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REVIEW ARTICLE

Therapeutic Potential of *Ipomoea reniformis*: Pharmacological Applications and Major Bioactive Constituents

Mehul Bhatt[1] and Divyang Patel[2*]

[1]School of Pharmacy, Indrashil University, Rajpur, Kadi - 82740, Gujarat, India; mkb_0999@yahoo.co.in

[2]Institute of Pharmaceutical Sciences, Faculty of Pharmacy, Parul University, Limda, Waghodia - 391760, Vadodara, Gujarat, India

Abstract

The present review explores the therapeutic potential of *Ipomoea reniformis*, a perennial herb widely used in traditional medicine across India for treating various ailments. The study compiles information on its phytochemical constituents, pharmacognostic characteristics, and extensive pharmacological activities. Methods include microscopic examination of plant parts, phytochemical screening, Gas Chromatography-Mass Spectrometry (GC-MS) analysis, and evaluation of biological activities through *in vitro* and *in vivo* models. Microscopic analysis revealed characteristic anatomical features in the leaf, stem, and root tissues. Phytochemical investigations identified bioactive compounds such as iridoids (gardenoside), coumarins (scopoletin), and various fatty acids, sterols, and phenolic acids via GC-MS profiling.

Major Findings: A variety of pharmacological actions, such as antioxidant, hepatoprotective, anticonvulsant, antidiabetic, and anticancer effects, are demonstrated by *I. reniformis.* Its therapeutic potential across metabolic, hepatic, neurological, and oncological disorders was supported by the significant free radical scavenging, α-amylase inhibition, and GABA modulation demonstrated by methanolic extracts.

Keywords: Antioxidant Activity, Anticonvulsant, Hepatoprotective, *Ipomoea reniformis*, Phytochemicals, Traditional Medicine

1. Introduction

Herbal remedies, which are made from plant components, are the cornerstone of conventional medical systems and are still essential to contemporary treatment. Almost one-third of the best-selling medications worldwide are made from natural ingredients and their derivatives. Traditional medicine remains a vital aspect of India's healthcare system, particularly in rural and tribal areas, where generations of indigenous knowledge have guided the use of medicinal herbs.

The *Convolvulaceae* family includes the creeping herb *I. reniformis* (syn. *Merremia emarginata*), which is found across India, particularly in grassy and damp areas. It has historically been used to treat a wide variety of illnesses, such as epilepsy, neuralgia, fever, cough, inflammation, and renal diseases. Comprehensive scientific information on its pharmacological effectiveness and bioactive ingredients is still scarce, despite its extensive use.

Ipomoea reniformis has a wide range of ethnomedicinal applications, but little is known about its phytochemical and pharmacological makeup. Numerous bioactive components, including flavonoids, alkaloids, glycosides, tannins, saponins, and coumarins, including scopoletin and gardenoside compounds linked to significant medicinal benefits, have been found in preliminary investigations.

*Author for correspondence

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This review combines current phytochemical and pharmacological research on *I. reniformis* with ethnobotanical knowledge. It emphasises important bioactive substances, like gardenoside and scopoletin, and assesses their biological activity, such as their anticancer, hepatoprotective, antidiabetic, antioxidant, and neuroprotective benefits. The purpose of this synthesis is to encourage more investigation into *I. reniformis* as a possible source of new medicinal compounds[1].

Ipomea reniformis 1) Name in Hindi: *Chuhakanni Musakani* 2) Name in Bengali: *Indurakani* 3) *Undarakani* is the Gujarati name. 4) *Ilikivi Gida* is the Kannada name. 5) *Undirkani* in Marathi 6) *Elichhevi* in Malayalam 7) *Elikatu Keerayi* in Tamil 8) Name in Telugu: *Ellika Jemudu* 9) Name in Urdu: *Chukakani, Merremia emarginata*, sometimes known as *Ipomea reniformis,* is a botanical name[1].

1) Plantae, or the kingdom of plants 2) Subkingdom: Vascular plants (*Tracheobionta*) 3) Superdivision: Seed plants, or *Spermatophyta* 4) Division: Flowering plants (*Magnoliophyta*) Class: *Dicotyledons* (*Magnoliopsida*) 6) *Solanales* is the order 7) *Morning-glory* family: *Convolvulaceae* 8) *Ipomoea* is the genus 9) Species: *reniformis*; medicinally useful parts entire plant, including the stem, root tuber, leaves, fruit, and flowers[1].

Salvinia cuscullata, also known as *Ipomoea reniformis* (*Convolvulaceae*), is a creeping shrub that roots at nodes (Figure 1). The kidney-shaped to ovate-cordate leaves are up to 1.9 cm long, toothed, and broader than long. The yellow, axillary flowers have hairy sepals—the plant blooms throughout the colder months and during the rainy season[2].



Figure 1. Twig of *I. reniformis* choisy[2].

2. Materials and Methods

2.1 Cultivation and Collection

A perennial, much-branched herb, found in damp places in the upper Gangetic plain, mainly grows in grassy areas. It is adulterated with *Centella asiatica*. It's mainly weed. It requires full sun exposure or sun to partial shade. This plant is attractive to bees, butterflies and / birds. It requires average water, suitable for growing in containers.

2.2 Propagation Methods

Plants can be propagated through various methods, including herbaceous stem cuttings, where healthy stem sections are placed in moist soil or water to encourage root development. Seeds can be started indoors before the last frost by sowing them in a controlled environment to ensure optimal germination. Another effective method is germinating seeds in a damp paper towel, which maintains consistent moisture and warmth, promoting faster sprouting. Additionally, seeds can be germinated *in vitro* using gelatin, agar, or other sterile media, offering precise control over growth conditions.

2.3 Seed Collection and Storage

To collect seeds, allow the pods to dry naturally on the plant before breaking them open to retrieve the seeds. Properly cleaned seeds, free from debris and moisture, can be successfully stored in a cool, dry place in airtight containers to maintain their viability for future use (Figure 2).

2.1 Pharmacognostic Study

2.1.1 T.S. of Leaf

The upper and bottom epidermis of the dorsiventral leaf lamina is single-layered and thinly cuticled. There are no trichomes and anomocytic stomata in both epidermal layers. The mesophyll is divided into a single layer of palisade cells and 3-4 layers of spongy parenchyma, some of which contain calcium

oxalate crystals. Three to four layers of thick-walled parenchyma make up the biconvex form of the midrib, which has collenchyma beneath the epidermis on both sides. The vascular bundle is bowl-shaped with lignified xylem and phloem, and some starch granules are present[3] (Figure 3).

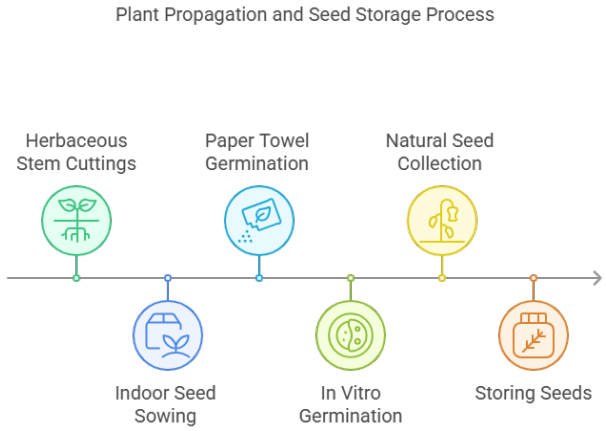


Figure 2. Plant propagation and seed storage process[2].

2.1.2 T.S. of Stem

The structure was cylindrical with a cortex comprised of 4-5 layers of polygonal lignified parenchyma and collenchyma cells. The epidermis was single-layered with quadrangular, thick-walled cells, covered by a cuticle, and included anomocytic stomata. The vascular bundles, which numbered roughly seven to eight, were open, collateral, and ring-shaped. They had phloem and xylem with sieve tubes that were fully developed. On the upper side of the vascular bundle, there were green-colored lignified pericyclic fibres. The big pit was made up of polygonal parenchymatous cells with narrow walls. Clusters of two to three lignified cells made up the fibres[3] (Figure 4).

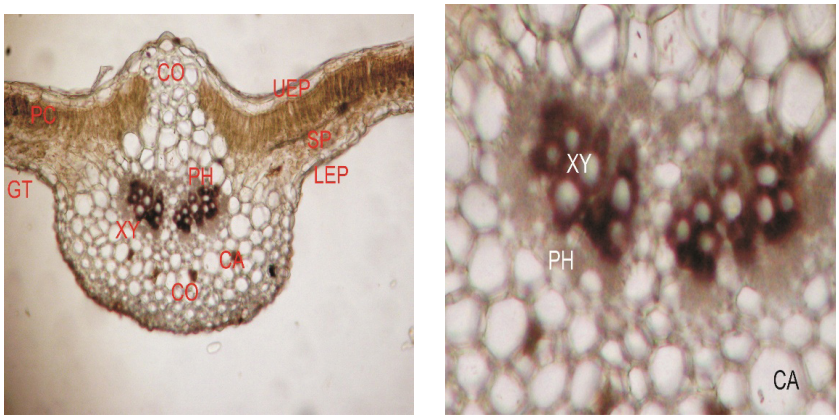


Figure 3. Microscopy of leaf[3].

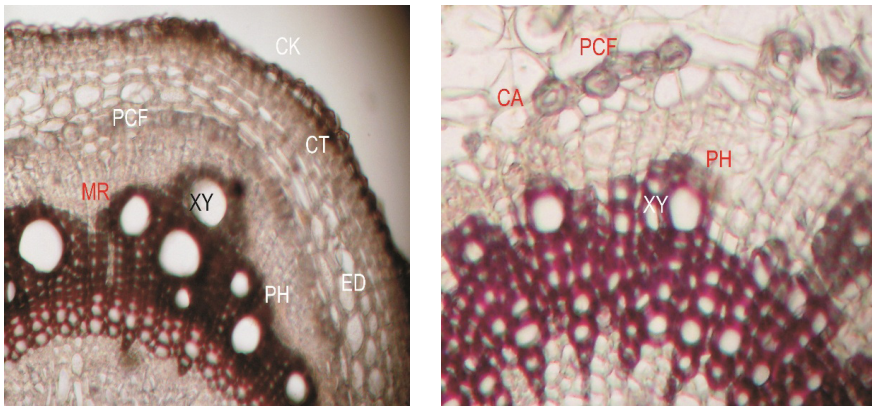


Figure 4. Microscopy of stem[3].

2.1.3 T.S. of Root

The T.S. of the root showed the presence of cork, endodermis, a distinct layer that separates the cortical region from vascular bundles. It consists of xylem and phloem. Presence of uni- uniseriate medullary rays in continuation with the xylem. Numerous dark resin canals traversed throughout the cortex, and prismatic and cluster crystals of calcium oxalate traversed throughout the parenchymatous tissue. Pith is present[4] (Figure 5).

Chemical component: analysis of the plant's phytochemistry has demonstrated the presence of reducing sugars, resin, glycosides, starch, and esters of caffeic, p-coumaric, ferulic, and sinapic acids[4] (Figure 6).

2.2 Phytochemical Analysis

The iridoid gardenoside was originally identified from an *Ipomoea* species, specifically *Ipomoea reniformis* (*Convolvulaceae*), in addition to a known coumarin derivative, Scopoletin (Figure 7). Its spectroscopic information was used to determine its structure[4].

2.3 GC-MS Analysis of Ethyl Acetate Extract of *Ipomoea reniformis*

The GC-MS analysis of *Merremia emerginata*, a natural medicinal plant that has long been used to treat conditions like fever, headache, neuralgia, rheumatism, diuretic problems, inflammation, and nasal diseases, is the focus of this work. According to

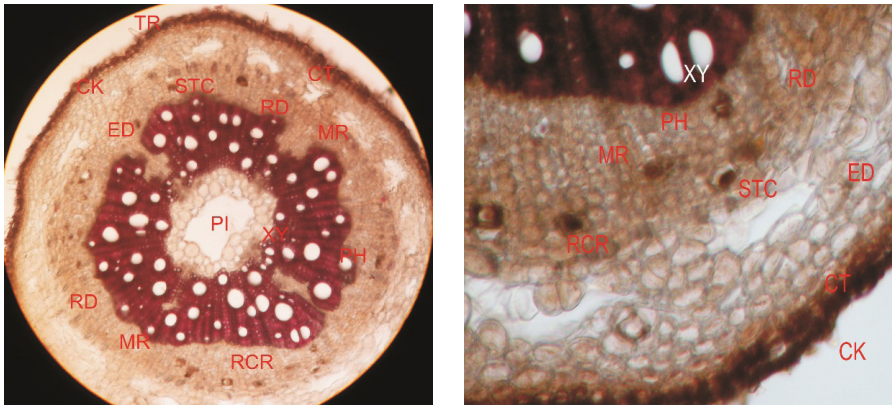


Figure 5. Microscopy of root[4].

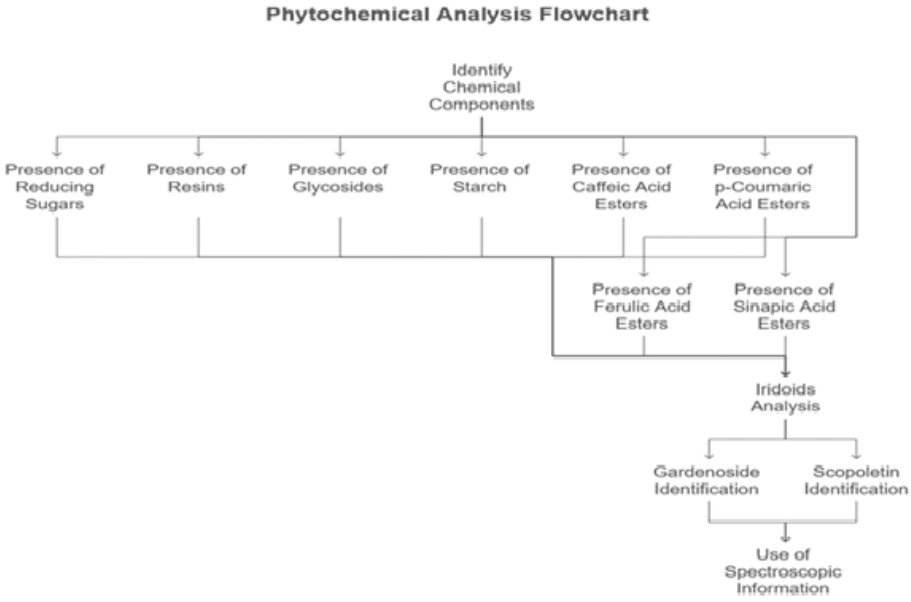


Figure 6. Phytochemical analysis flowchart[4].

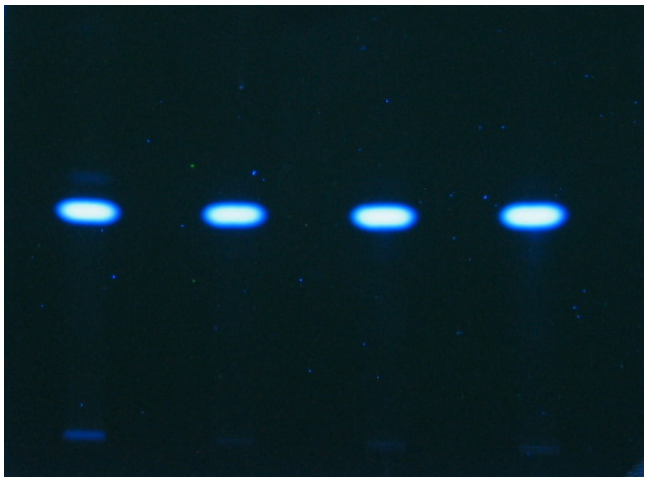


Figure 7. TLC of Scopoletin present in *I. reniformis*[5].

conventional procedure, the plant was gathered from Chengalpattu, Tamil Nadu, India, and its entire ethyl acetate extract was made and subjected to GC-MS analysis. Methyl 4-O-methyl-β-D-xylopyranoside, D-Mannitol, Caryophyllene oxide, 11-Dodecenoic acid, 10-hydroxy-, methyl ester, Octadecanoic acid, Phytol, 9,12,15-Octadecatrienoic acid, Octadecanoic acid, Methyl stearidonate, Eicosanoic acid, Gamma-linolenic acid, Docosanoic acid, β-Tocopherol, O-methyl, Stigmasterol, β-Sitosterol, dl-α-Tocopherol, p-Coumaric acid, and 1-Heptatriacotanol were among the bioactive compounds found in the analysis. These substances support the plant's efficacy in treating the aforementioned conditions by exhibiting pharmacological characteristics consistent with its traditional applications[6].

3. Traditional Medicinal Uses

Ethnobotanical Use: *Ipomoea reniformis* has been used in Indigenous medicine to treat renal illnesses, rheumatism, headaches, neuralgia, cough, inflammation, nose problems, fever from liver enlargement, and diuretic. Leaf powder is used as a snuff during epileptic episodes, juice has purgative properties, and the root has laxative and diuretic properties. It is also used to treat gum and eye diseases. Handle the fever 2) Manage diabetes; 3) Address rhinitis; 4) Address snakebite; 5) Address ear pain 6) Take care of your headache 7) To treat asthma and cough 8) To treat infections of the urinary tract 9) For conditions of the skin(2) Whole plant decoction is useful in cough, headache, neuralgia, rheumatism, and diuretic activity. The whole plant has antipyretic activity and is also useful in headache, bronchitis, paralysis, inflammation, troubles of the nose, and fevers due to enlargement of the liver. The plant is bitter, acrid, pungent; cooling, anthelmantic, laxative, carminative; useful in diseases of the kidney, the bladder, the lungs, the uterus, good in pain, fever, urethral discharges, anaemias, fistula, leucoderma; useful in the disease of heart and the abdomen; reduces tumours. Powder of leaves is used as a snuff during epileptic seizures. Juice acts as a purgative. The root is having diuretic, laxative and applied in the disease of the eyes and gums (Figure 8).

4. Biological Activities

4.1 Antioxidant and Anti-abdominal Activity

Antioxidant and anti-abdominal properties. The extracts' antioxidant qualities were investigated using the DPPH (1,1-Diphenyl-2-Picrylhydrozyl) radical scavenging activity technique. With an IC_{50} of 8.59 μgmL^{-1} in the DPPH radical scavenging experiment, the methanol extract demonstrated superior antioxidant activity compared to other extracts. The α-amylase inhibitory activity of methanol and hexane extract was demonstrated by their respective IC_{50} values of 104.5 and 133.4 μgmL^{-1}. In the brine shrimp lethality test, ethyl acetate extract demonstrated cytotoxicity with an ED_{50} of 34.29 μgmL^{-1}. The current investigation revealed that the most promising biological activities were exhibited by *I. reniformis* extracts IB and IC. This plant's methanol extract may have anti-oxidant and anti-obesity properties with low toxicity[8-11].

4.2 Anti-psychotic Activity

Using apomorphine and pilocarpine-induced psychosis models, the current study assessed the antipsychotic efficacy of the methanolic extract of *I. reniformis* in albino rats and mice. For 15 days before induction, MEIR was given at doses of 200 mg/kg and 400 mg/kg body weight. In the apomorphine-induced model, the extract considerably ($p<0.001$) lowered stereotypical behaviour; in the pilocarpine-induced model, it decreased aimless chewing ($p<0.01$);

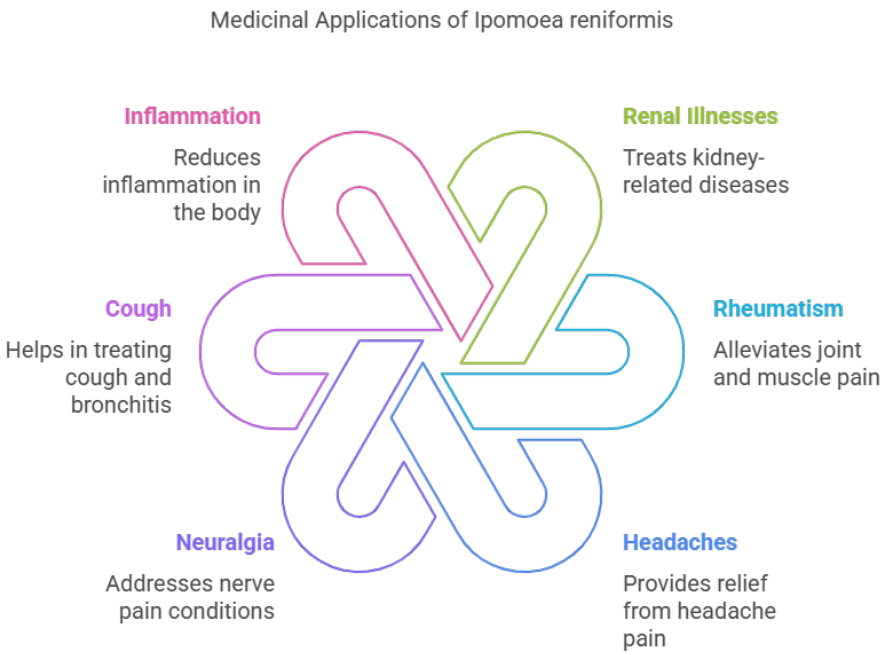


Figure 8. Medicinal application of *I. reniformis*[7].

and in the mice, it decreased climbing behaviour ($p<0.001$). The findings, which are on par with those of conventional antipsychotic medications, indicate that MEIR exhibits encouraging antipsychotic activity and merits additional research for possible therapeutic uses[12].

4.3 Hepatoprotective Activity

Using silymarin (100 mg/kg p.o.) as the standard reference, this study assessed the hepatoprotective activity of the methanolic extract of *Ipomoea reniformis* (MEIR) in rats with ethanol-induced hepatotoxicity (4 g/kg p.o.). Serum biomarkers such as total and direct bilirubin, Total Protein (TP), Serum Glutamate oxidoase (SGOT), Serum Glutamate Pyruvate Transaminase (SGPT), and tissue antioxidant levels, including glutathione (GSH) and lipid peroxidation (LPO), were measured. GSH and TP levels were significantly lower in the ethanol-induced toxicant group, although SGOT, SGPT, bilirubin, and LPO levels were significantly higher. GSH and TP levels increased while SGOT, SGPT, bilirubin, and LPO levels were dramatically decreased by treatment with silymarin, MEIR low dose (200 mg/kg), and MEIR high dose (400 mg/kg). These results imply that MEIR has strong hepatoprotective properties, on par with silymarin[13].

4.4 Anti-convulsant Activity

The second most prevalent neurological condition, epilepsy, has a major impact on people, families, and healthcare systems. Modern antiepileptic medications have several drawbacks, such as side effects, intolerability, and resistance. As a result, there is a growing demand for safer and more efficient substitutes. The *Convolvulaceae* family plant *I. reniformis* has long been used to treat epileptic seizures. With phenytoin (25 mg/kg) and diazepam (2 mg/kg) serving as reference medications, this study assessed the antiepileptic efficacy of the ethanolic leaf extract of *I. reniformis* (200 mg/kg and 400 mg/kg) in rats using Maximal Electroshock (MES), Pentylenetetrazole (PTZ), and Isoniazid-induced convulsion models. The extract demonstrated a considerable increase ($p<0.01$) in brain GABA levels in comparison to the control group, and it significantly ($p<0.01$ and $p<0.001$) reduced seizures in a dose-dependent manner across all models. These results imply that *I. reniformis*'s anticonvulsant properties might be related to its capacity to raise GABA levels in the brain[14-31].

4.5 Anti-mutagenic Activity

Two techniques were used to assess the antioxidant qualities of the methanolic leaf extract of *Ipomoea reniformis* Roxb. (MLPIR): Lipid peroxidation caused by DPPH and ferric chloride. The findings demonstrated that MLPIR's antioxidant activity was on par with that of ascorbic acid, the industry standard. The cyclophosphamide-induced bone marrow micronucleus test was used to evaluate the antimutagenic effect of MLPIR in mice at two dose levels (200 mg/kg and 400 mg/kg body weight) in light of these encouraging antioxidant results. MLPIR-treated animals showed a favourable P/N ratio and a significant decrease in the frequency of Micronucleated Polychromatic Erythrocytes (MNPCE) and Micronucleated Normochromatic Erythrocytes (MNNCE) in comparison to the disease control group, suggesting that it may have antimutagenic properties[32-52].

4.6 Anti-urolithiasis Activity

This study assessed how well an ethanolic leaf extract of *I. reniformis* prevented rats from developing urolithiasis brought on by ethylene glycol. Five groups of six animals each were included in the experimental design: To generate renal calculi, Groups II–V were given 0.75% ethylene glycol in drinking water for 28 days, while Group I was given a conventional rat diet and water as the normal control. Group III took Cystone (750 mg/kg), a common antiurolithiatic medication, from days 15 to 28. Group II served as the urolithiatic control. During the same period, *I. reniformis* leaf extract in ethanolic form was administered to groups IV and V at doses of 200 mg/kg and 400 mg/kg, respectively. Urine samples were taken on day 28 to measure the levels of calcium, phosphate, and oxalate. Serum creatinine, uric acid, and urea nitrogen levels were also measured using blood samples. When compared to the urolithiatic control group, the results showed that treatment with *I. reniformis* extract resulted in notable changes in several biochemical parameters, indicating that it may be effective in both preventing and treating urolithiasis[53-68].

4.7 Anti-cancer Activity

In this work, methanolic and aqueous leaf extracts of *Ipomoea reniformis* (IPR) were tested for their anticancer and antioxidant properties against Ehrlich Ascites Carcinoma (EAC) in mice. Ascorbic acid, methanolic extract, and aqueous extract had EC_{50} values of 2.278, 2.392, and 2.951 (DPPH assay) and 66.45, 68.11, and 100 (lipid peroxidation assay), respectively, according to the results of the DPPH and lipid peroxidation assays used to measure antioxidant activity. EAC cells were kept in Swiss albino mice for the anticancer investigation by intraperitoneal transplantation every nine days. Six groups (n=12) of 72 mice were created: Group I was the standard saline control; Group II was the EAC control; Group III was given the reference medication 5-fluorouracil (20 mg/kg i.p.) for nine days in a row; and Groups IV through VI were given plant extracts orally for nine days in a row. The remaining mice were tracked for mean survival time and percentage increase in lifespan, while six animals from each group were euthanised 24 hours after the last treatment to assess antitumor, haematological, and biochemical characteristics. The findings showed that *I. reniformis* extracts, both methanolic and aqueous, have strong anticancer and antioxidant qualities[69-78].

4.8 Anti-bacterial Activity

Diarrhoea leads to newborn mortality and hospitalisation in the elderly and is responsible for about 8% of all deaths in children under five worldwide. It has long been believed that Ipomoea triloba L. has antidiarrheal qualities. To support its traditional use, a study assessed the antibacterial qualities of its ethanol and aqueous extracts, as well as their fractions, against bacteria that cause diarrhoea. *Escherichia coli* (35.1%), *Staphylococcus aureus* (5.4%), *Pseudomonas aeruginosa* (12.2%), *Shigella dysenteriae* (24.3%), *Salmonella typhi* (10.8%), and *Vibrio cholerae* (12.2%) were the six genera identified by the study, which isolated 74 bacterial strains from 20 diarrheal stool samples. Both extracts contained flavonoids, saponins, terpenes, carbohydrates, and steroids, according to a phytochemical study. In comparison to the water extract, which showed inhibition zones ≥18 mm, the ethanol extract demonstrated more powerful broad-spectrum antibacterial activity (inhibition zones ≥30 mm). A time-dependent bactericidal mode of action was indicated by the Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC), which varied from 250 to 500 mg/mL and 500

to 1000 mg/mL, respectively. The dichloromethane fraction showed the strongest antibacterial activity of all the fractions. According to these results, I. triloba may help cure bacterial diarrhoea because it has antibacterial qualities[79].

4.9 Anti-diabetic and Anti-oxidant Activity

The Convolvulaceae family member *Ipomoea reniformis* has long been used for its therapeutic qualities. Its hypoglycemic and antioxidant properties have been examined in recent research. DPPH and lipid peroxidation assays were used to assess the radical scavenging capabilities of both alcoholic (ALCIPR) and aqueous (AQUIPR) leaf extracts; ALCIPR showed stronger antioxidant activity. Over seven days, both extracts dramatically and dose-dependently lowered blood glucose levels in both normal and alloxan-induced diabetic rats used in *in vivo* tests. Furthermore, throughout a three-week treatment period, both extracts increased the body weight and glucose tolerance of diabetic rats.

The alcoholic extract contains carbohydrates, glycosides, flavonoids, saponins, phytosterols, phenolics, tannins, and amino acids, according to phytochemical analysis, whereas the aqueous extract also contains these and other substances. These results imply that the presence of these bioactive chemicals and the antioxidant qualities of *Ipomoea reniformis may* be responsible for its hypoglycemic action[80-88].

4.10 Hypotensive, Angiotensin-Converting Enzyme Inhibitory and Diuretic Activity

The cardiovascular properties of *Ipomoea reniformis* Roxb. (*Convolvulaceae*), a little weedy herb that has long been used in Pakistan and India to treat heart conditions, have been studied scientifically. A study evaluated the Angiotensin-Converting Enzyme (ACE), diuretic, and hypotensive properties of an aqueous-methanol (30:70) extract made from the aerial parts of the plant. The extract significantly decreased mean arterial blood pressure in anaesthetised normotensive rats by 21.51 ± 3.41%, 28.99 ± 2.30%, 53.34 ± 0.88%, and 61.71 ± 3.37% when administered intravenously at dosages of 0.1, 0.3, 1.0, and 3.0 mg/kg. The extract reduced ACE activity, as shown by *in vitro* tests, with an IC_{50} value of 422 ± 21.16 µg/mL. Additionally, rats' urine output and salt excretion were markedly enhanced by intraperitoneal injection of the extract at doses of 30 and 50 mg/kg. The traditional usage of *I. reniformis* as a diuretic, cardioprotective, and antihypertensive medication is supported scientifically by these findings[89-99].

4.11 Anti-Ulcer Activity

Rats with pyloric ligation and ethanol-induced ulcer models were used in the study to examine the anti-ulcer potential of *Ipomoea reniformis* seeds. Petroleum ether, ethanol, and aqueous extracts of the seeds were examined for their ability to protect the stomach mucosa, while ranitidine was used as the standard reference medication. The results showed that in both animals, all extracts greatly decreased the development of ulcers. In particular, both extract dosages significantly reduced ulcer index, stomach volume, free acidity, and total acidity in the pyloric ligation model as compared to the control group. According to histopathological evaluations, pretreatment with the 500 mg/kg dose of the ethanolic extract significantly reduced hemorrhagic lesions and mucosal oedema, suggesting a protective effect on the stomach lining. These findings support the potential therapeutic use of *Ipomoea reniformis* seeds in the treatment of stomach ulcers by indicating that they have strong anti-ulcer action[101-127].

4.12 Antioxidant Activity

The biological activity of many solvent extracts of *Ipomoea reniformis*, such as hexane, ethyl acetate, methanol, and aqueous methanol, was examined by Babu A. V. *et al.* The DPPH (1,1-Diphenyl-2-Picrylhydrazyl) radical scavenging method and the superoxide radical scavenging activity method were used to assess these extracts' antioxidant capability. In the DPPH assay, the methanol extract showed the highest antioxidant activity of all the extracts, indicating that it is better at scavenging free radicals. Furthermore, α-amylase inhibitory activity was demonstrated by both methanol and hexane extracts, suggesting possible anti-diabetic effects. In the brine shrimp lethality test, the ethyl acetate extract demonstrated significant cytotoxicity, suggesting that it may find use in anticancer studies. Overall, the results indicate that *Ipomoea reniformis* ethyl acetate and methanol extracts have interesting biological properties, with the methanol extract showing promise as a low-toxicity antioxidant agent[128].

4.13 Anti-hypertensive Activity

The hypotensive, ACE-inhibiting, and diuretic effects of the aqueous-methanol (30:70) extract of the dried aerial portions of *Ipomoea reniformis* were studied in rats by Qaiser Jabeen and Naveed Aslam. Their research showed that the extract had strong serum ACE inhibitory action and successfully lowered mean arterial blood pressure in sedated rats. The extract's diuretic capability was further supported by the fact that it greatly raised urine volume and improved sodium (Na^+) excretion in the urine. The traditional usage of *Ipomoea reniformis* as a diuretic, antihypertensive, and cardioprotective treatment has been scientifically validated by these findings. In a different study, Natarajan P. *et al.* investigated how a hydroalcoholic extract of *Ipomoea reniformis's* entire plant affected rats' myocardial infarction caused by isoproterenol. The extract increased the activity of antioxidant enzymes while successfully preventing the rise in lipid peroxidation brought on by isoproterenol. Additionally, the extract significantly aided the heart's recovery from isoproterenol-induced ischemia injury, demonstrating its anti-ischemic, anti-lipid peroxidative, and antioxidant qualities. These results support the long-standing practice of treating ischemic heart conditions with *Ipomoea reniformis*[128].

4.14 Anti-pyretic Activity

The ethanolic extract of *Merremia emarginata*'s antipyretic properties. Even at a dose of 2 g/kg, no adverse effects were seen, indicating that the extract was safe. One-tenth of the acute toxicity dose was employed for the antipyretic investigation. When the extract was given intraperitoneally (i.p.) to albino rats at a dose of 200 mg/kg, it had notable antipyretic action in comparison to the usual medication, paracetamol, which was given at a dose of 150 mg/kg i.p. According to these results, *Merremia emarginata* ethanolic extract may have antipyretic qualities on par with conventional therapy[128].

4.15 Nephroprotective

Nephrotoxicity is a prevalent clinical issue that is frequently disregarded while having the potential to cause serious morbidity. One of the most frequent causes of medication-induced nephrotoxicity is cisplatin, a strong antineoplastic medicine used to treat a variety of malignancies. Many herbs have long been used to treat renal disorders caused by drugs or toxins to lessen these negative consequences. In a related study, *Ipomoea reniformis's* nephroprotective and antioxidant capacity in relation to cisplatin-induced nephrotoxicity. When given orally to both preventive and curative groups at a dose of 250 mg/kg, their study showed that the ethanolic extract of *Ipomoea reniformis* significantly decreased the elevation of blood urea nitrogen, serum creatinine, serum total proteins, urinary urea, urinary creatinine, and urinary total proteins brought on by the administration of cisplatin. In rats, our results imply that *Ipomoea reniformis* provides significant protection against cisplatin-induced nephrotoxicity. Additionally, by raising the levels of reduced glutathione, catalase, and superoxide dismutase and decreasing lipid peroxidation, the herb extract demonstrated exceptional antioxidant activity. These findings offer scientific support for *Ipomoea reniformis's* nephroprotective properties, which have long been asserted in traditional indigenous medical systems[128].

4.16 Arthritis

The anti-inflammatory properties of ethanolic and ethyl acetate extracts of *Ipomoea reniformis* on Freund's adjuvant-induced arthritis were examined and found that both extracts significantly decreased paw thickness by the end of the 21-day treatment period. Both extracts were potent during the acute phase of inflammation, but the ethanolic extract was more effective than the ethyl acetate extract during the chronic phase. By the end of the study, the ethanolic extract had a more noticeable anti-inflammatory effect, demonstrating its superior efficacy in arthritis management and suggesting its potential as a therapeutic agent for inflammatory conditions[128].

4.17 Analgesic and Anti-Inflammatory

The analgesic effects of the ethanolic extract of *Ipomoea reniformis* leaves, which was made by Soxhlet extraction, using the tail immersion method and acetic acid-induced writhing in mice. At 200 mg/kg body weight, the extract demonstrated significant central analgesic activity by reducing the number of writhes in the acetic acid-induced animal. The tail immersion model showed a significant increase in reaction time, indicating that the extract successfully reduced pain. Similarly,

Purushoth Prabhu T. *et al.* investigated the analgesic, anti-inflammatory, and anti-arthritic properties of the ethanolic extract of the whole *Ipomoea reniformis* plant using a range of experimental animal models. The carrageenan-induced rat paw oedema model was used to test the anti-inflammatory activity, the Complete Freund's Adjuvant (CFA) model was used to test the anti-arthritic activity, and the hot plate analgesia method was used to determine the analgesic activity in mice. Both indomethacin and the ethanolic extract's % suppression of paw oedema was determined. In rats with adjuvant-induced arthritis, treatment with the extract increased haemoglobin (Hb) levels, improved Erythrocyte Sedimentation Rate (ESR), and restored body weight. The extract's strong anti-inflammatory, anti-arthritic, and analgesic properties were confirmed throughout the investigation when it demonstrated a considerable inhibitory effect on FCA-induced paw oedema and delayed reaction time in the tail flick method[128-129].

4.18 Scopoletin and Its Antioxidant and Cytotoxic Activity

India is home to a large population of *Ipomoea reniformis*, which has long been used to cure a variety of illnesses, including cancer. The objective of this study was to separate and describe the phytoconstituents from the bioactive extract and assess the cytotoxic and antioxidant qualities of the extracted component, as well as the extracts of chloroform (CH), ethyl acetate (EA), ethanol (ET), and hydroalcoholic (HA) at 50% v/v. The 1,1-diphenyl-2-picryl hydrazyl (DPPH) radical scavenging assay was used to evaluate the antioxidant capacity, while the MTT (3-[4,5-dimethylthiazol-2-yl]-2,5 diphenyl tetrazolium bromide) assay was used to examine the cytotoxic activity. With an IC_{50} value of 52.24 µg/ml and the maximum antioxidant potential (94.84 ± 1.56% at 1000 µg/ml), all extracts showed notable antioxidant activity. With a maximum antioxidant activity of 96.29 ± 0.86% at 1000 µg/ml and an IC_{50} value of 52.24 ± 0.9367 µg/ml, scopoletin (SM), which was separated from the ET extract, had even greater antioxidant activity than the ET extract. Human cancer cell lines MCF-7, A-549, and HCT-116 were used to test the extracts' and SM's cytotoxic capability. Following ET extract treatment, MCF-7, A-549, and HCT-116 showed 4.4117 ± 6.2711%, 0.0605 ± 0.7748%, and 9.8290 ± 2.1149% cell viability, respectively. In contrast, SM showed slightly more potent cytotoxic activity, with cell viability of 4.23 ± 1.38%, 0.059 ± 0.32%, and 8.92 ± 0.87%, respectively. Thus, the results of this investigation showed that scopoletin, the isolated component, had greater cytotoxic and antioxidant capability than the *Ipomoea reniformis* ET extract[130].

4.19 Colon Cancer Treatment

By altering the expression of apoptotic signalling molecules in human colon cancer cells, the ethanolic extract of *Merremia emarginata* demonstrates anticancer effects in HT-29 cells. According to this study's *in vitro* experiments, *Merremia emarginata* may be a useful natural medication for the treatment of colon cancer. Additional research on the protein expression of apoptotic pathways' downstream signalling molecules must be taken into account[131].

4.20 Scavenger Activity

This work aimed to determine possible sources of new antioxidants by assessing the Total Phenolic Content (TPC) and *in vitro* antioxidant capacity of methanolic and aqueous extracts of the creeping herb *I. reniformis*. The DPPH free radical scavenging assay and the lipid peroxidation (LPO) method were used to measure antioxidant activity. According to the results, both extracts exhibited dose-dependent antioxidant activity; in the DPPH assay, the methanolic extract exhibited the highest percentage inhibition, 81.40% at a concentration of 20 µg/ml, and in the LPO assay, 82.32% at 1000 µg/ml. In comparison to the aqueous extract, which had a substantially lower phenolic content (19.15±0.2406 mg GAE/g), the methanolic extract also had the highest overall phenolic content (61.11±0.1829 mg GAE/g). These results emphasise *I. reniformis*' potential as a natural antioxidant source by indicating that its increased phenolic content causes its methanolic extract to demonstrate considerable antioxidant activity[132].

4.21 Anti-microbial Activity

Ipomoea reniformis is one plant that has been researched for its traditionally claimed properties, but is still mainly unknown. Many medicinal herbs in India are still utilised traditionally despite the lack of scientific proof. To explore its potential further, the entire *I. reniformis* plant was gathered, dried, and extracted using different solvents according to their solubility index. The

antifungal and antimicrobial properties of five distinct extracts were assessed against a fungus species as well as Gram-positive and Gram-negative bacteria using the well diffusion assay. The ethyl acetate extract showed the strongest antibacterial activity, according to the study, which led to additional fractionation using various solvents. While the aqueous extract showed activity exclusively against *Staphylococcus aureus*, subsequent antimicrobial investigations of these fractions indicated activity against both Gram-positive and Gram-negative bacteria. Furthermore, the extracts in chloroform and ethanol showed inhibitory effects on *Aspergillus niger*. These results imply that *Ipomoea reniformis has* strong antibacterial qualities, underscoring the necessity of more investigation to separate and pinpoint the chemical ingredients responsible for this action[133].

5. Discussion

Ipomoea reniformis's therapeutic potential has been carefully examined, demonstrating its many uses in both conventional and alternative medicine. This plant has a rich phytochemical profile that includes bioactive substances with anti-cancer, hepatoprotective, antidiabetic, antioxidant, and neuroprotective qualities, such as phenolic acids and scopoletin. Its traditional use, including the treatment of renal conditions, rheumatism, and neuralgia, is consistent with scientific evidence showing it is effective in reducing oxidative stress, promoting glucose metabolism, and preventing organ damage. *I. reniformis* also exhibits broad-spectrum pharmacological properties, such as antibacterial, anticonvulsant, antipsychotic, antiurolithiatic, and anti-inflammatory actions. Although the results highlight its potential as a natural medicinal agent, more investigation is required to clarify molecular pathways, guarantee bioavailability, and carry out clinical trials to determine safe and efficient dosages. All things considered, *I. reniformis* offers a strong chance for medication development by bridging the gap between contemporary pharmacological innovation and ethnomedicinal expertise.

6. Conclusion

Ipomoea reniformis's broad range of biological actions, including hepatoprotective, nephroprotective, antioxidant, anti-inflammatory, anticonvulsant, antidiabetic, anticancer, anti-ulcer, antimicrobial, and antiarthritic qualities, are bolstered by its rich phytochemical profile and noteworthy pharmacological activities. These actions are supported by important bioactive substances, including scopoletin and phenolic acids, which validate its traditional medicinal usage in treating illnesses like rheumatism, diabetes, liver and kidney problems, and neuralgia. The article emphasises the need for additional research to improve extraction techniques, clarify molecular mechanisms, guarantee bioavailability, and carry out clinical studies to create safe and standardised therapeutic regimens, notwithstanding its encouraging applications. All things considered, *I. reniformis* is a great source for medication research that unites traditional knowledge with contemporary pharmacology.

7. References

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