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## A comprehensive review on a Unani medicinal plant: *Tribulus terrestris* Linn.

**Khan Zeeshan Amanullah, Fahmeeda Zeenat, Wasim Ahmad, Shaihba Firoz and Ansari Naeela**

### Abstract

*Tribulus terrestris* Linn is one of the most important medicinal plants traditionally used for various health purposes. The fruit, leaves, stem and root of the plant are therapeutically used. The fruits are greenish to grey in color with faintly aromatic odour and slightly acidic taste. While the roots are light brown in color with aromatic odour and sweetish astringent taste. The dried fully ripe fruit of this plant is known as Khar-e-Khasak Khurd in Unani System of medicine. It acts as diuretic and useful in dysuria and gonorrhoea. Traditionally it has been used for boosting hormone production in men and women. The herb is found in Mediterranean, subtropical and desert climate regions around the world. The plant is common in sandy soil throughout India. The plant grows more or less throughout the years. The plant is described in detail in ethnobotanical and scientific literature and various actions have been reported to possess by this. A number of studies have also been carried out on *Tribulus terrestris* in recent years showing that it possesses diverse biological and pharmacological activities. It has been used in Unani Medicine (*Tibb-e-Unani*) and other traditional system of medicine from time immemorial. Keeping in view the high medicinal importance of the drug in Unani Medicine, this review provides available information on its traditional uses, phytochemistry and pharmacological properties.

**Keywords:** *Tribulus terrestris*, khar khasak khurd, gokhru

### 1. Introduction

The genus *Tribulus* belonging to family Zygophyllaceae, comprises about 20 species in the world, of which three species, viz. *Tribulus cistoides*, *Tribulus terrestris* and *Tribulus alatus* are of common occurrence in India [1]. *Tribulus* is Latin for “three-pointed a caltrop”, the shape of which is suggested by the three-pronged *Tribulus terrestris* fruit, and referring to the caltrop, a military weapon, an iron ball with projecting spikes, it is also called ‘puncture vine’ [2]. The dried fully ripe fruit of *Tribulus terrestris*, Linn is known as Khar-e-Khasak Khurd. It acts as diuretic and useful in dysuria and gonorrhoea [3]. Traditionally it has been used for boosting hormone production in men and women [4]. The dried fruit of *Pedaliium murex* (Pedaliaceae) are known as Khar-e-Khasak Kalan or Bara Gokhru [3]. *Tribulus terrestris* L. variety is also known as *mitha* (sweet) *Gokhru* as distinguished from *kadva* or *moto Gokhru* (*Pedaliium murex*) [5].

It has been described in classical Unani literature that Khar-e-Khasak is a thorny fruit of a plant which grows in rainy season. It is classified by Greek physicians as *Barri* (wild) and *Bustani* (cultivated). Former one mostly found in forest, branches are thorny run along the soil and thorn arises at the junction of leaves. Test of dew over its leaves are sour (*Tursh*) and taste less at mastication. Fruit is triangular in shape with spines around it, contain pulp inside which is white in color. While *Bustani Gokhro* found in drizzly areas and near the canals, flowers are small and yellowish in color, leaves are broad and has thorn near it, and branches are spread over the ground. Stems are hairy bulky at superior side and thin at lower side. Fruit is same as former type hard, thorny and contain small granules which are white in color [6-7]. Fresh green *Bustani Khar-e-khasak* well thought out better and standard [7].

In India *Khar-e-Khasak* are of two types *Khar-e-Khasak Kalan* (large variety) and *Khar-e-Khasak Khurd* (small variety). *Khar-e-Khasak Kalan* is also called *Wilayati Gokhru*. The *Khurd* variety is medicinally used [6-7]. The plant of this type is found in south India, and sandy areas. The plant is small about a hand in length. Its branches and leaves produce large quantity of mucilage when mix with water. Its roots are yellow or *sindoorya* in color. It bears fruit which measures about an inch and fruit has a thorn on each four corners. Fruit is green in color, yellow when ripened and becomes brownish when dried. The spines are sharp, that is why it is also called *hast chingar* in Hindi. The plants of small *gokhru* are found in North West State of India. These plants spread on ground. The leaves are similar to gram (*chana*). It bears

small yellow flowers and two fruits either side of branches, each fruit has three thorns which are very sharp. It is also called *Dakhni Gokhru* [6].

The fruit, leaves, stem and root of the plant *Tribulus terrestris*, Linn are therapeutically used [8]. The fruits are greenish to grey [3] or yellow in color with faintly aromatic odour and slightly acidic taste. While the roots are light brown in color with aromatic odour and sweetish astringent taste [9].

## 2. Ethnobotanical description

### 2.1. Plant

*Tribulus terrestris*, Linn is a procumbent herb, stems and branches pilose, young parts silky-villous [10]. It is a 30-60 cm [11], small, prostrate, hirsute or silky hairy [8], much branched, annual herb [9].

### 2.2. Leaves

The leaves are opposite and compound [12]. These are abruptly pinnate [8, 10], usually unequal [8], sometimes wanting, stipules lanceolate, hairy, leaflets 3-6 pairs, 6-12 mm long, oblong, mucronate, sericeovillous with appressed hairs, base rounded oblique, petioles very short, pilose [10].

### 2.3. Flowers

The flowers are perfect (hermaphroditic) and insect pollinated, with five-fold symmetry [12]. These are axillary or leaf opposed, solitary [10], yellow or white in color [8], pedicels 1.2-2 cm long, slender, hairy; Sepals 6 mm lanceolate, acute, hairy; Petals 1 cm long, oblong-obovate, claw short, hairy; Ovary bristly, style short, stout, stigmatic lobes longer than the diameter of style [10]. The ovary is divided into locules that are in turn divided by 'false septa' [12].

### 2.4. Fruit

Fruits are globose, consisting of usually 5 hairy or nearly glabrous, often muriculate, woody cocci, each with 2 pairs of hard sharp spines, one pair longer than the other [10], 1 cm in diameter and yellow in color. The average weight of one fruit is 0.18 gm [13].

### 2.5. Seeds

Seeds are small, pale brown [13], obliquely pendulous [8], several in each coccus, with transverse partitions between them [10].

## 3. Habitat

*Tribulus terrestris* is found in Mediterranean, subtropical and desert climate regions around the world, viz. India, China, southern USA, Mexico, Spain, and Bulgaria [1]. The plant is common in sandy soil throughout India [5], up to 11000 ft in Kashmir [10]. Occasionally found in waste places and dry habitats throughout the warmer regions of India [8], abundant in Bihar, Andhra Pradesh, Tamil Nadu, North-West States and the Gangetic plains [11].

## 4. Period of occurrence

The herb is common weed, springing up everywhere soon after the first showers [14]. The plant grows more or less throughout the years and flowering takes place from September to December. Fruits mature between May to June [11]. The flowering starts within 25-30 days and the fruit mature in 14 days after the formation of seed [14].

## 5. Procedure and time of collection

The fruits are collected during the month of May and June,

generally by hand, but sometimes the whole herb is gathered and then the spiny fruits are separated [11].

## 6. Preservation and storage

The fruits are dried in shade, thoroughly garbled and stored in bottles and preserved in a cool and dry place. Fruits retain their medicinal efficacy for a period of about 6 months only [11].

## 7. Vernaculars

The plant is known by different vernacular names in different language, areas and traditions: *Krunda* (Afghanistan); *Devil's Thorn* (Africa); *Caltrop*, *Dubbeltjiedoring*, *Duiweltjies*, *Morester*, *Volstruisdoring* (Afrikaans); *Bastitaj*, *Busteyrumi*, *Khasak* (Arabic); *Gokhru*, *Gukhuru*, *Gokhuri* (Bengal); *Gokhru*, *Lahangokru*, *Sarate* (Bombay); *Charatte*, *Suleanen* (Burma); *Gokhru* (Central Provinces); *Chi Li*, *Tsi Li Tse* (Chinese); *Ghokru*, *Kanteghokhri* (Deccan); *Calthrops*, *Small Calthrops*, *Land Calotrops*, *Puncture Vine* (English); *Croix de chevalier*, *Croix de Malte*, *Herbe terrestre*, *Herse terrestre*, *Saligot terrestre*, *Tribule commune*, *Tribule terrestre* (French); *Betagokhru*, *GokhBaru*, *Gokhru*, *Mithagokhru*, *Nahanagokhru* (Gujrat); *Burragakhru*, *Chhotagakhru*, *Hatechanghara*, *Hussuk*, *Gokhru*, *Gokshri* (Hindi); *Neringil*, *Nerinnil*, *Nerungil*, *Nerinnil* (Malayalam); *Ghokaru*, *Lahanagokharu*, *Sharatte* (Marathi); *Kharekhasak*, *Khussuck* (Persian); *Bakhra*, *Bhakhra*, *Bhukri*, *Gokhrudesi*, *Lotak*, *Kurkundai* (Panjab); *Bahukantaka*, *Bhakhshataka*, *Chanadruma*, *Gokantaka*, *Gokhura*, *Gokshura*, *Gokshuri*, *Ikshugandha*, *Kanta*, *Kantaphala*, *Kshudragokshura*, *Kshura*, *Laghugokshura*, *Palankasha*, *Shadanga*, *Shvadanshra*, *Sthalashringataka*, *Sudumstra*, *Trikantaka*, *Vanashringataka*, *Trikantah* (Sanskrit); *Gokhru*, *Trikundri* (Sind); *Abrojos* (Spanish); *Nerunji*, *Sirunerinji*, *Cherunerinche*, *Nerinji*, *Nerinjal* (Tamil); *Pallerumullu*, *Nirunji* (Telugu) [5, 9-10].

## 8. Mizaj (Temperament)

Unani physicians described the *Mizaj* of *Khar-e-Khasak Khurd* (*Tribulus terrestris*) as Hot and Dry in 1<sup>st</sup> degree [6, 11, 15], while some others categorized it as Murakabul Quwa [6, 16], and Cold and Dry in 2<sup>nd</sup> degree [17].

## 9. Afaal (Action)

In classical Unani literature, various actions of the plant *Tribulus terrestris* have been described such as *Muddir-e-bol wa haiz* [6, 9, 15, 18], *Mulaiyyan*, [7, 9, 11, 16], *Munzij* [7, 16], *Mudir-e-Bol* [11, 19], *Jali* [7, 16], *Musakkim-e-Dard Masana* [16], *Muhalil-e-Warm* [6], *Muzyed-e-Mani* [7, 16], *Mufatit-e-Sang-e-Gurda wa Masaana* [15], *Mukhrij-e-Hisat-e-Girda wa Masaana* [18], *Muqqawi Bah* [6-7, 9, 11, 15, 17, 19], *Muddir* [16], *Rade* [16, 19] and *Mufatitt-e-Hisat* [9, 11, 16].

## 10. Istemaal (Uses)

### 10.1. Eyes

Its extract (*usarah*) used with honey as a *surma* cures eye diseases [7], and its fresh leaves when crushed and applied over eyes cures the *ramad* (conjunctivitis) [6].

### 10.2. Oral cavity

Gargling with decoction is beneficial in infective ulcers of gums and toothache and stomatitis [7].

### 10.3. Respiratory system

Its decoction is useful in cough, shortness of breath and hoarseness of voice [6]. Gargling with decoction also cures

*warm-e-halaq* (pharyngitis, laryngitis) and *Khunaque* (diphtheria) [6-7].

#### 10.4. Cardiovascular system

Its leaf produces diluted blood [17].

#### 10.5. Gastrointestinal tract

It corrects the function of stomach [7], increases appetite and relieves gastric pain [6]. It is beneficial in ascites [15], and *reyahi qoolanj* [6].

#### 10.6. Reproductive system

Powder of *Khar-e-Khasak Khurd* is useful in female infertility. It produces extra semen and has aphrodisiac property. It is found more aphrodisiac if gram seeds are soaked and dried many times in infusion of *gokhru* [6]. Its decoction is used in amenorrhea and dysmenorrhea [18].

#### 10.7. Urinary system

It is useful in burning micturition, retention of urine and has a lithotriptic activity so used in renal and vesicular calculi. Its *khisanda* is useful in gonorrhoea. The fine powder of *Gokhru* and *Misri* in equal quantity is useful in premature ejaculation, dysuria and dribbling of urination [6]. In case of burning micturition, it is used with *Javakhar*. It is beneficial in chronic nephritis and albuminuria [15]. It is beneficial in dysuria and anuria [20].

#### 10.8. Skin

Local application of paste of *Gokhru* subside the inflammation. Its powder mixed with honey is used locally to inhibit the spreading of wound [7]. It is also used in backache, *balghami* and *safrawi* diseases [6], and as an antidote [15].

#### 11. Muzir (Adverse effect)

It produces adverse effect on spleen [7, 16-17], head [7] and *Amraz e Raas* [15, 19].

#### 12. Musleh (Corrective)

Different correctives are used like:

*Badam* [15-17, 19]

*Roghan-e-Kunjad* [15, 19]

Milk [19]

*Roghan-e-Badam, Gulqand*, cow's butter [6-7]

*Badam Shireen* [11]

#### 13. Badal (Substitute)

Different substitutes are used like:

*Kakanj* [6-7, 16]

Seeds of *Kakdi* [17]

*Khar-e-Khasak Kalan* [11]

#### 14. Doses (Miqdar khurak)

5-7 gm [11, 15]

6 gm [16-17]

6-10 gm [19]

#### 15. Pharmacological action

(As described in ethnobotanical and traditional literature)

The drug *Tribulus terrestris* is described in detail in ethnobotanical and scientific literature and various actions have been reported to possess by it. Some pharmacological actions and therapeutic uses are as follows:

The fruits are tonic, diuretics [5, 8, 10, 14, 21-22], demulcent [5, 8], aphrodisiac [5, 8-10, 22-23], cooling [5, 10, 21-22], fattening and

alterative [10].

Roots are emmenagogue, stomachic [9-10], appetizer, diuretic, carminative [10], demulcent [8], aphrodisiac [9], aperient [8-9, 14], tonic [8, 10, 14].

Leaves are tonic, diuretics [10], stomachic [8, 14].

Stems are astringent [8].

#### 16. Therapeutic uses

In Unani medicine fruits are used in painful micturition, calculus affection, urinary discharges and impotency. In the form of infusion it is useful in gout, kidney disease and gravel [10, 22-23]. Decoction of fruit is efficacious in chronic cystitis, gonorrhoea [8], renal and bladder calculi. For impotency, it is used in the form of powder or *Majoon* [11]. Used in Gall bladder calculi [13], burning sensation, skin and heart disease [9]. It removes gravel from urine and stone in the bladder, cures strangury, gleet [10]. It also prescribed in Bright's disease [14].

A paste prepared from leaves is given for the treatment of stones in bladder [14]. It is used in affection of urinary calculi [8], ophthalmia, and scabies [9]. They enrich the blood, increase the menstrual flow, and cure gonorrhoea and gleet. A decoction is useful as a gargle for mouth troubles and painful gums; reduce inflammation [10]. Roots are useful in burning sensation, skin and heart diseases [9]. They cure lumbago [10]. Infusion of stem is useful in gonorrhoea [8].

#### 17. Phyto-chemistry

The herb is rich in calcium and contains (dry basis), crude protein 12.06%, ether extract 2.61%, crude fiber 27.78%, N-free extract 40.83%, total ash 16.72%, calcium 4.21%, phosphorus 0.25% and total digestive nutrients 55.63% [14].

The plant contains carboline alkaloids, flavonoids [24], harman, hermine [3]. Additionally, they contain saponins which on hydrolysis yield steroidal sapogenins, diosgenin, gitogenin, chlorogenin, ruscogenin [3, 14], and 25 D- spirosta-3, 5-diene [14].

Astragalin, dioscin, 3-deoxy- - diosgenin, gracillin, harman, hecogenin, ruscogenin, trillin, furostanol glycoside, spirosterol saponin and a dihydroxy spirosteroidal sapogenin, triogogenin-3-diglucorhamnoside (terresteroside F), along with saponins C and G, (mixture of tigogenin and five diosgenin glycosides- one containing arabinose, glucose and rhamnose, two having glucose and rhamnose units and the remaining two glucose residues) isolated from aerial parts [8]. Two new steroidal glycosides – neohecogenin glucoside tribulosin, four glycosides of kaempferol, six glycosides of quercetin and eight glycosides of isorhamnetin also isolated from aerial part [25].

Saponins having high hemolytic index are present in leaves and roots, but absent in stem and seeds. Three saponins in leaves and two in roots have been identified [14].

Analysis of leaves gave (dry matter basis): fat 2, crude fiber 2, total available carbohydrate 79,  $\beta$ -carotene 141, ascorbic acid 5mg/100 g. The minerals present are ca 842, P 280, Zn 3, Fe 32 and Mn 5mg/100g. The anti-nutritional factors reported are phytic acid 83, phytate P 12, phytate (as % of total P) 4 and oxalic acid 600mg/100gm [21].

The fruits contain alkaloids, resin, fixed oil, essential oil, nitrates [10, 14, 22], quercetin, kaempferol [24, 26], chlorogenin, diosgenin and its acetate, gitogenin, glucose, rhamnose and rutin [8], tannins, reducing sugar, sterols, peroxidases, diastase, traces of glucoside [14]. The fatty oil has excellent drying properties [3, 14], and seedcake is rich in phosphorus and nitrogen [14].

Flavonoid, kaempferol, Kaempferol-3-glucoside, Kaempferol-3-rutinoside, and tribuloside have been also isolated from leaves and fruits <sup>[14]</sup>.

Diosgenin and its acetate, gitogenin, kaempferol, campesterol,  $\beta$ -sitosterol, stigmasterol, neogitogenin, quercetin and reducing sugars <sup>[8]</sup>, hecogenin, ruscogenin and spirosta-3,5-diene have been isolated from the flowers <sup>[21]</sup>.

The alkaloid herman has been reported from the herb and Hermine from the seeds <sup>[27]</sup>.

Roots contain aminoacids, phytosterols <sup>[24]</sup>, campesterol,  $\beta$ -sitosterol, stigmasterol <sup>[8, 24, 28]</sup>, diosgenin <sup>[28]</sup>, hecogenin and neogitogenin <sup>[21]</sup>.

## 18. Pharmacological studies

A number of studies have been carried out on *Tribulus terrestris* in recent years showing that it possesses diverse pharmacological effects. Some of the important pharmacological effects are as follows:

### 18.1. Analgesic

The analgesic effect of methanolic extracts of the fruit of *Tribulus terrestris* on male albino mice was evaluated by formalin and tail flick test. The results showed that a dose of 100 mg/kg of percolated extract had the highest significant analgesic effect compared to the control group ( $P < 0.01$ ) in formalin and tail flick test <sup>[29]</sup>.

### 18.2. Anthelmintic

Two isolated constituent's tribulosin and  $\beta$ -sitosterol-D-glucoside have shown anthelmintic activity <sup>[30]</sup>.

### 18.3. Antiarthritic

Anti-arthritic activity is probable due to presence of flavonoids. These flavonoids are having the surface charge neutralizing effects. It was found that the administration of *Tribulus terrestris* leads to inhibition of leukocyte migration which may have beneficial effect for joint preservation. The activity may be due to presence of steroidal glycoside <sup>[31]</sup>.

### 18.4. Antibacterial

Antimicrobial activity of saponin extract showed inhibiting effect on Gram-positive and Gram-negative bacteria, indicating presence of broad-spectrum antibiotic compounds or simply general metabolic toxins in the plant <sup>[32]</sup>.

Antimicrobial and antifungal activity of organic and aqueous extracts from fruits, leaves and roots of *Tribulus terrestris* which demonstrated activity against the most prevalent Gram-negative bacteria in urinary infections, namely *E. coli*, the use of the plant as a urinary anti-infective is validated <sup>[33]</sup>.

### 18.5. Antidiabetic

A study was designed to investigate the protective effects of *Tribulus terrestris* in diabetes mellitus. This investigation suggests that its protective effect for streptozotocin induced diabetic rats may be mediated by inhibiting oxidative stress <sup>[34]</sup>.

Another study suggests that ethanolic extract of *Tribulus terrestris* produced protective effect in streptozotocin induced diabetic rats by inhibiting oxidative stress. This exhibited 70% inhibition of  $\alpha$ -glucosidase and 100% inhibition of aldose reductase <sup>[35]</sup>.

### 18.6. Antifungal

The anti-fungal activity of saponins isolated from *Tribulus terrestris* was studied against fluconazole resistant yeasts,

*candida albicans*. The results showed that saponins from *Tribulus terrestris* have significant *In Vitro* and *In Vivo* antifungal activity by weakening the virulence of candida albicans and killing fungi through destroying the cell membrane <sup>[36]</sup>.

### 18.7. Antihypertensive

Antihypertensive effect of an aqueous extract of *Tribulus terrestris* in renin-dependent 2-kidney 1-clip (2K-1C) model of hypertension and suggested that this might be related to its inhibitory effect on angiotensin converting enzyme (ACE) activity. This was based on the observation that treatment with the aqueous extract *Tribulus terrestris* significantly reduced ACE activity in all tissues of the rat <sup>[37]</sup>.

In another study methanolic and aqueous extracts of *Tribulus terrestris* possess significant antihypertensive activity in spontaneously hypertensive rats. The antihypertensive effects appeared to result from a direct arterial smooth muscle relaxation possibly involving nitric oxide release and membrane hyperpolarization <sup>[38]</sup>.

### 18.8. Anti-inflammatory

The ethanolic extract of *Tribulus terrestris* inhibits the expression of mediators related to inflammation and expression of inflammatory cytokines, which has a beneficial effect on various inflammatory conditions <sup>[39]</sup>.

### 18.9. Antioxidant

Antioxidant activity of the aqueous extract of *Tribulus terrestris* fruit in spleen cells scavenged reactive oxygen species (ROS) induced by  $\gamma$ -radiation as well as AAPH showed protection against oxidative stress induced apoptosis. It also exhibited mitogenic activity in spleen cells <sup>[40]</sup>.

### 18.10. Antitumor

The study aims to analyze the effect on cell viability and apoptotic activity of total extract and saponin fraction of Bulgarian *Tribulus terrestris* L. on human breast cancer and normal cell lines. The results showed that total extract of the herb has a marked dose-dependent inhibitory effect on viability of human breast cancer cells. Cell viability of normal cell lines was moderately decreased without visible dose-dependent effect <sup>[41]</sup>.

### 18.11. Antiuro lithic

An ethanolic extract of the fruits of *Tribulus terrestris* showed significant dose dependent protection against uroliths induced by glass bead implantation in albino rats. The extract provided significant protection against deposition of calculogenic material around the glass bead, and protected leucocytosis and elevation in serum urea levels <sup>[42]</sup>.

The activity of *Tribulus terrestris* on the nucleation and growth of calcium oxalate (CaOx) crystals as well as on oxalate-induced cell injury of renal epithelial cells was evaluated. The experiments revealed that *Tribulus terrestris* extract not only has a potential to inhibit nucleation and growth of the CaOx crystals but also has a cytoprotective role <sup>[43]</sup>.

### 18.12. Diuretic

A study was designed to investigate the effects of herbal extract of *Tribulus terrestris* on the urine output and electrolytes in rabbits. A significant increase in urine volume over a period of study was observed. Additionally, it significantly decreased the sodium level and serum potassium

level throughout the study period [44].

The aqueous extract of the leaves and fruits of *Tribulus terrestris* in oral dose elicited positive diuresis activity which was slightly higher than furosemide. Sodium, potassium and chloride concentrations in urine were also increased [45].

### 18.13. Hepatoprotective

The current work aimed to investigate the protective effects of *Tribulus terrestris* extracts against ivermectin-induced hepatic and renal toxicity in male rabbit. This study concluded that, *Tribulus terrestris* extracts could be used as an effective treatment to ameliorate the ivermectin-induced renal and hepatic toxicity in rabbits [46].

### 18.14. Hypolipidemic

The aqueous extract of the fruits of *Tribulus terrestris* was evaluated for their hypolipidemic activity in Wistar albino rats. The extract was found to decrease cholesterol induced hyperlipidemia, with a decrease in cholesterol, triglycerides, low density lipoprotein, very low-density lipoprotein, and atherogenic index, and an increase in high density lipoprotein levels in the blood [47].

### 18.15. Immunomodulatory

Saponins isolated from the fruits of *Tribulus Terrestris* demonstrated dose-dependent increase in phagocytosis, indicating stimulation of nonspecific immune response. An alcoholic extract of the whole plant exhibited a significant dose-dependent increase in humoral antibody titer and delayed type hypersensitivity response, indicate increased specific immune response [48].

### 18.16. Nephroprotective

A study carried out to investigate the influence of methanolic fraction of *Tribulus terrestris* fruit extract on the kidney tissues of mercury intoxicated mice, *Mus musculus*. The results suggested that the oral administration of methanolic fraction of *Tribulus terrestris* fruit extract provided protection against the mercuric chloride induced toxicity in the mice [49].

### 18.17. Radioprotection

The aqueous root extract of *Tribulus terrestris* produced significant radioprotection when given orally prior to gamma irradiation. The extract pretreatment protected against radiation damage by inhibiting radiation-induced glutathione depletion and decreasing lipoperoxidation level in the liver of mice [50].

### 18.18. Spermatogenic

The study aimed to investigate the effect of *Tribulus terrestris* extract on the primary spermatocyte in rat. The results showed that extract can probably balance the functions of the male reproductive system and can be used in treatment of male infertility, while affecting the testis spermatocyte [51].

### 18.19. Reproductive system

In a study effect of the aqueous extract of *Tribulus Terrestris* on the reproductive system of mature albino female mice was evaluated. Results showed significant increase in the number of growing follicles, diameter of mature follicles, endometrial lining cells height and endometrial glands diameter [52].

### 19. Conclusions

*Tribulus Terrestris* Linn (Family-Zygophyllaceae) has been in use since times immemorial to treat wide range of indications.

It has been subjected to quite extensive phytochemical, experimental and clinical investigations. Experimental studies have demonstrated its analgesic, anthelmintic, antiarthritic, antibacterial, antidiabetic, antifungal, antihypertensive, anti-inflammatory, antioxidant, antitumor, antiurolithic, diuretic, hepatoprotective, hypolipidemic, immunomodulatory, nephroprotective, radioprotection, spermatogenic activities and effect on reproductive system. The scientific studies have proved most of the claims of traditional medicines. However, further, detailed clinical research appears worthwhile to explore the full therapeutic potential of this plant in order to establish it as a standard drug.

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### 21. Conflict of interest

The authors have no conflict of interest of any kind with anybody.

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