Tribulus

(Tribulus terrestris Linn.)

Family

Zygophyllaceae

A family of flowering plants which includes around 285 species in 22 genera. There are 108 scientific plant names of species rank for the genus *Tribulus* of which seven, including *Tribulus terrestris*, are accepted species names. There are 29 synonyms and 72 unassessed.[1]

Parts Used

Fruit (or leaf)

Description

Commonly known as caltrops, goathead, bindii or puncture vine, tribulus is a ground-hugging plant with spiny fruit (burrs). It is native to the Mediterranean region but has spread to tropical and sub-tropical climates and is widely distributed throughout Australia, the Middle East and southern Africa. It can thrive even in desert climates and poor soil. It is a prostrate annual with stems to two metres long, usually forming flat patches though it may grow upright in shade. The leaves have four to eight pairs of oblong leaflets, each leaflet to 12 mm long, the upper surface is dark green and often with hairy margins, the lower surface is paler and hairy. The flowers have five yellow petals which fruit a week after the flower blooms. The fruit is 11–20 mm wide (including spines), comprising a cluster of five segments each with two larger divergent spines above and two smaller downward projecting spines below. Each segment has one to five seeds. The spines are sharp enough to puncture bicycle and lawn mower tyres, and to cause painful injury to bare feet. Its fruit has been used in Chinese, Ayurvedic and Arabic medicine. In Australia it is a troublesome weed of wasteland, pastoral land, cropping, vineyards and recreation areas. The sharp spines on the dry fruit hamper stock handling and are a nuisance in recreation areas. Stock grazing on it experience photosensitisation, staggers and nitrate poisoning. Young sheep are especially sensitive. A native insect and mite can damage plants and overseas biological control has been used to reduce problems associated with this species in Australia.[2]

Traditional and Empirical Use

The Latin name tribulus originally meant a thorny plant or thistle and is derived from the Greek tribolos which means a three pronged instrument, a plant with spikes or thistles or a caltrop, a spiky antipersonnel weapon made up of two or more sharp nails or spines arranged in such a manner that one of them always points upward from a stable base. Caltrops were part of defenses that served to slow the advance of horses and human troops. In modern times caltrops are used against car tyres. The tribulus plant offers similar hazards to sandaled or bare feet.[3]

There is no well-documented information on the traditional use of tribulus leaf.[4] Traditionally tribulus fruit has been used in the folk medicine of India, China, Bulgaria and South Africa for a variety of reproductive conditions, such as infertility and sexual impotence, as well as for muscle strength, oedemas, abdominal distention, cardiovascular diseases and general health. It has been suggested that it was used in ancient Greece and India as a physical rejuvenation tonic. In Ayurvedic medicine, tribulus fruit has cooling, diuretic, tonic and aphrodisiac properties, and is used for painful urination, kidney and bladder stones, urinary disorders and impotence. It is also used to treat gout, cough and heart disease. In China, it is used as a component of therapy for conditions affecting the liver, kidney, cardiovascular system and immune systems. It has also been used in Eastern European folk medicine for increased muscle strength and sexual potency. Despite its history of use, there is limited human data available in order to evaluate its clinical effectiveness.[5]

In the 1930s tribulus was mentioned under the common name Burra Gookeroo in the classic book A Modern Herbal, the first comprehensive encyclopaedia of herbs to appear since Culpeper (1600s). The author Maude Grieve used the seeds as a diuretic, demulcent and aphrodisiac for impotence in males, nocturnal emissions, gonorrhoea,

gleet (a watery discharge from the urethra caused by gonorrhoeal infection) and incontinence of urine.[6]

The herb became widely known in the West when medal-winning Bulgarian athletes from the 1996 Summer Olympics in Atlanta, Georgia claimed that the use of tribulus had contributed to their success. However, current evidence suggests that it does not enhance sports performance (see ergogenic aid activity below).[7]

Constituents

The steroidal saponins are considered to be the factor responsible for the biological activity of products derived from tribulus.[8] Steroidal saponins consist of a furanstanol- or spirostanol-based aglycone and an oligosaccharide attached to a steroid nucleus. Steroidal saponins are common in the plant kingdom and are natural components in many foods such as asparagus, potato and oats.[9] The steroidal saponin component of tribulus includes constituents such as protodioscin, diosgenin, tribulosin, yamogenin, epismilagenin, tigogenin, neotigogenin, gitogenin and neogitogenin, terrestrinins A (1) and B (2).[10,11] New saponins continue to be isolated from tribulus fruit however their significance is yet to be determined.[12,13,14,15,16,17] In 2013 two oligosaccharides and a stereoisomer of di-p-coumaroylquinic acid, an antioxidant, were isolated.[18] Beta-sitosterol, vitamin C, potassium and calcium have been isolated from the fruit.[19] The alkaloids harmane and norharmane have been identified and are believed to contribute to causing the staggers in stock that graze on it.[20]

Studies have shown that protodioscin is present in different amounts in samples from China, India and Bulgaria and the Indian sample has shown a totally different saponin profile.[21] The bio-stimulating activity of protodioscin and prototribestin, the cytotoxic effects of protodioscin, pseudoprotodioscin and dioscin, and the anthelmintic properties of tribulosin have been reported.[22,23,24] In 2008 a liquid chromatography, electrospray ionization and mass spectrometry analysis of samples of tribulus from different geographical regions (Bulgaria, Greece, Serbia, Macedonia, Turkey, Georgia, Iran, Vietnam and India) revealed great differences in their chemical composition and content of the steroidal saponins protodioscin, prototribestin, pseudoprotodioscin, dioscin, tribestin, tribulosin and the flavonoid rutin depending on the plant part studied, stage of plant development and the region of sample collection. The samples from Bulgaria, Turkey, Greece, Serbia, Macedonia, Georgia and Iran exhibited similar chemical profiles and only some quantitative difference in the content of the measured steroidal saponins, with protodioscin and prototribestin as main components. The Indian and Vietnamese samples exhibited a totally different chemical profile. While tribulosin is present in high amounts they lack prototribestin and tribestin. Compounds different from those measured dominated. The data suggested the existence of one chemotype common to East South Europe and West Asia. The high content of protodioscin and the presence of the sulphur containing saponins prototribestin and tribestin is a characteristic feature of this chemotype. The samples from India and Vietnam belong to other chemotypes. In these chemotypes tribulosin is present in high amounts but they all contain minor amounts of protodioscin and lack prototribestin and tribestin. The use of prototribestin and tribestin as chemotaxonomic markers to differentiate between the East South European – West Asian chemotype and those in Vietnam and India was proposed. A TLC comparison of the analysed samples revealed that their flavonoid profiles were also distinctly different. However, of the flavonoids, only rutin was included in the comparison. The distribution of the flavonoids in the studied samples is expected to provide important information about the chemotaxonomy of tribulus and will be the subject of future investigations.[25]

Actions

Diuretic, demulcent, aphrodisiac, tonic.

Pharmacological Activity

Tribulus has not undergone significant testing so much of the information is speculative and evidence of activity is primarily derived from traditional use, animal and *in vitro* studies.

A standardised tribulus preparation containing furostanol saponins, as the sapogenin protodioscin, is marketed as Tribestan and is available in tablet form containing 100mg of protodioscin. The company in Bulgaria that has the patent for Tribestan has conducted practically all of the research on the product and this has become the primary source of most current health claims regarding tribulus. Much of this work has not been published and all data provided about Tribestan must be evaluated in this light.[26] According to this research, tribulus increases levels of various hormones in the steroid family including testosterone, DHEA and oestrogen, and for this reason improves sports performance, fertility in men and women, sexual function (again in men and women) and symptoms of menopause (such as hot flushes).[27,28,29,30,31] However, due to the different chemotypes of tribulus referred to above, the interpretation of some studies is particularly controversial, and the clinical relevance of some pharmacological studies is uncertain and remains to be established.

Due to the Bulgarian company's (Chemical Pharmaceutical Research Institute http://www.nihfi.com/index.htm) research it has been suggested in some current literature that tribulus products should be made only from aerial plant parts (leaf and stem, not the fruit), should be sourced only from Eastern Europe and be standardised to protodioscin,[32] however, this disregards the traditional use of tribulus. Traditional herbal medicine is based on the premise that the medicinal activity of herbal products is not due to a single chemical but the combined effect of

all its constituents. As mentioned in Constituents (above), new saponins and other constituents are constantly being discovered in tribulus as more research is conducted. When extracted in a balanced way the synergistic activity of all the constituents allows the key compounds to work effectively. 'The body is not a one-note melody, but a symphony of many interactive components functioning synergistically … the active ingredient model does not stem from a strength of the scientific method, as often supposed; rather, it stems from a weakness – from the inability of the reductionist method to deal with complex systems'.[33,34]

The majority of recent scientific studies on tribulus employ the standardised Bulgarian tribulus leaf referred to earlier, which should be noted before extrapolating to crude fruit or whole herb extracts. The information in this monograph will focus on research conducted on tribulus fruit from India.

Hormonal and aphrodisiac activity

The exact mechanism by which tribulus influences sexual behaviour is not known but it has been suggested that increasing androgenic status and nitric oxide release are responsible.[35] Protodioscin has been found to improve sexual drive and to enhance erection in men. The mechanism of protodioscin's action is suspected to involve its conversion to dehydroepiandrosterone (DHEA) as well as testosterone.[36]

The findings of a 2012 study validate the traditional use of tribulus fruit as a sexual enhancer in the management of sexual dysfunction in males. The study observed the effect of acute and repeated dose administration of lyophilised (freeze dried) aqueous extract of the dried fruits of tribulus on sexual function in sexually sluggish male albino rats. Aphrodisiac activity of the test drug was evaluated in terms of exhibited sexual behavior. In order to assess the effect of chronic tribulus exposure on the hypothalamus--pituitary--gonadal axis, testosterone level estimation and sperm count were carried out. Twenty-eight-day oral toxicity studies were carried out to evaluate the long-term effects of the tribulus administration on different body systems. A dose-dependent improvement in sexual behaviour was observed with the tribulus treatment as characterised by an increase in mount frequency, intromission frequency and penile erection index, as well as a decrease in mount latency, intromission latency and ejaculatory latency. The enhancement of sexual behavior was more prominent on chronic administration of tribulus. Chronic administration of tribulus produced a significant increase in serum testosterone levels with no significant effect on the sperm count. No overt body system dysfunctions were observed in 28-day oral toxicity study.[37]

A 2011 *in vitro* and *in vivo* study has found that an ethanolic extract of tribulus offered a protective effect against cadmium-induced testicular damage in rats. The protective effect appears to be mediated through inhibition of testicular tissue peroxidation by antioxidant and metal chelator activity, and also indirectly by stimulating the testosterone production from Leydig cells. Further studies are needed to confirm the protective effect through testosterone production. Whole herb of tribulus collected from the Indian college campus and farm was identified by a botanist and a copy of herbarium was deposited to Department of Pharmacology and Toxicology for record. The ethanolic extract of tribulus was prepared by adding coarse powder of shade-dried whole plant to ethanol at the rate of 1: 20 in conical flask. The flask was closed airtight with nonabsorbent cotton and subjected to constant shaking overnight on an orbital shaker at room temperature. The following day, filtrate was subjected to slow evaporation by keeping in water bath at a temperature of 60°C until a consistent solid material mass was formed.[38]

Despite positive data from animal studies (see paragraph below), a Bulgarian study found that tribulus steroid saponins possess neither direct nor indirect androgen-increasing properties. Twenty-one healthy young 20-36 year old men with body weight ranging from 60 to 125 kg were randomly separated into three groups-two experimental (each n=7) and one control (placebo) group (n=7). The subjects were assigned to consume 20 and 10 mg/kg body weight per day of tribulus extract, respectively, separated into three daily intakes for four weeks. Testosterone, androstenedione and luteinizing hormone levels in the serum were measured 24 hours before supplementation (clear probe) and at 24, 72, 240, 408 and 576 hours from the beginning of the supplementation.[39]

Sexual behaviour and intracavernous pressure were studied in both normal and castrated rats to further understand the role of tribulus containing protodioscin as an aphrodisiac. In contrast to the above androgen research, the scientists concluded that tribulus appears to possess aphrodisiac activity probably due to androgen increasing property of tribulus (as observed in an earlier study on primates).[40]

The hormonal effects of tribulus were evaluated in primates, rabbits and rats to identify its usefulness in the management of erectile dysfunction. Administration of tribulus demonstrated a statistically significant increase in testosterone and DHEA levels in the primates, an increase of these hormones in rabbits but very little increase in rats. The results suggest that tribulus may be useful in mild to moderate cases of erectile dysfunction.[41]

Ergogenic aid (performance enhancing) activity

A small, randomised, placebo controlled human study compared the effects of tribulus (3.21 mg per kilogram of body weight—for example, 292 mg daily for a 90kg man) against placebo on body composition and endurance

among 15 men engaged in resistance training. At the end of the eight week study, the only significant difference between the treatment and placebo groups was that the placebo group showed greater gains in endurance.[42]

Another double-blind, randomised, placebo-controlled study enrolled 22 elite Australian male rugby league players and followed them for five weeks. The dose used in this trial was fixed at 450 mg daily for all participants. No benefits were seen. Tribulus is promoted to produce large gains in strength and lean muscle mass in 5-28 days. Although some manufacturers claim tribulus will not lead to a positive drug test, others have suggested that it may increase the urinary testosterone/epitestosterone (T/E) ratio, which may place athletes at risk of a positive drug test. The purpose of the study was to determine the effect of tribulus on strength, fat free mass and the urinary T/E ratio during five weeks of preseason training in elite rugby league players. Twenty-two Australian elite male rugby league players (mean +/- SD; age = 19.8 +/- 2.9 years; weight = 88.0 +/- 9.5 kg) were match-paired and randomly assigned in a double-blind manner to either a tribulus (n = 11) or placebo (n = 11) group. All subjects performed structured heavy resistance training as part of the club's preseason preparations. A tribulus extract (450 mg/day) or placebo capsules were consumed once daily for five weeks. Muscular strength, body composition and the urinary T/E ratio were monitored prior to and after supplementation. After five weeks of training, strength and fat free mass increased significantly without any between-group differences. No between-group differences were noted in the urinary T/E ratio. It was concluded that tribulus did not produce the large gains in strength or lean muscle mass that many manufacturers claim can be experienced within 5-28 days. Furthermore, tribulus did not alter the urinary T/E ratio and would not place an athlete at risk of testing positive based on the World Anti-Doping Agency's urinary T/E ratio limit of 4:1.[43]

These studies used a low dose of tribulus and larger controlled studies testing higher doses that are reflective of real world use are required to determine its efficacy.[44]

Cardioprotective activity

A 2013 study has provided a new insight into the antiatherosclerotic properties of tribulus and a pharmacological basis for the clinical application of tribulus in anti-atherosclerosis. The study investigated the cellular and molecular mechanisms of tribulus underlying protection against atherosclerosis. Air-dried and powdered fruits of tribulus (240g) were extracted three times with 70% ethanol. The combined extracts were evaporated to dryness under vacuum. The residue was dissolved in water and extracted by aqueous n-Butanol three times. The n-Butanol extract was evaporated to dryness under vacuum and was subjected to chromatography on D101 resin, and first eluted (removed by washing with a solvent) successively with water and then with 50%, 70% and 100% ethanol. Fractions containing saponins were combined and then evaporated to dryness under reduced pressure to give the tribulus sample. This was dissolved in phosphate buffered saline and sterilised by passing through a syringe filter. Tribulus significantly suppressed the increase in cell proliferation induced by angiotensin II, significantly suppressed the increase in the intracellular production of hydrogen peroxide induced by angiotensin II, significantly inhibited the increase in intracellular free calcium induced by hydrogen peroxide, significantly inhibited the increase in phosphorylation of extracellular signal-regulated kinase 1/2 induced by angiotensin II and significantly inhibited the increase in messenger RNA expression of c-fos, c-jun and pkc-α induced by angiotensin II.[45,46,47]

Tribulosin, a component of gross saponins of tribulus, has been shown to produce cytoprotective effects in the heart but the precise mechanisms are not fully understood. A recent study examined the mechanisms of tribulosin on myocardial protection. Ventricular myocytes were isolated from the heart of neonatal rats and were exposed to three hours of hypoxia followed by two hours reoxygenation. The results indicated that treatment with tribulosin in the culture medium protected cardiac myocytes against apoptosis induced by hypoxia/reoxygenation. Tribulosin has protective effects via protein kinase C epsilon and extracellular signal-regulated kinase 1 and 2 signaling pathway.[48]

Chronic administration of a standardised (total saponin content 43.77% w/w) hydro-alcoholic lyophilised extract of whole plant extract of tribulus improved cardiac function and attenuated myocardial infarction in rats. The study was undertaken to evaluate the cardioprotective potential of tribulus. It demonstrated that multiple mechanisms may be responsible for the cardioprotective effect of tribulus. The study found the possible underlying mechanism of the cardioprotective effect of tribulus could be due to restoration of endogenous myocardial antioxidant status or free radical scavenging activity along with correction of the altered haemodynamic parameters and preservation of histoarchitectural and ultrastructural alterations. The researchers concluded that their observations provide a scientific basis for the cardioprotective effect of tribulus during myocardial ischemia (insufficient blood flow to the heart muscle via the coronary arteries) and demonstrate its therapeutic potential in the treatment of ischemic heart disease.[49]

An *in vitro* study has found that a triterpene saponin of tribulus (hecogenin-3-O-beta-D-glucopyranosyl(1-->4)-beta-D-galactopyranoside) may play a role in cardiocyte survival during chemical hypoxia-ischaemia. The Chinese study suggests that the saponin may play a role in cardiocyte survival via protein kinase C-epsilon and B-cell lymphoma 2.[50]

The methanolic and aqueous extracts of tribulus 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 hyperpolarisation.[51]

In an Iranian study 10 mg/kg/day of lyophilised aqueous extract of tribulus fruit has shown antihypertensive effects in rats. These results indicated that the effects are possibly due to inhibition of angiotensin-converting enzyme activity.[52]

An earlier study has demonstrated the preventive and therapeutic effects of saponins from tribulus on diet-induced hyperlipidaemia in mice. The saponins could significantly lower the levels of serum total cholesterol ($p<0.05$), low density lipoprotein cholesterol ($p<0.01$) and liver total cholesterol ($p<0.05$), triglycerides ($p<0.05$) and increase the activities of superoxide-dismutase in liver.[53]

Coronary heart disease was treated in a Chinese study with the saponin content of tribulus suggesting that it dilates the coronary artery and improves coronary circulation. According to 406 cases of clinical observation and a cross test (67 cases treated with Yufen Ningxin Pian as control), the results showed that the total efficacious rate of remission in angina pectoris was 82.3%. It was higher than the control group with a total effective rate of 67.2% ($p <0.05$).[54]

A semipurified water soluble extract of tribulus fruits exhibited cardiac stimulant action.[55]

Antiurolithiatic and nephroprotective activity

An Indian study investigated the influence of a methanolic fraction of tribulus fruit extract on the kidney tissues of mercury intoxicated mice. The results suggest that the oral administration of tribulus at a dose of 6 mg/kg body weight provided protection against the mercuric chloride induced toxicity in the mice.[56]

In vitro studies using human urine suggest that the diuretic properties of tribulus may be the most crucial mechanism for preventing urinary stone formation.[57]

An ethanolic extract of the fruits of tribulus showed significant dose dependent protection against uroliths (bladder stone) induced by glass bead implantation in albino rats. It provided significant protection against deposition of calculogenic material around the glass bead. It also protected leucocytosis and elevation in serum urea levels. Further, fractionation lead to decreased activity. This could be either due to loss of active compounds during fractionation, or the antiurolithiatic activity of tribulus being a combined effect of several constituents present in the methanolic fraction.[58]

Administration of an aqueous extract of tribulus to sodium glycolate fed rats produced a significant decrease in urinary oxalate excretion and a significant increase in urinary glyoxylate excretion.[59]

Hypoglycaemic activity

A study investigating the protective effects of tribulus in diabetes mellitus suggested that the protective effect of tribulus for streptozotocin-induced diabetic rats may be mediated by inhibiting oxidative stress. The tested tribulus extract significantly decreased the levels of alanine aminotransferase and creatinine in the serum ($p < 0.05$) in diabetic groups and lowered the malondialdehyde level in liver ($p < 0.05$) in diabetic and ($p < 0.01$) nondiabetic groups. On the other hand, levels of reduced glutathione in liver were significantly increased ($p < 0.01$) in diabetic rats treated with tribulus.[60]

Saponins from tribulus could significantly reduce the level of serum glucose in mice following a study on the plant's hypoglycaemic effect. Alloxan was used to establish the diabetic model in mice. Phenformin Hydrochloride Tables were used as the positive control. The level of glucose, triglyceride, cholesterol and SOD in serum were determined.[61]

A decoction of tribulus significantly inhibited gluconeogenesis and influenced glycometabolism in normal mice. The decoction could also reduce the level of triglyceride and the content of cholesterol in the plasma.[62]

Antimicrobial and antifungal activity

The antimicrobial activity of organic and aqueous extracts from fruits, leaves and roots of tribulus was examined against 11 species of pathogenic and non-pathogenic microorganisms: *Staphylococcus aureus*, *Bacillus subtilis*, *Bacillus cereus*, *Corynebacterium diphtheriae*, *Escherichia coli*, *Proteus vulgaris*, *Serratia marcescens*, *Salmonella typhimurium*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and *Candida albicans*. All the extracts from the different parts of the plant showed antimicrobial activity against most tested microorganisms. The most active extract against both Gram-negative and Gram-positive bacteria was ethanol extract from the fruits with a minimal inhibitory concentration (MIC) value of 0.15 mg/ml against *B. subtilis*, *B. cereus*, *P. vulgaris* and *C. diphtheriae*. In addition, the same extract from the same plant part demonstrated the strongest antifungal activity against *C. albicans* with an MIC value of 0.15 mg/ml.[63]

Steroidal saponins isolated from tribulus have shown significant *in vitro* antifungal activity against fluconazole-resistant fungi and *in vivo* activity against fluconazole-resistant *Candida albicans*.[64]

Anti-inflammatory cytoprotectve activity

A recent study has found that injectable tribulus fruit saponin preparation protects the brain damage caused by ischemia-reperfusion injury in rats. The study found this may be closely related to the regulation of reactive oxygen species (malondialdehyde and superoxide dismutase activity) and nitric oxide levels in the rat cerebrum, as well as vasoactive factors in the plasma (prostaglandin F1α, thromboxane B2 and endothelin).[65]

The inhibitory effect of saponins from tribulus on Bcap37 breast cancer cell line were determined by cell growth curve, MTT assay, protein content assay and morphological observation. The results showed that tribulus had a potent inhibitory effect on Bcap-37 cell line in a concentration-dependent manner. Bcap-37 cell exhibited morphological alteration in which the cells became round and shrank and the nuclei contracted after treatment with tribulus.[66]

A methanolic extract of tribulus showed inhibition of prostaglandin E(2) production (for COX-2 inhibitors) and nitric oxide formation (for iNOS inhibitors) *in vitro* warranting further research for development of new cancer chemopreventive and/or anti-inflammatory agents.[67]

Tribulusamides A (1) and B (2), new lignanamides embracing two cinnamic amide parts joined in a cis configuration, were isolated from the fruits of tribulus. Addition of these compounds to primary cultured mouse hepatocytes significantly prevented cell death induced by D-galactosamine (D-GalN)/tumour necrosis factor alpha (TNF-alpha).[68]

Antispasmodic activity

An *in vitro* study investigated the effects of lyophilised saponin mixture of tribulus on several smooth muscle preparations. The lyophilised material was obtained from dried and powdered tribulus by specific extraction method for saponins. The saponin mixture caused a significant decrease in peristaltic movements of isolated sheep ureter and rabbit jejunum preparations in a dose-dependent manner ($p < 0.05$). The results suggest that tribulus, or its saponin mixture, may be useful in some smooth muscle spasms or colic pains.[69]

Analgesic activity

A methanolic extract of tribulus fruit has demonstrated an analgesic effect at a dose of 100mg/kg in an Iranian study on mice. The analgesic effect was evaluated by formalin and tail flick test. The gastric ulcerogenecity of the plant extract was lower than that of indomethacin (non-steroidal anti-inflammatory drug) in the animal's stomach.[70]

Indications

- Urinary disorders: cystitis, kidney stones, oedema
- Reproductive conditions: infertility, sexual impotence, decreased libido
- Coronary heart disease
- Muscle strength
- Gout
- Cough

Toxicity

Toxicity levels in humans are not known but tribulus is known to cause hepatogenous (liver) photosensitisation in sheep and goats, characterised by hepatic damage and non-pigmented skin predisposed to sunburn.[71,72]

Use in Pregnancy

Not recommended during pregnancy or lactation due to lack of sufficient data.

Contraindications

Tribulus appears to be generally safe. One case of pneumothorax (collapsed lung) upon digestion of the fruit has been reported.[73]

Drug Interactions

Controlled studies are not available and currently no interactions are known.[74]

Administration and Dosage

Liquid extract: 1:1 60% alcohol : 10 to 20 mL weeky

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