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Tribulus Terrestris: An Important Medicinal Herb of Indian Desert

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Abstract: *Tribulus terrestris* L. (Family Zygophyllaceae), commonly known as Small Caltrop or Chhota Gokhru, growing wildly in sandy areas is known for its medicinal uses in traditional medicine system. The fruit, leaves, stem and root of the plant are used medicinally. *T. terrestris* possessed many pharmacological attributes such as nephroprotective, aphrodisiac, anti-inflammatory, anti-oxidant, antimicrobial and insecticidal activities. These marvellous bioactivities of the *T. terrestris* can be attributed to the presence of a wide range of phytochemicals including flavonoids, flavonol glycosides, steroidal saponins, and alkaloids. The dried fruit of the herb is very effective in most of the genitourinary tract disorders. The present study highlights the potency of *T. terrestris* in controlling the reproductive disorders, mainly impotence, nocturnal emissions, erectile dysfunction in men and gonorrhoea in women. In addition, it acts as a diuretic and provides remedy for urinary tract disorders. The present study provides a comprehensive overview of the phytochemistry, folk medicinal uses and pharmacological aspects of *T. terrestris*. The information will be helpful in developing the new formulation with therapeutic and economic value in the future.

Keywords: Aphrodisiac, Diuretic, Gokhru,, Genitourinary diseases, Nephroprotective, Pharmacology

I. INTRODUCTION

Indian desert located in the north-west part of the Rajasthan state representing an environment with limited sources. Limited and erratic nature of rainfall, extreme temperatures with large diurnal and seasonal variation, strong solar radiations, low relative humidity and high wind velocity are some of the noteworthy climatic features of this desert.[1],[2] The soil is poor in organic matter with very low productivity. In spite of these extreme conditions, this unique region has many important medicinal plants which are very useful in various diseases. The use of various plants had already been reported in the traditional medicinal system. *T. terrestris* is also such a wonderful plant that has manifold importance.

T. terrestris is an annual herb found in Mediterranean, subtropical and arid climate regions around the world including South America, Mexico, Bulgaria, Spain, India and China.[3],[4] It is a common weed of pasturelands, roadsides and other barren places mainly in hot, dry and sandy regions in India including western Rajasthan and Gujarat.[5] It grows on almost any type of soil, but grows best in dry, loose, sandy soil and in loose soil near sand dunes or around the edges of fields. It also grows in heavy soils, especially when they are fertile or moist, and on narrow soils such as along roadsides.[6] It has many common names like *Gokshur* (Sanskrit); puncture vine, land caltrop (English); *Gokharu* (Hindi); *Nanagokharu* (Gujrati); *Nerinjil* (Tamil); and *Khar-e-khusak khurd* (Urdu).[7] In Rajasthan it is commonly known as *Bhankhdi* or *Chhoto gokhru*. It is a medicinal herb that has been used in traditional Chinese, Siddha, Unani and Indian medicines and is now considered as one of the most popular aphrodisiacs.[8] The fruits and seeds are of great importance and used as an aphrodisiac, diuretic, anthelmintic and to treat cough and urinary infections.[9],[10] The plant parts have different pharmacological activities including antimicrobial, anti-inflammatory, anthelmintic aphrodisiac and antioxidant potential.[11] Although used as traditional medicine for centuries, *Tribulus* supplements have recently become popular. It is used in many countries as a dietary supplement against sexual impotency, oedema, abdominal distention and cardiovascular diseases.[12] It is also used by athletes to increase muscle strength and improve performance in sports.[13],[14] The plant is used individually as a single therapeutic agent or as a major or subordinate component of many compound formulations and food supplements.[8]

II. TAXONOMY

The genus *Tribulus*, belonging to family Zygophyllaceae, consists of about 20 species in the world, of which three species, viz. *Tribulus terrestris*, *Tribulus cystoides*, and *Tribulus alatus*, are common in India.[15] Among them, *Tribulus terrestris* is a well-established and widely spread species of *Tribulus* genus and is a well-preserved medicinal herb by Ayurvedic seers as well as modern herbalists.[16]

III. MORPHOLOGY

Tribulus terrestris is a prostrate or procumbent, 10-60 cm height annual hirsute and branched herb. The stems and branches are pilose and young parts are silky-villous. Leaves are stipulate, opposite usually unequal and abruptly pinnate. Leaflets are 5-8 pairs, oblong to linear oblong and mucronate; petioles very short and pilose. Flowers are yellow in color. Fruits are faint greenish yellow with spines [Figure 1]. They are small, globose, consisting of five wedge-shaped woody cocci, each with two pairs of hard sharp spines, one pair longer than the other. Tips of spines almost meet in pairs together forming pentagonal framework around the fruit. There are several seeds in each coccus, with transverse partitions between them. The seeds are oily in nature. Fruits and roots are mainly used as a folk medicine for the treatment of various ailments. The root is slender, fibrous, cylindrical and frequently branched, bears a number of small rootlets and is light brown in colour.[9]



Figure 1: Whole Plant of *Tribulus terrestris* with flower and fruit

IV. TRADITIONAL MEDICINAL USES

Gokshur or *Gokharu* or puncture vine has been used since ancient times in the traditional medicine of major cultures, such as traditional Indian medicine (Ayurveda) and traditional Chinese medicine and the traditional medicine of south-eastern Europe. In India, *T. terrestris* is used in folk medicine as a tonic and diuretic. The fruit, root and whole plant of *T. terrestris* alone or in combination with other medicinal plants are widely used in Ayurvedic medicine for the treatment of genital-urinary disorders ranging from difficulty urinating to urinary stones and sexual debility.[17] Simple and multi-ingredient formulations made of Gokshura are listed in the Ayurvedic Formulary [18] and Pharmacopoeia of India.[19] It is an important component of Gokshuradi Guggul, a powerful Ayurvedic medicine used to support the proper functioning of the genital tract and remove urinary stones.[9],[20] The leaves are rich in Calcium, provide a cheap supplement to rice diets.[21] It has potential and also used in eczema, psoriasis, high blood pressure, liver and eye diseases, Parkinson's disease and benign prostatic hyperplasia.[22]-[27] The plant can improve male sexual function[28] and the performance of athletes.[29] In addition, the roots and fruits are considered to have cardiotoxic properties. In Kashmir, a tea is made out to treat all kinds of fevers.

In Traditional Chinese medicine, the fruits of *T. terrestris* are used to tone the kidneys and as a diuretic and cough expectorant. They are also used to improve vision and treat itching of the skin, headache, vertigo, blockage of the mammary duct and against sexual impotence.[30] *T. terrestris* is described as a highly valuable drug in the Shern-Nong Pharmacopoeia in restoring the depressed liver, for treatment of fullness in the chest, mastitis, flatulence, acute conjunctivitis, headache, and vitiligo. In Unani medicine, *T. terrestris* is used as diuretic, mild laxative, and general tonic.[31] In Siddha medicine, it is used in the form of decoction to treat urinary tract infections, urolithiasis, dysmenorrhoeal and edema. In Sudan, *T. terrestris* has been used as demulcent and in nephritis and the treatment of inflammatory disorders.[32] In addition, it has been used for diuretic and uricosuric effects in Pakistan. In Bulgaria, the plant is used as a folk medicine for treating impotence.

The entire plant and particularly the fruits are extensively used in Indian desert for the treatment of various diseases. Harvested plant material is dried in the sun or with a dryer. It is then finely ground with a grinder and sifted through a sieve to remove fibre and wood particles. The powder is kept in an air tight container to protect it from moisture.

To prepare the decoction of *Gokshura*, 20 to 30 grams of powder is boiled in 160 to 240 ml of water until one-fourth of the liquid remains. This decoction should be consumed fresh.[33] The dried fruits of *T. terrestris* and *Pedaliium murex* are grinded and mixed with sugar to make *laddus* which is taken 2-3 times in a day for increasing the vigor in men.[34] In Shekhawati region of Rajasthan, fruit powder of *T. terrestris* is mixed with *Sesamum indicum* seeds and taken orally with water by the rural men to cure impotency. Fruit powder is given orally to cure urinary disorders and mixed with sugar is given for easy delivery.[35]

V. PHYTOCHEMISTRY

Gokshura has cooling, diuretic, anti-urolithiatic, styptic, antimicrobial, muscle relaxant, aphrodisiac, emollient, anti-inflammatory and cytoprotective properties.[36] The fruit and root of *T. terrestris* contain many different compounds with a variety of biological properties and chemical structures including saponins, flavonoids, glycosides, alkaloids, tannins, terpenoids, amino acids, and proteins.[37]-[39] Among the different types of constituents, steroidal saponins and flavonoids are considered to be the most important metabolites with various bioactivities. The flavonoids are mainly derivatives of quercetin, kaempferol and isorhamnetin. It has been found that the genus *Tribulus* is rich in biologically active furostane, cholestane and spirostane type steroidal saponins.[40] The quantities and presence of these important metabolites depend on the various parts of the plant used. The fruit and root of *T. terrestris* contains pharmacologically important metabolites.

VI. NEPHROPROTECTIVE ACTIVITY

Gokshura is indicated for burning urination, difficulty in passing urine, decreased urination, urinary crystals and stones, albuminuria, haematuria and spermaturia. It is useful for improving the urinary function and management of urinary complaints resulting from inflammation, infection, calculi and abnormal discharge.³³ Calcium oxalate monohydrate and calcium oxalate dihydrate containing stones (calculi) are commonly found as urinary stones. *T. terrestris* is used in India as herbal medicine for urinary stones. The diuretic action and contractile effects makes it useful in the propulsion of urinary stones.[20],[41]

VII. APHRODISIAC ACTIVITY

T. terrestris is believed to have has aphrodisiac activity in different cultures due to its putative positive influence on sexual performance in humans. Studies on both animal models and human trials show that *T. terrestris* improves various aspects of sexuality. It was found to improve libido and erectile function in hypogonadal men and it also improved the seminological indices in infertile men.[42]-[44] In another clinical study, improvement in fertility was observed in infertile male patients treated with *T. terrestris* and their partners were subsequently able to achieve pregnancy. This was attributed to *Tribulus* for increasing the quality of semen in terms of motility as well as quantity.[45] Gauthaman et al., (2002) discussed androgens and the regulation of penile erection and observed that the *T. terrestris* extract has similar properties to androgens and confirmed the role of TT as an aphrodisiac in the traditional medicine.[28]

VIII. TRIBULUS TERRESTRIS AS A NUTRITION SUPPLEMENT

The role of *Tribulus terrestris* as a nutritional supplement for the athletes is highly debated regarding its physiological and actual effects. *Tribulus* is a popular food supplement used by a large number of athletes. It increases protein synthesis and muscular mass and facilitates recuperation after physical loads. Several studies suggest that *T. terrestris* will act as an excellent nutraceutical that prevents the harmful effects on the human body. However, data on the efficacy is not sufficient.⁴⁷ Singh et al, 2009 have shown that *T. terrestris* extract affects the body metabolism and reproductive functions.[46]

IX. INSECTICIDAL ACTIVITIES

Vector-borne diseases are human illnesses caused by parasites, viruses and bacteria that are transmitted by vectors.[33] Mosquitoes are carriers of many serious and well-known diseases including malaria, dengue, chikungunya fever, Zika virus fever, yellow fever, West Nile fever and Japanese encephalitis. These diseases produce significant morbidity and mortality in humans and livestock around the world. *Aedes aegypti* transmits etiologic agents of yellow fever and dengue. The evaluation of *T. terrestris* acetone extract for larvicidal activity against *A. aegypti* was tested by many workers. The larvicidal and repellent activity of the crude ethanol, acetone and petroleum ether extract leaves of *T. terrestris* were effective against larvae and adults of mosquito *A. aegypti* and these extracts can be used as an effective alternative to the existing synthetic pesticides for the control of *A. aegypti*. [47],[48]

X. CONCLUSIONS

T. terrestris has been traditionally claimed for a large number of pharmacological actions and its uses in traditional system of medicine. It can be considered as a potential drug used in the treatment of various range of disease especially in the urogenital diseases. It is a very popular medicinal plant and its use is still in high demand throughout the country, especially in remote areas where tribes and local people live. The number of important secondary metabolites, such as flavonoids, flavonol glycosides, steroidal saponins and alkaloids present in *T. terrestris*, along with their pharmacological activity, prove that it can be used in the pharmaceutical industry as well as a source of health-promoting compounds. However, further studies are needed to determine some of the unknown molecular mechanisms of action of the clinically active compounds found in *T. terrestris*.

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