An Ethnomedical and phytochemistry review (2003-2021) of an Ayurveda weed (Tribulus terrestris)

Kirti Goel[1], Md Sohel Ahmed[2], Randhir Singh[3], Seema Bansal[4*]

***Corresponding author:-**Dr. Seema Bansal,
[1] Research Scholar, Department of Pharmaceutical Science, M.M. College of Pharmacy, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, India, kirtijain2727@gmail.com
[2]Scholar, Department of Pharmaceutical Sciences, M.M. College of Pharmacy, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, India, gazisohel0914@gmail.com
[3]Associate Professor, Department of Pharmacology, Central University of Punjab, Bhatinda, Punjab, India, randhirsingh.dahiya@gmail.com
[4*]Professor, Department of Pharmacology Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, India, 133207
E-mail: seema.bansal@mmumullana.org

Abstract

A medicinal herb of the *Zygophyllaceae* family-*Tribulus terrestris* is home to many countries (India, Sudan, South Africa, Sudan, Europe, and China) in the form of weed. Though this traditional herbal plant has several regional and vernacular names but is known as Gokhru in Hindi in India. This plant has played a pivotal role in the Chinese and Ayurveda folklore medicinal system. This plant played an integral role in treating fertility issues, impotence, and erectile dysfunction in conventional age-old treatment therapies in China and India as its fruits and leaves were used as a diuretic in the Chinese and Indian medicinal systems. Owing to the presence of a plethora of active phytoconstituents such as steroidal saponins, flavonoids, tannins, and phenolic compounds this plant is widely under exploration. TT has been explored by herbalists worldwide and clinically proved its efficacy in the treatment of human ailments. This current review aims to summarize (2003-2021) in vitro and in vivo studies carried out on any segment of Tribulus terrestris along with the phytochemistry of active constituents present in it. This review may invite herbalists to approach forward with exploring molecular mechanisms related to phytoconstituents of TT for targeting diseases.

Keywords: *Tribulus terrestris*, Traditional medicine, pharmacologically active, Phytoconstituents

DOI Number: 10.14704/nq.2022.20.9.NQ44355 Neuro Quantology 2022; 20(9):3073-3081

Introductions

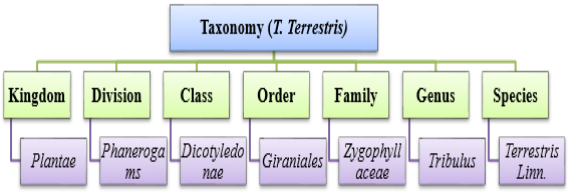
The plant *Tribulus terrestris* (TT) is an annual herb of the *Zygophyllaceae* family, widely recognized as "Gokshur", "Gokharu" in India, "puncture vine", "Tribulus", "hard thorns" in English, and "goat head" in China (Zhu et al., 2017). It is mostly found in South Africa, Australia, India, and Europe (Ştefănescu et al., 2020). It has been used for a very significant period of time across both the Indian and Chinese medical systems to treat a wide range of ailments (Hammoda et al., 2013; Pokrywka et al., 2014). Ayurvedic healers and traditional herbalists have frequently used *T. terrestris* as a therapeutic plant (Das et al., 2017; Ivanova et al., 2016;Lee et al., 2017).

Since ancient times, India has employed the fruits and roots of TT as a traditional remedy (Kevalia & Patel, 2011). It has received certification for its pharmacological properties during the past few years, including enhancement of sexual dysfunction, cardiovascular diseases, anti-urolithic, antihyperlipidemic, anti-inflammatory, anticancer, hypoglycemic, and antioxidant benefits. The most significant compounds of TT are claimed to be steroidal saponins and flavonoids, which have a variety of therapeutic potentials (Zhu et al., 2017; V. Neychev & Mitev, 2016).

Taxonomical classification

Tribulus is a genus with around 20 species, three of which are prevalent in India: *Tribulus cistoides*, *Tribulus terrestris*, and *Tribulus alatus* (Sahani & THAKUR, 2019). The scientific taxonomical description of TT is represented

below in chart 1. (Zhu et al., 2017; Patil, 2016; Kevalia & Patel, 2011; Bahmani et al., 2016).



Flowchart 1. Flowchart-based representation of taxonomy of *Tribulus terrestris*

Botanical descriptions

Table 1: Botanical description of Tribulus terrestris

Parts of herb	Botanical description	References
Plants	Tiny, prostrate shrub with silky hair that grows 10–60 cm long	(Zhu et al., 2017; Patil, 2016; Chhatre et al., 2014; Arentz et al., 2017)
Leaves	Elliptic or oval shaped, opposite, paripinnate, petiolate from 5 to 8 pairs, and frequently asymmetrical	
Flowers	Yellow, 4-5 flowered, small in size	
Fruits	Brittle texture, 5 mericarps produce ax-shaped, 3-6 mm long, radially distributed with diameters of 7–12 mm	
Roots	Yellow-light brown, thin, fibrous, tubular, usually branching and contains numerous tiny rootlets, length 7-18 cm and diameter 0.3-0.7 cm	
Seeds	Oily in nature, transversely partitioned crocus	

Figure 1. Various parts of *Tribulus Terrestris*

Morphological description

Tribulus terrestris is dispersed over a large geographic area. It is a perennial yellowish wildflower plant (Meena & Anand, 2019) that grows in hot climates in a variety of subtropical nations, including India, Pakistan, China, Africa, France, Australia, South, and Western Europe, Bulgaria, Mexico, and North America (Rainer W. et al., 2015; Bahmani et al., 2016). In India, it can be found in Kashmir, Ceylon, Gujarat, and West Rajasthan, up to a height of 11,000 feet, across India (Chhatre et al., 2014). *T. terrestris* is a typical weed shrub with divaricate spines that grows in sandy soil, sludge areas, roadsides, grazing fields, and wastelands (Rainer W. et al., 2015; Kokate et al., 2002).

Traditional uses

The pharmacological qualities of *Tribulus terrestris* medicinal plants have been extensively studied, and a wide variety of pharmaceutical medicines are readily available on the global market (Rainer W. et al., 2015; Zheng et al., 2017). *T. Terrestris* is highly recognized for its wide range of activities, including its usage as an aphrodisiac, anti-inflammatory, anthelmintic, diuretic, and remedy for asthma, cough, splenetic illnesses, heart abnormalities, and limb pain (Maheswari & ., 2019). Most genitourinary tract diseases can be effectively treated with the dried fruits of the herb. It is an essential component of Gokshuradi Guggul, a strong Ayurvedic remedy used to assist in the removal of urinary stones and the healthy operation of the genitourinary tract (Chhatre et al., 2014; Ashwani & Ashish, 2012). The leaves are employed in the production of herbal tonics in the pharmaceutical sector, and they are crucial in the treatment of urinary tract infections, spermatozoa growth, and digestive issues (Patel et al., 2019). The astringent stem is used to treat gonorrhea. The entire plant's ash is used to treat rheumatoid arthritis, and the roots are said to be aperients and demulcents and used to make tonics (Rainer W. et al., 2015).

Table 2: Traditional uses of TT

Parts of plants	Applications/uses	Country	References
Fruits	Diuretic, cough expectorant, eye discomfort, edema, abdominal bloating, morbid leucorrhea, and dysfunctional erections	China	(Zhu et al., 2017; Kang et al., 2017; Abu-Gharbieh et al., 2019; H. O. Santos et al., 2019; Pi. Ercan & El, 2016)
	Low libido, erectile dysfunction, impotence, and infertility	India	
	Treatment of hypertension, anti-inflammatory, and muscle relaxant	Pakistan	
Roots	Treat kidney sand and Hemorrhoids.	Turkey	(Wang et al., 2016)
	Cardiotonic properties	India	
Seeds	Diuretic and aphrodisiac	Saudi Arabia	(Marques et al., 2016; X. Zhang et al., 2012)
	Homicidal weapon	South Africa	
Leaf	Treatment of impotence	Bulgaria	(Chen et al., 2012)
Whole plants	Improvement of sexual behavior	Nigeria	(Patil, 2016)

Ayurvedic formulation and uses

In the Indian herbal medicinal system, Ayurveda, TT is available in formulation forms which are given in Table 4.

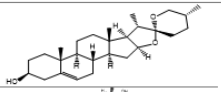
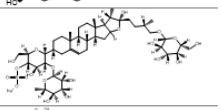
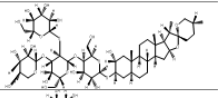
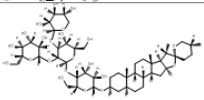
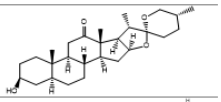
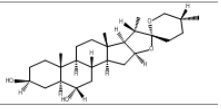
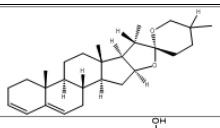
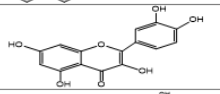
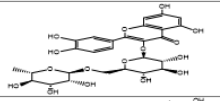
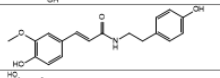
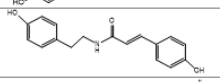
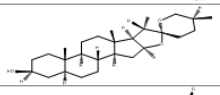
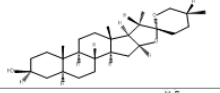
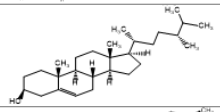
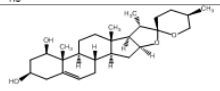
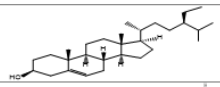
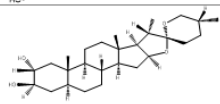
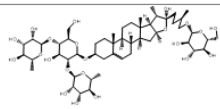
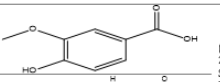
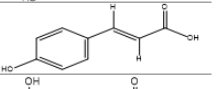
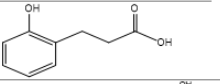
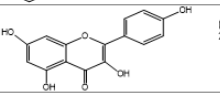
Table 4: Ayurvedic formulation and recommended dose of TT

Formulations	Recommended dose	References
❖ *Gokshuradi Guggulu,* ❖ *Trikantak Ghruta,* ❖ *Drakshadi Choorna,* ❖ *Rasayana Choorna,* ❖ *Gokshuradi Kwatha,* ❖ *Dashamoola Kwatha*	❖ Fruit: 3-6g of the ingredient in powder form and 20-30g of the ingredient for decoction ❖ Root: 20-30 g of the preparation for decoction	(Chhatre et al., 2014; Kang et al., 2017; Khare, 2015)

Phytochemistry

The phytochemical analysis of TT uncovered saponins, polyphenols, glycosides, alkaloids, and tannins (Hammoda et al., 2013). According to previous research findings, the saponin structure and concentration of TT from various geographical locations varied (Kostova & Dinchev, 2005). TT also discovered for the presence of furostanol and spirostanol saponins such as tigogenin, neotigogenin, gitogenin, neogitogenin, hecogenin, neohecogenin, diosgenin, chlorogenin, ruscogenin, and sarsasapogenin (Chhatre et al., 2014). The phytochemistry of Tribulus terrestris is given below in table 5 with their phytochemical classes and structure. All the structure was drawn using ChemDraw-Ultra-12.0.2.1076.

Table 5: Phytochemistry of Tribulus Terrestris

Parts of plants	Phyto-chemical classes	Chemical constituents	Chemical structure	References
Fruits	Saponin	Diosgenin		(Ranjithkumar et al., 2013; Semerdjieva & Zheljazkov, 2019; Hammoda et al., 2013; Kostova & Dinchev, 2005)
		Prototribestin		
		F-gitonin		
		Degalactotigonin		
		Hecogenin		
		Chlorogenin		
		Spirosta-3,5 diene		
	Flavonoids	Quercetin		(Semerdjieva & Zheljazkov, 2019; Alzahrani et al., 2018)
		Rutin		
	Cinnamic amide	Feruloytyramine		(Das et al., 2017; Alzahrani et al., 2018)
		Coumaroyl tyramine		
Roots	Saponin	Neotigogenin		(Chhatre et al., 2014; Zhu et al., 2017)
		Tigogenin		
	Phytosterol	Campesterol		(Chen et al., 2012; Semerdjieva & Zheljazkov, 2019)
Flowers	Saponin	Ruscogenin		(Chen et al., 2012; Meena & Anand, 2019)
	Phytosterol	Beta-Sitosterol		
Areal plants	Saponin	Gitogenin		(Ştefănescu et al., 2020; Chen et al., 2012)
Whole plants	Saponin	Protodioscin		(Chen et al., 2012)
Leaves	Acid	Vanillic acid		(Ştefănescu et al., 2020; Semerdjieva & Zheljazkov, 2019; Oluwagunwa, 2021)
		P-coumaric acid		
		Mellilotic acid		
	Flavonoids	Kaempferol		(Ştefănescu et al., 2020)

Reported pharmacological activities

The whole plant including roots, stems, leaves, and fruits has shown pharmacological activities. The 21st clinically proven studies on *Tribulus terrestris* are discussed and summarized in Table 6.

Table 6: Reported Pharmacological Activities of Tribulus Terrestris

Extracts / active constituents	Model used	Therapeutic dose	Reported uses	References
		***In-vitro* studies**		
Whole plant extracts	Male rabbit corpus cavernosum smooth muscle in the organ bath	Dose-dependent relaxation response	Improve erectile functions	(Kam et al., 2012)
	Sperm motility, viability, and DNA fragmentation analysis of 40 healthy human volunteer	20, 40, and 50 µg/mL	Male fertility capacity	(Khaleghi et al., 2017; V. K. Neychev & Mitev, 2005)
Fruits extracts	α-Glucosidase and aldose reductase	Dose dependent, p < 0.05	Anti-diabetic	(Lamba et al., 2011)
Fruits aqueous extracts	Comet assay and cytogenetic methods on cultured human peripheral blood lymphocytes	Dose-dependent activity at 10, 20, 40, and 80 mg/L for 24 h	Geno-toxic activity	(Qari & El-Assouli, 2019)
Saponins	MTT assay	IC_{50} at 12.6 µg/ml	Anti-cancer and anti-proliferation activity	(V. K. Neychev et al., 2007)
Seeds acetone extracts	Pancreatic α-amylase inhibitor kinetic studies	Concentration-dependent inhibition at 511 µg/mL	Hypoglycemic. Diabetes mellitus	(Ravi Kumar et al., 2011)
Whole plant aqueous, methanol, and chloroform extracts	*Salmonella typhimurium* TA98 and TA100 variants were tested using the Comet assay in a rat kidney cell line (NRK-52E) and the Ames assay.	3–2400mg/mL	estrogenic and genotoxic activities	(Abudayyak et al., 2015)
Pet-ether extracts	Larvicidal action against *Aedes aegypti* mosquito larvae and adults in the third instar	LC_{50} at 64.6 ppm	Anti-larvicidal, Insecticidal, and repellent activities	(El-Sheikh et al., 2012)
Leaves aqueous extracts	Assessment of the lipase, α-amylase, and α-glucosidase activity in the digestion of fat and starch digestive enzymes	Inhibitory activity against α-glucosidase, α-amylase, and lipase with IC_{50} 6987 ± 343, 343 ± 26.2, and 15.3 ± 2.03 µg/ml respectively	Body weight management, anti-obesity, anti-diabetic	(P. Ercan & El, 2016)
		***In-vivo* studies**		
Fruits (Ethanolic extracts)	Hyperglycemia induced vascular damage in Wistar albino rats	75 mg/Kg body weight	Anti-hyperglycemic	(Lamba et al., 2011)
	Streptozotocin induced diabetic wistar albino rat	100 mg/kg body weight for 30 days	Anti-diabetic	
Fruits and leaf aqueous extracts	Guinea pig ileum strips and diuretic rat model	5 gm/kg orally	Diuretic and anti-hypertensive agents	(Al-Ali et al., 2003; Chhatre et al., 2014)
Ethanolic fruit extracts	Mice with acute pancreatitis induced by Cerulein	200 and 400mg/kg (p.o.)	Antioxidant, anti-inflammatory, and antimicrobial and acute pancreatitis	(Borran et al., 2017; Akbar, 2020)
TT extracts	acetaminophen-induced hepatotoxicity in *Oreochromis mossambicus* fish	250 mg/kg	Hepatoprotective activity	(Kavitha et al., 2011)
Aqueous extracts of plants	Experimentally induced nephrolithiasis in Wistar rats	750 mg/kg for 28 days	Antiurolithic agent	(Kaushik et al., 2019)
Aqueous and ethanolic extracts	RAW 264.7 macrophages triggered by lipopolysaccharide	Dose-dependent	Anti-inflammatory	(Lee et al., 2017; Singh & Sharma, 2020)
Fruits, leaves, and roots aqueous extracts	11 species of pathogenic and non-pathogenic micro-organisms were tested for their anti-microbial activity	0.15 mg/ml	Anti-bacteria, anti-fungal	(Al-Bayati & Al-Mola, 2008)
Methanol extracts	Carrageenan-induced inflammation in rats	Dose-dependent inhibition at 200 and 400 µg/mL	Anti-inflammatory and anti-microbial	(Baburao et al., 2009)
Saponin	Diet-induced hyperlipidemia in mice	Dose dependently at 40-80mg/kg	Anti-hyperlipidemic	(Chu et al., 2003)
Whole plant aqueous extracts	Oxalate-induced renal epithelial cell line damage (NRK 52E)	Dose-dependent	Treatments of urolithiasis	(Aggarwal et al., 2012)
Saponin isolated from fruits	Delayed type hypersensitivity test	Different doses intraperitoneally for 7	Immunomodulatory activities	(Tilwari et al., 2011)
TT extracts, Protodioscin (PTN)	Intracavernous pressure and sexual activity in castrated and non-castrated adults Sprague-Dawley rats.	5 mg/kg/day orally	Aphrodisiac activity, improve sexual functions and behavior	(Gauthaman et al., 2002)
Fruits ethanolic extracts	Male albino Wistar rat for the assessment of sperm quality and testicular histomorphometry	42 mg/kg/day for 70 days	Improved sperm quality	(Oliveira et al., 2015; Miranda et al., 2022)
Fruits aqueous extracts	Streptozotocin-induced in hepatocytes of adult male albino rats	10 mg/kg/day for eight weeks orally	Hypoglycemic, Anti-diabetic	(Al-Eisa et al., 2022)
Whole plant extracts	Relaxation effects on adult rat corpus cavernosum	Dose-dependent oral administration for 1 month	Improved erectile function	(Kam et al., 2012)
Fruits (Saponins) alcoholic extracts	An overtraining-induced rise in IGF-1R in the rat liver was observed in a rat overtraining model.	120 mg/kg	Improve exercise and training performance, exhausting time	(Yin et al., 2015)
Hydro-alcoholic extracts	streptozotocin-induced diabetic adult male Wistar rat (200-250gm)	Dose dependently 100, 250, 500mg/kg for 1 week	Anti-diabetic and improve the function of the male reproductive system	(Ghanbari et al., 2016)
Steroidal saponin	Cyclophosphamide induced male reproductive damage in rat	11 mg/kg body weight	Protecting the male reproductive system	(Pavin et al., 2018)
Flower and root dried extracts	Male albino Wistar rat fertility parameters model	Dose dependently	Treatment of male infertility, increase sperm viability and motility and testosterone level	(Haghmorad et al., 2019)
Gross saponins	By restoring the endothelial function of the penile corpus cavernosum, streptozotocin stimulates erectile performance in a rat model.	30mg/kg	Improves erectile dysfunction	(H. Zhang et al., 2019)
Ariel part alcoholic extracts	Streptozotocin-induced diabetic male Swiss albino rats (150-200gm)	55 mg/kg	Hypoglycemic	(El-Tantawy & Hassanin, 2007)
Diosgenin	Streptozotocin -induced diabetes male Wistar rats	5-10 mg/kg orally for 30 days	Cardiovascular and antidiabetic	(Kalailingam et al., 2014)
Diosgenin	Trigonelline and diosgenin diminish ER stress and oxidative stress-mediated damage in the pancreas while enhancing PPAR	35 mg/kg	anti-diabetic activities	(Tharaheswari et al., 2014)
	activity in adipose tissue in type 2 diabetes rats.			
Aerial part methanolic extract	Glucose-loaded normal rabbits	250 mg/kg	Anti-hyper glycemic activities	(El-Shaibany et al., 2015)
Fruits ethanolic extracts	Anticariogenic activity against *Streptococcus mutans*	0.1-0.5 mg/ml)	Anticariogenic activity	(Oh et al., 2011)
Plant extracts	Androgen receptor (AR) immunoreactivity and nicotinamide adenine dinucleotide phosphate-diaphorase (NADPH-d) activity in the brain of a Sprague-Dawley rat	5mg/kg/day orally for 8 weeks	Treatments of aphrodisiac	(Gauthaman & Adaikan, 2005)
Protodioscin	Management of male erectile dysfunction through rat, rabbit, and primate models	7.5, 15, and 30 mg/kg iv in primates and 2.5, 5, and 10 mg/kg orally for 8 weeks in rabbits and rats	Mild to moderate erectile dysfunctions	(Gauthaman & Ganesan, 2008)
Plant extracts	A post-menopausal rat model using ovariectomized females and endocrine sensitive organs in intact and castrated male rats.	11, 42 and 110 mg/kg/day	Increased sperm productions	(Martino-Andrade et al., 2010)
		Clinical studies		
Steroid saponins	Investigate the androgen metabolism in young males 20-36 years old 60-125kg	20 and 10 mg/kg/day 3 times for 4 weeks	Aphrodisiac activity	(V. K. Neychev & Mitev, 2005)
Whole plants placebo/ capsule	Australian elite male rugby league players for testing the muscle strength and body composition	450 mg/day once for 5 weeks	Improve the muscle strength and body composition	(Rogerson et al., 2007)
Whole plant extracts	The body homeostasis and cognitive fitness of athletes aged 20-22	Tribulus (Optimum Nutrition, U.S.A.) 1 capsule t.i.d 20 days	Increased blood testosterone of athletes	(Milasius et al., 2009)
Extracts or capsule	Among sixty-year-old male patients participating in a randomized, double-blind trial with decreased libido and either erectile dysfunction or not	396 mg/day for 2 months	Erectile dysfunctions	(Iacono et al., 2012)
Placebo/ capsule	In a prospective, randomized, double-blind, and placebo-controlled trial, 30 healthy males participated.	800 mg/day for 1 month	Erectile dysfunction in men	(C. A. Santos et al., 2014)
Plant extracts	A study of hypoactive sexual drive dysfunction in postmenopausal women	750 mg/day for 120 days	Hypoactive sexual desire disorder	(De Souza et al., 2016; Vale et al., 2021)
Leaves extract	A randomized clinical trial was conducted on women suffering from hypoactive sexual drive conditions.	7.5 mg/day for 4 weeks	Sexual dysfunction in women and hypoactive sexual desire disorder	(Akhtari et al., 2014)
Extracts / Tribestan film-coated tablet	Clinical trial in men with mild to severe erectile dysfunction	112.5mg, taken orally twice a day after meals, for 12 weeks.	Male sexual dysfunctions	(Kamenov et al., 2017)
Fruit extract	Perimenopausal women in a parallel, randomized, single-blind, placebo-controlled trial.	3 g powder taken orally twice daily for 8 weeks	Alleviation of menopausal transition symptoms	(Fatima & Sultana, 2017)
Whole plant extracts/ tablets	Clinical trial investigation of hypoactive sexual desire syndrome in premenopausal women	Dose-dependent	Hypoactive sexual desire disorder	(Vale et al., 2018)
Ayurvedic preparation of TT	Patients suffering from diabetes mellitus with microalbuminuria	30 and 300 mg/kg	Diabetes mellitus	(Ramteke et al., 2012)
Hydro-alcoholic extracts	A clinical trial for females with type 2 diabetes	1000 mg/day for 3 months	Antihyperglycemic and antihyperlipidemic	(Samani et al., 2016)

Discussion and conclusion

The ancient medical systems of Ayurveda, Chinese, Siddha, and Unani provide great significance for the herb *Tribulus terrestris*, which is widely available. TT is also a well-known plant in the traditional medicine of many nations for treating a variety of illnesses. The phytochemical and pharmacological properties of the whole TT plant have been thoroughly investigated (Chhatre et al., 2014). The majority of the pharmacological studies on TT have been focused on sexual diseases, but studies in vitro and in vivo have also shown that the drug has considerable anti-hyperglycemic, anti-inflammatory, antioxidant, and antibacterial benefits. The possibility of nephrotoxicity after the use of TT supplements has been underlined by toxicological investigations, notwithstanding its limitations. However, more research is required to identify some of the therapeutic active chemicals detected in Tribulus extracts that have yet to be identified in molecular mechanisms of action. Although TT has been well studied, additional study is required to

elucidate key issues such as a more precise link between the phytochemical and pharmacological profiles, pharmacokinetic investigations of the most significant chemicals, as well as the assessment of potential pharmacokinetic and pharmacodynamic interactions with other substances (Ştefănescu et al., 2020). To develop innovative medications, the pharmacological studies conducted on animals must be carried through to the next stage of clinical trials. This will assist TT in gaining medical status or being recommended as a dietary supplement in a variety of illness situations (Chhatre et al., 2014).

Conflict of interest

The authors declare no conflict of interest.

Author's contribution

All authors have participated combinedly in the preparation of the document.

REFERENCE

Abu-Gharbieh, E., Shehab, N. G., Almasri, I. M., & Bustanji, Y. (2019). Antihyperuricemic and xanthine oxidase inhibitory activities of Tribulus arabicus and its isolated compound, ursolic acid: In vitro and in vivo investigation and docking simulations. *PLoS ONE*, *13*(8), 1–12. https://doi.org/10.1371/journal.pone.0202572

Abudayyak, M., Jannuzzi, A. T., Özhan, G., & Alpertunga, B. (2015). Investigation on the toxic potential of Tribulus terrestris in vitro. *Pharmaceutical Biology*, *53*(4), 469–476. https://doi.org/10.3109/13880209.2014.924019

Aggarwal, A., Tandon, S., Kumar Singla, S., & Tandon, C. (2012). A Novel Antilithiatic Protein from Tribulus terrestris Having Cytoprotective Potency. *Protein & Peptide Letters*, *19*(8), 812–819. https://doi.org/10.2174/092986612801619552

Akbar, S. (2020). Handbook of 200 medicinal plants: A comprehensive review of their traditional medical uses and scientific justifications. In *Handbook of 200 Medicinal Plants: A Comprehensive Review of Their Traditional Medical Uses and Scientific Justifications*. Springer International Publishing. https://doi.org/10.1007/978-3-030-16807-0

Akhtari, E., Raisi, F., Keshavarz, M., Hosseini, H., Sohrabvand, F., Bioos, S., Kamalinejad, M., & Ghobadi, A. (2014). Tribulus terrestris for treatment of sexual dysfunction in women: randomized double-blind placebo - controlled study. *Daru : Journal of Faculty of Pharmacy, Tehran University of Medical Sciences*, *22*(1), 40. https://doi.org/10.1186/2008-2231-22-40

Al-Ali, M., Wahbi, S., Twaij, H., & Al-Badr, A. (2003). Tribulus terrestris: Preliminary study of its diuretic and contractile effects and comparison with Zea mays. *Journal of Ethnopharmacology*, *85*(2–3), 257–260. https://doi.org/10.1016/S0378-8741(03)00014-X

Al-Bayati, F. A., & Al-Mola, H. F. (2008). Antibacterial and antifungal activities of different parts of Tribulus terrestris L. growing in Iraq. *Journal of Zhejiang University: Science B*, *9*(2), 154–159. https://doi.org/10.1631/jzus.B0720251

Al-Eisa, R. A., Tag, H. M., ElNaggar, M. S., Abdelrazek, H. M. A., & El-Shenawy, N. S. (2022). Evaluation of Tribulus terrestris Extracts Relative to Metformin on Oxidative Stress and Histopathology of the Liver for Diabetic Male Rats. *Diabetology*, *3*(1), 46–55. https://doi.org/10.3390/diabetology3010004

Alzahrani, S., Ezzat, W., Elshaer, R. E., Abd El-Lateef, A. S., Mohammad, H. M. F., Elkazaz, A. Y., Toraih, E., & Zaitone, S. A. (2018). Standardized Tribulus terrestris extract protects against rotenoneinduced oxidative damage and nigral dopamine neuronal loss in mice. *Journal of Physiology and Pharmacology*, *69*(6), 979–994. https://doi.org/10.26402/jpp.2018.6.14

Arentz, S., Smith, C. A., Abbott, J., Fahey, P., Cheema, B. S., & Bensoussan, A. (2017). Combined Lifestyle and Herbal Medicine in Overweight Women with Polycystic Ovary Syndrome (PCOS): A Randomized Controlled Trial. *Phytotherapy Research*, *31*(9), 1330–1340. https://doi.org/10.1002/ptr.5858

Ashwani, K., & Ashish, B. (2012). Comparative, Qualitative and Quantitative Chemotypic Characterization Among North Indian Tribulus Terrestris. *International Research Journal of Pharmacy*, *3*(6), 212–218.

Baburao, B., Rajyalakshmi, G., Venkatesham, A., Kiran, G., Sunder, A. S., & Rao, B. G. (2009). ANTI-INFLAMMATORY AND ANTIMICROBIAL ACTIVITIES OF METHANOLIC EXTRACT OF TRIBULUS lINN pLANT. *Int. J. Chem. Sci.*, *7*(3), 1867–1872.

Bahmani, M., Baharvand-Ahmadi, B., Tajeddini, P., Rafieian-Kopaei, M., & Naghdi, N. (2016). Identification of medicinal plants for the treatment of kidney and urinary stones. *Journal of Renal Injury Prevention*, *5*(3), 129–133. https://doi.org/10.15171/jrip.2016.27

Borran, M., Minaiyan, M., Zolfaghari, B., & Mahzouni, P. (2017). Protective effect of Tribulus terrestris fruit extract on cerulein-induced acute pancreatitis in mice. *Avicenna Journal of Phytomedicine*, *7*(3), 250–260. http://www.ncbi.nlm.nih.gov/pubmed/28748172%0Ahttp://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC5511977

Chen, G., Liu, T., Lu, X., Wang, H. F., Hua, H. M., & Pei, Y. H. (2012). New steroidal glycosides from Tribulus terrestris L. *Journal of Asian Natural Products Research*, *14*(8), 780–784. https://doi.org/10.1080/10286020.2012.694871

Chhatre, S., Nesari, T., Somani, G., Kanchan, D., & Sathaye, S. (2014). Phytopharmacological overview of Tribulus terrestris. *Pharmacognosy Reviews*, *8*(15), 45–51. https://doi.org/10.4103/0973-7847.125530

Chu, S., Qu, W., Pang, X., Sun, B., & Huang, X. (2003). Effect of saponin from Tribulus terrestris on hyperlipidemia. *Zhong Yao Cai = Zhongyaocai = Journal of Chinese Medicinal Materials*, *26*(5), 341–344.

Das, S., Vasudeva, N., & Sharma, S. (2017).

Pharmacognostical Evaluation of Tribulus Terrestris L. *International Journal of Pharmaceutical Sciences and Research*, *8*(3), 1393–1400. https://doi.org/10.13040/IJPSR.0975-8232.8(3).1393-00

De Souza, K. Z. D., Vale, F. B. C., & Geber, S. (2016). Efficacy of Tribulus terrestris for the treatment of hypoactive sexual desire disorder in postmenopausal women: A randomized, double-blinded, placebo-controlled trial. *Menopause*, *23*(11), 1252–1256. https://doi.org/10.1097/GME.0000000000000766

El-Shaibany, A., Al-Habori, M., Al-Tahami, B., & Al-Massarani, S. (2015). Anti-hyperglycaemic activity of Tribulus terrestris L aerial part extract in glucose-loaded normal rabbits. *Tropical Journal of Pharmaceutical Research*, *14*(12), 2263–2268. https://doi.org/10.4314/tjpr.v14i12.16

El-Sheikh, T., Bosly, H., & Shalaby, N. (2012). Insecticidal and repellent activities of methanolic extract of Tribulus terrestris L. (Zygophyllaceae) against the malarial vector Anopheles arabiensis (Diptera: Culicidae). *Egyptian Academic Journal of Biological Sciences. A, Entomology*, *5*(2), 13–22. https://doi.org/10.21608/eajbsa.2012.14784

El-Tantawy, W. H., & Hassanin, L. A. (2007). Hypoglycemic and hypolipidemic effects of alcoholic extract of Tribulus alatus in streptozotocin-induced diabetic rats: A comparative study with T. terrestris (Caltrop). *Indian Journal of Experimental Biology*, *45*(9), 785–790.

Ercan, P., & El, S. N. (2016). Inhibitory effects of chickpea and Tribulus terrestris on lipase, α-amylase and α-glucosidase. *Food Chemistry*, *205*, 163–169. https://doi.org/10.1016/j.foodchem.2016.03.012

Ercan, Pi., & El, S. N. (2016). Erratum: Inhibitory effects of chickpea and Tribulus terrestris on lipase, α-amylase and α-glucosidase (Food Chemistry (2016) 205 (163-169)). *Food Chemistry*, *208*, 338. https://doi.org/10.1016/j.foodchem.2016.04.062

Fatima, L., & Sultana, A. (2017). Efficacy of Tribulus terrestris L. (fruits) in menopausal transition symptoms: A randomized placebo controlled study. *Advances in Integrative Medicine*, *4*(2), 56–65. https://doi.org/10.1016/j.aimed.2017.04.005

Gauthaman, K., & Adaikan, P. G. (2005). Effect of Tribulus terrestris on nicotinamide adenine dinucleotide phosphate-diaphorase activity and androgen receptors in rat brain. *Journal of Ethnopharmacology*, *96*(1–2), 127–132. https://doi.org/10.1016/j.jep.2004.08.030

Gauthaman, K., Adaikan, P. G., & Prasad, R. N. V. (2002). Aphrodisiac properties of Tribulus Terrestris extract (Protodioscin) in normal and castrated rats. *Life Sciences*, *71*(12), 1385–1396. https://doi.org/10.1016/S0024-3205(02)01858-1

Gauthaman, K., & Ganesan, A. P. (2008). The hormonal effects of Tribulus terrestris and its role in the management of male erectile dysfunction - an evaluation using primates, rabbit and rat. *Phytomedicine*, *15*(1–2), 44–54. https://doi.org/10.1016/j.phymed.2007.11.011

Ghanbari, A., Moradi, M., Raoofi, A., Falahi, M., & Seydi, S. (2016). Efectos de la administración del extracto hidroalcohólico tribulus terrestris sobre los parámetros reproductivos y el nivel sérico de glucosa en ratas macho diabéticas. *International Journal of Morphology*, *34*(2), 796–803. https://doi.org/10.4067/S0717-95022016000200058

Haghmorad, D., Mahmoudi, M. B., Haghighi, P., Alidadiani, P., Shahvazian, E., Tavasolian, P., Hosseini, M., Mahmoudi, M. B., Haghighi, P., Alidadiani, P., Shahvazian, E., Tavasolian, P., Hosseini, M., & Mahmoudi, M. (2019). Improvement of fertility parameters with Tribulus Terrestris and Anacyclus Pyrethrum treatment in male rats. *International Braz J Urol*, *45*(5), 1043–1054. https://doi.org/10.1590/S1677-5538.IBJU.2018.0843

Hammoda, H. M., Ghazy, N. M., Harraz, F. M., Radwan, M. M., ElSohly, M. A., & Abdallah, I. I. (2013). Chemical constituents from Tribulus terrestris and screening of their antioxidant activity. *Phytochemistry*, *92*, 153–159. https://doi.org/10.1016/j.phytochem.2013.04.005

Iacono, F., Prezioso, D., Illiano, E., Romeo, G., Ruffo, A., & Amato, B. (2012). Sexual asthenia: Tradamixina versus Tadalafil 5 mg daily. *BMC Surgery*, *12*(SUPPL. 1). https://doi.org/10.1186/1471-2482-12-S1-S23

Ivanova, S., Ivanov, K., Mladenov, R., & Papanov, S. (2016). *FOOD SUPPLEMENTS WITH ANABOLIC AND ANDROGENIC ACTIVITY -UHPLC World Journal of Pharmaceutical Research ACTIVITY - UHPLC ANALYSIS OF FOOD ADDITIVES ,. 5*(February), 6–13.

Kalailingam, P., Kannaian, B., Tamilmani, E., & Kaliaperumal, R. (2014). Efficacy of natural diosgenin on cardiovascular risk, insulin secretion, and beta cells in streptozotocin (STZ)-induced diabetic rats. *Phytomedicine*, *21*(10), 1154–1161. https://doi.org/10.1016/j.phymed.2014.04.005

Kam, S. C., Do, J. M., Choi, J. H., Jeon, B. T., Roh, G. S., & Hyun, J. S. (2012). In Vivo and in Vitro Animal Investigation of the Effect of a Mixture of Herbal Extracts from Tribulus terrestris and Cornus officinalis on Penile Erection. *Journal of Sexual Medicine*, *9*(10), 2544–2551. https://doi.org/10.1111/j.1743-6109.2012.02889.x

Kamenov, Z., Fileva, S., Kalinov, K., & Jannini, E. A. (2017). Evaluation of the efficacy and safety of Tribulus terrestris in male sexual dysfunction—A prospective, randomized, double-blind, placebo-controlled clinical trial. *Maturitas*, *99*, 20–26. https://doi.org/10.1016/j.maturitas.2017.01.011

Kang, S. Y., Jung, H. W., Nam, J. H., Kim, W. K., Kang, J. S., Kim, Y. H., Cho, C. W., Cho, C. W., Park, Y. K., & Bae, H. S. (2017). Effects of the Fruit Extract of Tribulus terrestris on Skin Inflammation in Mice with Oxazolone-Induced Atopic Dermatitis through Regulation of Calcium Channels, Orai-1 and TRPV3, and Mast Cell Activation. *Evidence-Based Complementary and Alternative Medicine*, *2017*. https://doi.org/10.1155/2017/8312946

Kaushik, J., Tandon, S., Bhardwaj, R., Kaur, T., Singla, S. K., Kumar, J., & Tandon, C. (2019). Delving into the Antiurolithiatic Potential of Tribulus terrestris Extract Through –In Vivo Efficacy and Preclinical Safety Investigations in Wistar Rats. *Scientific Reports*, *9*(1). https://doi.org/10.1038/s41598-019-52398-w

Kavitha, P., Ramesh, R., Bupesh, G., Stalin, A., & Subramanian, P. (2011). Hepatoprotective activity of

Tribulus terrestris extract against acetaminophen-induced toxicity in a freshwater fish (Oreochromis mossambicus). *In Vitro Cellular and Developmental Biology - Animal*, *47*(10), 698–706. https://doi.org/10.1007/s11626-011-9457-9

Kevalia, J., & Patel, B. (2011). Identification of fruits of Tribulus terrestris Linn. and Pedalium murex Linn.: A pharmacognostical approach. *AYU (An International Quarterly Journal of Research in Ayurveda)*, *32*(4), 550. https://doi.org/10.4103/0974-8520.96132

Khaleghi, S., Bakhtiari, M., Asadmobini, A., & Esmaeili, F. (2017). Tribulus terrestris Extract Improves Human Sperm Parameters In Vitro. *Journal of Evidence-Based Complementary and Alternative Medicine*, *22*(3), 407–412. https://doi.org/10.1177/2156587216668110

Khare, C. P. (2015). *M Madhuca indica to Myristica fragrans* (1st ed.). Taylor & Francis.

Kokate, C. K., Purohit, A. P., & Gohkale, S. B. (2002). *Pharmacognosy.* (21st Editi, Vol. 1). Nirali Prakashan, Scientific Research Publishing.

Kostova, I., & Dinchev, D. (2005). Saponins in Tribulus terrestris - Chemistry and bioactivity. *Phytochemistry Reviews*, *4*(2–3), 111–137. https://doi.org/10.1007/s11101-005-2833-x

Lamba, H. S., Bhargava, C. S., Thakur, M., & Bhargava, S. (2011). α-glucosidase and aldose reductase inhibitory activity in vitro and antidiabetic activity in vivo of tribulus terrestris L. (dunal). *International Journal of Pharmacy and Pharmaceutical Sciences*, *3*(3), 270–272.

Lee, H. H., Ahn, E. K., Hong, S. S., & Oh, J. S. (2017). Anti-inflammatory effect of Tribulusamide D isolated from Tribulus terrestris in lipopolysaccharide-stimulated RAW264.7 macrophages. *Molecular Medicine Reports*, *16*(4), 4421–4428. https://doi.org/10.3892/mmr.2017.7208

Maheswari, M. S. U., & . R. R. (2019). Comparative Evaluation of Qualitative and Quantitative Phytochemical Analysis of South Indian Bioactive Medicinal Plant Tribulus terrestris. *International Journal of Scientific Research in Biological Sciences*, *5*(6), 144–149. https://doi.org/10.26438/ijsrbs/v5i6.144149

Marques, C., Meireles, M., Norberto, S., Leite, J., Freitas, J., Pestana, D., Faria, A., & Calhau, C. (2016). High-fat diet-induced obesity Rat model: a comparison between Wistar and Sprague-Dawley Rat. *Adipocyte*, *5*(1), 11–21. https://doi.org/10.1080/21623945.2015.1061723

Martino-Andrade, A. J., Morais, R. N., Spercoski, K. M., Rossi, S. C., Vechi, M. F., Golin, M., Lombardi, N. F., Greca, C. S., & Dalsenter, P. R. (2010). Effects of Tribulus terrestris on endocrine sensitive organs in male and female Wistar rats. *Journal of Ethnopharmacology*, *127*(1), 165–170. https://doi.org/10.1016/j.jep.2009.09.031

Meena, P., & Anand, A. (2019). A comprehensive overview of Gokshura (Tribulus terrestris Linn.). *Journal of Ayurveda and Integrated Medical Sciences*, *4*(06), 205. https://www.jaims.in/jaims/article/view/788

Milasius, K., Dadeliene, R., & Skernevicius, J. (2009). The influence of the Tribulus terrestris extract on the parameters of the functional preparedness and athletes' organism homeostasis. *Fiziolohichnyĭ Zhurnal (Kiev, Ukraine : 1994)*, *55*(5), 89–96. https://pubmed.ncbi.nlm.nih.gov/20095389/

Miranda, D. R., Chaves, B. R., Vilela Soares, L., Konig, I. F. M., Pinto, J. T., Miranda, J. R., & Zangeronimo, M. G. (2022). Use of Tribulus terrestris and Lepidium meyenii extract in rats: reproductive, biochemical and body parameters. *Andrologia*, *54*(4), e14358. https://doi.org/10.1111/and.14358

Neychev, V. K., & Mitev, V. I. (2005). The aphrodisiac herb Tribulus terrestris does not influence the androgen production in young men. *Journal of Ethnopharmacology*, *101*(1–3), 319–323. https://doi.org/10.1016/j.jep.2005.05.017

Neychev, V. K., Nikolova, E., Zhelev, N., & Mitev, V. I. (2007). Saponins from Tribulus terrestris L. are less toxic for normal human fibroblasts than for many cancer lines: Influence on apoptosis and proliferation. *Experimental Biology and Medicine*, *232*(1), 126–133.

Neychev, V., & Mitev, V. (2016). Pro-sexual and androgen enhancing effects of Tribulus terrestris L.: Fact or Fiction. *Journal of Ethnopharmacology*, *179*, 345–355. https://doi.org/10.1016/j.jep.2015.12.055

Oh, H. K., Park, S. J., Moon, H. D., Jun, S. H., Choi, N. Y., & You, Y. O. (2011). Tribulus terrestris inhibits caries-inducing properties of Streptococcus mutans. *Journal of Medicinal Plant Research*, *5*(25), 6061–6066. https://doi.org/10.5897/JMPR11.1008

Oliveira, N. N. P. M., Félix, M. A. R., Pereira, T. C. S., Rocha, L. G. P., Miranda, J. R., Zangeronimo, M. G., Pinto, J. E. B. P., Bertolucci, S. K. V., & de Sousa, R. V. (2015). Sperm quality and testicular histomorphometry of wistar rats supplemented with extract and fractions of fruit of Tribulus terrestris L. *Brazilian Archives of Biology and Technology*, *58*(6), 891–897. https://doi.org/10.1590/S1516-89132015060278

Oluwagunwa, O. (2021). *Structural and functional properties of bioactive vegetable leaf polyphenols*. https://mspace.lib.umanitoba.ca/handle/1993/36262

Patel, A., Soni, A., Siddiqi, N. J., & Sharma, P. (2019). An insight into the anticancer mechanism of Tribulus terrestris extracts on human breast cancer cells. *3 Biotech*, *9*(2), 0. https://doi.org/10.1007/s13205-019-1585-z

Patil, A. S. (2016). *Pharmacological aspects of Tribulus terrestris Linn. (Goksura): progress and products. Therapeutic medicinal plant: From lab to the market. January*.

Pavin, N. F., Izaguirry, A. P., Soares, M. B., Spiazzi, C. C., Mendez, A. S. L., Leivas, F. G., dos Santos Brum, D., & Cibin, F. W. S. (2018). Tribulus terrestris protects against male reproductive damage induced by cyclophosphamide in mice. *Oxidative Medicine and Cellular Longevity*, *2018*. https://doi.org/10.1155/2018/5758191

Pokrywka, A., Obmiński, Z., Malczewska-Lenczowska, J., Fijałek, Z., Turek-Lepa, E., & Grucza, R. (2014). Insights into supplements with tribulus terrestris used by athletes. *Journal of Human Kinetics*, *41*(1), 99–105. https://doi.org/10.2478/hukin-2014-0037

Qari, S. H., & El-Assouli, S. M. (2019). Evaluation of cytological and genetic effects of Tribulus terrestris

fruit aqueous extract on cultured human lymphocytes. *Saudi Journal of Biological Sciences*, *26*(1), 91–95. https://doi.org/10.1016/j.sjbs.2017.01.012

Rainer W., Bussmann, & Sharon, D. (2015). From Plant Collection to Lab and Market—Traditional Medicine in Northern Peru. In *Therapeutic Medicinal Plants* (pp. 353–362). CRC Press. https://doi.org/10.1201/b19773-19

Ramteke, R., Thakar, A., Trivedi, A., & Patil, P. (2012). Clinical efficacy of Gokshura-Punarnava Basti in the management of microalbuminuria in diabetes mellitus. *AYU (An International Quarterly Journal of Research in Ayurveda)*, *33*(4), 537. https://doi.org/10.4103/0974-8520.110535

Ranjithkumar, R., Prathab Balaji, S., Balaji, B., Ramesh, R. V., & Ramanathan, M. (2013). Standardized aqueous Tribulus terristris (Nerunjil) extract attenuates hyperalgesia in experimentally induced diabetic neuropathic pain model: Role of oxidative stress and inflammatory mediators. *Phytotherapy Research*, *27*(11), 1646–1657. https://doi.org/10.1002/ptr.4915

Ravi Kumar, A., Ponnusamy, S., Ravindran, R., Zinjarde, S., & Bhargava, S. (2011). Evaluation of traditional Indian antidiabetic medicinal plants for human pancreatic amylase inhibitory effect in vitro. *Evidence-Based Complementary and Alternative Medicine*, *2011*. https://doi.org/10.1155/2011/515647

Rogerson, S., Riches, C. J., Jennings, C., Weatherby, R. P., Meir, R. A., & Marshall-Gradisnik, S. M. (2007). The effect of five weeks of tribulus terrestris supplementation on muscle strength and body composition during preseason training in elite rugby league players. *Journal of Strength and Conditioning Research*, *21*(2), 348–353. https://doi.org/10.1519/R-18395.1

Sahani, K., & THAKUR, D. (2019). GCMS ANALYSIS OF ENDOPHYTIC FUNGI CURVULARIA AERIA MTCC-12847 ISOLATED FROM TRIBULUS TERRESTRIS L. *International Journal of Pharmacy and Pharmaceutical Sciences*, 26–32. https://doi.org/10.22159/ijpps.2019v11i4.28440

Samani, N. B., Jokar, A., Soveid, M., Heydari, M., & Mosavat, S. H. (2016). Efficacy of the Hydroalcoholic Extract of Tribulus terrestris on the Serum Glucose and Lipid Profile of Women With Diabetes Mellitus: A Double-Blind Randomized Placebo-Controlled Clinical Trial. *Journal of Evidence-Based Complementary and Alternative Medicine*, *21*(4), NP91–NP97. https://doi.org/10.1177/2156587216650775

Santos, C. A., Reis, L. O., Destro-Saade, R., Luiza-Reis, A., & Fregonesi, A. (2014). Tribulus terrestris versus placebo en el tratamiento de la disfunción eréctil: un estudio aleatorizado, prospectivo y doble ciego. *Actas Urologicas Espanolas*, *38*(4), 244–248. https://doi.org/10.1016/j.acuro.2013.09.014

Santos, H. O., Howell, S., & Teixeira, F. J. (2019). Beyond tribulus (Tribulus terrestris L.): The effects of phytotherapics on testosterone, sperm and prostate parameters. *Journal of Ethnopharmacology*, *235*, 392–405. https://doi.org/10.1016/j.jep.2019.02.033

Semerdjieva, I. B., & Zheljazkov, V. D. (2019). Chemical Constituents, Biological Properties, and Uses of Tribulus terrestris: A Review. *Natural Product Communications*, *14*(8). https://doi.org/10.1177/1934578X19868394

Singh, B., & Sharma, R. A. (2020). Secondary metabolites of medicinal plants: Ethnopharmacological properties, biological activity and production strategies. In *Secondary Metabolites of Medicinal Plants: Ethnopharmacological Properties, Biological Activity and Production Strategies*. Wiley Blackwell. https://doi.org/10.1002/9783527825578

Ştefănescu, R., Tero-Vescan, A., Negroiu, A., Aurică, E., & Vari, C. E. (2020). A comprehensive review of the phytochemical, pharmacological, and toxicological properties of tribulus terrestris l. *Biomolecules*, *10*(5). https://doi.org/10.3390/biom10050752

Tharaheswari, M., Jayachandra Reddy, N., Kumar, R., Varshney, K. C., Kannan, M., & Sudha Rani, S. (2014). Trigonelline and diosgenin attenuate ER stress, oxidative stress-mediated damage in pancreas and enhance adipose tissue PPARγ activity in type 2 diabetic rats. *Molecular and Cellular Biochemistry*, *396*(1–2), 161–174. https://doi.org/10.1007/s11010-014-2152-x

Tilwari, A., Shukla, N. P., & Uma Devi, P. (2011). Effect of five medicinal plants used in Indian system of medicines on immune function in Wistar rats. *African Journal of Biotechnology*, *10*(73), 16637–16645. https://doi.org/10.5897/AJB10.2168

Vale, F. B. C., Boroni, J. D., Geber, G., Antunes, E. M. G., Bretas, T., Lopes, G. P., & Geber, S. (2021). Effect of Tribulus Terrestris in the Treatment of Female Sexual Dysfunction and Clitoral Vascularization. Results of a Randomized Study Comparing Two Different Dosage Regimes. *Journal of Sex and Marital Therapy*, *47*(7), 696–706. https://doi.org/10.1080/0092623X.2021.1938764

Vale, F. B. C., Zanolla Dias de Souza, K., Rezende, C. R., & Geber, S. (2018). Efficacy of Tribulus Terrestris for the treatment of premenopausal women with hypoactive sexual desire disorder: a randomized double-blinded, placebo-controlled trial. *Gynecological Endocrinology*, *34*(5), 442–445. https://doi.org/10.1080/09513590.2017.1409711

Wang, Z. F., Wang, B. B., Zhao, Y., Wang, F. X., Sun, Y., Guo, R. J., Song, X. B., Xin, H. L., & Sun, X. G. (2016). Furostanol and spirostanol saponins from Tribulus terrestris. *Molecules*, *21*(4), 3–16. https://doi.org/10.3390/molecules21040429

Yin, L., Wang, Q., Wang, X., & Song, L. N. (2015). Effects of Tribulus terrestris saponins on exercise performance in overtraining rats and the underlying mechanisms. *Canadian Journal of Physiology and Pharmacology*, *94*(11), 1193–1201. https://doi.org/10.1139/cjpp-2016-0086

Zhang, H., Tong, W. T., Zhang, C. R., Li, J. L., Meng, H., Yang, H. G., & Chen, M. (2019). Gross saponin of Tribulus terrestris improves erectile dysfunction in type 2 diabetic rats by repairing the endothelial function of the penile corpus cavernosum. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy*, *12*, 1705–1716. https://doi.org/10.2147/DMSO.S205722

Zhang, X., Wei, N., Huang, J., Tan, Y., & Jin, D. (2012). A new feruloyl amide derivative from the fruits of Tribulus terrestris. *Natural Product Research*, *26*(20), 1922–1925.

https://doi.org/10.1080/14786419.2011.643886

Zheng, W., Wang, F., Zhao, Y., Sun, X., Kang, L., Fan, Z., Qiao, L., Yan, R., Liu, S., & Ma, B. (2017). Rapid Characterization of Constituents in Tribulus terrestris from Different Habitats by UHPLC/Q-TOF MS. *Journal of the American Society for Mass Spectrometry*, *28*(11), 2302–2318. https://doi.org/10.1007/s13361-017-1761-5

Zhu, W., Du, Y., Meng, H., Dong, Y., & Li, L. (2017). A review of traditional pharmacological uses, phytochemistry, and pharmacological activities of Tribulus terrestris. *Chemistry Central Journal*, *11*(1), 1–16. https://doi.org/10.1186/s13065-017-0289-x