# *"GOKHRU (PEDALIUM MUREX L.):* EXPLORING THE THERAPEUTIC POTENTIAL AND BIOLOGICAL MARVELS OF AN ANCIENT MEDICINAL TREASURE"

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**Abstract:**
In India, Bada Gokhru (Pedalium murex L.) stands out as a highly prized traditional medicinal plant, with every part of the neem tree offering valuable medicinal properties ripe for commercial exploitation. Over the past five decades, significant strides have been made in understanding the chemical composition of Pedalium murex compounds, alongside notable advancements in elucidating its diverse biological activities and medicinal uses. Recognized as a rich source of unique natural products, this plant holds promise for the development of pharmaceuticals targeting various diseases and industrial applications. This review provides a comprehensive overview of the biological activities of isolated compounds, pharmacological effects of extracts, clinical research findings, and potential medicinal applications of Gokhru, accompanied by safety assessments.

**Keywords:** Traditional medicine, Gokhru, Antimicrobial activity etc.

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**Introduction:**

Pedalium murex (P. murex) Linn, an annual herb abundant along the coastlines of South India, Sri Lanka, Ceylon, Mexico, and tropical Africa, is recognized for its medicinal properties. Notably, dinatoin glycoside and diosmetin glucuronides are derived from its leaves, with reports of their use in treating gonorrhea and dysurea through leaf and stem infusions. Previous investigations have also identified several flavonoids in its leaves and flowers, while recent discoveries include heptatriacontan-4-one and tetratriacontanyl oxononanoate in its fruits, known for their demulcent, diuretic, antispasmodic, and aphrodisiac effects. The plant's roots are utilized as an antibiliary agent. These findings underscore P. murex as a source of bioactive compounds with diverse pharmacological effects, suggesting its potential for novel therapeutic applications as a biopesticide agent and fertility enhancer. Isolates from its fruits, such as 2',4',5'-trihydroxy 5,7-dimethoxy flavones and triacotanyl dotriacontanoate, exhibit promise in managing urinogenital disorders. Traditionally, it has been used for treating various ailments including puerperal diseases, digestive issues, ulcers, fevers, wounds, and debility. The present study aims to assess its preliminary phytochemical profile, aiding in the discovery of potent drugs. Given India's rich biodiversity and traditional medicinal practices, particularly prevalent among rural communities like the Warangal district tribes, there is significant reliance on plant resources for various purposes. The use of native plants like P. murex in herbal medicine is widespread among low-income populations in developing countries, driving the need for scientific validation of their medicinal properties. Ethnopharmacological insights combined with phytochemical research offer a promising avenue for substantiating the traditional uses of plants like P. murex and unlocking their therapeutic potential shown table no 1, and figure no. 1.

P. murex is known by various names, including Telugu-Yenugu palleru, Sanskr-Brihat gokshur, Hindi-Bada goshur, and English-Large caltrops.

**Table 1: The taxonomical classification are as follows:**

| | |
|---|---|
| Kingdom: | Plantae, Plant |
| Phylum/Division: | Magnoliophyta, |
| Class: | Magnoliopsida (Dicotyledonae), |
| Subclass: | Lamiidae, |
| Order: | Caryophyllales, |
| Family: | Pedaliaceae, |
| Genus: | Pedalium, |
| Species: | P. murex L. |

**Figure 1: image of Gokhru plant.**

**Herbal plant description:**

Pedalium murex L. is a creeping herbaceous plant, reaching approximately 2 to 3 feet in length, with sprawling branches and irregularly shaped leaves arranged in pairs of 5 to 8. Its small, yellow flowers bloom in early winters, giving way to round fruits with 5 to 12 compartments, each containing a seed rich in aromatic oil. The roots, measuring 4 to 5 inches long, emit a sweet aroma and are brown in color. This succulent herb thrives near the sea coast of South India and certain tropical regions of India, typically emerging from July to September. It flourishes in fertile soils and agricultural lands, often appearing as a weed in temperatures ranging from 25-30 degrees Celsius.

**Chemical constituents of Gokhru:**

The fruit contains various chemical constituents including alkaloids (3.5%-5%), stable oil, aromatic oil, resins, glycosides, carbohydrates, saponins, and triterpenoids. Meanwhile, the seeds comprise saponins, herniarin, phytosterols, tannins, and xanthotoxin. Leaves contain rutin, alkaloids, flavonoids, triterpenoid acids, and flavonoid glycosides. These constituents contribute to the fruit's pharmacological properties and potential health benefits. Alkaloids, saponins, and flavonoids are particularly noteworthy for their biological activities, while the presence of triterpenoids and tannins adds to its medicinal value. Overall, the combination of these chemical

compounds underscores the fruit's significance in traditional medicine and its potential for further exploration in pharmacological research shown in figure no. 2.

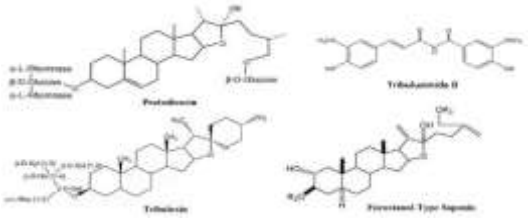

**Figure 2: Chemical constituent present in Gokhru plant.**

**Phytochemical studies:**

Phytochemical studies of P. murex reveal a rich array of constituents. The whole plant contains medicinal oil, aromatic oil, fruits rich in alkaloids (3.5%-5%), carbohydrates, and triterpenoids, along with two significant flavonoids, 5,7-dihydroxy-4',5'-dimethoxy flavones. Leaves harbor diosmetin, its 7-glucuronide, pedaltin, and pedalin. Additionally, alkaloids, steroids, resins, saponins, and proteins are present. The root boasts novel phenolic compounds. Notably, phytosterols, 2-tannin, and carbohydrates were predominant in stems, while flavonoids, steroids, and triterpenoids were abundant in leaves. Root-derived compounds await further identification. These findings underscore P. murex's pharmacological potential, offering a diverse repertoire of bioactive compounds for medicinal and therapeutic exploration shown in figure no. 3.

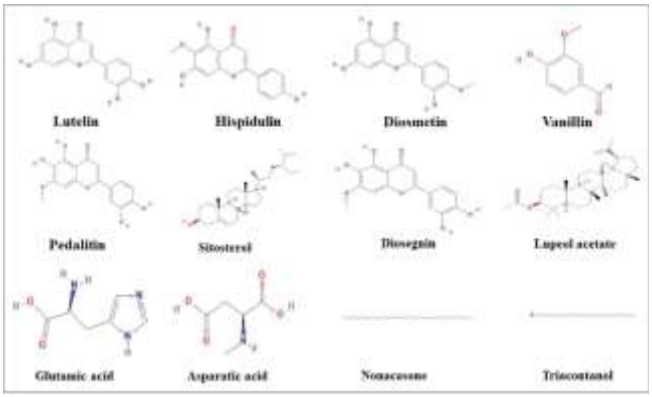


**Figure 3: Different phytoconstituents present in Gokhru Plant.**

***Pharmacological studies:***


**Figure 4:Different pharmacological studies of Gokhru plant.**

**Insecticidal and anti-feedant effects assessment:**

Pharmacological studies revealed the insecticidal and anti-feedant effects of ethanol extract from P. murex root (0.1%, 0.2%, 0.4% active). It significantly deterred feeding of Spodoptera litura (S. litura) larvae via leaf-dip method, causing over 50% larval mortality at higher concentrations (0.8%). LC50 values for third, fourth, and fifth nymphal instars ranged from 0.100% to 0.258%. P. murex extract reduced food consumption index and hindered growth, indicating effective insecticidal properties against S. litura. This highlights its potential as a botanical pesticide, promising for eco-friendly pest management in agricultural settings shown in figure no. 4.

**Anti-hyperlipidemic activity:**

The anti-hyperlipidemic activity of P. murex ethanolic extract (200 and 400 mg/kg, p.o.) was assessed in high-fat diet-fed rats. Biochemical parameters including serum total cholesterol (TC), high-density lipoproteins (HDL), low-density lipoproteins (LDL), very low-density lipoproteins (VLDL), and triglycerides (TG) were compared with gemfibrozil and atorvastatin-treated groups. The extract significantly decreased TG ($P<0.01$), LDL ($P<0.001$), VLDL ($P<0.01$), and cholesterol ($P<0.001$) levels, while increasing HDL ($P<0.05$). This highlights the potential of P. murex extract as an effective anti-hyperlipidemic agent, comparable to standard medications shown in figure no. 5.

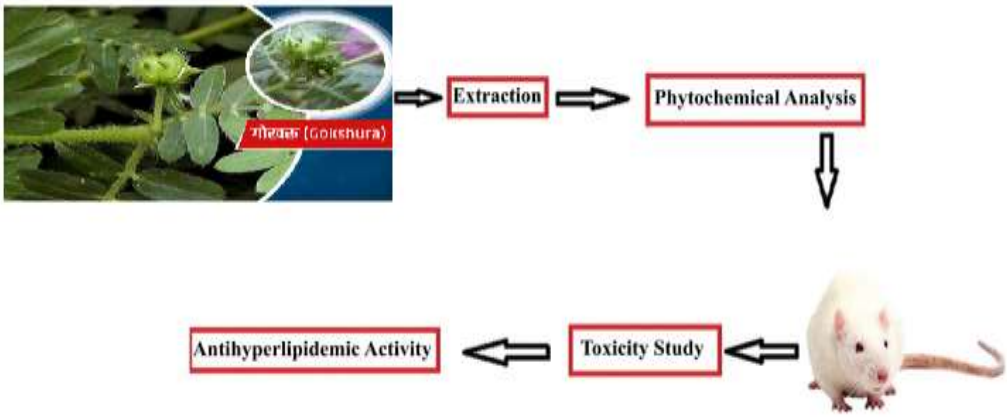


**Figure 5: Anti-hyperlipidemic activity study of Gokhru using wistar rats' model.**

**Anti-nephrolithiasis activity:**

The anti-nephrolithiasis activity of P. murex extracts was investigated in sodium oxalate-induced nephrolithiasis in rats. Petroleum ether, chloroform, ethanol, and aqueous extracts were prepared and assessed. Treatment with these extracts exhibited significant anti-nephrolithiasis activity compared to the control group. This study underscores the potential therapeutic benefits of P. murex in preventing the formation of kidney stones shown in figure no. 6.

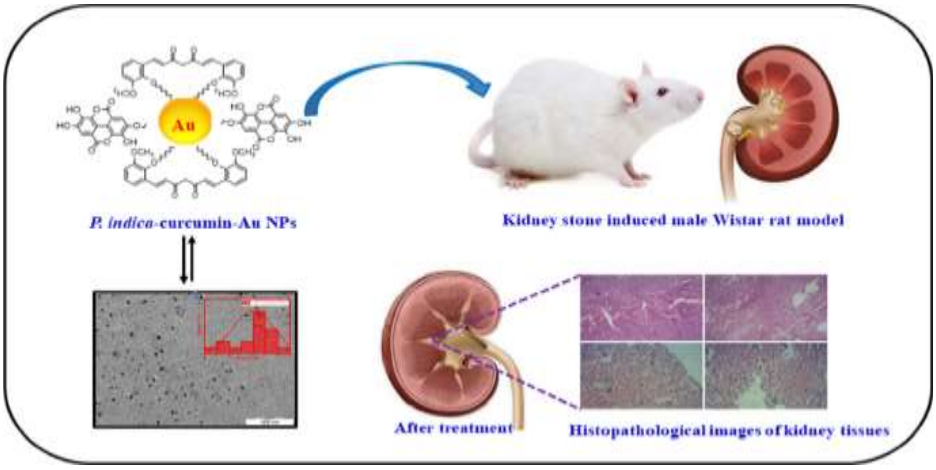


**Figure 6: Anti-nephrolithiasis activity study of Gokhru using wistar rats' model**

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**Nephroprotective activity:**

The nephroprotective activity of P. murex was evaluated in Wistar rats through the administration of its ethanolic extract at a dose of 250 mg/kg for five days after inducing renal damage. Changes in body weight and serum creatinine levels were monitored as indicators of kidney function. The ethanolic extract significantly mitigated renal damage, evident from the observed changes in body weight and serum creatinine levels. This highlights the potential of P. murex as a potent nephroprotective agent, surpassing the efficacy of standard drugs. Additionally, the study aims to explore the therapeutic efficacy of P. murex in treating upper gastrointestinal disorders, aligning with its traditional use. Further investigation is warranted to identify and validate the active constituents responsible for its pharmacological effects, thus supporting its traditional medicinal applications shown in figure no. 7.

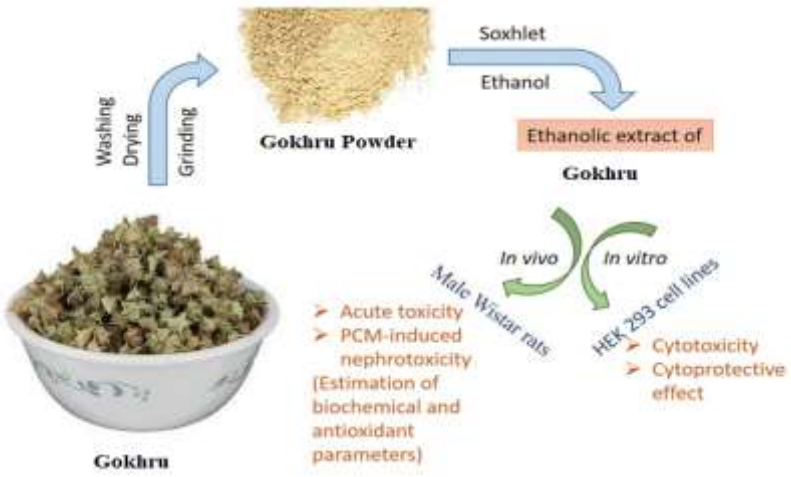


**Figure 7: Nephroprotective activity studies of Gokhru plant**

**Antiulcer activity:**
The antiulcer activity of P. murex leaf extract was investigated, primarily targeting alterations in gastric mucosal integrity induced by aggressive factors. Parameters including acid volume, total protein, ulcer index, and glutathione were assessed. Ulcers were induced in rats using 80% ethanol, with famotidine (3 mg/kg) and aqueous leaf extract administered at doses of 50, 100, and 200 mg/kg. Significant protection against gastric mucosal lesions, reduction in acid volume, preservation of total protein levels, and enhancement of glutathione were observed with the aqueous extract. Notably, the 200 mg/kg dose exhibited superior efficacy in mitigating ulcerogenic effects and preserving mucosal integrity. This suggests the potential of P. murex leaf extract as a promising antiulcer agent, emphasizing its therapeutic relevance in managing gastric disorders.

**Anti-inflammatory activity:**
The anti-inflammatory activity of P. murex and A. bonum was evaluated using carrageenan-induced paw edema model in rats. Both plants exhibited significant anti-inflammatory effects. Paw volume (mL) was measured before and 1, 2, 3, 4, and 5 hours after carrageenan injection. The reduction in paw volume post-injection indicated the anti-inflammatory potential of P. murex and A. bonum extracts. These findings highlight the therapeutic relevance of these plant species in managing inflammatory conditions, emphasizing their potential as natural anti-inflammatory agents.

**Antioxidant activity:**
The antioxidant activity of P. murex methanol extract (MEC) was assessed using a carbon tetrachloride (CCl4)-intoxicated rat liver model. Rats were orally administered MEC for 90 days at 70 mg/kg bodyweight. MEC significantly reduced lipid peroxidation and elevated levels of antioxidant enzymes, including superoxide dismutase, catalase, glutathione peroxidase, and glutathione reductase. It effectively combated oxidative stress induced by CCl4, restoring near-normal levels of antioxidant enzymes. The aqueous extract of P. murex exhibited high scavenging activity against DPPH, superoxide, and nitric oxide radicals, along with a notable reducing power. These findings underscore the potential of P. murex as a natural antioxidant, highlighting its significance in combating oxidative stress-related disorders. Further investigation is warranted to elucidate the specific compounds responsible for its antioxidant properties and explore its pharmacological applications.

**Antibacterial activity:**
The methanol extract of P. murex exhibited significant antibacterial activity against both gram-positive and gram-negative bacteria. It demonstrated a higher inhibitory effect against gram-positive bacteria compared to gram-negative bacteria. The presence of compounds like flavonoids, glycosides, alkaloids, and tannins in the extract contributed to its antibacterial properties. Specifically, it showed more potency against Streptococcus progeny and Enterococcus faecalis compared to gram-negative bacteria. This highlights the potential of P. murex as a natural source of antibacterial agents, particularly effective against gram-positive bacterial strains shown in figure no. 8.

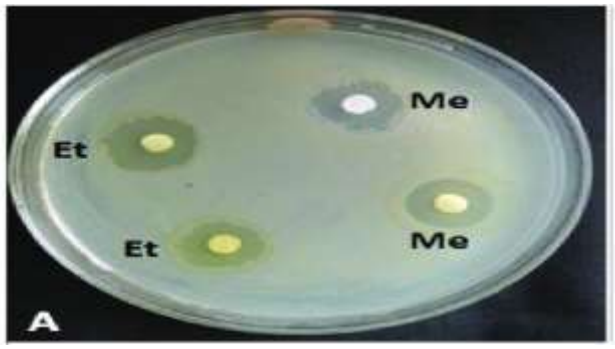


**Figure 8: Antibacterial activity studies of Gokhru plant**

**Protective effect of prostane in experimental prostatic hyperplasia in rats:**

The protective effect of P. murex, a component of prostane, was evaluated in experimental prostatic hyperplasia in rats. P. murex independently inhibited 5α-reductase and exerted α-adrenergic antagonistic activity. When administered with prostane at doses of 250, 500, and 750 mg/kg body weight, it significantly reduced epithelial hyperplasia, providing relief in experimental prostatic hypertrophy. This highlights the potential of P. murex as a beneficial component in prostane formulation, offering therapeutic benefits in managing prostatic hyperplasia shown in figure no. 9.

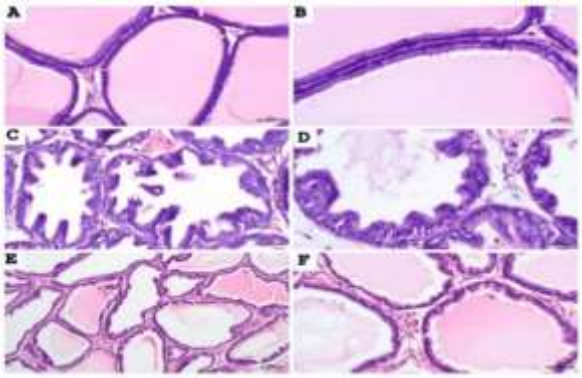


**Figure 9: Protective effect of prostane in experimental prostatic hyperplasia study of Gokhru using wistar rats' model.**

**Hepatoprotective activity:**

The hepatoprotective activity of P. murex fruit extract was evaluated against oxidative stress-induced liver damage. Female Swiss albino mice were orally administered aqueous-alcoholic extract at doses of 200 and 400 mg/kg for 14 days. Liver enzymes and biochemical parameters were measured, revealing significant protection against hepatotoxicity, particularly at the 400 mg/kg dose. The extract effectively normalized elevated liver enzymes (SGPT, SGOT, TB, TG) and lipid peroxidation levels, indicating its hepatoprotective potential. Furthermore, histopathological examination corroborated the protective effects. The study underscores the hepatoprotective properties of P. murex fruit extract, attributed to its antioxidant activity, thus highlighting its therapeutic potential in managing liver disorders induced by oxidative stress. Further investigation is warranted to elucidate its precise mechanisms of action and therapeutic applications shown in figure no. 10.

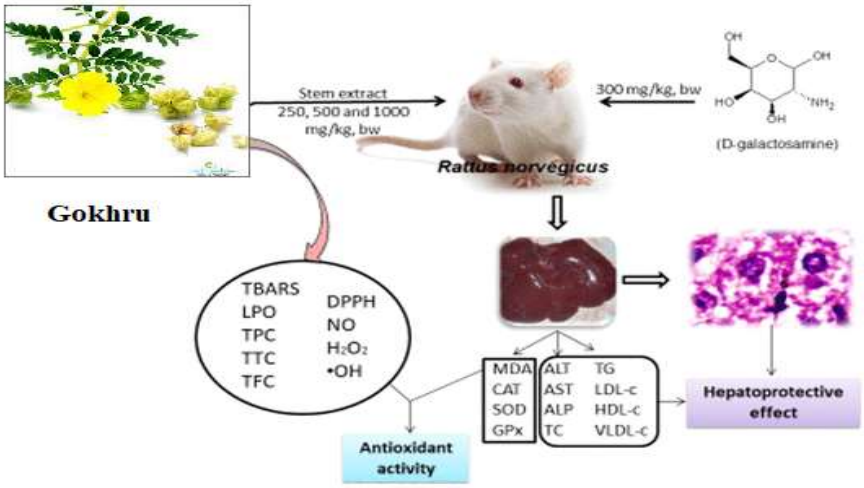


**Figure 10: Hepatoprotective activity study of Gokhru using wistar rats' model.**

**Aphrodisiac activity and curative effects:**

Petroleum ether extract of P. murex (PEPM) demonstrated aphrodisiac activity and curative effects against testicular damage in male rat models. Administering doses of 200 and 400 mg/kg of PEPM significantly increased mating and mounting behavior ($P < 0.01$, $P < 0.001$). Moreover, fertility parameters such as sperm motility and count were significantly enhanced in a dose-dependent manner ($P < 0.01$, $P < 0.001$) compared to the ethanol-treated group. Additionally, PEPM treatment at 400 mg/kg led to significant increases in protein ($P < 0.05$) and testosterone levels ($P < 0.05$). Microtome sections of testes from PEPM-treated animals resembled those of the control group, indicating curative effects. These findings highlight the potential of PEPM as a natural aphrodisiac and fertility-enhancing agent, making it a promising option for improving reproductive health in males shown in figure no. 11.

**Figure 11: Aphrodisiac activity and curative effects study of Gokhru using wistar rats' model.**

**Additional characteristics:**

Malva sylvestris and P. murex mucilage emerged as promising alternatives for formulating suspending agents due to their improved properties compared to Acacia. Various tests, including sedimentation profile, particle size analysis, and rheological parameters, were conducted on purified mucilage from both plants. The results indicated that Malva sylvestris and P. murex mucilage exhibit low sedimentation rates, high viscosity, and slightly basic pH values, making them suitable for use as suspending agents. Additionally, these mucilages contain medicinally useful components and have been traditionally utilized for various therapeutic purposes. Their exploration as pharmaceutical excipients present a valuable avenue for research in the field of drug formulation, offering natural and effective alternatives to synthetic suspending agents. This highlights the potential of these plant-derived mucilages as versatile and beneficial ingredients in pharmaceutical formulations.

**Result and discussion:**

The study explores Bada Gokhru's (Pedalium murex L.) significance in traditional Indian medicine, emphasizing its potential in pharmaceutical and industrial domains. With the neem tree's diverse medicinal attributes, there are ample commercial prospects. Over the last fifty years, rigorous research has elucidated Pedalium murex's chemical composition, unveiling its multifaceted biological and medicinal properties. Noteworthy for housing unique natural compounds, this plant holds promise for developing pharmaceutical interventions and addressing industrial needs. The review comprehensively examines isolated compound activities, extract pharmacology, clinical findings, and Gokhru's medicinal potential, all while

ensuring safety. This discussion underscores the plant's role as a valuable resource in traditional medicine and its potential for future drug development and industrial applications. This format condenses the original paragraph into a concise discussion, focusing on the key points and implications of the study regarding Bada Gokhru's medicinal properties and industrial potential.

**Conclusions:**

In the realm of traditional medicine in India, Bada Gokhru (Pedalium murex L.) shines as a coveted botanical treasure trove. With each part of the neem tree brimming with medicinal goodness, opportunities for commercial utilization abound. In the past half-century, rigorous exploration has unveiled the chemical intricacies of Pedalium murex, unveiling its multifaceted biological prowess and medicinal utilities. Esteemed for harboring a plethora of unique natural compounds, this plant emerges as a beacon of hope for crafting pharmaceutical marvels targeting a spectrum of maladies and industrial necessities. This review serves as a panoramic vista, delving into the biological prowess of isolated compounds, the pharmacological dance of extracts, clinical revelations, and the potential medicinal marvels of Gokhru, all under the vigilant eye of safety assessments.

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**Conflict of Interest:**

Not applicable.

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