TRIBULUS TERRESTRIS: AN AYURVEDIC HERB WITH PHYTOCHEMICAL BOOSTER

Lakshya Dharamdasani*, Dr. Nirmala Gupta, Kriti Rai, Pallavi Nair and Prerna Bodhankar

Institute for Excellence in Higher Education, Bhopal-462016, India.

ABSTRACT

In modern times the use of Ayurvedic herbs seems to be increased with physiological responses. One such plant species Tribulus terrestris isolated from nature has proved to be promising drug for treatment of various diseases. Tribulus terrestris commonly called as “puncture vine” or “Gokshur” has been in use since ages in Indian and Chinese system of medical treatment. It belongs to the family Zygophyllaceae and constitutes ample of chemical constituents which are of medicinal importance. TT, medicinal herb shows presence of biochemical compounds like flavonoids, steroidal saponins, and alkaloids. Being a therapeutic drug it is recommended for the treatment of male health. It is a common supplement used for boosting testosterone and as potent libido enhancer. It has diuretic, anti- urolithic, anti-diabetic, immunomodulatory and therapeutic properties as well. The methanolic and ethanol extract of the plant showed immense importance of this plant in medicine for its hepatoprotective, anti-carcinogenic, anti-helmintic and antibacterial properties have stood in times. In last few decades extensive research showed the importance of biological and pharmacology activities of Tribulus terrestris extract. This review article focuses on the physiochemical properties of plant and its wide range effect on anti-oxidative or anti-bactericidal proving it as value added utility drug.

KEYWORDS: Tribulus terrestris; Phytochemical; Alkaloids; Flavonoids; Glycosides; Steroidal

Abbreviation: TT- Tribulus terrestris.
INTRODUCTION

*Tribulus* is a big genus and its specie *terrestris* is its best known member.[1] *Tribulus terrestris* is a tap rooted dicotyledonous herbal plant[3] and one of the great plants in use. The plant belongs to a big family of Zygophyllaceae.[2,4,5] It is famous by its common name that is Gokshur or Gokharu (clove’s hoof) or a puncture vine[5] or mitha,[1] used greatly in medicines thus a valuable herb,[2,4] It is known for its nature of forming a mat.[5] It is exclusively found in warm areas of sub tropical regions and is found to be spread all over the world.[2,8] The plant is perennial in nature though they can grow as annuals during colder climate and is observed that it is found near Dardanelles.[1] In morphology, the flowers of plant are hermaphrodite and entenomophilous in nature while ovary is divided by false septa[1,2] distinguishing it from others. *Tribulus terrestris* is of great importance in folk medicines of India and China[2] for treating huge number of diseases. It is found to be rich in therapeutics like flavonoids, glycosides, steroids, saponins,[8] estradiols, vitamins, tannins and alkaloids[1]. It is used to treat infertility and libido disorders,[4] cardiac diseases, urogenital and gastrointestinal problems and acts as hepatoprotective.[1,3,8] This specie shows antibacterial activity due to steroidal saponins,[2,4] antifungal and anti-inflammatory, anticancer[1,2] and antidepressant[7] activity hence is greatly used in pharmacological industries.[1,5,8]

Taxonomic Classification

*Kingdom- Plantae*
*Division- Phanerograms*
*Sub Division- Angiospermae*
*Class- Dicotyledonae*
*Sub Class- Polypetalae*
*Series- Disciflorae*
*Order- Geraniales*
*Family- Zygophyllaceae*
*Genus- Tribulus*
*Specie- terrestris*

Distribution and Habitat

*Tribulus terrestris* is a plant that is native to both India as well as spread worldwide. It is found in the areas that are warm tropical or temperate regions of the world like Southern Europe, Western Asia and major part of Africa and Australia. Apart from these, this plant can
also be found in Europe, China and Japan and Korea.\textsuperscript{[5]} As an annual herb it is found in Mediterranean and desert climatic regions.\textsuperscript{[6,8]} While it grows well in the soil that is light textured\textsuperscript{[5]} but can even thrive in areas with poor soil\textsuperscript{[6]} with different range and texture. In India it is specifically found in warmer regions though spread to wide areas but mainly include west Gujarat, Rajasthan\textsuperscript{[7,8]} and high altitudes of Kashmir.\textsuperscript{[1]} It is a common weed in India that grows in pasture\textsuperscript{[8]} waste and dry lands.\textsuperscript{[8]}

**Therapeutic Properties**

*Tribulus terrestris* is an extensively effective plant with various pharmacological properties. The air dried extract of the plant is said to contain steroidal glycosides in which the major saponin present is protodioscin (PTN). The classical and literary experiments have showed the dealings of this plant against many diseases with the help of its therapeutic properties like analgesic, anti-inflammatory, diuretic and aphrodisiac.

- **Anti-Bacterial Effect**
  
  Al Bayati *et al*, 2008; Mohammad *et al*, 2008; Kianbakht *et al*, 2003 carried out studies with different parts fruits, stems, leaves and roots using ethanolic extracts but it showed no detectable antimicrobial activity while methanolic extract was found to show the most active anti bacterial activity.\textsuperscript{[13,14]}

  Another experiment conducted by Al Bayati *et al*, 2008 involved use of organic and aqueous extracts of plant and observed the antibacterial activity and the mode of action involved membrane lytic properties instead of simply modifying the surface tension of the medium.\textsuperscript{[1]} This activity is due to the complex that exists between extra cellular and soluble proteins with that of bacterial cell walls.

- **Anti-fungal Effect**
  
  The seven different types of saponins are extracted from *T. terrestris* out of which only spirostanol showed anti fungal activity specifically against *C. albicans* and *Cryptococcus neoformans*. Also furostnal derivatives and other compounds too did not show any inhibitory activity against other strains like *S. aureus*, *Aspergillus* and *Mycobacterium*.\textsuperscript{[5,10]}

  Al-Bayati *et al*, 2008 tested the anti fungal activity of the ethanolic extracts of fruits against fungal pathogens with minimal inhibitory concentration of 0.15 mg/ml\textsuperscript{[12]} Apart from saponins, flavonoids too showed *in vitro* effectivity against wide spectrum of fungi as well as
bacteria. More over lipophilic flavonoids are believed to act by disrupting the membranes of fungal organism.[1]

- **Diuretic effect**

Significant rise in the volume of urine over period of time was observed, which in turn decreased the level of sodium and potassium serum level on treating the urine and electrolytes of rabbit with *T. terrestris* extract.[1] Hence it was seen as an herbal plant that can be used as diuretic agent as its fruits and seeds contain good amount of nitrates and potassium.[7,8]

Chopra *et al.*, 2009 and Jashni *et al.*, 2012 also propounded that as a diuretic agent this plant acts as anti-hypertensive agent[1,8] and renal disease patients. Ali *et al.*, 2003 evaluated the aqueous extract of *T. terrestris* in strips of isolated Guinea pig as well as in albino rats and found the increased tonicity of smooth muscles that along with diuretic effect propelled the stones out of urinary tract.[10]

- **Anti Diabetic effect**

Amin *et al.*, 2006 showed that when extract was used to treat diabetic rats the level of GSH was reduced leading to the recovery of liver. Hence this protective effect of *T. terrestris* can be used for the treatment of angina pectoris and cardiac diseases and the level of ROS (reactive oxygen specie) can be inhibited.[17]

Li M *et al.*, 2001 extracted saponins from *T. terrestris* as they possess hypoglycemic properties and examined on mice. On treatment with *T. terrestris* though reduced the level of serum glucose, triglyceride and cholesterol but increased the serum superoxide dismutase level that contributed to the pathogenesis of diabetes.[18] The mice were divided into six groups and treated with *T. terrestris* extract and by the end of experiment it was noted that extracted saponins reduced the levels of alanine aminotransferase (ALT) and creatinine in diabetic group of mice while in non-diabetic group the level of malondialdehyde (MDA) was reduced in liver.[8]

- **Anti-cancer Effect**

Bedir *et al.*, 2002 observed that saponins from different parts of the *T. terrestris* when extracted showed that only spiro compounds had the remarkable anti cancer activity. Out of all the spiro compounds it was Hecogenin that was found to be the most active spirostanol
glycoside exhibiting the broad spectrum anti cancer activity against cell lines SKMEL, KB, BT-549.\[^9\]

- **Aphrodisiac Property**

Adaikan *et al*, 2000 reported that *T. terrestris* extracts exhibited a pro-erectile effect when treated against rabbit corpus smooth muscle. It was observed that an effective relaxation in the levels of nitroglycerine, acetylcholine and electrical field stimulation took place in rabbits when *T. terrestris* was given in oral doses, this account for the aphrodisiac property.\[^21\] Singh *et al*, 2012 used fruit extract of *T. terrestris* and found an increase in the level of serum testosterone in male rats thus acting as a sexual enhancer for maintenance of sexual dysfunction.\[^22\] The main components of saponins that are responsible for aphrodisiac property include protodioscin and protogracillin.

Gauthaman *et al*, 2005 studied *T. terrestris* effect on nicotinamide adenine dinucleotide phosphate diaphorase (NADPH-d) activity and androgen receptor (AR) and it was found that there is an increase in AR and NADPH positive neurons that could probably be due to aphrodisiac activity that is claimed in *T. terrestris*.\[^23\] *T. terrestris* is also believed to improve reproductive functionality, libido and ovulation by increasing levels of estradiol.

- **Hepatoprotective Activity**

Kavitha *et al*, 2011 performed an experiment in which the extract from *T. terrestris* was treated against *Oreochromis mossambicus* fish that was induced with acetaminophen-induced hepatotoxicity it showed a remarkable activity of being hepatoprotective in nature. This extract of *T. terrestris* normalized the reduced level of glutathione enzyme for this induced toxicity.\[^24\]

The ethanolic extract from the *T. terrestris* was extracted from the aerial part and was examined for hepatoprotective activity against mercury induced hepatotoxicities in mice or rat. It was noted that on treating with mercury the levels of Aspartate transaminase (AST), Alanine transaminase (ALT), alkaline phosphatase (ALP), and Bilirubin were increased while that of Glutathione (GSH) content was decreased. This resulted in the free radical formation that claimed the hepatoprotective action of the plant.\[^25,26\]
• **Antihelmintic Activity**
Deepak *et al*., 2002 and Kiran *et al*., 2011 used the methanolic extract of *T. terrestris* to test for Anthelmintic activity of the plant using nematode *Caenorhabditis elegans* and on investigation of its bioactive parameter it was found that tribulosin and β-sitosterol-d-glucoside present in extract act as the active compounds that showed anthelmintic activity.[27,28]

• **Analgesic Activity**
Heidari *et al*., 2007 used male mice to detect the analgesic activity of *T. terrestris* using formalin and tail flick test. The methanolic extract of *T. terrestris* produced analgesic effect that may be peripherally or centrally. The comparative study was done that showed that the effect of extract got reduced as compared to morphine and aspirin in both the tests. Further the presence of opioid receptors on treatment changed the activity of analgesic hence its effect is actually excluded.[29]

Further Evan *et al*., 2005 used chloroform extract and it was administered in to mice intra peritoneally which too showed analgesic activity.[30]

• **Anti-arthritic Activity**
The methanolic extract of fruit of *Tribulus terrestris* showed the anti-arthritic activity and it was induced in the rat using Frund’s complete adjuvant after 21 days of the dose given to assess anti-arthritic activity.

Mishra *et al*., 2013 overviewed that the membrane stability modulating effect is an important mechanism of anti arthritic activity which is basically due to the presence of flavonoids in the plant specie. The result was noted that the inhibition of leukocyte migration takes place on administration of extract of *T. terrestris* that results in the beneficial joint preservation. Even the steroidal glycoside is believed to possess the same activity.[31]

• **Anti-hypertensive Activity**
Coronary disease, myocardial infarction, cerebral arteriosclerosis, hypertension and the sequelae of cerebral thrombosis are some of the cardiac disorders that can be effectively treated with *T. terrestris*. Zhang *et al*., 2010 extracted tribulosin from *T. terrestris* and studied its protective effect against cardiac ischemia or injury and its mechanism in rats. The result studied showed that Tribulosin protected the rats against these injuries with the help of
activation of protein kinase.\textsuperscript{[32]} It was seen that the methanolic and aqueous extract of \textit{T. terrestris} had a significant anti-hypertensive activity and this is due to direct relaxation of smooth muscle and hyperpolarisation observed in rats.

Philips \textit{et al}, 2006 showed that crude extract of \textit{T. terrestris} enhanced electrically and nitroglycerine induced relaxation of the corpus of rat.\textsuperscript{[33]}

Sharifi \textit{et al}, 2003 investigated the anti-hypertensive activity of \textit{Tribulus} specie in 2K1C cells of hypertensive rats by measuring their local ACE (angiotensin converting enzyme) activity in aorta, kidney and lung and it was noted that systolic blood pressure (SBP) level was increased in 2K1C rats while SBP of \textit{Tribulus} fed hypertensive rats was decreased and ACE activity also got lowered.\textsuperscript{[11]}

**CONCLUSION**

It is now well defined and proven fact that in modern era where available drugs could not heal all the adverse diseases, people are restoring back to the use of traditional herbs. The naturally available therapeutic effects in plants have given boon to traditional medicines. One such plant in use is Tribulus terrestris which is an Ayurvedic herb known to serve mankind against its various diseases. Tribulus terrestris since time back has been used as tonic and aphrodisiac in Unani system of medicine. It is largely used for treating impotency and acts as stimulant for enhancing sexual drive. It has massive potential with its therapeutic properties like anti-diuretic, anti-bactericidal, and other pharmacological activities to treat several disorders. It is effective in urogenital, nervous and cardiovascular system and contains phytoconstituents like linoleic acid, stearic acid, estradiol and saponins. It is considered to be an important herb for controlling of blood pressure and has been in use over centuries. Also study has been done to study hormonal effects of Tribulus terrestris in primates, rabbit and rat and its utility in erectile dysfunction has gained popularity. The various concentrations of methanolic and ethanolic plant extract has played indispensible role to treat human disorders. To generate novel drugs the plant extract experiments have been extended to next level of clinical trials to give it as the status of medicine helpful to man.

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