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# A Systematic Medico Historical Review of Gokshura (*Tribulus terrestris* L.): A Traditional Indian Medicine

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## ABSTRACT

**Objective:** This review aims to reveal the classic and experience-based traditional uses of *Gokshura* for health and wellness, and emphasizes the pharmacological and biochemical scientific evidence to confirm them.
**Data Source:** The available literature on *Gokshura* from original Ayurvedic scriptures, classical Ayurvedic texts from different periods, Indian Ayurvedic Pharmacopoeia, and scientific databases such as ScienceDirect, PubMed, and Google Scholar, with *Gokshura* and *T.terrestris* as keywords were searched to determine the basis of the Latin scientific name, the correct identity, properties, pharmacological actions and clinical uses.
**Review Methods:** In search of scientific evidence of use, international and national journals and other published materials were also searched to pique the curiosity of academics interested in Ayurvedic medicinal plants. This article reveals the ancient brilliance behind the therapeutic use of a promising plant, *Gokshura* from ancient India, to date. Several bioactive phytoconstituents, which include steroids, saponin, flavonoids, alkaloids, glycosides, and unsaturated acids, were isolated and recognized from *Gokshura* which might be responsible singly or in compound form for numerous pharmacological activities, and traditional application confirms that the basic principles of available Ayurvedic classics in various periods in India have been too scientific, and authentic.
**Conclusion:** In this research work, it was found that *Gokshura* overcome diseases of *Mutravaha srotasa* (Urinary Tract Disorders) and other systems. Various simple and compound preparations can reasonably maintain health and are used as analgesic, diuretic, anti-inflammatory, aphrodisiac, and rejuvenator.

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## 1. INTRODUCTION

*Gokshura* has been identified as *Tribulus terrestris* L. (Family: *Zygophyllaceae*), an annual, rarely perennial, prostate herb and common weed grass land, roadsides, and other wastelands [1]. It is native to the Mediterranean region and is widely distributed around the world from 35° south latitudes to 47°northlatitude [2]. *Zygophyllaceae* is a family of flowering plants that contain legumes and thistles. This family includes 22 genera and about 285 species [3]. Tribulus comes from the Latin *tribo*, which means "tear", and is the Latin name for "caltrop", referring to the shape of the fruit of this plant resembling a barbed metal ball used as a throwing weapon in medieval wars at the foot of a horse; *Terrestris* in Latin means the "earth" and refers to the creeping growth habit of plants [4]. The plant grows to 90 cm in length [Fig. 1]. The fruit is globose, consisting of 5-12 woody cocci, each with two pairs of hard, sharp, and forked spines, one pair being longer than the other. There are several seeds in each coconut and there are horizontal partitions between them [5]. Physicians are the implementers of clinical drug management, and they play an irreplaceable role in promoting the improvement of rational drug use. Selection of authentic drug is an important aspect of Ayurvedic medical practice. Selection of the authentic drug for treatment purpose should always be judicious and should follow specified guidelines in order to attain success in the treatment. The purpose for the review is to provide a comprehensive view regarding the utility of *Gokshura* according to the Ayurvedic literature as well as contemporary sciences.

## 2. MATERIALS AND METHODS

The full review of original *Ayurvedic* scriptures, classical *Ayurvedic* texts from different periods, Indian Ayurvedic Pharmacopoeia, and scientific databases such as Science Direct, PubMed, SciFinder, and Google Scholar, with *Gokshura* and *T. terrestris* as keywords, focusing on botany, literature, and pharmacology was done. Some published data were reviewed and data related to the title of the manuscript and the purpose of the research was selected. A total of 513 articles were reviewed in this regard and out of them 59 were selected to write the review. Also, 23 original *Ayurvedic* scriptures and classical *Ayurvedic* texts were used.


**Fig. 1. Showing A. Whole Fresh plant of *T. terrestris* Linn. B. Whole Dry plant of *T. terrestris* Linn.**

## 3. SIGNIFICANCE OF THE NAME-*GOKSHURA* AND ITS SYNONYMS AND VERNACULAR NAMES

*Gokshura* is a Sanskrit word that means that its fruit will damage the legs of grazing cows because they have thorns. Other synonyms used are: *Ikshugandhika*, which means that it, has the aroma of sugarcane; *Sthalashringataka*, which means that it has fruits similar to water chestnuts; Except for the usual five parts (i.e., root, stem, leaf, fruit, flower) Also, *Shadanga* has the sixth part, the thorn; *Chanadruma* leaves are like the leaves of the Bengal gram plant [Fig. 2] [6].

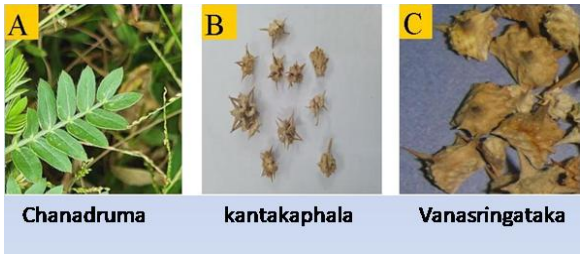


**Fig. 2. Showing Synonyms of *Gokshura* A. *Chanadruma* (Leaves looking like leaves of Gram) B. *Kantakaphala* (Spiny fruits) C. *Vanasringataka* (Fruits similar to Trapa fruits)**

## 4. THE BASIC PHARMACEUTICAL FORMS OF *GOKSHURA* IN *AYURVEDA*

The useful parts of the *Gokshura* plant used for medicinal purposes are the fruit and *Panchanga* (five parts, namely stem, root, leaf, fruit, flower) [7]. In addition, the five forms of essential medicines as a single preparation of *Ayurvedic* medicine are *Svarasa* (juice) , *Kalka* (paste), *Shrita* (decoction), *Shita* (cold infusion) and *Phanta* (hot infusion) [8]. It is important here that the above five basic pharmaceutical forms are prescribed according to the condition of the disease and the physical strength of the patient.

## 5. CLASSIFICATION OF GOKSHURA IN VARIOUS VARGAS ACCORDING TO DIFFERENT AYURVEDIC TEXTS

*Gokshura* is mentioned in various *Vargas* in various *Ayurvedic* texts as per its different uses and properties.

## 6. DIFFERENT KINDS OF GOKSHURA

Many kinds of *Gokshura* do not appear in the *Brihattrayi* of the *Ayurvedic* text, i.e., *Charaka Samhita*, *Sushruta Samhita*, and *Ashtanga Hridaya*. *Bhavamishra* considers only one type of *Gokshura* in his work [9]. According to *Priyavrata Sharma*, another species of *Gokshura* as *Brihatgokshura* is also famous throughout the country, and it has been identified as *Pedalium murex* Linn. (Floral-plants). According to him, this variant is considered *Shrangika* in various Ayurvedic texts [6]. In *Raj Nighantu*, two types of Gokshura mentioned having the same characteristics [10]. *Shankara Nighantu* also mentions the same two types of *Gokshura* as before [11]. According *to Nighantu Adarsha*, there are three types of *Gokshura*, viz. *Kshudra-gokshura, Brihatgokshura*, and *Gokshura-kalaan*, the latter of which is identified as *Xanthium strumarium* [Fig. 3]. This last variety is not used for medicinal purposes [7].

## 7. RASA PANCHAKA (PENTA PRINCIPLES OF AYURVEDIC DRUG ACTION) OF *GOKSHURA*

Properties of drugs are mentioned as per *Rasa Panchaka*, which consists of *Rasa, Guna, Virya, Vipaka* and *Prabhava* in *Ayurveda*. According to different texts *Rasapanchaka* and *Karma* (actions) of *Gokshura* mentioned [Table 1,2] .

## 8. *GOKSHURA* FOR HEALTH AND WELL-BEING IN *AYURVEDA*

The meaning of *Gokshura* as *Vrushya* (aphrodisiac) and *Mutravirechaniya* (diuretic) was first explained in *Charaka Samhita* and *Sushruta Samhita* based on their characteristics. When describing drugs and their effects, the terms "*Mutrala*" and "*Mutravirechaniya*" seem to be very similar, although their understanding is slightly different. *Mutrala dravyas* are those that increase urine output but do not necessarily excrete urine. However, *Mutravirechaniya dravyas* are substances that are easily excreted from the body regardless of the amount of urine produced [12].

### 8.1 *Charaka Samhita* (1000 BCE)

In *Charaka Samhita*, *Gokshura* is designated as *Mutravirechaniya* (diuretic), *Shothahara* (edemareliever), *Krimighna* (Antihelmenthic),Use *Gokshura* boiled milk to check for bleeding, especially the urethral [8]. In addition, this original manuscript also mentioned various formulations of *Gokshura* in compound [8].

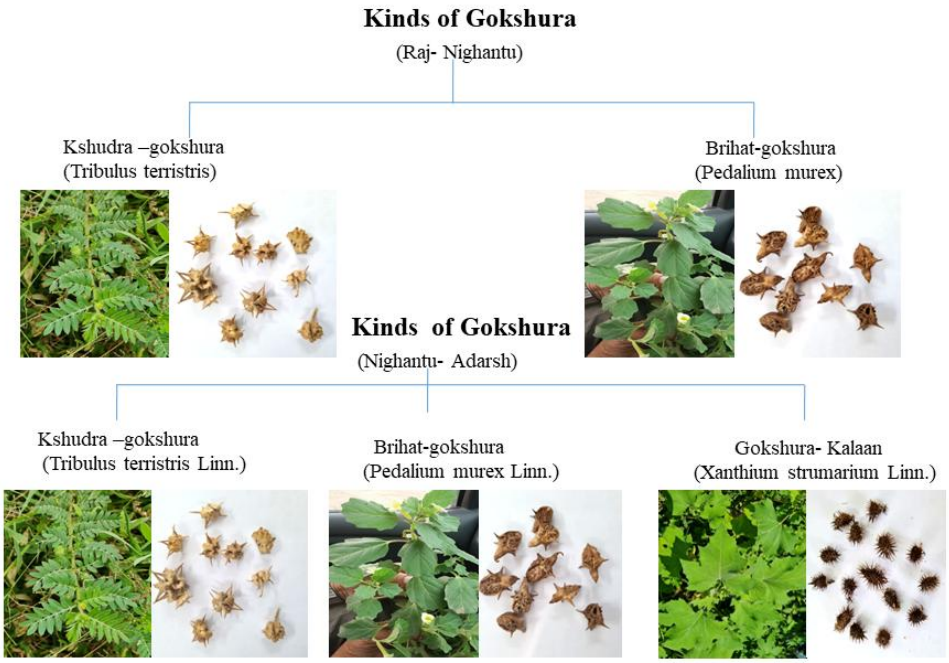


**Fig. 3. Kinds of Gokshura**

**Table 1. Rasa Panchaka of Gokshura according to different Ayurvedic texts**

| Nighantus (Lexicons) | ***Rasa*** **(Taste)** | ***Guna*** **(Property)** | ***Virya*** **(Potency)** | ***Vipaka*** **(Biotransformation of drug)** | ***Prabhava*** **(Specific potency)** |
|---|---|---|---|---|---|
| *Bhavaprakasha Nighantu* | *Madhura* | - | *Shita* | - | *Vatahara* |
| *Dhanvantari Nighantu* | - | - | | - | *Tridoshahara* |
| *Madanapala Nighantu* | *Madhura* | - | *Shita* | - | *Vatahara* |
| *Kaiyadeva Nighantu* | *Madhura* | - | *Shita* | - | *Kapha-vatahara* |
| *Priya Nighantu* | *Phala-Madhura* | - | *Mula-Ushna Phala-Shita* | - | *Mula- Vata-kaphahara* |
| *Nighantu Adarsha* | *Madhura, Tikta* | *Snigdha* | *Shita* | *Madhura* | *Vatahara* |
| *Shodhala Nighantu* | *Madhura* | - | - | *Madhura* | *Vata-pittahara* |
| *Madhava Dravyaguna* | - | - | - | - | *Vataghna* |
| *Mahaoushadha Nighantu* | *Madhura* | - | *Shita* | - | *Vatahara* |
| *Raj Nighantu* | *Madhura* | - | *Shita* | - | - |
| *Shankara Nighantu* | *Madhura, Tikta* | - | *Shita* | - | *Tridoshahara* |
| The Ayurvedic Pharmacopoeia of India | *Madhura, Tikta* | *Guru, Snigdha* | *Ushna* | *Madhura* | *Tridoshahara* |

**Table 2. Karma (Therapeutic action) of Gokshura according to various ayurvedic classics**

| ***Ayurvedic* Classics** | ***Karma (Therapeutic action)*** |
|---|---|
| *Charaka Samhita* | *Krimighna, Shothahara, Mutravirechaniya,* |
| *Ashtanga Sangraha* | *Krimighna, Shothahara, Mutravirechaniya* |
| *Bhavaprakasha Nighantu* | *Vatahara, Bala-krut, Basti-shodhana, Dipana, Vrushya, Pushtida, Ashmarihara, Pramehahara, Shvasa-kasahara, Arshahara, Mutrakricchahara, Hridrogahara,* |
| *Dhanvantari Nighantu* | *Tridoshahara, Bringhana, Vrushya, Dipana, Shulahara, Hridrogahara, Mutrakricchahara, Pramehahara* |
| *Madanapala Nighantu* | *Vatahara* |
| *Kaiyadeva Nighantu* | *Kapha-vatahara* |
| *Priya Nighantu* | *Phala- Balya, Vrushya, Mutrala*<br>*Mula- Vata-kaphahara* |
| *Nighantu Adarsha* | *Vatahara, Balya, Vrushya, Mutrala, Ashmarihara, Pramehahara, Shvasahara, Mutrakricchahara, Hridrogahara, Rasayana* |
| *Shodhala Nighantu* | *Vata-pittahara, Balya, Vrushya, Mutrashodhana, Mutrakrichhaghna,* |
| *Madhava Dravyaguna* | *Vataghna, Vrushya, Balya, Mutrakricchahara* |
| *Mahaoushadha Nighantu* | *Vatahara, Balya, Bastishodhana, Dipana, Bringhana, Vrushya, Pushtida, Ashmarihara, Pramehahara, Shvasa-kasahara, Arshahara, Mutrakricchahara, Hridrogahara* |
| *Raj Nighantu* | *Balya, Bringhana, Mutrakricchahara, Ashmarihara, Pramehahara, Vidahahara, Rasayana* |
| *Shankara Nighantu* | *Tridoshahara, Balya, Bringhana, Mutrakricchahara, Ashmarihara, Pramehahara, Dahahara, Bastishodhana, Vrushya, Dipana, Shvasa-kasahara, Hridrogahara, Arshahara, Kusthahara, Shulahara, Bastivatahara, Rasayana* |
| The Ayurvedic Pharmacopoeia of India | *Tridoshahara, Balya, Bringhana, Dipana, Keshya, Mutrala, Shothahara, Vrushya, Vedanasthapana* |

### *8.2 Sushruta Samhita* (1000 BCE)

In *Sushruta Samhita, Gokshura* is mentioned under variety of groups such as *Vidarigandhadi Gana, Virtarvadi Gana, Madhura Varga, Laghu Panchamula, Kantaka Panchamula*. So many compound formulations in which *Gokshura* appears as an ingredient is mentioned in *Sushruta Samhita*. [13].

### *8.3 Ashtanga Hridaya* (600 AD)

*Ashtanga Hridaya* is a well-known book in medieval *Ayurvedic* classics, advocating the use of *Gokshura* to treat dysuria. *Vagbhata* has mentioned *Gokshura Rasayana*, as well as different formulations of *Rasayana* therapy. *Gokshura* also appears in various compound formulations in this document [14].

### *8.4 Bhavaprakasha* (1600 AD)

*Bhavaprakasha* written by *Bhavamishra* and divided into two parts. It suggests that people should take the *Gokshura* seed decoction mixed with *Yavakshara*, Relieves dysuria, gravel and urolithiasis. *Gokshura* whole herb soup mixed with sugar and honey can alleviate all types of dysuria and *Ushnavata*. *Gokshura*, *Varuna* and *Shunthi* soup should be taken with honey [15,16].

### *8.5 Amarakosha* (500 AD)

In this book, the whole topic is divided into three parts. Its first two parts each consist of ten

chapters, while the last part has five chapters. *Gokshura* is mentioned in the second part of the *Vanaoushadhi Varga* drug group [17].

### *8.6 Vrindamadhava* (900 AD)

In this book*Vrinda Madhava* mentioned that milk boiled with it can be used to control bleeding. A decoction mixed with *Gokshura* and *Yavakshara* seeds treats *Sharkara*, dysuria, and urolithiasis. *Gokshura, Ikshuraka, Shatavari, Kapikacchu, Nagabala,* and *Atibala.* This powder is a good aphrodisiac when taken with milk at night [18,19].

### *8.7 Nighantu*

*Nighantu* is a unique ingredient in the field of *Ayurveda*. Food substances are reused for energy and physical development, while medicines are used to relieve diseases [20].

#### *8.7.1 Dhanvantari Nighantu* (10th -13th Century AD)

It is believed to be written by *Mahindra Bhogika*. *Gokshura* is mentioned in the *Guduchyadi Varga* drug group [21].

#### *8.7.2 Shodhala Nighantu* (12th Century AD)

This work by *Acharya Shodhala* describes *Gokshura* in *Guduchyadi Varga* and *Hrasva Panchamula* as *Gokanta*. He believes that it is best for pacifying *Pitta* and pacifying *Vata* [22].

#### *8.7.3 Abhidhanaratnamala* or *Shadrasa Nighantu* (13th Century AD)

*Gokshura* is mentioned in the medicine *Svadu Skandha* (with the sweet taste of medicine) [23].

#### *8.7.4 Madhava Dravyaguna* (13th Century AD)

This work by *Madhava Kara* placed *Gokshura* under the *Vividh aoushadhi Varga* drug group. In this work, *Gokshura* is considered *Vrushya* (aphrodisiac), *Balya* (strength booster), and helps to treat *Mutrakriccha* (dysuria) [24].

#### *8.7.5 Hridaya Dipaka Nighantu* (13th Century AD)

This work was composed by Acharya *Bopadeva*. *Gokshura* is listed in this with the drugs of the *Doshagna Varga* group [25].

#### *8.7.6 Madanapala Nighantu* (14th Century AD)

In this work, *Gokshura* is mentioned in the drugs of the group *Abhayadi Varga*.Its properties and synonyms are mentioned as mentioned above, and its principled *Doshakarma* is believed to be *Vatahara* [26].

#### *8.7.7 Kaiyadeva Nighantu (Pathyapathya Vibodhaka)* (15th Century AD)

In this *Nighantu*, *Gokshura* is referred to as a drug in the *Oushadhadi Varga* group synonymous with the properties mentioned above. Regarding *Doshas'* actions, according to this work, it is considered *Kaphavata Shamaka* [27].

#### *8.7.8 Raj Nighantu (Nighantu Raj/ Abhidhana Chudamani)* (17th Century AD)

This *Nighantu* was composed by *Acharya Narahari Pandita*. A drug called *Gokshura* is listed in the *Shahatvadi Varga* group of drugs. As mentioned earlier, this work has two types of *Gokshura*, along with properties and synonyms [10].

#### *8.7.9 Mahaoushadha Nighantu* (19th Century AD)

The author of this work is *Pandita Aryadas Kumar Singh*. *Gokshura* is mentioned synonymously with its characteristics as a constraint of the *Bilvadi Varga* group [28].

#### *8.7.10 Nighantu Adarsha* (20th Century AD)

The author of this work is *Vaidya Bapalal*. This work is a stand-out work for identification of various drugs. *Gokshura* is mentioned in *Pataladi Varga* group of drugs along with its properties, therapeutical uses and synonyms along with its three types in this work [7].

#### *8.7.11 Saraswati Nighantu* (20th Century AD)

The work of Dr. S.D. Kamath describes *Gokshura* in *Ulapadi Varga* group along with its synonyms. In this work there is a separate mention of *Ikshugandha* with synonyms and citing *Gokshura* [29].

#### *8.7.12 Priya Nighantu* (20th Century AD)

*Acharya Priyavrata Sharma* in his work *Priya Nighantu*, describes *Gokshura* in *Haritakyadi*

*Varga* group of drugs. it is known as *Vanashringhataka*; and as it is similar to molars of dog, it is known as *Shvadamshtra*. He has also mentioned botanical description of the plant along with its properties and therapeutical uses [19].

#### *8.7.13 Shankara Nighantu* (1983)

This work composed by *Pandita Shankardutta Goud.* There are two types of *Gokshura* according to this work. Botanical description of both the types is mentioned in this work too [30].

## 9. DESCRIPTION OF *GOKSHURA* IN THE AYURVEDIC PHARMACOPOEIA OF INDIA

*T. terrestris* is included as a monograph in *The Ayurvedic Pharmacopoeia of India* Part-I & Volume VI and mentioned along with its definition, synonyms, macroscopic and microscopic description, identity, purity and strength, assay, constituents, properties and actions, important formulations, therapeutic uses and dose [1].

### 9.1 Purity and Strength

Foreign matter should not be more than 2%. Total ash value should not exceed more than 1% whereas acid-soluble ash should not exceed more than 4%.

### 9.2 Active Constituents

*T. terrestris* contains alkaloids as *terrestriamide*, *tribulusamide* A, B. Also it has steroidal *saponin* namely *terrestrosin* C, D, E, F, G, H, I, J and K, *terrestroneoside* A and F, *terreside* A and B, *terrestroside* F; *tribulosaponin* A and B, *tribulosin*, *protodioscin saponin* C, *prototribestin*, *terrestrosin J, isoterrestrosin B.* It also contains flavonoid glycosides namely *isorhamnetin-3-gentiotrioside, quercetin-3-gentiobioside-7-glucoside*. Additionally, it also has amide in the form of *moupinamide* [1].

Active constituents according to different parts of *T. terrestris* (Table 3).

## 10. PHARMACOLOGICAL ACTIONS AND SCIENTIFIC EVIDENCE OF CLASSICAL USES OF *GOKSHURA*

On a review, it was found that the following biochemical & pharmacological activities has been published:

### 10.1 Anthelminthic activity

The methanolic extract was found to be more effective than the petroleum ether, chloroform, and water extracts for *in vitro* anthelmintic activity on the nematode *Caenorhabditis elegans*. Further bioactivity-guided fractionation confirmed *tribulosin* and *β-sitosterol-d-glucoside* to be the active components with $ED_{50}$ of 76.25 and 82.50 µg/ml, respectively [31,69].

### 10.2 Antibacterial Activity and Antifungal Activity

The ethanol extract showed antimicrobial activity against both gram-positive and gram-negative bacteria and antifungal activity [32]. The methanolic extract of fruit was found to be most active against gram-positive and gram-negative bacteria, while moderate activity was observed in its petroleum ether extract and chloroform extract [70]. Chloroform extract of the dried entire plant, on an agar plate, was active on *Mycobacterium phlei*, MIC 41.6 gm/liter [34]. Hot water extract of the dried entire plant was also found to be active on *Candida albicans* [39].

**Table 3. Active constituents according to different parts of *T. terrestris***

| Part | Active Constituents |
|---|---|
| Aerial parts | *Quercetin 3-O-glycoside, quercetin 3-O-rutinoside, kaempferol 3-O-glycoside* [65] |
| Leaves | *Kaempferol, kaempferol-3-glucoside, kaempferol-3-rutinoside, tribuloside* [66] |
| Fruits | *Kaempferol, kaempferol-3-glucoside, kaempferol-3-rutinoside, tribuloside* [66] , *terrestribisamide, 25R-spirot-4-en-3,12–dione, tribulusterine* [67] |

## 10.3 Antifilarial Activity

Hot water extract of the plant, in a mixture with *Melia rachta (15%), Sida cordifolia (15%), T. terrestris (12%), Terminalia chebula (39%),* and *Tinospora cordifolia* (19%), at a concentration of 100 mcg/ml, produced weak activity on *Acanthocheilonemaviteae*. A concentration of 500 mcg/ml was active [33].

## 10.4 Anti-inflammatory Activity

The dried fruit, administered by gastric intubation to mice at a dose of 2 gm/kg in a preparation containing *Bombyx mori, Aconitum sinense, Alpinia species, Menthaarvensis,* and *Sophora flavescens,* was active versus dextran-induced pedal edema, leakage of dye into the peritoneal cavity and yeast-induced inflammation of the paw in a rat model [34]. The ethanolic extract of TT inhibited the expression of cyclooxygenase-2 (COX-2) and inducible nitric oxide synthase (iNOS) in lipopolysaccharide-stimulated RAW264.7 cells. It also suppressed the expression of proinflammatory cytokines such as tumor necrosis factor-alpha (TNF-α) and interleukin (IL)-4 in macrophage cell line. Thus, the ethanolic extract of TT inhibits the expression of mediators related to inflammation and expression of inflammatory cytokines, which has a beneficial effect on various inflammatory conditions [71].

## 10.5 Antispasmodic Activity

Ethanol (95%) extract of the entire plant, at a concentration of 10 mcg/ml, was active on guinea pig ileum versus Ach-, histamine-, and Barium chloride-induced spasms [35]. The lyophilized saponin mixture of the plant exhibited a significant decrease in peristaltic movements of rabbit jejunum preparation in a dose-dependent manner. These results showed that the saponin mixture may be useful for smooth muscle spasms or colic pains [72].

## 10.6 Antitumor Activity

Water extract of the dried fruit, at a dose of 100 mg/kg was active on the mouse Sarcoma 180 (ASC) (H, 1988). There is a notable change in gene expression of CXCR4, CCR7, and BCL2 after the treatment of breast cancer cells with saponin extract from *T. terrestris* [36]. Saponins isolated from the aerial parts were studied for their cytostatic/cytotoxic activity on human fibroblasts. The saponins showed a dose-dependent decrease in $^{3H}$ thymidine incorporation into the DNA, indicating decreased proliferation [73]. The aqueous extract of TT blocked proliferation in HepG2 cells and could also induce apoptosis through the inhibition of nuclear factor kappa-light-chain-enhancer of activated B cells (NF-κB) signalling. Thus, *T. terrestris* has clinical therapeutic effects against liver cancer cells [74].

## 10.7 Anti-urolithiasis Activity

Ethanol (95%) extract of the dried fruit, administered intragastrically to rats at a dose of 25 mg/kg, was active versus seed-induced cystolithiasis. [37] An ethanolic extract of fruits was tested in urolithiasis induced by glass bead implantation in albino rats. It exhibited significant dose-dependent protection against deposition of calculogenic material around the glass bead, leukocytosis, and elevation in serum urea levels [75]. *T. terrestris* was found to inhibit stone formation in various models of urolithiasis using sodium glycolate and ethylene glycol [76].

## 10.8 Aphrodisiac Activity

Phytochemical and pharmacological studies in humans and animals revealed an important role for *T. terrestris* in treating erectile dysfunction and sexual desire problems. It was also reported that the drug *T. terrestris* has more potential than *Ashvagandha* and *Kapikachhu*. All three drugs are good enhancers of sexual function and behavior by increasing the testosterone levels and regulating the NF-κB and Nrf2/HO–1 pathway in male rats [38] The two main components of the saponin fraction from the plant, namely *protodioscin* and *protogracillin*, are responsible for the observed biological aphrodisiac activity [77] Ethanolic extract exhibited protective effect against cadmium-induced testicular damage. The protective effect appears to be mediated directly either through inhibition of testicular tissue peroxidation by antioxidant and metal chelating activity or by stimulating the testosterone production from Leydig cells [78].

## 10.9 Benign Prostatic Hyperplasia Improvement

Hot water extract of the dried entire plant, in a preparation that also contained *Orchis mascula, Lactucaserriola, Astercantha longifolia, Macuna Pruriens, Oarmeliaperlata, Argyreia speciosa,*

*Leptadenia reticulata*, and gold, was taken orally by 45 patients with prostatitis and 10 patients serving as untreated controls. Of the 38 patients with benign hyperplasia in the test group, 28 improved and did not need surgery. All of the controls needed surgery [40].

### 10.10 Cardiotonic Activity

The *tribulosin* reduced the myocardial apoptosis rate and treated rats showed reduced MDA, AST, CK, CDH contents with elevated activity of SOD. The major phytochemical saponin is positive in response to dilate the coronary artery and improves circulation in blood vessels [41] *T. terrestris* also appears to protect the heart cells and may even improve the heart function following a heart attack [83].

### 10.11 Diuretic Activity

Hot water extract of the plant, administered intraperitoneally to male rats at a dose of 0.2 ml/animal, was active. The duration of action was 60 minutes [42] The aqueous extract of it in an oral dose of 5 gm/kg elicited a positive diuresis, which was slightly more than that of furosemide. In addition to its diuretic activity, it had evoked a contractile activity on the Guinea pig ileum [43] Different extracts of fruits, viz. aqueous, methanolic, *Kwatha*-high strength, *Kwatha*-low strength, and *Ghana* powder, were examined for diuretic activity in rats. *Kwatha*-high strength showed diuretic effect comparable to that of the reference standard frusemide and also exhibited additional advantage of potassium-sparing effect [68].

### 10.12 Hypocholesterolemic Activity

The extract (aqueous) of the fruits of *T. terrestris* was evaluated for the hypolipidemic activity in Wistar albino rats with a decrease in cholesterol, triglycerides, low-density lipoprotein (LDL), very-low-density lipoprotein (VLDL), and atherogenic index (AI), and an increase in high-density lipoprotein (HDL) levels in the blood. Hypolipidemic activity may be due to the presence of phenolic compounds [44]. Saponins from the drug were studied on diet-induced hyperlipidemia in mice for its preventive and therapeutic effect. The preventive effect was demonstrated by decrease in the levels of serum total cholesterol (TC) and LDL-cholesterol. It also reduced the liver TC and triglycerides and increased the activity of SOD in the liver. It showed therapeutic effect by significantly reducing the serum TC and liver TC [81].

### 10.13 Hypotensive Activity

Ethanol (95%) extract of the dried entire plant, administered intraperitoneally to mice and intravenously to rabbits at a dose of 500 mg/kg was active [45]. A dose of 50 mg/kg, administered intravenously to dogs, was effective [46]. Methanolic and aqueous extracts are shown to possess significant antihypertensive activity by direct arterial smooth muscle relaxation and membrane hyperpolarization in spontaneously hypertensive rats [82].

### 10.14 Immunomodulatory Effect

An alcoholic extract of the whole plant of *T. terrestris* exhibited a significant dose-dependent increase in humoral antibody titer and delayed-type hypersensitivity response, indicating increased specific immune response [47].

### 10.15 Antidiabetic Activity

The decoction of *T. terrestris* showed inhibition of gluconeogenesis in mice [48]. Saponin from the drug possesses hypoglycemic properties [79]. Ethanolic extract of TT exhibited 70% inhibition of α-glucosidase at 500 µg/ml using maltose as the substrate and 100% inhibition of aldose reductase at a dose of 30 µg/ml using dl-glyceraldehyde as the substrate [80].

### 10.16 Sclerosing Effect

Saponin fraction of the dried leaf, administered intravenously to adults, was active. The biological activity has been patented [49].

### 10.17 Skeletal Muscle Relaxant Activity

Ethanol (95%) extract of the entire plant, administered intraperitoneally to mice at a dose of 300 mg/kg was active [50].

### 10.18 Toxicity

The methanol extract of the plant showed cytotoxic effects, the others did not show the same. The water extract showed genotoxic and estrogenic effects, while the other extracts had anti-estrogenic properties [51].

### 10.19 Anti-oxidant and Protective Activity

The drug showed the anti-oxidant properties in DPPH and FRAPS methods [52].

## 11. CLINICAL TRIALS ON *GOKSHURA*

A good number of clinical trials have been done on *Gokshura*, which are as: sexual dysfunction activity in women, [53] Erectile Dysfunction and LUTS (Lower Urinary Tract Symptoms) in late-onset hypogonadism activity, [54] Male sexual dysfunction activity, [55] Hypoglycemic and hypolipidemic activity on women with Diabetes Mellitus, [56] Benign Prostatic Hyperplasia, [57,58] Microalbuminuria in Diabetes mellitus, [59] Oligozoospermic activity, [60] Menopausal transition symptoms, [61] Nephrolithiasis [62].

## 12. DISCUSSION

This review finds that for medicinal purposes all the parts of *Gokshura* have been used extraneously. During the review, we found that *Gokshura* was present in most of the classical textbooks with the name *Gokshura*, *Svadanstra*, and *Trikantaka*.

As stated in this review it is clear that *Gokshura* is designated as *Mutravirechaniya* (diuretic), *Shothahara* (anti-inflammatory), *Krimighna* (Anthelminthic), *Anuvasanopaga* (unctuous enema) [7]*Vrushya* (Aphrodisiac), [8] *Bala-krut* (Strength promotor), *Basti-shodhana* (Intestinal cleanser), *Dipana* (Appetizer), *Pushtida* (Strength promotor), *Ashmarihara* (Anti-urolithiasis), *Pramehahara* (Anti-diabetic), *Shvasahara-Kasahara* (Improve respiratory diseases), *Arshahara* (Piles), *Mutrakricchahara* (Improve Urinary tract infection), *Hridrogahara* (Cardiac protective),[16] *Bringhana* (Growth promotor), *Shulahara* (Pain reliever)[10],*Vatahara (pacifies Vatadosha),* [11] *Tridoshahara* (Pacifies all doshas), *Dahahara* (Improve burning sensation), *Kusthahara* (Improve skin diseases),and *Rasayana* (Rejuvenator) [26].

*Gokshura* (T. terrestris) has been shown to exhibit anthelmintic, [31,69] antifungal and antimicrobial activity against Gram-positive and Gram-negative bacteria, [32,34,39,70] anti-urolithiasis activity, [37,75,76] aphrodisiac activity, [38,77,78] anti-inflammatory, [34,71] diuretic, [42,43,68] hypotensive, [45,46,82] anti-diabetic activity, [48,79,80] cardiotonic activity, [41,83] anti-hyperlipidemic, [44,81] anti-tumor, [36,73,74] immunomodulatory, [47] antioxidant [52].

Just as scientific verification in clinical cases confirmed the empirical use mentioned in Ayurveda, it has been confirmed in scientific platform, as shown below; female sexual dysfunction, [53] late-onset gonads Erectile dysfunction, and LUTS (lower urinary tract symptoms) of hypo function, hypoglycemia and hypolipidemic effects in diabetic women, [72] benign prostatic hyperplasia, [57,59] Microalbuminuria in diabetes, [58] menopausal transition symptoms, [61] kidney stones [62].

*T. terrestris* contains biologically – rich compounds as steroids, saponin, flavonoids, alkaloids, glycosides, and unsaturated acids, which are involved in promoting numerous physiological responses [63]. A large number of furosterol glycosides are found, including protodiasaponins and proanthocyanidins, which are important for the treatment of erectile dysfunction [64].

## 13. CONCLUSION

The plant *Gokshura* has been used since centuries in Ayurvedic system of Medicine. It has been used to treat sexual disorders. *Gokshura* has long been used in traditional medicine to relieve urinary tract diseases, diabetes, worms, piles, and as an anti-inflammatory, and analgesic plant. It is concluded that T. terrestris has anti-inflammatory, analgesic, diuretic, aphrodisiac, and rejuvenator effects.

## CONSENT

It's not applicable.

## ETHICAL APPROVAL

It's not applicable.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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