and (CRP) expressions.		
3	<i>Abutilon indicum</i> Malvaceae	250-500 mg/kg	Alcoholic extract of Root, bark	<i>Abutilon indicum</i> has potent Anti-inflammatory action that's why it has nephroprotective action.	Asparagines, Mucilage, Tannin, alkaloids	13
4	<i>Acacia arabica</i> Rubaceae	400 mg/kg	Methanolic extract of Leaves	<i>Acacia arabica</i> has antioxidant mechanism of action that's why it has nephroprotective activity	Tannin, Flavonoid	14
5	<i>Acacia catechu</i> Rubaceae	20-30 mg/kg	Aqueous extract of Bark	<i>Acacia catechu</i> has Anti-inflammatory, Chemoprotective and Antioxidant activity.	Flavonoid, Tannin	15
6	<i>Acacia sinuates</i> Rubaceae	200-400 mg/kg	Methanolic extract of Bark	<i>Acacia sinuate</i> has antioxidant effect and it is nephroprotective in action.	Saponin, Flavonoid, Tannin	16
7	<i>Achillea millefolium</i> Compositae	200-400 mg/kg	Methanolic extract of Whole plant	<i>Achillea millefolium</i> has antioxidant effect and it is nephroprotective in action.	Alkaloid, Essential oil	17
8	<i>Achyranthus uspera</i> Amaranthaceae	60 mg/kg	Hydroalcoholic extract of Root and bark	<i>Achyranthus uspera</i> has nephroprotective properties due to its antioxidant and anti-inflammatory activity and it shows activity against lead acetate induce nephrotoxicity.	Alkaloids, saponin, Tannin Oil	18
9	<i>Acorus calamus</i> Araceae	80 mg/kg	Methanolic extract of Aerial plant	<i>Acorus calamus</i> is antioxidant in mechanism	Asarone, calamine, calamenenol, calameone, pinene, camphene, cineole, camphor, caryophyllene, hydrocarbons, ester, heptylic acid	19
10	<i>Adiantum lunulatum</i> Polypodiaceae	300 mg/kg	Ethanollic extract of Leaves	<i>Adiantum lunulatum</i> has antioxidant action when ethanollic extract used.	Tannin, flavonoid, steroid, saponin, anthocyanin, coumarin, emodin, phlobatannins, alkaloids, phenols, terpenoids, anthraquinone, glycosides.	20
11	<i>Aerva javanica</i> Amaranthaceae	200-400 mg/kg	Ethanollic extract of Fresh roots	The nephroprotective activity of ethanollic extract of <i>Aerva javanica</i> revealed its promising hepatoprotective and antioxidant potential against chemically induced hepatic injury.	Isoquercetin, 5 methylmellein, 2hydroxy - 3-O-β primeveroside naphthalene-1,4dione, Apigenin7Oglucoronide and Kaempferol.	21
12	<i>Aerva lanata</i> Rutaceae	500mg/kg	Ethanollic extract of Whole plant	Alkaloids and flavonoids which were isolated from this plant may be responsible for its nephroprotective action.	Botulin, β-sitosterol, Amyrin, Hentriacontane, Campesterol, Stigma sterol, Kaempferol, Propionic acid, βcarboline-I, Aervoside and Aervolanine	22
13	<i>Alangium salvifolium</i> Alanglanceae	200-400 mg/kg	Ethanollic extract of Bulb	<i>Alangium salvifolium</i> has antioxidant action.	Alkaloids, glycosides, terpenoids, steroids and tannins	23
14	<i>Allium cepa</i> Liliaceae	100-400 mg/kg	Methanolic extract of Bulb	Nephroprotective activity of EEAC treatment was found compared with the standard group and control group against the toxic control group animals in parameters including serum creatinine, total protein, kidney weights, and body weight. The histopathological studies were also revealing the protective effect of EEAC.	Quercetin, lipid, kaempferol, fatty acid, cholesterol, allicin, diallyl disulfide, propyl disulfide.	24
15	<i>Amaranthus spinosus</i> Amaranthaceae	200-400 mg/kg	Ethanollic extract of Roots	<i>Amaranthus spinosus</i> has antioxidant action.	Diglycoside flavonoids hesperidin, rutin, phenolic acid-ferulic acid, amino acids namely tyrosine and arginine and sterols comprising spinasterol and spinasterol 3-O-β-D-glucopyranoside.	25
16	<i>Andrographis</i>	200	Herbal extract of	<i>Andrographis paniculate</i> has potent anti-	Squalene, polyprenol,	26

	<i>paniculata</i> Acanthaceae	mg/kg	Roots	inflammatory effect.	lutein, chlorophyll a, and a mixture of β -sitosterol	
17	<i>Angle marmelos</i> Rutaceae	100-200 mg/kg	Aqueous extract of Leaves	<i>Angle marmelos</i> has <i>In vitro</i> antioxidant and anti-inflammatory action	Aegelinol, marmesin, marmin, psoralen, scopoletin, umbelliferone, xanthotoxin	27
18	<i>Arachis hypogaea</i> L. Fabaceae	3 mg/kg	Extract of skin of the seed	<i>Arachis hypogaea</i> L. has a novel therapeutic potential in kidney tissues in male albino mice, against oxidative damages on CCl ₄ .	acids, arachin, lecithin protein, flavonoids, beta-carotene, amino acids, minerals, fat, carbohydrates	28
19	<i>Arctium lappa</i> L. Compositae	100-200 mg/kg	Aqueous extract of Roots, leaves and seeds	<i>Arctium lappa</i> has antioxidant effect and may be that is the reason why this plant has nephroprotective activity.	Flavonoid Hexa-saccharide, tannin volatile oil	29
20	<i>Asclepias syriaca</i> L. Asclepiadaceae	200-400 mg/kg	Organic extract of Whole plant, seeds	The nephroprotective action of <i>Asclepias syriaca</i> L. is due to its immunosuppressant effect.	Resinoids, alkaloids, cardiac glycoside.	30
21	<i>Bacopa monnieri</i> Scrophulariaceae	2400 mg/kg	Methanolic extract of Leaves	<i>Bacopa monnieri</i> has potent <i>In vitro</i> antioxidant activity.	Alkaloid brahmine, nicotine, herpestine, bacosides A and B, saponins A, B and C, triterpenoid saponins, stigmastanol, β -sitosterol, D-mannitol, betulinic acid, stigmasterol, α -alanine, aspartic acid, glutamic acid, serine, pseudo- jujubogenin glycoside	31
22	<i>Bambusa nutans</i> Arundinaceae	2-5.5 gm/day	Leaf extract	<i>Bambusa nutans</i> has antioxidant, anti-inflammatory, immunomodulatory and nephroprotective activities.	_____	32
23	<i>Barleria prionitis</i> Linn. Acanthaceae	100 mg/kg	Ethanol extract of Whole plant	<i>Barleria prionitis</i> has anti-inflammatory as well as the antioxidant effects and due to this <i>Barleria prionitis</i> possess nephroprotective effect.	Essential oil, Flavonoid Glycoside, β sitosterol	33
24	<i>Basella alba</i> Basellaceae	250-500 mg/kg	Ethanol extract of Leaves	<i>Basella alba</i> has antidiabetic, anti-inflammatory, antimicrobial, antioxidant, antiulcer, antiviral, CNS depressant, hepatoprotective effect.	proteins, fat, vitamin C, vitamin K, vitamin A, vitamin E, vitamin B9 (folic acid), riboflavin, niacin, thiamine and minerals such as calcium, magnesium, iron, betalain, basellasaponins, kaempferol.	34
25	<i>Boerhaavia Diffusa</i> Nyctaginaceae	200mg/kg	Alcoholic extract of Fresh Roots	The nephroprotective activity of <i>Boerhaavia Diffusa</i> is due to its antioxidant and anti-inflammatory activity	Flavonoids, Alkaloids, Steroids, Triterpenoids, Lipids, Lignins, carbohydrates, Proteins, Glycoproteins.	35
26	<i>Bombax ceiba</i> L. Bombacaceae	4-6 gm/day	Alcoholic extract of Fruit, stem, bark, root	<i>Bombax ceiba</i> L. is having antioxidant and anti-inflammatory action.	Lupiol, gallic acid, rutin, scopoletin	36
27	<i>Butea monosperma</i> Lam Fabaceae	300 mg/kg	Aqueous extract of Whole plant, flowers	<i>Butea monosperma</i> has antioxidant activity may be therefore it is nephroprotective with its action.	Glucoside Butine, proteolytic lipolytic enzyme, Flavonoid	37
28	<i>Cajanus cajan</i> Fabaceae	250 mg/kg	Methanolic extract of Leaves, seeds	<i>Cajanus cajan</i> has antioxidant effect.	Sesquiterpene α -himachalene, β -himachalene, γ -himachalene, α -humulene, α -copaene.	38
29	<i>Carica papaya</i> Caricaceae	8gm/kg	Aqueous extract of Seeds	The aqueous extract of <i>Carica papaya</i> seeds produces adequate nephroprotective activity by the reduction in the biochemical parameters and improvement of the kidney. This supported the traditional use of the title plant in renal disorders.	Flavonoids, Sterols, Terpenoids, Phenols, Alkaloids, Protein, Carbohydrates, Steroids, Tannins, Terpins, Glycosides, and Saponins.	39
30	<i>Cassia absus</i> Leguminosae	2000 mg/kg	Alcoholic extract of Seed, leaves	<i>Cassia absus</i> also has antioxidant activity.	Linoleic acid, palmitic acid, stearic acid, arachidic acid,	40

					fatty acid,	
31	<i>Clitoria terneata</i> L. Papilionaceae	200-400 mg/kg	Extract of Root, seeds, leaves	On evaluating biochemical parameters, it was found that methanolic extract of <i>Clitoria ternatea</i> 1000 mg/kg showed nephroprotective activity in rats.	Teraxeron, glucoside, oligosaccharide	41
32	<i>Commiphora mukul</i> Engl Burseraceae	250 mg/kg	Ethanol extract of Steam, bark, fruit	<i>Commiphora mukul</i> Engl has anti-inflammatory effect and may be due to that it possesses nephroprotective effect.	Guggulesterone, Flavonoid.	42
33	<i>Cordia dichotoma</i> Forst Boraginaceae	250-1000 mg/kg	Aqueous extract of Fruit pulp	<i>Cordia dichotoma</i> has anti-inflammatory effect and may be due to that it possesses nephroprotective activity.	Alkaloid, Tannin	43
34	<i>Crataeva nurvala</i> Capparaceae	60 ml/day	Alcoholic extract of Stem, bark	<i>Crataeva nurvala</i> has anti-inflammatory, antimycotic, antioxidant, antiurolithiatic effects	dodecanoic anhydride, methyl pentacosanoate, kaemferol-3-O- α -D-glucoside and quercitin-3-O- α -D-glucoside	44
35	<i>Crataeva Religoea</i> Buch,Ham Capparidaceae	200 mg/kg	Extract of Leaf, fruit	<i>Crataeva Religoea</i> Buch,Ham has anti-inflammatory effect.	Linalool, limonene, β -phellandrene, linalyl acetate, thymol, β -caryophyllene α -pinene borneol, citronellol	45
36	<i>Curculigo orchioides</i> Gaertn Amaryllidaceae	5-15 gm/kg	Alcoholic extract of Whole plant	<i>Curculigo orchioides</i> Gaertn has anti-inflammatory as well as the antioxidant effects and due to this <i>Barleria prionitis</i> possess nephroprotective effect.	Saponin, curculigo, phenolic glycoside	46
37	<i>Curcuma Longa</i> Linn. Zingiberaceae.	1.6 to 3.2 mg/kg	Rhizome	The nephroprotective activity of <i>curcuma longa</i> Linn is due to its Anti-inflammatory activity	Curcumin, Turmeric oil, Terpenoids, Curcumin (Terpene), Starch and Albuminoids.	47
38	<i>Cynodon dactylon</i> Pers Gramineae	500 mg/kg	Aqueous extract of Whole plant	<i>Cynodon dactylon</i> Pers has immunomodulatory effects and due to that it has nephroprotective effect.	β -ionone, 2-propionic 4hydroxybenzoic	48
39	<i>Cyperus rotundus</i> L Cyperaceae	250-500 mg/kg	Methanolic extract of Leaves	<i>Cyperus rotundus</i> L has antioxidant effects and due to that it possesses nephroprotective activity.	Essential oil, cyperene, cyperol, starch β -sitosterol	49
40	<i>Datura metel war</i> Solanaceae	25,50,75 mg/kg	Ethanol extract of Leave, flower	<i>Datura metel war</i> has anti-inflammatory effect.	pterodotriol B, disciferitriol, ilekudinoside C, and dioscoroside D, scopolamine, adenosine, thymidine.	50
41	<i>Digitalis purpurea</i> Scrophulariaceae	100 mg/kg	Alcoholic extract of Leaves	<i>Digitalis purpurea</i> has antioxidant activity.	primary and secondary glycosides, cardiac glycosides, volatile oil, fatty matter, starch, gum and sugars, cardioactive glycoside digoxin.	51
42	<i>Dioscorea lanata</i> Dioscoreaceae	150 mg/kg	Extract of Whole plant	<i>Digitalis lanata</i> has antioxidant activity.	Steroidal saponin glycosides: Dioscin and its aglycone is diosgenin, Hecogenin. Resin-Botagenin. Alkaloids, Sterol like Cholesterol, stigmasterol, P-sitosterol. And Enzyme like saponenase.	52
43	<i>Diospyros lotus</i> Ebenaceae	2.5-5 mg/kg	Lotus fruit extract of Seeds	Nephroprotective action of <i>Diospyros lotus</i> is because it has antioxidant activity.	Kaempferol, gallic acid, methylgallate, ellagic acid, quercetin, myricetin, myricetin 3-O-beta-glucuronide, and myricetin-3-O-alpha-rhamnoside.	53
44	<i>Dolichos biflorus</i> L Leguminosae	100 mg/kg	Aqueous extract of Seeds	These results provided evidence of the significant protective effect of <i>Dolichos biflorus</i> towards hyper-uricemic and nephrotoxicity and thus can be used as dietary food.	lectin carbohydrate, urease.	54
45	<i>Drynaria fortune.</i> Polypodiaceae	0-347 mg/kg	Whole plant	The nephroprotective activity of <i>Drynaria fortune</i> is because presence of	Arsenic, Ca ²⁺ , Cu ²⁺ , Glucose, Iron, Mg,	55

				phytochemicals	Mn, Hg, Naringin, K+, Na+, Starch and Zn.	
46	<i>Elephantopus scaber</i> Asteraceae	100-200 mg/kg	Methanolic extract of Leaves	The antioxidant and antihepatotoxic actions of methanolic extract of <i>Elephantopus scaber</i> root was probably due to scavenging activity of free radicle.	Sesquiterpene lactone, lupeol, elephantopin, stigmaterol, deoxyelephantopin, syringaresinol.	56
47	<i>Eruca sativa</i> Carssulaceae	250-500 mg/kg	Seeds	<i>Eruca sativa</i> seed possess antioxidant activity and exert a pharmacological effect on mercuric chloride induced renal toxicity	Flavonoids	57
48	<i>Euphorbia nerifolia</i> Euphorbiaceae	400 mg/kg	Leaf extract	<i>Euphorbia nerifolia</i> has antioxidant mechanism of action because of presence of flavonoids in it.	Saponins, Flavonoids and Tannins	58
49	<i>Ficus religiasal</i> Moraceae	200mg/kg	Alcoholic extract of Latex	<i>Ficus religiosa</i> 's chemical constituents include saponin gluanol acetate, tannins, β -sitosterol, leucoanthocyanin, leucoanthocyanidin which are used for the treatment of pain, inflammation, impotence, uterine tonic menstrual disturbances, and urine related problems.	Amino acids, Flavonoids, and Tannins.	59
50	<i>Ficus religiosa</i> L f-Moraceae	200 mg/kg	Ethanollic extract of Fruit	Nephroprotective effect against acute renal failure due to its antioxidant activity.	Arabinose, mannose, glucose β sitosterol D-glucoside	60

Conclusion

It is undeniable that medicinal plants play a significant role in the diagnosis of a variety of diseases. A variety of medicinal plants and plants extracts have been reported for its significant nephroprotective activity. The nephroprotective activity is probably due to the presence of Flavonoids in all the few medicinal plants. The results of this study indicate that extracts of leaves and other parts of the plants of some herbs having therapeutic characteristics have good potentials for use in kidney damage. The present review study gives evidential explore mechanism of action of medicinal plants against experimentally induced nephrotoxicity. Therefore, the review of the study says that the herbal drug possesses nephroprotective activity and it has been proven by different animal models which gives many ideas to develop the future trials. It is aimed to record medicinal folklore for curing nephrotoxicity that exists in current stage. Several herbs are suggested for minimising renal damage and avoiding kidney-related disorders in India's ayurvedic medicine system. These can have great value in combating kidney damage. In this paper, we have attempted to use our best endeavours of indigenous herbs to alternative medicine of kidney damage.

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