A Comprehensive Review of the Botany, Chemistry, and Therapeutic Potential of Tribulus terrestris Linn

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***Abstract*—Gokshura (Tribulus terrestris), a member of the Zygophyllaceae family, is a medicinal herb that is found all over the world. It is used in traditional Ayurvedic and Unani medicine because it is a diuretic and lithontriptic, which means it can help with kidney stones, high blood pressure, and urinary problems. Contemporary studies validate its multifaceted pharmacological effects, encompassing antimicrobial and anti-inflammatory attributes, while corroborating its historical application in reproductive health and its botanical differentiation from alternatives such as Pedalium murex.**

***Index Terms*—Gokshura (Tribulus terrestris) , Kidney stones (Urolithiasis) , Unani medicine**

I. INTRODUCTION TO GOKSHURA (*TRIBULUS TERRESTRIS*)

Gokshura*, scientifically known as **Tribulus terrestris** (Family: *Zygophyllaceae*), is an important medicinal herb found in tropical and subtropical areas around the world, including India and the Mediterranean. The name comes from the Latin *tribo* (to tear) and *caltrop*, which refers to its round fruit that has sharp, woody spines resembling medieval barbed weapons. It is also called "puncture vine," "goat head," "small caltrop," and "Trikantaka" in various regions.

The plant is well-known in traditional medicine systems like Ayurveda and Unani** for its various health benefits. It is mainly recognized for its **diuretic and lithontriptic** properties and is often used to treat urinary disorders, kidney stones, and painful urination. In its effectiveness in managing high blood pressure due to its diuretic effects. Additionally, *Gokshura* is an important part of the popular Ayurvedic formula *Dashamoola* and is traditionally used to boost hormonal production and address reproductive issues such as infertility and impotence.
In addition to its primary uses, the plant has a wide range of pharmacological effects, including antimicrobial, anti-inflammatory, pain-relieving, and immune-boosting properties. While *Tribulus terrestris* is the recognized source of *Gokshura* in the Ayurvedic Pharmacopoeia of India (API), some local debates exist about its identity. Plants like *Pedalium murex* (known as "Large Caltrop" or *Brihat Gokshura*) are sometimes mentioned as substitutes or related species. Overall, *Gokshura* continues to be a key part of herbal medicine, connecting ancient knowledge with modern clinical studies.

II. CASE STUDY: GOKSHURA (T. TERRESTRIS) IN GYNECOMASTIA MANAGEMENT

A 44-year-old male with Chronic Liver Disease (CLD) and improvement in gynecomastia; however, further clinical studies are required to confirm efficacy with 1000mg/day of Gokshura aqueous extract for three months.

- Key Outcomes:

Physical Reversal: Breast enlargement and tenderness were completely resolved by the end of the treatment period.

Hormonal Recovery: Serum testosterone levels increased significantly from a baseline of 6.56 ng/ml to 748.34 ng/ml. (ng = nanograms)
Safety: The herb was well-tolerated with no adverse reactions or herb-drug interactions reported.

- Conclusion: Gokshura effectively reversed gynecomastia by correcting hormonal imbalances and significantly boosting testosterone levels.

- Types of gokharu In classical pharmacology, Gokharu is generally categorized into two distinct forms based on the plant species and the size of the fruit. They have similar names, but they come from different botanical families and have somewhat different therapeutic uses.

1.Chota Gokshura (Small Caltrop)
2.Bada Gokshura (Large Caltrop)

1. Chhota Gokshura (Small Caltrop)

Botanical Name: Tribulus terrestris
Family: zygophyllaceae
Characteristics: It is the most commonly used variety. It is a trailing perennial herb with yellow flowers and small woody fruits in five chambers covered in sharp spines.
Primary Uses: It is mainly used for kidney stones, urinary tract infections (UTIs) and as a natural testosterone booster in today's supplements.

2. Bada Gokshura (Large Caltrop)

Botanical Name: Pedalium murex
Family: Pedaliaceae
Characteristics: Larger and more upright than the small variety. The fruits are larger and heavier and usually with four sharp spines near the base. The leaves release a mucilaginous (thick/slimy) liquid when agitated in water.
Primary Uses: It is highly valued for "Sheeta Virya" (cooling property). It is used for treatment of inflammatory conditions of the urogenital tract and to improve sperm count and quality.

Table 1: Comparative morphological and therapeutic characteristics of Chhota Gokshura (Tribulus terrestris) and Bada Gokshura (Pedalium murex)

Feature	Chota Gokhru (Small Caltrop)	Bada Gokhru (Large Caltrop)
Botanical Name	Tribulus terrestris Linn.	Pedalium murex Linn.
Family	Zygophyllaceae	Pedaliaceae
Growth Habit	Creeping/trailing annual herb (stems up to 95 cm)	Erect, succulent annual herb (stems 2 to 3 feet tall)
Leaf Type	Compound leaves (similar to chickpea leaves)	Simple, opposite, fleshy, and irregular ovate leaves
Fruit	Small, globose, with 5 ribbed sections and pairs of spines	Larger, ovoid, 4-ridged with 4 sharp spines at the base

Feature	Chota Gokhru (Small Caltrop)	Bada Gokhru (Large Caltrop)
Primary Use	Kidney stones and urinary tract disorders	Sexual disorders (infertility, erectile dysfunction)

1. Taxonomy and Botanical Description

According to Systematic Medico-Historical Review , Gokshura has been classified on the basis of its morphological characters as mentioned in classical texts to distinguish it from “Large Caltrop” (Pedalium murex).

• Ayurvedic Taxonomy: It is traditionally known as Laghu Gokshura (small) to differentiate it from Brihat Gokshura (large). Synonyms like Trikantaka and Shwadaustra are specific to the ‘three-pronged’ or ‘dog-teeth’ look of the fruit spines.

• Detailed Anatomy * Stems: Procumbent, spreading, branched and often creeping.Leaves: Paripinnate, 5–8 pairs of leaflets (5–15 mm long).

o Fruit Structure: A schizocarpic fruit breaking into five woody, wedge-shaped cocci. Each coccus bears two long stiff divergent aerial spines and two shorter basal spines.

Table 2: Taxonomical classification of Tribulus terrestris Linn.

Rank	Classification
Kingdom	Plantae
Division	Phanerogams
Subdivision	Angiospermae
Class	Dicotyledonae
Subclass	Polypetalae
Series	Disciflorae
Order	Giraniales
Family	Zygophyllaceae
Genus	Tribulus
Species	terrestris Linn.

2. Phytochemistry of Gokshura

The research synthesized from various scientific journals confirms that T. terrestris is a pharmacologically significant plant with diverse therapeutic applications, notably its diuretic, anti-inflammatory, and anticancer properties. The plant's potential as a medicinal resource is summarized through the following key findings:

- Chemical Defense Mechanisms: The plant produces organic phytochemicals, including alkaloids, flavonoids, phenols, and saponins, which serve as "immunological weapons" to overcome various biotic and abiotic stress conditions.
- Steroidal Saponins & ACE Modulation: Beyond the well-known protodioscin, the plant contains Terrestrosins A, B, C, D, and E, and Gitonin. These specific saponins have been identified as markers that can modulate the activity of the Angiotensin-Converting Enzyme (ACE).
- Alkaloidal Profile & Neuroprotection: The plant contains traces of beta-carboline alkaloids, specifically norharman and harman. These compounds are noted for their potential

contribution to the neuroprotective effects observed in systematic reviews.

- Mechanism of Diuretic Action: The potent diuretic (Mootrala) effect is mechanically attributed to high levels of potassium salts, specifically potassium nitrate. These salts induce osmotic diuresis, providing a clear physiological basis for the plant's traditional use.
- Anatomical Distribution: Vital constituents—including resins, fats, and minerals—are distributed throughout the plant's anatomy, with therapeutic extracts derived from the fruit, bark, roots, and leaves.
- Inorganic and Mineral Content: T. terrestris is a rich source of essential inorganic elements such as calcium, magnesium, potassium, chloride, and sulphate, which contribute to its overall health benefits.
- Fruit-Specific Composition: The fruits are particularly complex, harboring essential oils, nitrates, Vitamin C, and a 0.001% concentration of alkaloids. Additionally, they contain essential amino acids such as Aspartic acid and Glutamic acid.

3. Therapeutic Applications and Preparations

T. terrestris is highly valued for a broad range of clinical properties, including the treatment of asthma, cough, heart disorders, and urinary stones.

- Industrial Utility: In the pharmaceutical industry, the leaves are used to prepare herbal tonics that address digestive problems, enhance libido, and treat urinary tract infections.
- Nutritional Enhancement (Ksheerpaka): Research indicates that preparing Gokshura as a Ksheerpaka (medicated milk) significantly improves its nutritional profile. For instance, the Ksheerpaka preparation increases total energy to 117.3 Kcal and calcium content to 187 mg/100g, compared to 73.48 Kcal and 59 mg/100g in simple powder form.
- Economic Impact: Because these products can be easily prepared from roots, shoots, seeds, and flowers, they provide cost-effective and accessible curative options for both low and high-economic countries.

Table 3: Major phytochemical constituents of Tribulus terrestris and their chemical classes

Group of phytochemicals	Chief phytochemicals
Alkaloids	Tribulusin A, tribulusamide C, tribulusterine, terrestriamide, harman, harmine, harmmol, N-trans-caffeoylyramine, N-transcoumaroyltyramine
Flavonoids	Kaempferol, isorhamnetin, and quercetin
Amino acids	Alanine and threonine
Saponins	108 types of steroidal saponins, 58 types of Spirostanol, and 50 types of furostanol
Organic acids	Benzoic acid, vanillic acid, 2-methyl benzoic acid, ferulic acid, succinic acid, palmitic acid

4. Traditional & Ethnomedical Uses

The documents offer a "Medico-Historical" view because they trace the use of Gokshura through several classical stages:

• Classical Ayurvedic Formulations:

o Dashamoola: For Vata-vyadhi (neurological and musculoskeletal disorders).

o Gokshuradi Guggulu: It is mainly indicated for urinary calculi and inflammatory conditions of the bladder.

Specific Medical Indications: -

o Diabetic Nephropathy: The Ghana (extract) tablets improve the microcirculation of the renal tissue, thus reducing proteinuria and serum creatinine levels.

o Anti-Hypertensive: Traditionally used for Vata-Kaphaja imbalances presenting as high blood pressure, acting as a natural "water pill."

o Cooling Agent (Sheeta Virya): Used in Unani system for the treatment of internal heat, burning micturition and inflammatory conditions such as piles (hemorrhoids) and leprosy.

• Ethno-Veterinary Use: In some folk traditions the decoction of the plant is used to treat urinary retention in cattle.

Table 4: Botanical, phytochemical, and pharmacological profile of Tribulus terrestris

Parameter	Scientific & Traditional Characterization
Botanical Identity	Tribulus terrestris Linn.
Family	Zygophyllaceae
Classical Synonyms	Gokshuraka, Trikantaka, Shwadaustra, Bhakshataka
Ayurvedic Properties	Rasa: Madhura (Sweet) Guna: Guru (Heavy), Snigdha (Unctuous) Virya: Sheeta (Cooling) Vipaka: Madhura (Sweet post-digestive effect)
Doshic Karma	Vata-Pitta Shamaka (Balances Vata and Pitta)
Morphological Key	Prostrate herb; Globose schizocarpic fruit consisting of 5 woody cocci; 2 pairs of prominent spines (long/short).
Major Phytoconstituents	Steroidal Saponins: Protodioscin, Terrestrosins A-E, Gitiogenin.
	Alkaloids: Harman, Harmine. Flavonoids: Quercetin, Kaempferol, Rutin. Inorganics: High Nitrate and Potassium content.
Therapeutic Actions	Mootrala (Diuretic), Ashmarighna (Lithontriptic), Vrishya (Aphrodisiac), Rasayana (Rejuvenative).
Primary Indications	Mutrakricchra (Dysuria), Ashmari (Urinary Calculi), Klaibya (Erectile Dysfunction), Prameha (Diabetes/Urinary disorders).
Authenticated Source	Ayurvedic Pharmacopoeia of India (API), Part I, Vol I.

III. CONCLUSION

Tribulus terrestris, known as Gokshura, is an important medicinal plant in traditional medicine systems like Ayurveda and Unani. This review discusses its plant features, chemical makeup, and various health benefits. The plant is particularly noted for its ability to act as a diuretic and help with kidney stones, supporting its traditional use for urinary problems. Research shows that its healing effects come mainly from steroidal saponins, flavonoids, alkaloids, and essential minerals. Studies in labs and some early clinical research suggest that T. terrestris has several biological effects, including reducing inflammation, lowering blood sugar, fighting infections, and improving reproductive health. However, most evidence comes from lab tests and animal studies, with few well-designed clinical trials. It's also important to distinguish between Tribulus

terrestris (Chhota Gokshura) and Pedalium murex (Bada Gokshura) to ensure proper identification and use in treatment. While the plant shows promise for health benefits, more standardized clinical studies are needed to confirm its effectiveness, safety, and how it works in the body. In summary, Gokshura is a valuable medicinal plant that could have uses in modern medicine. Future research should focus on clinical testing, standardizing the extracts, and understanding the mechanisms behind its effects to establish its place in evidence-based medicine.

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