

## Aphrodisiac & Tonic Activity of Tribulus Leaf

### Key Points at a Glance

#### Tribulus Leaf

- consumed as a vegetable and used traditionally as a tonic
- concentrated extract of Tribulus leaf (of Eastern European origin and/or containing furostanol saponins, predominantly protodioscin) clinically demonstrated to:
  - improve sperm and semen parameters in men with infertility
  - improve libido in men
  - improve ovulation in some women with infertility
  - relieve menopausal symptoms
  - possibly enhance the body's natural production of sex hormones, especially when at low levels, but is unlikely to increase beyond normal range
- steroidal saponins may act by binding to vacant receptors in the hypothalamus

#### Constituents & Quality

- contains furostanol glycosides (which are steroidal saponins), in particular, protodioscin
- protodioscin level may be critical for efficacy
- fruit as well as plant grown in locations other than Eastern Europe may contain furostanol saponins, but not necessarily with sufficient protodioscin
- method of analysis determines the accuracy of furostanol saponin content
- much clinical research published on Tribulus but often undefined for plant part, saponin profile or content of protodioscin

### Traditional Uses

There is little information available on the traditional use of the leaf of Tribulus (*Tribulus terrestris*). In Ayurveda the plant and fruit have been used to treat spermatorrhoea, gonorrhoea, impotence, uterine disorders after parturition, cystitis, painful urination, kidney stones and gout.<sup>1</sup> Tribulus is consumed as a green leafy vegetable in East and South Africa, India and Pakistan,<sup>2-5</sup> and used as a tonic, stomachic and to treat stomach ache and vaginal discharge.<sup>4,6-8</sup>

### Constituents

In the 1990s attention focused on the Bulgarian pharmacological and clinical research of a concentrated extract of Tribulus aerial parts (mostly leaf, some stem). The extract was standardised to contain not less than 45% furostanol saponins as protodioscin, because these saponins are important, active constituents.

The furostanol glycosides are a subclass of steroidal saponins. They have a sugar group at the carbon-3 (C-3) position and a second sugar group at position C-26. Furostanol glycosides readily convert into spirostanol saponins (with one sugar group at C-3) in the presence of plant enzymes or acid.<sup>9</sup> Such degradation, resulting in loss of sugars, may occur postharvest, in manufacturing or during experimental analysis.

The high content of steroidal saponins is a characteristic feature of *Tribulus terrestris*. The composition of the saponins correlates with the place of origin of the plant. The main constituent of Tribulus aerial parts (leaf and stem) from Bulgaria is the furostanol glycoside protodioscin.<sup>10</sup>

The method of analysis determines the accuracy of the furostanol saponin content. Inferior methods include gravimetric or colorimetric techniques.<sup>11</sup> The quality of Tribulus products is best assessed by high performance liquid chromatography (HPLC). Rigorous analytical studies, using HPLC, have determined the following information.

- There is a substantially higher content of protodioscin in the leaves (1.337%), than in the stem (0.276%) or fruit (0.245%). These plant samples were from Bulgaria.<sup>12</sup>
- Plant material from Eastern Europe is higher in protodioscin than material from India, China or Australia.
  - Bulgarian stem: 0.276%; Indian stem: 0.024%;<sup>12</sup>
  - Bulgarian fruit: 0.245%; Chinese fruit: 0.063–0.089%;<sup>12</sup>
  - Slovakian herb: 1.98%; Indian herb: none detected; Australian herb: none detected.<sup>11</sup>
- A study published in 2008 confirms that the content of steroidal saponins varies depending on plant part, geographical location of growth and stage of plant

development. It is likely that chemotypes of *Tribulus terrestris* exist: one in East South Europe and West Asian regions (high in protodioscin), as distinct from a chemotype in the Indian and Vietnamese regions (very low in protodioscin). Plant material from China was not assessed.<sup>13</sup>

## Pharmacological Activity

In addition to an aphrodisiac activity (described in the *Clinical Studies section below*) concentrated extract of *Tribulus terrestris* leaf of Bulgarian origin has demonstrated tonic activity in several experimental models (i.e. increase in nonspecific resistance, improve protein synthesis, increase physical performance).<sup>14,15</sup>

## Clinical Studies

Many clinical studies do not sufficiently define the evaluated *Tribulus* preparations. In general, only preparations defining leaf of Eastern European origin preferably standardised to contain furostanol saponins of mostly protodioscin are discussed here.

The beneficial therapeutic effects of concentrated extract of *Tribulus terrestris* leaf cannot be attributed to all *Tribulus* products. Health care professionals need to be wary of *Tribulus* products:

- made using different plant parts (or undefined),
- not specifying the furostanol saponin content (and with a majority of protodioscin),
- quantified using nonspecific test methods (i.e. other than spectrophotometric).

## Male Infertility & Impotence

Several uncontrolled clinical studies have been conducted by Bulgarian research teams involving over 300 men with fertility problems and impotence.<sup>16-20</sup> Concentrated extract of *Tribulus terrestris* leaf, containing furostanol saponins (predominantly protodioscin, not less than 45%) was found to have a **stimulating effect on sexual function**. Treatment with *Tribulus* extract increased serum testosterone in some patients with lowered levels, but levels were not increased in those with normal values of testosterone. Further details are outlined in Table 1 and Table 3. Concentrated extract of *Tribulus terrestris* leaf was found to be well tolerated, with gastrointestinal upset occurring in only a few patients.

Condition	Dosage	Results
idiopathic oligospermia	extract providing 337.5 mg/day furostanol saponins (predominantly protodioscin), for 60 days	<ul style="list-style-type: none"> <li>• significantly increased sperm motility</li> <li>• significantly increased rate of movement of sperm</li> <li>• at higher dose (675 mg/day furostanol saponins) and repeat treatment: normalised sperm profile with increase in serum luteinizing hormone and testosterone, decrease in serum oestradiol</li> </ul>
oligospermia after varicocele operation	extract providing 337.5 mg/day furostanol saponins (predominantly protodioscin), for 60 days	<ul style="list-style-type: none"> <li>• significant improvement in sperm motility</li> <li>• at higher dose (675 mg/day furostanol saponins for 90 days): increase in ejaculate volume, sperm concentration and motility</li> </ul>
unilateral or bilateral hypotrophy of the testes and oligospermia	extract providing 675 mg/day furostanol saponins (predominantly protodioscin), for 60 days	<ul style="list-style-type: none"> <li>• increase in ejaculate volume, sperm concentration and motility</li> <li>• increase in serum testosterone</li> <li>• increase in libido</li> </ul>
male infertility	extract providing 337.5 mg/day furostanol saponins (predominantly protodioscin), for 3 months	<ul style="list-style-type: none"> <li>• significant increase in ejaculate volume and sperm concentration, motility and velocity</li> <li>• sperm morphology normalised and ejaculate liquefaction time decreased</li> <li>• significant decrease in secreted immunoglobulin A (SIgA) and IgG</li> <li>• libido normalised or enhanced in those with poor libido</li> </ul>
couple infertility (sperm antibody-positive men <sup>*</sup> )	extract providing 337.5 mg/day furostanol saponins (predominantly protodioscin)‡	<ul style="list-style-type: none"> <li>• 31 pregnancies for 100 couples within 12 months of initiating treatment (average time taken to conceive was 5.2 months)</li> </ul>
hypogonadism and cryptorchidism§	not known	<ul style="list-style-type: none"> <li>• improvement in libido and erections in some patients</li> </ul>
chronic prostatitis with oligospermia or azoospermia	extract providing 337.5–675 mg/day furostanol saponins (predominantly protodioscin), for 30–67 days	<ul style="list-style-type: none"> <li>• no improvement in sperm parameters</li> <li>• improvement in libido in majority of patients</li> </ul>
chronic epididymitis	not known	<ul style="list-style-type: none"> <li>• sperm parameters not improved</li> </ul>

**Table 1. Uncontrolled clinical trials of concentrated extract of *Tribulus terrestris* leaf of Bulgarian origin for the treatment of male infertility.**

**Notes:** \* In addition, 74% of women had abnormal results in the post-coital test (assesses the interaction between sperm and cervical mucus). ‡ Same dosage for women from days 21 to 27 of the menstrual cycle until conception. § Patients with Klinefelter's syndrome (genetic primary hypogonadism), Noonan syndrome (a multifaceted disorder which includes cryptorchidism) and simple cryptorchidism.

Treatment	Results
Tribulus extract every day for 2–3 months; 15 women	<ul style="list-style-type: none"> <li>no improvement in ovulation parameters</li> <li>side effects were observed, especially when the treatment was abruptly terminated</li> </ul>
Tribulus extract only on days 5 to 14 of the menstrual cycle for 2–3 months; 36 women	<ul style="list-style-type: none"> <li>normalised ovulation with resultant pregnancy (6%)</li> <li>normalised ovulation without pregnancy (61%)</li> <li>no effect on ovulation (33%)</li> <li>no side effects observed</li> </ul>
Tribulus extract used in the preovulatory phase (days 5 to 14 of the menstrual cycle) in combination with an ovulation stimulant for 3 months (20 women)	<ul style="list-style-type: none"> <li>treatment with Tribulus and ovulation stimulant was better than treatment with either single agent (Tribulus or ovulation stimulant)</li> </ul>
one of three ovulation stimulants (epimestrol, clomiphene, cyclofenil; 112 women)	<ul style="list-style-type: none"> <li>results best for ovulation stimulant epimestrol: normalised ovulation with pregnancy (39%), normalised ovulation without pregnancy (35%), no effect on ovulation (26%)</li> <li>side effects for 6.5%, 10.6% and 38% of patients treated with epimestrol, clomiphene and cyclofenil, respectively.</li> </ul>

**Table 2. Clinical results of concentrated extract of *Tribulus terrestris* leaf of Bulgarian origin for the treatment of female infertility.**

Preliminary results in 2010 from a study involving 37 middle-aged male patients indicate a small increase in serum testosterone (from 9.7 to 11.2 nmol/L) occurred for treatment with concentrated extract of *Tribulus terrestris* leaf of Bulgarian origin.<sup>21</sup>

## Female Infertility

In an unblinded study conducted in a hospital in Bulgaria, concentrated extract of *Tribulus terrestris* leaf was evaluated in several groups of infertile women. After initial assessment of treatment with Tribulus (no control group), a group of 20 patients underwent combined treatment with Tribulus and an ovulation stimulant. Parallel control studies on a comparable cohort tested three ovulation stimulants. The total number of women assessed was 163. The dosage of Tribulus extract provided 337.5–675 mg/day of furostanol saponins (predominantly protodioscin). The results are outlined in Table 2.<sup>22</sup> See also couple infertility in Table 1.

## Menopause

In an unblinded study, treatment with concentrated extract of *Tribulus terrestris* leaf of Bulgarian origin had a **beneficial effect on menopausal symptoms** such as hot flushes, sweating, insomnia and depression in 98% of the 50 participating women. Fifty-two percent of patients were experiencing natural menopause and 48% had postoperative symptoms after removal of their ovaries. In nearly 70% of women **libido was enhanced**. Intake of placebo was ineffective. The dosage prescribed varied, but generally a maintenance dose of extract providing 225–337.5 mg/day furostanol saponins (predominantly protodioscin), was reached after higher initial doses (up to double this maximum dose). Treatment did not result in significant changes in follicle stimulating hormone (FSH), luteinizing hormone, prolactin, oestradiol, progesterone and testosterone, although FSH tended to be lower.<sup>22</sup>

## Athletes: Exercise Performance

A concentrated extract of Tribulus (plant part and geographical origin undefined) given for 8 weeks at a daily dose of 3.2 mg/kg did not enhance body composition or exercise performance in 8 resistance-trained males when coupled with a resistance-training program in a randomised, double-blind, placebo-controlled trial. The extract was standardised to 45% “saponins and protodioscin”. At an average weight of 75.2 kg the administered dosage of furostanol saponins was low: 108 mg/day.<sup>23</sup> The proportion of protodioscin is not known.

## Hormone Production in the Healthy & Potential for Doping

Mixed results have been found for the effect of concentrated extract of *Tribulus terrestris* leaf on hormone production in healthy volunteers.<sup>24,25,26</sup> Refer to Table 3 for more details. Together with the results in patients (outlined in Table 1), Tribulus may increase the **production of sex hormones**, especially when initially low, but the increase is likely to be within the normal range.

Tribulus is unlikely to affect the results of steroid analysis of urine tests in athletes,<sup>26</sup> although studies of longer duration are needed.

## Potential Mechanism of Action

In the postmenopausal woman Tribulus might alleviate symptoms of oestrogen withdrawal by the binding of its steroidal saponins to vacant receptors in the hypothalamus (in this low oestrogen situation). This could be sufficient to convince the body that more oestrogen is present in the bloodstream than actually is. A similar mechanism via the hypothalamus could apply for men.

Trial Details	Dosage	Results	Ref
uncontrolled; men and women	extract providing 337.5 mg/day furostanol saponins (predominantly protodioscin), for 5 days	<ul style="list-style-type: none"> <li>men: increased luteinizing hormone (LH) and testosterone in serum</li> <li>women: increased follicle stimulating hormone and oestradiol in serum</li> </ul>	<sup>24</sup>
randomised, placebo-controlled; men (body weight ranged from 60–125 kg)	extract providing 6 or 12 mg/kg/day furostanol saponins† (predominantly protodioscin), for 4 weeks	<ul style="list-style-type: none"> <li>no significant difference in serum testosterone, androstenedione or LH was apparent compared to controls</li> </ul>	<sup>25</sup>
uncontrolled; two women	extract providing 675 mg/day furostanol saponins* (predominantly protodioscin), for 2 days	<ul style="list-style-type: none"> <li>no effect on endogenous testosterone‡</li> </ul>	<sup>26</sup>

**Table 3. Clinical studies of concentrated extract of *Tribulus terrestris* leaf of Bulgarian origin in healthy volunteers.**

**Notes:** † This is a different extract (containing 60% furostanol saponins) to that used in the Bulgarian clinical studies (which contained about 45% furostanol saponins). \* Furostanol saponin dosage extrapolated from previous known content for this brand. ‡ For example, urinary testosterone/epitestosterone ratio and carbon isotope ratio of testosterone metabolites were unchanged.

## Actions

Aphrodisiac, oestrogenic in females (indirectly), androgenic in males (indirectly), fertility agent, tonic.

## Indications

- Male and female infertility, impotence, decreased libido, menopause.
- To restore or build vitality.

## Cautions and Contraindications

According to traditional Chinese medicine Tribulus fruit should be used with caution in pregnancy.<sup>27</sup> If Tribulus leaf is being used to promote fertility in women, its use should be ceased immediately after pregnancy is established.

Steroidal saponin-containing herbs such as Tribulus are best kept to a minimum in patients with pre-existing cholestasis. As with all saponin-containing herbs, oral intake may cause reflux and irritation of the gastric mucous membranes.

## REFERENCES

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