Review Article

Pluchea lanceolata – An Overview

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ABSTRACT

Traditional medicine is still the primary form of treating diseases of majority of people in developing countries. The increasing knowledge of metabolic process and the effect of plants on human physiology has emerged the range of application of medicinal plants. The plant *Pluchea lanceolata* (Rasna) (Oliver & Hiern) *Asteraceae* has been used traditionally in Indigenous system of medicine as an antipyretic, analgesic, bitter, laxative and nervine tonic. It is recommended for dyspepsia, rheumatoid arthritis and bronchitis. The plant contains different secondary metabolites viz. flavonoids, terpenoids, sterols, alkaloids, tannins, phenols, acids, oils, etc. Since these compounds are of pharmacological interest coupled with the use of this plant in traditional medicine prompted to review the work carried out on this plant. The present review covers the standardization parameters viz. macroscopic and microscopic characters, physicochemical analysis, phytochemical screening, chemical constituents and biological activities reported on the plant *Pluchea lanceolata*. The present review revealed that *Pluchea lanceolata* is an important source of many therapeutically and pharmacologically active constituents. The plant has been widely studied for its various chemical constituents and pharmacological activities and finds its position as a versatile plant having a wide spectrum of medicinal activities. This Knowledge will be the basis for development of new therapeutic approaches for diseases.

Keywords: Physicochemical, Phytochemical, Biological investigations.

INTRODUCTION

Medicinal plants have been a major source of treatment for human diseases since time immemorial. They are the richest biosource of drugs of traditional system of medicine, modern medicines, food supplements, folk medicines, pharmaceutical intermediates and chemical inteties for synthetic drugs. Plant products still remain the principle source of pharmaceutical agents used in traditional medicine. In recent years, there has been a great demand for plant derived products in developed countries. These products are increasingly being sought out as medicinal products, neutraceuticals and cosmetics. The increasing knowledge of metabolic process and the effect of plants on human physiology has enlarged the range of application of medicinal plants[1-3].

Pluchea lanceolata (D.C.) Oliver and Hiern belongs to the genus *Pluchea* (Family: *Asteraceae*). It is small shrub grows mainly in sandy and saline soil, found is hotter parts of India including Punjab, Rajasthan, Upper West Bengal, Uttar Pradesh and neighboring Asian countries together with North Africa. It is known locally as "Rasna", Gandhamula Rasya and Yuktarasa. Many controversies exist about the identification of Rasna but *Pluchea lanceolata* is the most widely accepted plant. The plant is used for the inflammation and bronchitis, psoriasis, cough and piles. It is also used as antipyretic, analgesic, dyspepsia, rheumatoid arthritis, bitter, laxative and nerve tonic. The decoction of the plant is used to prevent the swelling of joints in arthritis, rheumatism and neurological disorders. The roots are antipyretic, bitter, laxative and thermogenic, used for allaying and the pain caused by the sting of scorpions[4-8].

Rasna, *Pluchea lanceolata* is a natural cure for all problems of nervous system especially of the nerves. Rasna helps in the conditions like neuritis, sciatica and chronic inflammation of the nervous system. Because last part of the intestine is well controlled by the Vata so problems like constipation and flatulence which are associated with the last part of the intestine are well treated by rasna. Rasna works as a Rasayana and a drug of choice to delay process of aging. *Pluchea lanceolata* is used as digestive disturbances like flatulence, abdominal colic and indigestion. It is very useful in respiratory problems like asthma, bronchitis, pleuritis, chest pain. Being Vedana Sthapana and Vat pacifier, rasna is useful in rheumatoid arthritis and Vata disorbers. *Pluchea lanceolata* is useful in health problems related to female genital system like amenorrhoea, dysmenorrhoea, ring worm and eczema. In skin diseases, a paste of rasna roots prepared in cow's urine is applied. Its decoction is also used to wash the affected area. *Pluchea lanceolata* is anti-toxic and has the property of reducing "Kaf and Vat". For the treatment of rheumatism, it is given as Rasnaguggulam or Rasnapanckak orally and as Mahanarayan oil or Mahamesa oil externally. Anti-inflammatory activity in the crude extract of *Pluchea lanceolata* has been reported earlier[8-12].

In Ayurveda, the management of malaria considered as visham jwar, *Pluchea lanceolata* is a one of the ingredient of poly-herbal formulations has been used to treat jwar (fever) including. "visham jwar". According to Ayurvda,

herbs are taken in combination with other herbs to neutralize the toxicity of one herb with the opposing effect of the other or to enhance the particular effect of one herb with the help of other. *Pluchea lanceolata* is one of the ingredient of more than 80 poly-herbal formations[7, 13, 14].

PHYSICOCHEMICAL STUDIES

Medicinal plants have played a significant role in ancient traditional system of medicine. An impressive number of modern drugs have been isolated from natural sources. Plant derived substances has recently become a great interest owing to their versatile applications. According to the WHO, the first step for identification, purification and standardization of herbal drugs is the pharmacognostic (macroscopic and microscopic) and physicochemical studies which are essential for any phytopharmaceutical products used for standard formulation. Preliminary phytochemcial studies are helpful in finding out chemical constituents in the plant material that may well lead to their quantitative estimation. *Pluchea lanceolata* is one of the important medicinal plant having many therapeutic uses. It is therefore necessary to establish the quality control parameters for the leaf stem and roots of *Pluchea lanceolata* with various pharmacognostical and standardization techniques. It comprises of macroscopical and microscopical characters, physicochemical constants, extractive values with various solvents, fluorescence analysis, its reaction after treatment with chemical reagents under visible and in UV light, preliminary phytochemical screening of leaf, steam and root extracts following official compendia. The results help to establish the standardization of the drug[15-17].

Macroscopic Characters

The plant *Pluchea lanceolata* is an erect allelopathic, perennial under shrub growing up to 30-100 cm high. Stem is cylindrical, 2-3 mm in diameter. Outer surface is whitish green, having branched and branches are pubescent. Leaves are simple (0.8–1.3 × 3.1–4.7cm), alternate, sessile, oblong or lanceolate, apex with tiny point and round, base is narrow, margin is entire. Leathery and minutely velvety on both surface. Flowers are 3.5 mm in diameter, purplish in color, ovoid in shape, arranged in corymbs at the end of branches. Roots are about 3-20 mm in diameter, 10 to 20 inches in length, somewhat twisted and gradually tapering. The external surface is white when young while it is light to dark brown in mature one and the wood is brownish. External surface showed longitudinal rough striations, odour indistinct and fracture is short[17].

Microscopic Characters

Leaf

The transverse section passing through midrib of leaf of *Pluchea lanceolata* reveals its isobilateral nature that has upper and lower epidermis with thick circle, traversed with stomata. The leaf has both covering and granular trichomes; the covering trichomes were uniseriate, multicellular (2 - 5 cells of about 90 μm in size and lignified while the granular trichomes were sessile as well as stocked. The function of collenchymatous tissues, vascular bundles and parenchymatous bundle has also been studied. Further studies revealed that the transverse section of the leaf passing through lamia shows a row of small sized palishade under both upper and lower epidermis in continuation within midrib[18].

Stem

The transverse section of the stem of *Pluchea lanceolata* is almost circular in outline covered with thick circle. Epidermis consists of single layer of thick walled cells along with covering and granular trichomes. Covering trichomes are uniseriate, multicellular with two to many thick walled cells while granular ones are sessile as well as stalked. Collenchymatous hypodermis lies underneath the epidermis, followed by 5 - 7 layered parenchymatous cortex[18].

Root

The transverse section of the root of *Pluchea lanceolata* is almost circular in outline. Epiblema is single outer most layers made up of parenchymatous cells along with uniseriate multi cellular root hairs. Cortex is next to epiblema and consists of parenchymatous cells with sufficient intercellular spaces. The cells of cortex contain starch grains, oil cells and lignified cells. Cortex is followed by endodermis and pericycle. The presence of phloem, parenchyma, phloem fibers, xylem and parenchymatous has also been discussed[17].

Physicochemical Analysis

Air dried plant material of *Pluchea lanceolata* were used for quantitative determination of physicochemical values. Total ash, acid insoluble and water soluble ash of all *in vivo* (leaf, stem, root) and *in vitro* (callus) plant samples were determined following WHO/QCMMPM guidelines (1992) for five times and their mean ± SE were recorded. The total ash value was found to be maximum in stem and minimum is leaf. The extracts of all *in vivo* (leaf, stem, root) and *in vitro* (callus) plant samples were prepared with different organic solvents such as hexane, benzene, chloroform, ethylacetate, acetone, ethanol, methanol and water following WHO guidelines. The exhactives were determined five times and their mean ± SE was recorded. Water soluble extractive was found to be very high when compared to other extractives[17-20].

Fluorescence Analysis

The dried powdered *Pluchea lanceolata* plant samples (leaf, stem, root) was extracted with desired quantity of different organic solvents (hexane, benzene, chloroform, acetone, ethylacetate, ethanol and methanol) and after 24 hours fluorescence of each extractive was observed and recorded in both day and UV light. This analysis determines the constituents in the plant that gives a definite idea of the chemical nature[18, 21, 22].

It is thus concluded that the macroscopical and microscopical findings of the plant *Pluchea lanceolata* will lay down the standards which will be useful for detection of the identity and authenticity. The other parameters viz. ash value, extractive values and fluorescence analysis will help to its quality control and assurance for future studies.

PHYTOCHEMICAL STUDIES

Preliminary phytochemcial analysis was carried out in the petroleum ether, ethylacetate, ethanol and methanol extracts *in vivo* (leaf, stem, root) and *in vitro* (callus) plant samples of *Pluchea lanceolata*. The presence of different constituents viz. alkaloids, flavonoids, steroids, terpenoids, tannins, glycosides, saponins, proteins, carbohydrates, sterols and phenols were tested using standard procedures. The qualitative phytochemical screening of *in vivo* and *in vitro* plant part of *Pluchea lanceolata* revealed that the ethanolic and methanolic extracts of the plant was found better suited for maximum metabolitcs. Leaves part was found to be richer in metabolites as compared to others *in vivo* (stem and root) and *in vitro* (callus) plant parts. Based on the phytochemicals of interest, it is necessary to use appropriate solvent for extraction and isolation. Further, preliminary phytochemical screening revealed the presence of major bioactive compounds. The pharmacognostic profile and phytochemcial screening showed favorable effects for the standardization parameters of plant parts[20, 23, 24].

Phytochemical Constituents

The plant *Pluchea lanceolata* contains different secondary metabolites which have been isolated using various isolation procedures viz. successive extraction, column chromatography. thin layer chromatography, paper chromatography, gas liquid chromatography, GC-MS, HPTLC etc. Their structures were established by various physicochemical and spectroscopic methods. Various chemical constituents isolated from *Pluchea lanceolata* are listed in the Table- 1.

Table 1: Chemical constituents isolated from *Pluchea lanceolata*

Chemical compounds	Plant parts	References
Pluchine	Flowers, whole plant	25, 26
Quercetin,	Aerial parts	25, 27-33
Quercitrin	Leaves	25, 32
Isorhamnetin	Leaves	25, 27, 28, 34
Hesperidin	Weeds	35
Taxifolin-3-arabinoside	Weeds	35
Formononetin-7-O-glucoside	Weeds, roots	36, 37
Diadzein	Stems	38
5,7-dihydroxy-8-isobutylflavone	Aerial parts	17
β-Sitosterol	Aerial parts	10
β-Sitosterol glucoside	Aerial parts	10, 25
β-Amryrin	Aerial parts	10
β-Amyrin acetate	Aerial parts	10
α-Amyrin	Aerial parts	39
β-Amyrin caproate	Aerial parts	39
ψ-Taraxasterol acetate	Aerial parts	10, 40
Taraxasterol acetate	Aerial parts	40
Stigmasterol acetate	Flowers	25
Stigmasterol	Flowers	25, 39
Sorghumol	Roots	14, 29, 41
Sorghumol acetate	Roots	14, 29, 41
Boehmerol	Roots	29
Moretenol	Flowers, leaves	25, 41
Moretenol acetate	Flowers	25, 30, 41
Neolupenol	Flowers, leaves	25, 30, 41
Neolupeol	Aerial parts	30, 41
Pluchoic acid	—	34
Phenol, Ascorbic acid	Aerial parts	42
Phloroglucinol, Chlorogenic acid, Methylated coumarins	Roots	37
Indole alkaloids	Leaves	43
n-Tridecanyl-n-octadecanoate, n-Nonadecanol	Aerial parts	17
Pleuchioside, Monoacetylpleuchioside, 3-Oxo-pleuchioside, Pleuchiol, Monoacetyl pleuchiol, 3-Oxo-pleuchiol	Leaves	44- 46
Nonacosane, Heptacosane, Hentriacontane,	Flowers	25

Octacosane		
Plucheaursenyl acetate, Plucheasesquiterpenyl ester, Pluchealactone, Plucheasesterpenyl ester, Plucheasequiterpenyl hexa-decanoate	Aerial parts	31
Two aliphatic hydrocarbons	Aerial parts	47
Monoterpene ester [4-Isopropyl-cyclohex-1-en-7-(2'-ox)-2'-methyl butyl) oate], Pluchea chromenone [2, 2-Dimethyl-7-acetyl-8-hydroxychromenone], Plucheasterolide [Ergost, 5, 22-diene-3β-ol-20, 28-olide]	Roots	48
Six Compounds (**1-6**): 14, 15-Seco-urs-18 β-H-20(30)-en-3β-yl acetate (**1**), 4, 8-Dimethyldodeca-7 Z-en-y-1-9'α, 10'α-dihydroxy undecan-1'-oate(**2**), α-Dotriconta-29, 32-olide (**3**),4'α-(2"-Ketotutylcyclohexyl)-20α-eincoson-14αl-α-1-oic acid (**4**), 5,9,13,17-Tetramethyl-18-en-8α-ol nonadicanoic acid octanyl ester (**5**), 3, 7, 11-Trimethyldodeca-10-en-yl-n-hexa-decan-9'α-ol-1-oate (**6**)	Aerial parts	31
47 Compounds representing various functional groups like COOH, OH, R-O-R,CO-, alkanes, alkenes and oxygen atom varied from 1-7-, nitrogen and fluorine (GC-MS/HPTLC)	Stem powder, callus	38
58 Compounds by GC-MS., out of which nine were major viz. Linalool, β-Caryphyllene, α-Terpineol, Spathulenol, Linalylacetate, Naphthalene-1,6-dimethyl-4-(1-methhyl ethyl), α-Copaene, Epicubebol and Trans-α-bergamontene	Aerial parts	49

BIOLOGICAL STUDIES

Recently much attention has directed towards extracts and biologically active compounds isolated from popular plant sources. In the discovery of newer drug, molecules, many plant products are evaluated on the basis of their traditional uses. The curative properties of medicinal plants are mainly due to the presence of various complex chemical substances of different compositions which occur as secondary metabolites[20, 50].

The plant *Pluchea lanceolata* contains different secondary metabolites viz. flavonoids, terpenoids, sterols, taraxasterols, alkaloids, phenols etc. (see Table-1). Since these compounds and extractives of hexane, benzene, chloroform, acetone, ethylacetate, ethanol, methanol and water, obtained from *Pluchea lanceolata*, are of pharmacological interest coupled with the use of this plant in traditional medicine prompted the research scientists to check *in vitro* and *in vivo* plant parts of *Pluchea lanceolata* for different activities.

Anti-inflammatory and anti-arthritic activities

Arthritis means joint inflammation, is chronic progressive and disabling auto-immune disease. It can progress very rapidly causing swelling and damaging cartilage and bone around the joints. It is systemic disease which can affect the hands, feet, wrists, shoulders, knees, spine, lips and internal organs such as the lungs, heart, eyes and other parts of the body. Arthritis can cause any part of the body to be inflamed creating severe disability which affects a person's ability to carryout every day works. There are mainly two types of arthritis i.e. oesteoarthritis and rheumatoid arthritis. Rheumatoid arthritis is an auto-immune disease that occurs when the body's own immune system mistakenly attacks the synovium (cell living inside the joints) which causes joint pain, stiffnes, swelling and loss of joint function. Oesteoarthritis is degenerative joint disease resulting from the wear and tear from day to day life, which leads to pain, tenderness, swelling and decreased function of joints. The nature has a remedy for these conditions and there are a number of herbs that synergistically to reduce chronic joint inflammation such as oesteoarthritis and rheumatoid arthritis. Various extractives viz, hexane, ethylacetate, ethanol, methanol, n-butanol, water and isolated chemical compounds viz. taraxasterol, taraxasterol acetate, psi-taraxasterol, querecetin, quercitrin, isorhamnetin, neolupenol, neolupeol, sorghumol, sorghumol acetate, boehmerol acetate, moretenol, moretenol acetate and other constituents from *Pluchea lanceolata*, were studied for anti-inflammatory and anti-arthritic activities[51-54].

The ethanolic extract of the aerial part of *Pluchea lanceolata* exhibited significant anti-inflammatory activity. The ethanolic extract was further fractionated into hexane, chloroform, n-butanol and water fractions. These fractions were screened for anti-inflammatory activity within the acute carrageenin induced oedema

test on mice and rats. The highest activity was found with the hexane extract from which psi-taraxasterol acetate was isolated as one of the active constituent[10].

Neolupenol, a pentacyclic triterpene isolated from *Pluchea lanceolata* flowers was studied to determine its anti-inflammatory activity against carrageenin induced rat-paw oedema. The degree of oedema inhibition was found to increase with dose as well as time interval and was found to be maximum at 300 min. Neolupenol when administered at 100 mg/kg p.o. was found to exhibit 70% oedema inhibition which was greater than that of reference compound ibuprofen (50 mg/kg. p.o., 65% inhibition and 300 min)[30].

The terpene sorghumol, sorghumol acetate, boehmerol acetate, moretenol, moretenol acetate, neolupenol, neolupeol and psi-taraxasterol acetate isolated from *Pluchea lanceolata* were subjected for anti-inflammatory testing which exhibited significant anti-inflammatory and anti-arthritic activities in carrageenin induced paw-oedema model in albino rats at 50 mg/kg p.o. dose level[14,53,55].

Pluchea lanceolata has been used in massage oil in traditional system of medicine. The plant *Pluchea lanceolata* is extracted with different organic solvents viz. methanol, ethanol, petroleum ether and chloroform. The different extracts obtained are then boiled separately with oil, till the solvent is completely evaporated. The oil obtained from these solvent extracts was checked for its anti-inflammatory activity with carrageenin induced rat-paw oedema. The prepared oil was compared with the marketed sample of mahanarayan oil. The ethanolic oil extract has shown to be having highly active anti – inflammatory agent[56].

The anti-inflammatory activity was carried out by HRBC (Human Red Blood Cell) membrane stabilization method and anti-arthritic activity by the inhibition of protein denaturation method. The methanolic extract of all plant parts exhibited notable anti-inflammatory activity and remarkable anti-arthritic action. The membrane stabilization was found to be maximum in leaves (86.8% at dose of 1000 μg/ml) and that of protein denaturation was also found to be maximum in leaves (70.85% at a dose of 1000 μg/ml) as compared to other *in vivo* (stem and root) and *in vitro* (callus) plant parts. The study supported the isolation and use of active constituents from *in vivo* and *in vitro* plant parts of *Pluchea lanceolata* in treating inflammations and rheumatism. The effect of *Pluchea lanceolata* extracts on gynaecological disorders was also studied and found that the extracts exhibited significant uterine relaxant activity[57,58].

Neurological Activity

Cholinesterase inhibitory activity of the essential oil of *Pluchea lanceolata* was evaluated using mouse brain homogenate. The major components of essential oil were linalool, β-coryophylline, α-terpeneol, spathulenol, linalylacetate, naphthalene-1, 6-dimethyl-4-(1-methyl ethyl-), α-copaene, epi-cubebol and trans-α-bergamontene identified (GC-MS). The experimental results showed that hydrodistilate of *Pluchea lanceolata* significantly inhibited anti-cholinesterase activity as compared to reference compound physostigmene. The study supported the use of *Pluchea lanceolata* for the management of neurodegenerative ailments like Dimentia and Alzeimer's disease[49].

It has been investigated that the effect of major pentacyclic triterpene and its naturally occurring acetate derivative isolated from *Pluchea lanceolata* as lipopolysaccharide (LPS) stimulated neuro-inflammatory condition associated to inflammatory cytokine production in rat astrocytoma cell line. The log concentration dependence of *Pluchea lanceolata*, taraxasterol significantly ($p < 0.05$) attenuates the release of pro-inflammatory cytokines, which *in situ* produced acetyl derivative, taxaxasterol acetate, did not inhibit the LPS induced IL-6 production at lower concentration ($p < 0.05$). The Surface-Dock molecular modeling study was also conducted to stimulate the binding capacity of compounds into the active site of the cytokines and proteins. The differential inhibition of cytokines by taraxasterol and taraxasterol acetate was further confirmed by high docking scores showing the hight afinity to target proteins. The findings thus supported the comparatively greater role of *Pluchea lanceolata* triterpene than its *in situ* produced acetate derivative in neuro-inflammation associated disorders[59].

Antimalerial Activity

The antimalerial activity of methanol, ethanol, ethylacetate, chloroform and hexane extracts of *Pluchea lanceolata* together with taraxasterol acetate isolated from hexane extract were tested. Hexane extract and taraxasterol acetate exhibited promising antimalerial activity *in vitro* and *in vivo* condition. Taraxasterol acetate attributed in inhibition of the pro-inflammatory cytokines as well as afford to significant increase in the blood glucose and haemoglobin level when compared with vehicle treated infected mice. *In vitro* and *in vivo* safety evolution study revealed that hexane extract is non-toxic at higher concentration. The study thus validated the ancient Indian traditional use of *Pluchea lanceolata* as an antimalerial agent[12].

Anti-asthamatic activity

The anti-asthamatic potential of ethylacetate fraction was evaluated by *in vitro* animal model in isolated guinea pig tracheal chain preparation. The study was carried out using dose 100 μg/ml of ethylacetate fraction that showed significant relaxant action against histamine induced contraction. The ethylacetate fraction showed significant anti-asthamatic activity of 57.81 ± 1.22 at the dose of 100 μg/ml and can be used for its ant-asthamatic properties[60].

Immunosuppressive effect

The immunosuppressive properties of *Pluchea lanceolata* were studied. The alcoholic extract of *Pluchea lanceolata* leaves inhibited the humoral antibody response and cell mediated immune responses. Flow cytometric studies also revealed the down regulation of pro-inflammatory cytokines and this is suggestive of its possible therapeutic usefulness in treatment of the inflammatory states of the body and autoimmune disorders like arthritis. However, the clinical margin of safety in long term therapeutics has to be established along with its biopharmaceutical evaluation for further therapeutic considerations[61].

Immunostimulating effect

The effect of hydroalcoholic extract of whole plant powder of *Pluchea lanceolata* was explored on the respiratory burst in human Polymorphonuclear Neutrophils (PMN) as compared to known stimulant Phorbol-12-myristate, 13-acetate (PMA). Prior to the *in vivo* tests, the bioactivity of the PMN was assessed using the Trypan blue dye exclusion test. The formation of various Reactive Oxygen Species (ROS) was measured performing *in vitro* assays viz. Phagocytosis of *Candida albicans*, Nitro Blue Tetrazolium (NBT) assay and Nitric Oxide (NO) assay. The studied concentration of hydroalcoholic extract of whole plant powder of *Pluchea lanceolata* were 50, 100, 200, 400 mg/ml. An increase in the respiratory burst at all the studied concentrations was observed in all the assays indicating its immunostimulating effect[62].

Antibiotic activity

The aqueous ethanol extract of *Pluchea lanceolata* was evaluated for anti-bacterial activity against medically important bacteria, *S. aureus, E. coli, K. pneumoniac and P. aeruginosa.* The *in vivo* anti-bacterial activity was performed by agar disc diffusion and agar well diffusion method. The anti-bacterial activity of the aqueous ethanolic extract of *Pluchea lanceolata* was compared with standard antibiotics. The results signify that the extract possess more growth inhibitory activity than the standard antibiotics against all the tested organisms[63].

It was further studied for the microbial activity of *Pluchea lanceolata* extract against multidrug resistant *Vibrio cholerae*. Three *V. cholerae* stains were isolated from the collected water from local area. The growth pattern of *V. cholerae* stains were observed on TCBC agar and 3%, 5% and 8% salt concentration. The multidrug resistance activities of these stains were examined by different antibiotics viz. kanamycin, gentamicin, ampicillin, sefixine, streptomycin and oxacilline. The methanolic extract of the leafs of *Pluchea lanceolata*, containing secondary metabolites inhibited the growth of isolated stains of *V. cholerae* at all concentrations (100%, 50%, 25% and 12.5%) and zone of diameter increased with the increase of concentrations. It is thus concluded that the extract of *Pluchea lanceolata* is a potent antibacterial drug in the treatment of *V. cholerae* It is non-toxic *in vivo* studies[64].

Renal carcinogensis and chemotherapy induced emesis

Ferric nitriloacetate (Fe-NTA) is a well established renal carcinogen. *Pluchea lanceolata* attenuates Fe-TNA induced renal oxidative stress, hyperproliferative resporse and renal carcinogenesis in rats. Oral treatment of rats was thus carried out with *Pluchea lanceolata* extract (100 and 200 mg/kg body weight) which resulted in significant decrease in lipid peroxidation, xanthene oxidase, hydrogen per oxide generation, blood urea nitrogen, serum creatinine, renal ODC activity, DNA synthesis ($p < 0.001$) and incidence of tumors. Renal glutatheonse content ($p < 0.001$) its metabolizing enzymes ($p < 0.001$) and antioxidant enzymes ($p < 0.001$) were also recovered to significant level ($p < 0.001$). Thus the study supported *Pluchea lanceolata* as a potential chemopreventive agent and suppresses Fe-TNA-induced renal carcinogenesis and oxidative damage response in wistar rats[65].

Cisplatin is an effective chemotherapeutic against a wide range of cancers but causes significantly nausea and vomiting. The effects of methanolic root extract of *Pluchea lanceolata* was investigated against cisplatin induced nausea using a rat pica. In rat pica model, rats react to cisplatin (emetic/nausea stimuli) with altered feeding habits manifested by increased consumption of kaolin. The pica in rats was measured to quantify cisplatin induced nausea and to evaluate the protective effect of pretreatment with methanolic *Pluchea lanceolata* extract given orally. Cisplatin at 3 mg/kg (i.p.) induced significant pica indicated by reduced food intake and increased kaolin consumption, suggesting the presence of nausea/emesis. Cisplatin-induced pica decreased significantly when animals were pretreated with methanolic extract of *Pluchea lanceolata* at dose of 400 mg/kg p.o. ($p < 0.05$). *Pluchea lanceolata* methanolic extract pretreatment decreased cisplatin-induced kaolin intake in the rat model of stimulated nausea suggesting that *Pluchea lanceolata* methanolic extract and/or its active constituents may play a therapeutic role as protective against chemotherapy-induced emesis[66].

Cadmium chloride induced oxidative stress and genotoxicity

Cadmium intoxication induces lipid peroxidation and causes oxidative damage to various tissues by altering antitoxidant defence system enzymes. Oral pretreatment with *Pluchea lanceolata* extract at doses of 100 and 200 mg/kg for consecutive days before cadmium chloride intoxication caused a significant reduction in malanoaldehyde formation and xanthine oxidase activity ($p < 0.001$). A significant restoration of the activity of antioxidant defence system enzymes was obtained. A significant dose-dependent decrease in chromosomal aberrations and micro nuclii formation has also observed ($p < 0.05$). The study indicated that pretreatment with *Pluchea lanceolata* attenuates cadmium chloride induced oxidative stress and genotoxicity by altering antioxidant

enzymes and reducing chromatid breaks and micronuclii formation[67].

Antioxidant activity

The antioxidant activity of methanolic and aqueous root extracts of *Pluchea lanceolata* was determined by 2,2-Diphenyl-1-picryl-hydrazyl hydrate (DPPH) free radical scavenging assay and hydrogen peroxide scavenging activity. The extract revealed marked activity as a radical scavenger concentration of 0.1 mg/ml of methanolic and aqueous extracts, exhibited significant inhibition of hydrogen peroxide when compared with control (0.1 mg/ml) using ascorbic acid as standard. The extracts are thus a potential source of antioxidants a natural origin and may be a tool for treating pathologies related to free radical scavenging due to its overall antioxidant effect in scavenging free radicals and acute oxygen species[40].

The antioxidant activity of phenols and ascorbic acid contents *in vivo* (leaf, stem, roots) and *in vitro* (callus) plant parts of *Pluchea lanceolata* was analyzed in terms of DPPH radical scavenging assay. An excellent DPPH radical scavenging activity was found in total phenols, ascorbic acid and in all extracts of plant. These primary findings showed that *Pluchea lanceolata* possesses higher levels of phenolic and ascorbic acid constituents that are responsible for antioxidant activity[42].

Benzo(a)pyrene administration leads to depletion of renal glutathione and its metabolising enzymes. Pretreatment with *Pluchea lanceolata* (100 and 200 mg/kg wt) restored renal glutathione content and its dependent enzymes significantly ($p < 0.001$) with simultaneous increase in catalase, quinone reductase in mouse kidney. Prophylactic administration of *Pluchea lanceolata* prior to benzo(a)pyrene administration significantly decreased the malonodialdehyde, hydrogen peroxide and xanthineoxidase levels of a significance of $p < 0.001$. *Pluchea lanceolata* extract pretreated groups showed marked inhibition in benzo(a)pyrene induced micronuclii formation in mouse bone narrow cells with simultaneous restoration of DNA integrity. The findings thus strongly supported the antioxidant efficacy of *Pluchea lanceolata* possively by modulation of antioxidant armory[68].

CONCLUSION

The present review represents physicochemical, phytochemical and biological studies carried out on the plant *Pluchea lanceolata.* The macroscopical and microscopical findings and fluorescence analysis will lay down the standards which will be useful for the detection of the identity and authenticity. The phytochemical screening described the presence of a large number of phytochemicals and it will be useful for further studies. The biological activity of the plant gives an idea about the current status of the plant research. The generated information of the present study will provide a significant scope to develop a broad spectrum use of *Pluchea lanceolata* in herbal medicine and as a base for the development of novel potent drugs and phytomedicine.

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