

GOKHRU (*TRIBULUS TERRESTRIS* AND *PEDALIUM MUREX*): MEDICINAL IMPORTANCE OF CHOTA GOKHRU AND BADA GOKHRU IN AYURVEDA AND MODERN SCIENCE

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Received: 09 March 2021, Revised and Accepted: 23 April 2021

ABSTRACT

Tribulus terrestris and *Pedaliium murex* are the two popular herbal plants originated from a very famous Ayurvedic plant named Gokshuru. These plants are well known for their medicinal importance. In Ayurveda, *T. terrestris* is known as laghu gokshuru and *P. murex* is known as brihat gokshuru. The fruits of *T. terrestris* plant are slightly astringent in taste while the fruits of *P. murex* are somewhat sweeter in taste. The fruits are used to treat various diseases such as urinary disorder adrenal stone. In this current paper, we have discussed the pharmacological, Ayurvedic and folk uses of these plants in every region of the world. From various reported studies, it was found that the *T. terrestris* plant carries much medicinal importance while the *P. murex* fruits is only used as a substitute or as an adulterant of the *T. terrestris* plant. It was found that the *T. terrestris* plant is mainly used to cure urinogenital disorders and kidney disorders such as renal and gall bladder stone. On the other hand, the *P. murex* plant carries aphrodisiac property and mainly used to cure sexual disorders like infertility, erectile dysfunctioning in both male and females. It was also found that these plants have some similar phytochemical constituents which possess aphrodisiac, anti-inflammatory, demulcent, diuretic properties, and also used to cure other diseases such as cough, asthma, cardiac disease, vesical calculi, and gall bladder stone. These plants are known for major therapeutic properties such as anti-ulcerative, antiurolithic, anticancer, aphrodisiac, analgesic, stomachic, anti-hypertensive, diuretic, urinary anti-infective, cardio tonic, antibacterial, anti-inflammatory, nephroprotective, antispasmodic, anthelmintic, and anti-carcinogenic.

Keywords: *Tribulus terrestris*, *Pedaliium murex*, Gokhru, Aphrodisiac, Rasapanchak, Ayurveda.

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INTRODUCTION

Tribulus genus belongs to the family *Zygophyllaceae* commonly known as "small caltrop," "Chota Gokhru," "puncture vine," goat head, devil's thorn, and "Gokhshura" in Sanskrit [1,2]. The Latin meaning of the word *Tribulus* is "three pointed caltrops" suggested for the three pronged fruit of *Tribulus terrestris* fruit with projecting spikes [2] It is the most important herbal plant popularly known for its folk uses in various parts of the world to treat different ailments [3]. There are almost 20 species of this plant out of which three main species *Tribulus cistoides*, *T. terrestris*, and *Tribulus alatus* are found in India (Fig. 1) [4]. It is a significant medicinal plant used traditionally and therapeutically to treat various diseases. It is mainly found in the tropical and subtropical regions of the world. Conventionally, it is used to enhance the hormonal production in both male and females [5]. The ripened dry fruit which is called as Khar-e Khasak Khurd is used to treat dysuria and gonorrhoea disease in Unani medicinal system [6]. Furostanol and spirostanol are the main saponin components found in this plant that is known for its therapeutic properties [7]. *T. terrestris* is mainly used to treat urinary and kidney disorders. Furthermore, it consists of other medicinal properties such as diuretic, antiurolithic, immunomodulatory, anticancer, aphrodisiac, analgesic, stomachic, anti-hypertensive, diuretic, lithontriptic, urinary anti-infective, cardiogenic, antibacterial, anti-inflammatory, antispasmodic, antihelmintic, larvicidal, and anti-carcinogenic [8]. The other type of caltrop is *Pedaliium murex* (Fig. 2) commonly known as "large caltrop," "Gokhru or gokhar" and "gaja-daunstraka, gokshura or tittagokshura" in Sanskrit [9]. It belongs to the family *Pedaliaceae*. This plant as a whole or individual parts are used to treat diseases like common cold, cough and is used as an antiseptic [10]. Conventionally, it is used to treat sexual and other reproductive disorders such as impotency gonorrhoea, infertility, and premature ejaculation as it contains diosgenin and vanillin constituents which are responsible for the aphrodisiac property [11,12]. It is used in Unani and Ayurvedic medicinal system as a cooling agent and improves appetite, asthma, inflammation, piles, leprosy, heart diseases, cough, and vesicular calculi. It also contains

pharmacological properties such as anti-oxidant, anti-ulcerogenic, nephroprotective, hypolipidemic, aphrodisiac, antimicrobial, and insecticidal properties [13]. Taxonomical classification and vernacular name are given in Tables 1 and 2.

BOTANICAL DESCRIPTION***T. terrestris* linn**

Tribulus terrestris is a small prostrate, branched, annual herb that belongs to the family *Zygophyllaceae* [22]. The height of this plant reaches up to 90 cm in length. The roots of the plant are fibrous, narrow, light brown, 4–5 inches long, fragmented, astringent, and sweet in taste. The leaves are opposite somewhat round shaped, pinnately compound, short petiole containing 5–6 pairs of leaflets that are 6–12 mm in length [23]. The flowers are silky, hermaphrodite, solitary axillary consists of 5 broad yellow petals that are 4–10 mm in width rises from axils of leaves [15]. The fruits of this plant are spinous, glabrous, five cornered, hairy and covered by greenish yellow colored sharp thorns, minutely muricate, woody cocci containing two pairs of sharp spines usually one pair longer than the other [24].

P. murex

P. murex commonly known as large caltrop and Bara Gokhru is branched, succulent fleshy, and annual glandular herbal plant that reaches up to the height of 30–50 cm. The leaves are simple, reticulate, ovoid, alternate, and opposite and are 3.2–5.3 cm in length and 1–2.7 cm in breadth [25]. The roots of the plant are white and have sweet fragrance. Flowers are round, solitary about 2.5–3 cm long, bright yellow and axillary with short pedicel consist of 5 calyxes with gamopetalous corolla, 5 lobes, 4 stamens, didynamous, 5 celled ovules, 2 lobed style, and stigma [18,26]. The corolla tube consists of glabrescent hairs. The fruits of this plant are four angled, fleshy containing conical horizontal trichrome from the angles [27]. The stem of the plant is stiffed. The leaves and stem of the plant when soaked into cold water turns into tasteless pale thick paste which carry great medicinal property.

Fig. 1: *Tribulus terrestris*Fig. 2: *Pedalium murex*

GEOGRAPHICAL DISTRIBUTION

T. terrestris

T. terrestris is a native of Mediterranean region and is mainly found in tropical and subtropical region in the universe. It is widely distributed in the countries like Southern USA, Mexico, South Africa, Middle east, Pakistan, Sri Lanka, Vietnam, Sothern Europe, Spain, Bulgaria, India and China [3,28,29]. The best soil considers for its growth is sandy soil but can also grow in loamy and clayey soil. It is mainly grown in waste land as a weed like in road side, dry and grazing land. It is commonly found at an altitude of 5400 m to 11000 feet in Kashmir. In India, it is mainly found in Bihar, Andhra Pradesh, Tamil Nadu, North-west states and the Gangetic plains [30].

P. murex

It is found mainly in the tropical and subtropical regions of the world. It is mostly seen in countries like south Africa, Sri Lanka, India, Mexico and Pakistan. It is distributed in the western and coastal regions of India and is mainly considered as weed which grows in waste and dry places [31]. In India, it is widely scattered in states like Tamil Nadu, Rajasthan, Punjab, Gujarat, Delhi, and Deccan peninsula [32,33].

PHYTOCHEMICALS CONSTITUENTS OF GOKSHURA

T. terrestris

T. terrestris plant contain number of chemical constituents named as steroids, saponins, flavonoids, alkaloids, vitamins, tannins, unsaturated acids, resins, nitrate potassium, aspartic acid, and glutamic acid [9]. This plant is the richest source of calcium 4.21%, crude protein 12.06%, ether extract 2.61%, total ash 16.72%, phosphorus 0.25%, and total digestive nutrients 55.63% [34]. The steroidal saponins, diosgenin,

Table 1: Taxonomical classifications of *Tribulus terrestris* [14,15]

Taxonomical rank	Taxon	
Taxonomy	<i>Tribulus terrestris</i>	<i>Pedalium murex</i>
Domain	Eukaryota	Eukaryota
Kingdom	Plantae	Plantae
Phyllum	Spermatophyta	Spermatophyta
Sub-phyllum	Angiospermae	Angiospermae
Class	Dicotyledonae	Magnoliopsida
Order	Geraniales	Lamiales
Family	<i>Zygophyllaceae</i>	<i>Pedaliaceae</i>
Genus	<i>Tribulus</i>	<i>Pedalium</i>
Species	<i>Terrestris</i>	<i>murex</i>
Common name	Chota Gokhru	Bara Gokhru

Table 2: Vernacular names of *Tribulus terrestris* Linn and *Pedalium murex*

Language	<i>Tribulus terrestris</i>	<i>Pedalium murex</i> [16]
English	Calotrops fruits [17], calthrops, small caltrops [18,19], Land caltrops, puncture vine [13]	Large Caltrops
Hindi	Gokhru [20,21], Gokshri, Burrokhur	Bara Gokhru, Fareed buti, Dakshini Gokshur
Sanskrit	Shvadanstra, Traikantaka, Gokshuru, Bahkanataka	Brihata Gokshur
Arabic	Khask, Kharakhusk, Zufatulajooz [14], Hamasulameer, Kohuj	kHasake-Kabir
Urdu	Gokharu	Gokharu
Marathi	Sarate, Gokharu, Lahanogokharu, Sarala, Sharatte, Lahangokhru	Mothe Gokharu
Bengali	Gokshura, Gokhri, Gokhru, Gokhura, Gokshra, Gokhuri	Bad gokhru
Gujarati	Nahannagokharu, Mithagokhru, Betagokhru	Oobha Gokhru, Mhyota Gokhru, Kadawa Gokhru
Punjab	Gokhrudesi, Lotak, Kurkundai	Gokru Kalan

gitogenin, chlorogenin, ruscogenin, and flavonoids are considered as the most significant phytochemicals extracted from the TT plant consisting of various biological properties [15].

Steroidal saponins

The saponin content is mostly found in leaves and roots and is absent in stem and seeds. The total 108 saponin components are reported to be isolated from TT plant out of which 58 are spirostane saponins and 50 are furostane saponins. The most considerable saponins found in the TT plant are spirostanol and furostanol. Protodioscin and protogracillin are the two steroidal saponins that are considered to carry great biological properties [35]. The other two new steroidal glycosides extracted from the aerial parts are neohecogenin glucoside of tribulosin, six-glycoside quercetin, eight glycosides of iso-hamnein, and four glycosides of kaempferol [36].

Flavonoids

The leaves and fruit part of TT plant are a source of flavonoids components named as kaempferol, kaempferol-3-glucoside, kaempferol-3-rutinoside, and tribuloside. The derivatives of quercetin component extracted are quercetin, isoquercitrin, rutin, quercetin-3-O-agent, quercetin-3-gentr, quercetin-3-O-rha-gent, and quercetin-3-O-gent-7-O-glu are flavonoids derived from its parent structure [24,37,38]. Isorhamnetin, isorhamnetin-3-O-glu, isorhamnetin-3-O-gent, isorhamnetin-3-O-rutinoside, isorhamnetin-3-O-gentr, isorhamnetin-3,7-di-O-glu, isorhamnetin-3-O-p-coumarylglu, isorhamnetin-3-O-gent-7-O-glu, isorhamnetin-3-O-gentr-7-O-glu with isorhamnetin as the

parent structure [39,40]. Kaempferol, kaempferol-3-O-glu, kaempferol-3-O-gent, kaempferol-3-O-rutinoside, kaempferol-3-O-gent-7-O-glu, and tribuloside with kaempferol as the parent structure [41,42].

Alkaloids

The alkaloids extracted from the leaf, fruit and roots of TT plant are tribulusamide C, tribulusterine, tribulusin A, harmine, harman, harmmol, tribulusimide C, terrestramide, *N-trans*-coumaroyltyramine, *N-trans*-caffeoyltyramine, and terretribisamide [43-45].

Other

The fruit part of the plant also contains essential oils, fixed oil, nitrates, ginsenosides, rhamnose, rutin, sterols, reducing sugar, ruscogenin, neogitogenin, hecogenin, and campesterol. The root part of the plant possesses phytosterols, amino acids, campesterol, stigma sterol, β -sitosterol, trillin, and furostanol of glycoside. The other organic acids extracted from the TT plant are succinic acid, benzoic acid [46], vanillic acid, 2-methyl benzoic acid, ferulic acid, palmitic acid monoglyceride, docosanoic acid [47], and tribulus acid [48]. Alanine and threonine are the two major amino acids extracted from TT plant. Furthermore, it contains coumarin, emodin, physcion [49], uracil nucleic acid, and 4-ketopinonesin [50] (Fig. 3) represents the chemical structures of some major phytochemical constituents of TT plant.

P. murex

The main chemical components present in the *P. murex* plant are diosgenin and vanillin. There are several other components which were reported to be present in the different parts of the plant [36]. The chemical constituents found in the *P. murex* plant include phytosterols, tannins, saponins, carbohydrates, reducing sugars, xanthoproteins, saponins, alkaloids, triterpenoids, flavonoids, phenolic compound, alkaloids, resins, flavonoids, saponins, proteins, steroids [47,51], stigma sterol, flavonoids, alkaloids, glycosides, stable oil, resins, aromatic oil, triterpenoid, carbohydrates, amino acids, and phenols [52].

Flavonoids

Flavonoids are reported as the main component extracted from the stem, flowers, roots, and leaves of the *P. murex* plant. It is known for its pharmacological and physiological property [8,53,54]. Pedalitin, diosmetin, dinatin, quercetin, kaempferol, luteolin, and 20,40,50-trihydroxy-5,7-dimethoxyflavone are some of the flavonoid components extracted from the *P. murex* plant [52,55,56].

Saponins

Sitosterol and Diosgenin are the two main phytochemicals extracted from the fruit of the *P. murex* plant. They are responsible for the production of sexual hormones, corticosteroids, and oral contraceptives [34,57-59].

Terpenoids

Lupeol acetate has been reported to have significant biological property and is used as a chemo preventive agent to treat various diseases [58,60,61]. Urosolic acid is also present as an active constituent in fruit part of the plant which is considered as pentacyclitriterpenoid. It is mainly used in cosmetics as an additive and also acts as an antitumor agent [62,63].

Phenols

The phenolic components of the *P. murex* plant are vanillic acid, luteolin. Vanillic acid is mainly used as an antioxidant agent and acts against cardiac disorder whereas luteol act as anti-inflammatory, anti-allergy, and anticancer agent [64-67]. The other acids reported are nonacosane, triacontanol acid, and amino acids such as threonine, aspartic acid, glutamic acid, and histidine which were extracted from the fruits of the *P. murex* plant [64,68,69] (Fig. 4) represents the chemical structures of some major phytochemical constituents of *P. murex* plant.

FOLK USES OF GOKSHURA

T. terrestris

T. terrestris is commonly known as chota gokhru in Indian culture. It is used in Indian medicinal system for 5000 years [12]. Traditionally, it is used as a medicine in Indian Ayurveda from ancient time to boost hormonal production in both the sexes, that is, in men and women [70]. The fruit part of this plant has been used to treat sexual problems, eye problem, edema, abdominal distension, and leucorrhoea in the traditional Chinese medicinal system. Furthermore, the roots and fruit part of the plant have been used for the treatment of other sexual diseases such as impotency, premature ejaculation, menorrhagia, piles, renal and vesical calculi, rheumatism, headaches, and dizziness [71]. In ancient time, it was used to treat diuretic, antiseptic, aphrodisiac, and anti-inflammatory diseases according to Indian Ayurveda system. The extract of the *T. terrestris* plant when mixed with honey it acts as surimi and applied over the eyes to treat eye disease. Furthermore, it is used to treat oral cavities by doing gargling with the decoction of the plant to treat toothache, gums, and stomatitis. It is not only used in the Indian medicinal system but also used by Unani medicinal system in powder form to treat female infertility, dysuria, and micturition problem. It is also used in the paste form to treat wound and skin inflammation when mixed with honey. It is effective against back pain and for treating gall bladder stone [72]. Furthermore, it is used to treat female sexual disorders, periods problem, burning sensation, heart diseases, kidney disease, and skin inflammation. In Turkey, it is used as a traditional medicine to treat colic pains, hypertension, and diabetes [73]. Bulgaria people used this plant as a sex enhancer and to treat sexual problems such as infertility and impotency. *T. terrestris* plant is also useful in hormonal balancing system and provides relief from pre-menstrual tension and menopause which results in optimum function [1].

P. murex

Whole plant

P. murex plant is of great medicinal importance and has been used in traditional medicinal system. It is consumed either as a whole plant or as individual parts. It is also used as a blood purifier and to treat gall bladder stones. It was studied that the tribal people use dry leaves of *P. murex*, *kalmishora*, and *Acacia nilotica* in crushed form to treat urinary bladder problem [35]. In Pakistan, *P. murex* plant was detected to possess diuretic property [74]. In Rayalaseema, it is used for treating urinary calculi and renal problems [73]. This plant is used for the treatment of diarrhea, headache, dysentery, cough and common cold, stomach ache, intestinal infections by Ayurveda doctors and vadhya in district Haridwar and Uttarakhand state of India [75,76]. This plant is utilized by tribal people of Rajasthan and Saperas community to treat sexual problems and male infertility. It is also utilized in laddu form to treat leucorrhoea in females where the plant is crushed with the root of chlorophyllum [77].

Fruit

Conventionally, the fruit of this plant is utilized in the powder form to cure reproductive disorders when mixed with *Cleome viscosa* [78]. Fruit part is also used to treat diuretic disease in goats and cattle's. The infusion of fruits is useful to treat urinary problems [79-81]. The fruit in the powder form when mixed with the roots of *Capparis sepiaris* cure GIT diseases when taken orally which acts as a cooling agent [76]. It is also reported to have aphrodisiac, antispasmodic and demulcent property [82].

Root

Conventionally, the roots of the plant are used to treat nocturnal emission and leucorrhoea. It is also used to calm down body temperature when taken in powder form with water [83]. Root paste possesses aphrodisiac activity.

Seed

The seed of the *P. murex* plant is utilized in laddu form to treat joint pain and lumbago [82].

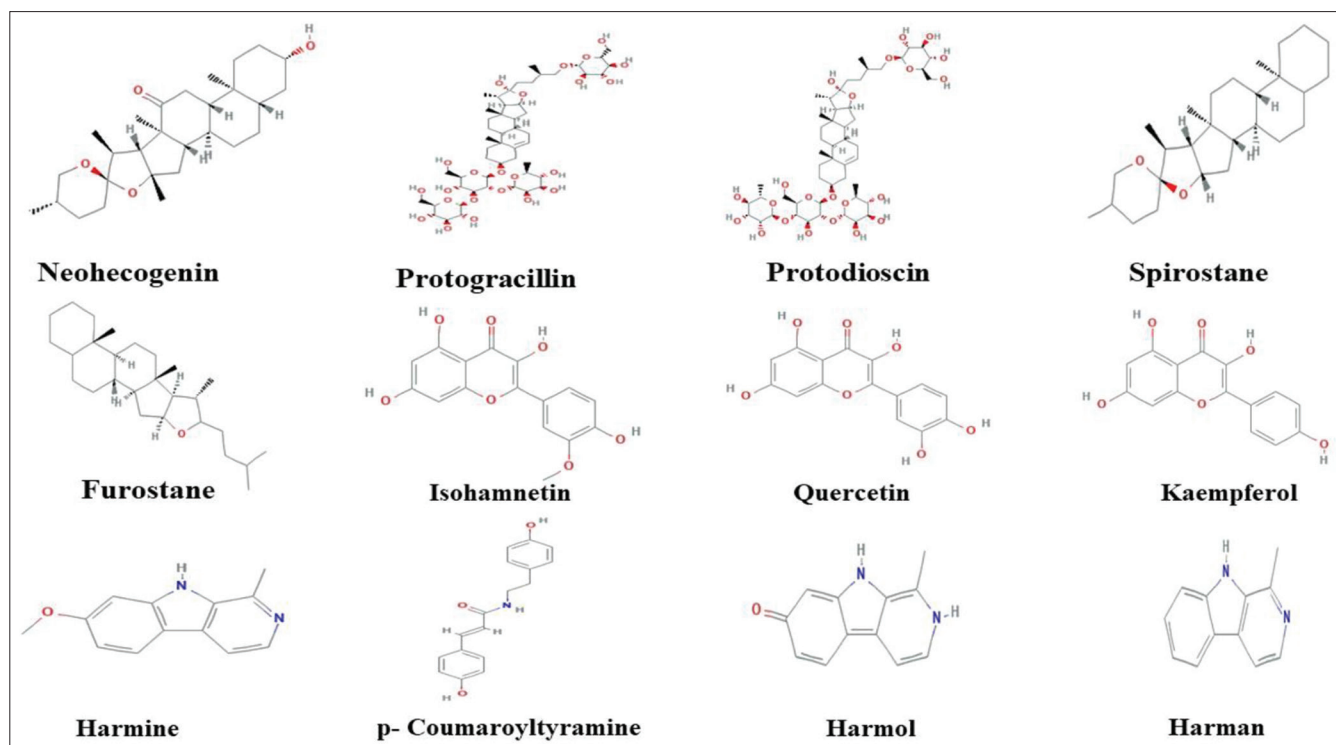
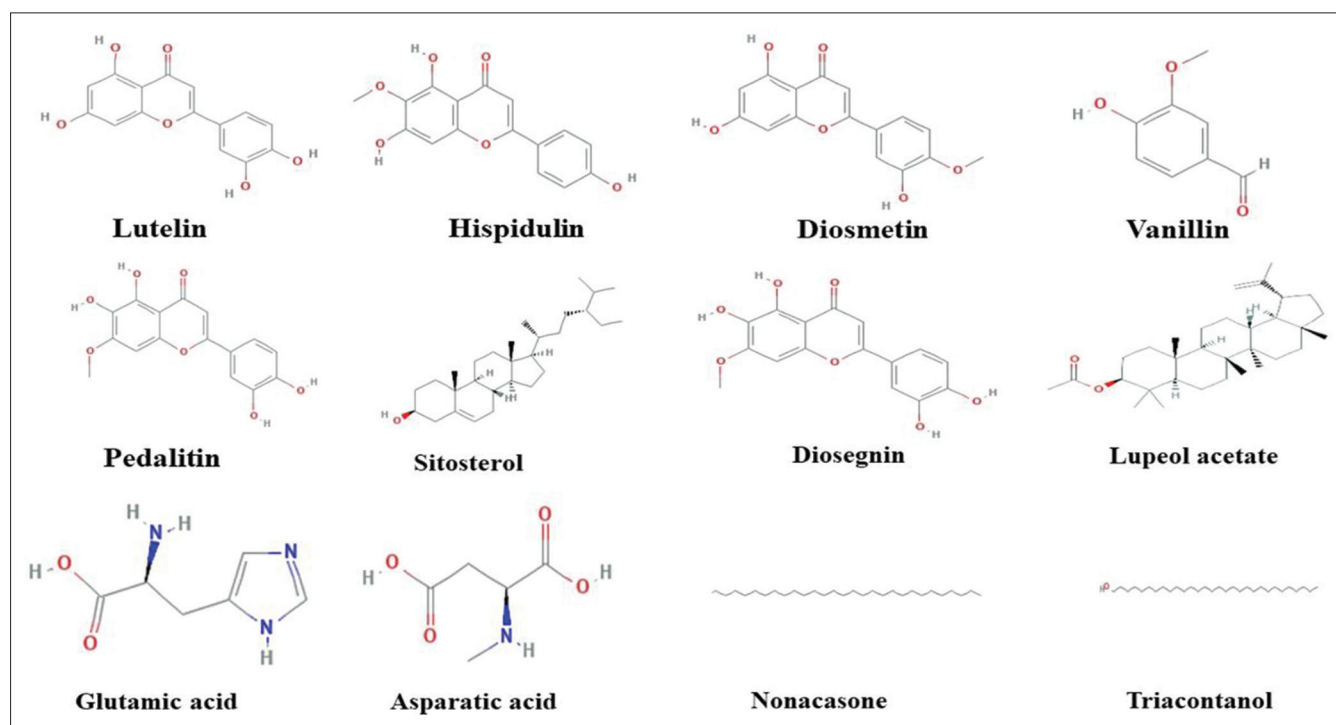


Fig. 3: Chemical structures of some major phytochemical structure of TT plant

Fig. 4: Chemical structures of some major phytochemicals of *Pedalium murex* plant

GOKHRU IN AYURVEDA

T. terrestris and *P. murex* plants are known as Gokshura in Ayurveda and are considered as well-known herbal plants used in the Indian medicinal system (Ayurveda). It is a component of dashmoola (group of ten medicinal plants) where root part is used to treat various ailments. This drug is well defined by Charaka Samhita, Sushrut Samhita, Astanga Hridaya (Brahatravyi). In madanapala Nighantu, it is

specified that fruit of the plant possess aphrodisiac property and roots are used in dashmoola (anti-inflammatory activities). In Samhitas and Nighantus, the two types of Gokshura found are Brihat Gokshura (*P. murex* Linn) and Laghu Gokshura (*T. terrestris* Linn) [84]. In Ayurvedic formulations, the fruit part of Laghu Gokshura is used to treat urinary disorders, impotency, calculus formation and other urinary related infections [85]. Furthermore, the fruit of the *P. murex* plant is used to treat antispasmodic, aphrodisiac, urinary problem, cough asthma,

Table 3: Rasapanchak (Properties) of Gokshura (*Tribulus terrestris* and *Pedalium murex*) [86]

Sanskrit/English	Sanskrit/English
Virya/Potency	Sheet/cold
Guna/Physical property	Guru/Heavy, Snigdha/
Vipak/Metabolic property	Madhura/sweet
Rasa/Taste	Katu/Astringent, Madhura/sweet

diuretic, demulcent, gall bladder stones, cardiac, and skin diseases. Table 3 represents the Ayurvedic properties of the Gokshuru plant.

Ayurvedic Action of Gokshura (Karma) [87]

Vatahara (वातहरा): Calms vata (maintain circulatory system).

Kaphahara (कफ हरा): It maintains the body fluid, control growth and strengthen the body.

Pittahara (पित्तिहरा): It is used to maintain digestive system.

Vrishya (वृष्य): It is used to treat sexual diseases.

Brimhana (ब्रिमिहाना): It is used to increase the body weight.

Mutrala (मुतराला): It is used to treat urinary disorders

Balya (बल्य): It enhances the immunity, strength and stamina.

Dipana (दीपना): It promotes digestion by producing digestive heat.

Kesya (केश्य): It improves the hair quality.

Shothahara (शोथहरा): It is used to decrease swelling or edema.

Vedanasthapana (वेदनास्थपना): It is used as a painkiller and also possesses anesthetic effect.

Properties of Gokshuru [88,89]

Amavata (अमवात): It is used to treat Rheumatoid arthritis disease.

Amlapitta (अमलापित्ति): It is used to treat hyperacidity.

Antravridhi (अंतरावेरिधी): It is used to treat hernia.

Ashmari (अश्मरी): It is effective against renal stone.

Arsha (अर्शा): It is used to cure piles.

Hridroga (हरतिरोगा): It is used to treat cardiac diseases.

Raktapitta (रक्तपित्त): It is used to treat bleeding disorder.

Shoola (शूल): It act as pain-reliever.

Shotha (शोथ): It is used to cure edema.

Vatarakta (वातरक्त): It is used to cure gout.

THERAPEUTIC USES OF GOKSHURA**Reported therapeutic uses of *T. terrestris****Diuretic*

The nitrate content present in seeds and fruit part of the TT plant is responsible for diuretic property. Furthermore, the aqueous extract of TT plant contains potassium salt in high concentration [90]. The aqueous extract of the TT plant when given orally to albino rat model, the sodium, and chloride concentration in urine increased. Reported studies showed the diuretic property of the plant which helps in treating kidney disorder patients [17].

Aphrodisiac

Various reported studies showed that the saponin component of the TT plant mainly protodioscin and protogracillin possess aphrodisiac property [91]. It was examined in albino rat model and was found that the protodioscin component converts testosterone into potent dehydrotestosterone very rapidly which increases the sex desire and also increases the production of RBCs [92]. So is used to treat sexual related diseases such as premature ejaculation, erectile dysfunctioning, and also increase the production of sex hormones [93].

Antiuro lithic

The experimental study was conducted on albino rats to find out the anti-uro lithic activity [94]. It was found that the ethanolic extract of TT fruits inhibited the growth of CaOx crystals and also possess cytoprotective activity [95]. Sodium glycolate and ethylene glycol are responsible for inhibiting the stone formation when tested in various models [96].

Antidiabetic

It was found from the reported studies that the ethanolic extract of the TT plant induces protective effect in streptozotocin-induced diabetic rats by inhibiting the oxidative stress. Furthermore, the saponin content was found to be responsible for lowering the blood sugar level [97].

Analgesic

The study was conducted in male mice using tail flick test and formalin to find out the analgesic activity of the TT plant. It was found that the methanolic extract of TT plant possesses analgesic activity when given in 100 mg/kg dosage in male mice [98].

Anthelmintic

From the reported studies, it was found that the beta sitosterol d-glucoside and tribulosin extracts of the TT plant showed anthelmintic property [99].

Antifungal

The saponin content extracted from TT plant was studied against fluconazole resistant yeast. It was found that saponin component of TT plant showed *in vitro* and *in vivo* antifungal property by destroying the cell membrane, killing fungi or by weakening the virulence of *Candida albicans* [100].

Reported therapeutic uses of *P. murex**Nephroprotective*

It was reported that the ethanolic extract isolated from the TT fruit possesses great nephroprotective property when compared to standard drug cysteine against renal damages produced by cisplatin and cadmium chloride in Wistar rats. The extract was found to lower down the cisplatin-induced nephrotoxicity [101].

Antiulcer

From the reported studies, it was found that the aqueous extract isolated from the *P. murex* leaves possesses antiulcer property when tested in rat model at 200 mg/kg dosage [102].

Antiproliferative

Reported studies revealed that the *P. murex* fruit is found to be a richest source of flavonoids and Vitamin C and acts as an anti-cancer agent by providing protection against cancer stages and by inhibiting oxidative cell damage. Various studies proved that the methanolic extract of the fruit inhibited the significant growth of A549 lung cancer line by lowering the percentage of cell viability [103].

Antioxidant

Experimental studies have shown that the ethyl acetate component extracted from the *P. murex* plant have antioxidant property [104]. It was also tested against hepatic rats which was treated with methanolic extract of fruit for 90 days with a dosage of 70 mg/kg. Results showed the decrease in normal level of thiobarbituric acid, diene conjugates, superoxide dismutase, catalase, glutathione peroxidase, and glutathione reductase in blood [105].

Aphrodisiac

It was found that ethanolic and petroleum ether extract of the *P. murex* plant possesses aphrodisiac property and treat ethanol induced germ cell damage and infertility when studied in male rat model [106]. It ultimately enhances sperm motility, body weight, mounting behavior, sexual desire, protein, total cholesterol, and testosterone level [107].

Activity against urogenital diseases

The flavones content present in the *P. murex* fruit was reported to be effective against urogenital disorders, for example, dysuria, gonorrhoea, and discontinuous of urine flow [108].

Anti-inflammatory and analgesic

The anti-inflammatory activity of the *P. murex* plant was proved when tested against Lambda- carrageenan induced paw edema in Wistar albino rats at 200 and 400 mg/kg dosage. It was found that the ethanolic extract of the fruit of the *P. murex* plant showed anti-inflammatory and analgesic effect [109].

Insecticidal

It was reported that the root extract of the *P. murex* plant showed insecticidal activity when tested against *Spodoptera litura* at third fourth and fifth larval stage. Saponin and tannin component are responsible for the insecticidal property [110].

Antimicrobial

The reported studies have shown that all the part of the *P. murex* plant possesses antimicrobial activity. It was reported that ethyl acetate isolated from flower of *P. murex* plant was found to be effective against *Salmonella typhi*, *Escherichia coli*, *Enterococcus faecalis*, *Bacillus cereus*, and *Bacillus subtilis*, *Lactobacillus*. The ethanolic extract isolated from the fruit part was found to be effective against fungal pathogen *Trichophyton rubrum* and methanolic extract isolated from the leaves and fruit part was found to be effective against bacterial pathogen (*Streptococcus pyogenes*, *E. faecalis*, and *Klebsiella pneumonia*) [111].

Antihyperlipidemic

It was reported that the ethanolic extract of fruit of the *P. murex* plant was tested against high fat diet fed hypercholesterolemic rats. The decrease in the total cholesterol, triglycerides, low-density lipoprotein - cholesterol, and increased high-density lipoprotein -cholesterol was observed [112].

CONCLUSION

Conclusively, due to the enrichment in the therapeutic phytochemical constituents, the *T. terrestris* and *P. murex* plants are used in various Ayurvedic products and formulations to cure various diseases. From the reported pharmacological studies, it was found that the *T. terrestris* plant is mainly used to cure urinogenital disorders and kidney disorders such as renal and gall bladder stone. On the other hand, *P. murex* plant has aphrodisiac property and mainly used to cure sexual disorders such as infertility, impotence, premature ejaculation, erectile dysfunction in both male and females. Due to the presence of some similar chemical constituents both the plants possesses some similarity in their properties and is used to treat various other diseases such as asthma, cardiac disorder, skin diseases, cough, and also acts as an anti-inflammatory, anticancer, antioxidant, aphrodisiac, antimicrobial, antidiabetic, nephroprotective, and antifungal agent. Both these plants are of significant medicinal value and can be further investigated for developing more Ayurvedic and herbal formulations for wellness of humankind.

AUTHOR CONTRIBUTION

We declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by the authors.

Dr. Gitika Choudhary drafted the article and contributed in writing ayurvedic view of the article. Dr. Hemlata Kaurav contributed in drafting and writing pharmacological portion of plant. Shailja Choudhary contributed in data collection and writing the paper.

CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

AUTHOR FUNDING

No any funding for this article writing.

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