Article

Not peer-reviewed version

Awareness and Risk Behaviors Associated with *Tribulus terrestris* (*Tt*), Dietary Supplements, and Anabolic Steroids: Evidence from an Italian Questionnaire-Based Study

Adele Minutillo †, Omayema Taoussi †, Simona Pichini *, Francesco Paolo Busardò, Giulia Bambagiotti

Posted Date: 3 November 2025

doi: 10.20944/preprints202511.0004.v1

Keywords: tribulus terrestris; protodioscin; dietary supplements; survey; anonymous questionnaire

 doi:10.20944/preprints202511.0004.v1

Article

Awareness and Risk Behaviors Associated with *Tribulus terrestris* (*Tt*), Dietary Supplements, and Anabolic Steroids: Evidence from an Italian Questionnaire-Based Study

Adele Minutillo [1,†], Omayema Taoussi [2,†], Simona Pichini [1,*], Francesco Paolo Busardò [2] and Giulia Bambagiotti [2]

[1] National Centre on Addiction and Doping, Istituto Superiore di Sanità, viale Regina Elena 299, Roma 00161, Italy

[2] Department of Biomedical Sciences and Public Health, Marche Polytechnic University, Ancona, Italy

* Correspondence: simona.pichini@iss.it.

† Contributed equally.

Abstract

Background: *Tribulus terrestris* (*Tt*) is a popular herbal supplement marketed for performance enhancement. However, evidence regarding its efficacy and safety remains inconclusive. This study aimed to investigate the prevalence of *Tt* use, awareness, and motivations for using it among athletes and gym-goers in Italy. Methods: An anonymous questionnaire, approved by the National Ethics Committee and developed in accordance with the GDPR and the Declaration of Helsinki, was administered in paper and digital formats across Italian gyms. The survey collected socio-demographic and anthropometric data, information on sports practice, dietary supplement and anabolic steroid use, and motivations for consumption. After data cleaning, 512 valid responses were analyzed using descriptive statistics, chi-square tests, t-tests, and non-parametric analyses.
Results: Dietary supplement use was widespread across genders and age groups. Only 5.1% of respondents reported using *Tt*-containing products in the past six months, while 14.9% were unsure whether their supplements contained *Tt*. Use of *Tt* was significantly associated with performance enhancement as the primary motivation ($\chi^2(6) = 21.83$, $p = .001$). No associations with age, gender, or purchase channels were observed. Anabolic steroid use was infrequent, but was linked to online purchasing from potentially unregulated sources. Conclusions: Supplement use appears normalized among Italian gym-goers, while *Tt* intake remains limited and poorly informed. These findings highlight the importance of targeted education and preventive strategies to address misinformation and dangerous self-administration behaviors.

Keywords: tribulus terrestris; protodioscin; dietary supplements; survey; anonymous questionnaire

1. Introduction

Plant-based supplements and botanical extracts are widely used by athletes as they are often promoted for their presumed ability to increase muscle mass, enhance energy availability during exercise and aid weight loss. However, the current scientific evidence does not provide significant support for effectiveness or safety of these products in sports. In particular, there is a need to identify any potential adverse effects that could result from their uncontrolled use, whether taken individually or in combination with other supplements or pharmacological agents. Among the most popular products in the health and fitness market, Tribulus terrestris-based supplements are widely

 doi:10.20944/preprints202511.0004.v1

recommended for their supposed ability to increase testosterone production, enhance libido and fertility.

Tribulus terrestris (Tt) extract, also known as "puncture vine" or "gokhru", is a herbal supplement obtained from the leaves and roots of the herbaceous plant Tt, which belongs to the Zygophyllaceae family and grows in subtropical regions worldwide. Traditionally used in Chinese and Ayurvedic medicine to treat erectile dysfunction, male impotence, rheumatism, edema, hypertension and kidney stones, it has become increasingly popular in Western countries since the 1980s, particularly among athletes and bodybuilders interested in enhancing their performance [1–5]. Tt also exhibits marked stimulating activity on the central nervous system [6].

Commercial Tt products are often sold in tablet form, containing a lyophilized extract that is enriched in protodioscin, a steroidal saponin representing approximately 45% of the total extract [2–4], which in animal models has been shown to enhance the endogenous production of sex hormones (e.g., testosterone, luteinizing hormone (LH) and dihydrotestosterone) and to promote nitric oxide release, resulting in vasodilation [7–9]. In addition to being promoted for their purported antioxidant [4,10,11], bacteriostatic [12,13], and antitumor properties [14], *Tt* supplements are widely marketed as testosterone enhancers and are also known for their claimed efficacy in managing sexual health disorders in both males and females [15–17]. These products are available to anyone without a medical prescription, both through online platforms and authorized herbal product retailers [18–21].

To date, no regulatory restrictions have applied to their sale and production, and the World Anti-Doping Agency (WADA) has not prohibited their use in sport.

Despite its popularity, there is no scientific evidence that supports the effectiveness of Tt in improving athletic performance [22,23]. While the supplement appears to be generally well tolerated in humans and adverse effects are rarely reported, the lack of pharmacokinetic and pharmacodynamic studies makes it difficult to establish the optimal dosage [13]. Notably, clinical case reports describe significant adverse events that have occurred even following occasional consumption of Tt-based products [10,21,24].

Overall, although the global consumption of Tt continues to increase, there is currently no evidence to support its supposed beneficial properties.

Given the worldwide spread of Tt consumption, its high content of bioactive compounds (including flavonoids, alkaloids, lignanamides, sterols, and steroidal saponins), its frequent use in both traditional medicine and sports contexts and the absence of comprehensive human studies, there is a need for updated, reliable data on its efficacy, mechanism of action, optimal dosage and frequency of intake and potential adverse effects in humans.

This study aims to evaluate the real-actual consumption and potential misuse of *Tt* and/or protodioscin-containing supplements by analyzing data collected via an anonymous questionnaire administered to gym attendees across Italy. The primary objectives are to achieve an in-depth understanding of consumption patterns, the underlying motivations and frequency of use, as well as to evaluate the participants' assessment of the impact on sports performance.

2. Materials and Methods

The questionnaire was developed based on previously validated survey forms that were used in other public health campaigns conducted by the Italian National Institute of Health (ISS) and it was reviewed and approved by the National Ethics Committee. Supported by the Italian Ministry of Health, the study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki, as well as in compliance with Regulation (EU) 2016/679 of the European Parliament and of the Council (General Data Protection Regulation, GDPR), which governs the protection of individuals with regard to the processing of personal data. Participation required explicit informed consent for the processing of personal data to be provided. The questionnaire was divided into five thematic sections containing multiple-choice questions and was designed to take a few minutes to complete. The questions covered socio-demographic information, such as sex and age, and anthropometric data like body weight and height, as well as demographic characteristics concerning

 doi:10.20944/preprints202511.0004.v1

place of residence and gym attendance. Additional sections explored details of sports practice and the use of dietary supplements in general. There was also specific information requested regarding the use of *Tt*-containing supplements, including the type of product, purchasing channels and intended purpose. Information was also requested about the use of anabolic-androgenic steroids.

The survey was distributed in paper format at several gyms across Italy and in digital format, via web links and QR codes. The digital option was implemented at the request of participating gyms and facilitated data collection and management while ensuring a higher degree of confidentiality for respondents. In compliance with the General Data Protection Regulation (GDPR) and Italian privacy legislation, all questionnaires were anonymized and each survey was assigned a randomly generated alphanumeric code. The completed questionnaires were collected and examined to determine the prevalence of dietary supplement use among athletes.

A dedicated database was configured using available software at the ISS for data management and analysis. The dataset included demographic variables and detailed information on the type and frequency of dietary supplement and anabolic-androgenic steroid use, as well as the motivational context underlying these behaviors. Questionnaires were excluded from the analysis if respondents had not acknowledged the privacy policy and provided informed consent. In the case of digital submissions by minors, questionnaires were excluded if no informed consent had been obtained from a parent or legal guardian.

A total of 696 questionnaires were initially collected. Of these, 51 were excluded: 50 due to the absence of consent and 1 due to incomplete completion, despite the participant providing consent. The remaining 645 questionnaires underwent data cleaning, following confirmation that participants had reviewed the information on personal data processing and provided informed consent.

Data cleaning procedures led to the exclusion of an additional 133 questionnaires because they were either incomplete, unreliable, or completed by minors. The final sample of valid questionnaires included in the analyses comprised 512 respondents.

3. Results

The final sample consisted of 512 participants, (47.1% men and 49.0% women). Participants' ages ranged widely from 18 to 71 years, with a mean age of 32.44 years, as shows in Table 1. The most frequently reported age was 18, indicated by 37 participants. Regarding anthropometric characteristics, the mean height was 171.46 cm (range: 148–196 cm), and the mean weight was 69.69 kg (range: 42–110 kg). From a geographical perspective, participants were primarily residents of Ancona (n = 110; 21.36%), followed by Rome (n = 76; 14.76%), Florence (n = 57; 11.07%), Palermo (n = 24; 4.66%), and Milan (n = 11; 2.14%). The remaining participants were distributed across various smaller locations throughout the country. 66.5% reported regularly training at the gym, while 11.7% engaged in competitive sports. Only 5.1% of participants (n = 26) reported using supplements containing Tribulus Terrestris in the past six months, and 14.9% were uncertain whether their supplements contained this ingredient. Usage during the previous week was even lower (n = 21; 4.1%).

Table 1. Characteristics of the Total Sample (N = 512).

Variable	Category	n	%
Gender	Male	240	47.1
	Female	250	49.0
	Prefer not to answer	20	3.9
Sport activity	Yes, competitive level	59	11.7
	Yes, train regularly at the gym	336	66.5
	No	57	11.3

 doi:10.20944/preprints202511.0004.v1

	Other	39	7.7
	No response	14	2.8
Reason for using supplements	To improve performance	66	12.9
	To compensate for nutritional deficiencies	53	10.4
	To improve physical appearance	32	6.3
	Other	21	4.1
Use of supplements containing Tribulus Terrestris (last 6 months)	Yes	26	5.1
	No	88	17.2
	Don't know	60	11.7
Usual purchase channel	Internet	22	4.3
	Pharmacy	16	3.1
	Sports store	8	1.6
	Gym	4	0.8
	Other	6	1.2
Age (years)	Mean (SD)	32.46	12.23
Weight (kg)	Mean (SD)	71.09	33.79
Height (cm)	Mean (SD)	170.47	15.75

Analyses of gender, type of sports activity, and supplement purchase channels revealed no statistically significant associations with *Tt* use, as indicated by chi-square tests ($p > .05$). However, a significant difference was observed regarding the reason for supplement use ($\chi^2(6) = 21.83$, $p = .001$): *Tribulus* was more frequently used by individuals aiming to enhance performance than by those using supplements for aesthetic purposes or to compensate for nutritional deficiencies.

Independent-samples t-tests showed no significant differences between users and non-users of Tt in terms of age or the number of capsules or sachets consumed. Similarly, the non-parametric Kruskal-Wallis test confirmed that age did not differ significantly across the different usage subgroups ($p = .959$).

3.1. Tribulus Terrestris Users

Among the 114 participants reporting recent supplement use, 22.8% (n = 26) reported using Tt. All the characteristics of the participants who used Tt are presented in Table 2. Its use was not significantly associated with gender, sport participation, purchase channel, or recent anabolic steroid use (all $p > .12$).

A significant association emerged, however, between Tt use and the primary reason for supplement intake ($\chi^2(3) = 19.733$, $p < .001$), with the substance more frequently used by those aiming to enhance physical performance (57.7%) compared to other purposes, such as addressing nutritional deficiencies or improving appearance.

No significant differences were observed between Tt users and non-users in terms of age, weekly number of capsules/sachets, or gender (all $p > .40$, small effect sizes), nor in relation to purchase channel.

Table 2. Characteristics of Participants Who Used Tribulus Terrestris (n = 26).

Variable	Category / Statistic	Value
Gender	Male	61.5%

 doi:10.20944/preprints202511.0004.v1

	Female	34.6%
	Prefer not to answer	3.8%
Age (years)	Mean (SD)	34.12 (9.18)
Sport activity	Competitive	26.9%
	Regular gym training	61.5%
	Other / none	11.6%
Reason for using supplements	Improve performance	57.7%
	Compensate nutritional deficiencies	3.8%
	Improve physical appearance	38.5%
Usual purchase channel	Internet	42.9%
	Sports store	21.4%
	Gym	21.4%
	Pharmacy	7.1%
	Other	7.1%
Capsules taken in the last week	Mean (SD)	8.65 (7.62)
Sachets taken in the last week	Mean	1.00
Drops taken in the last week	Mean	140
Use of anabolic steroids (last 6 months)	Yes	4.2%
Significance (χ^2)	Reason for use ↔ TT use	$\chi^2(6)=21.83$, p=.001

4. Discussion

The present study provides an updated and comprehensive overview of the awareness, motivations, and consumption patterns associated with Tt and other dietary supplements among gym-goers and athletes in Italy. There was evidence of a specific and significant association between its use and the intention to enhance body performance, although the overall low prevalence of Tt use was 5.1%. This suggests that Tt is perceived overall as an ergogenic supplement, consistent with the widespread belief that it can increase testosterone release and physical performance. This understanding is discordant with current scientific research that does not demonstrate any appreciable anabolic or ergogenic effect in people [1,19,22,23]. Indeed, while early preclinical animal studies suggested androgenic-like effects of Tt, largely as a result of saponin Protodioscin effect [7–9], subsequent controlled human clinical trials all reported infinitesimal or non-statistically significant findings. For example, Fernández-Lázaro et al. [1] reported no increase in hormonal response, body composition, or performance after six weeks of Tt supplementation in trained CrossFit® athletes, while a systematic review by the same authors confirmed the absence of apparent advantages in sport and health biomarkers [23]. These findings underscore a persistent discrepancy between popular perception and evidence-driven knowledge, uncovering the processes of placebo effects, expectancy bias, and advertising messages that organize consumer decision making.

The notion that "natural" can be equated with "safe" or "effective" appears deep-seated among supplement consumers, particularly within gym settings where social influence and casual expertise are strong [19,20]. These assumptions can lead to unsupervised consumption and risk minimization, like product adulteration, dosing variations, and potential interactions with other supplements or medications [13,21]. Notably, a high percentage of this study's participants (14.9%) did not know whether their supplements contained Tt, reflecting overall label illiteracy and ingredient awareness, because of the high heterogeneity in the composition of commercial Tt products, which changes according to factors such as plant source, extraction methods, and standardization processes [2–4,7].

 doi:10.20944/preprints202511.0004.v1

Moreover, quality control issues, including adulteration with unlisted pharmacologically active ingredients or synthetic analogues, have been reported [22], suggesting the need for stricter regulatory surveillance and more transparent labeling.

Motivational analysis shows that the primary reason for Tt-supplement intake was enhancement of performance. This supports existing literature where performance optimization has been noted as a dominant factor for supplement use by recreational athletes [19,22,23]. Many users seem to perceive Tt as a natural, legal substitute for anabolic steroids, with the belief that it is safe, even without adequate evidence of effectiveness [19]. These attitudes are generally supported by social media, peer advising, and fitness culture, that valorize supplementation as a legitimate path to improvement.

Consequently, the consumption of supplements is normalized as part of the training schedule in both sexes and across all age ranges, as suggest also by other European research [20,22] raising ethical and public health concerns over medicalization of sport and performance.

While the prevalence of anabolic-androgenic steroid (AAS) use in our data was low, the data revealed a notable preference for online purchasing, especially among individuals motivated by aesthetic goals. This behavior poses serious risks, as online markets for performance-enhancing substances often lack adequate regulation and quality assurance [21]. The anonymity and accessibility of these channels may lower barriers to experimentation and facilitate access to counterfeit or contaminated products. This phenomenon fits within the broader paradigm of image- and performance-enhancing drug use, where the pursuit of rapid physical transformation often overrides considerations of safety and health. Addressing such behaviors requires targeted interventions focused on digital literacy, consumer awareness, and the regulation of e-commerce platforms involved in supplement distribution.

From a public health perspective, the findings of this study underscore the urgent need for coordinated strategies integrating education, regulation, and risk communication. Better labeling regulations, disclosure of active compounds, and product authenticity certification would better safeguard consumers. Concurrently, there must be educational campaigns to encourage evidence-based knowledge among gyms' customers and sportsmen to emphasize low effectiveness and potential harm of untested herbal supplements. As Tt is absent in the World Anti-Doping Agency (WADA) Prohibited List [20], it is likely to be viewed by athletes as a harmless performance-enhancer. However, such reasoning blurs the distinction between legal enhancement and doping intent, and suggests the need for preventive measures and education campaigns aimed at so-called "grey-zone" drugs—that is, drugs that are not banned but are widely abused due to insidious manipulation.

Despite the strengths of this research, such as its focus on a circumscribed but unstudied population, some limitations should be noted. Cross-sectional design precludes causal inference, and self-reports may be subject to recall or social desirability bias, particularly for sensitive topics such as steroid use. Furthermore, if spread geographically, the sample might not be representative of all Italian gym-goers. Future research should therefore use longitudinal and mixed-method designs to assess temporal change in supplement consumption and analyze psychological, sociocultural, and online drivers of use. The combination of biomarker-based evaluation and label confirmation may enhance the accuracy of data and help deliver a more accurate assessment of exposure, efficacy, and safety. Further studies must investigate dose–response relations, interactions between drugs and pharmacological effects, and the interaction between knowledge, motivation, and risk perception, thus informing the development of personalized preventive and educational policies.

Finally, the results of this study highlight the gap between perceived and actual effectiveness of Tt, universality of normalization of supplement use, and prevalence of myths relating to natural products safety and efficacy. These results demand a multidisciplinary approach—synthesizing public health policy, sports medicine, and behavioral sciences—to bring about informed decisions and prevent risk of uncontrolled supplementation in sport and recreational settings.

5. Conclusions

 doi:10.20944/preprints202511.0004.v1

Analysis of the collected questionnaires suggests that dietary supplements are widely used by individuals engaged in sports activities at various levels, both to compensate for potential nutritional deficiencies and to enhance physical performance. This behaviour appears to be uniformly distributed across gender and age groups, suggesting the intake of supplements has become normalised within the sporting population.

By contrast, the use of supplements containing Tt is considerably less prevalent, and users are less well-informed about them. Many participants reported being uninformed about the presence of this substance in the products they consumed, highlighting a significant lack of information regarding supplement labelling and composition.

Although the percentage of people reporting the use of anabolic-androgenic steroids (AAS) was low, this still represents a significant finding. The data highlight a clear preference for online purchasing, often from potentially unregulated sources, with motivations primarily related to enhancing physical appearance and, to a smaller amount, improving performance. These findings underscore the need for targeted educational interventions, improved labeling standards, and stronger market surveillance to reduce misinformation and prevent self-administration of potentially harmful substances. Future studies should explore the psychosocial and digital factors influencing supplement use, as well as investigate the real composition and physiological effects of herbal ergogenic aids like Tt. Strengthening the connection between public health policies, sports medicine, and behavioral education will be key to promoting informed, safe, and evidence-based supplementation practices.

Author Contributions: Conceptualization, G.B., A.M. and O.T.; methodology, G.B., A.M. and O.T.; validation, G.B., A.M. and O.T.; formal analysis A.M. and O.T.; investigation, G.B., A.M. and O.T.; resources, S.P., F.P.B. and G.B.; data curation, G.B. and A.M.; writing—original draft preparation, A.M. and O.T.; writing—review and editing, G.B., A.M., F.P.B. and O.T.; visualization, G.B. and A.M.; supervision, F.P.B. and S.P.; project administration, F.P.B. and S.P.; funding acquisition, S.P.. All authors have read and agreed to the published version of the manuscript.

Funding: This investigation was funded by the section for Doping Supervision and Control and Health Protection in Sports Activities of the Technical Health Committee of the Italian Ministry of Health.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by Ethics Committee of Istituto Superiore di Sanità (protocol code 0058106 and 14/12/2023).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.
Data Availability Statement: Dataset available on request from the authors.

Acknowledgments: The authors thank Laura Martucci, Simonetta di Carlo, Michele Sciotti, Valeria Aquilina, Chiara Fraioli and Antonella Bacosi for technical help.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Fernández-Lázaro D, Mielgo-Ayuso J, Del Valle Soto M, Adams DP, González-Bernal JJ, Seco-Calvo J. The Effects of 6 Weeks of Tribulus terrestris L. Supplementation on Body Composition, Hormonal Response, Perceived Exertion, and CrossFit® Performance: A Randomized, Single-Blind, Placebo-Controlled Study. *Nutrients.* **2021**;13:3969.
2. Bhandari B. Chopra D, Kohli Sk. Pharmacological Effects Of Tribuls Terrestris: A Review. *Int J Contemporary Med.* **2013**;1:71-75.
3. Ivanova A, Lazarova I, Mechkarova P, Semerdjieva I, Evstatieva L. Intraspccific Variability Of Biologically Active Compounds Of Different Populations Of Tribulus Terrestris In Thracian Floristic Region. *Biotcchnol Biotcchnol Equip* **2011**;25:2357-2361.

 doi:10.20944/preprints202511.0004.v1

4. Hammoda HM, Ghazy NM, Harraz FM, Radwan MM, ElSohly MA, Abdallah II. Chemical constituents from Tribulus terrestris and screening of their antioxidant activity. *Phytochemistry*. **2013**;92:153-9.
5. Akram. M, Asif, Hm, Akhtar N, Shah Pa, Uzair M, Shaheen G, Shamim T, Ali Shah Sm, Ahmad K. Tribulus Terrestris Linn.: A Review Article. *J Med Plants Res.* **2011**;5:3601-3605.
6. Mohd J, Akhtar Aj, Abuzer A, Javed A, Ali M, Ennus T. Pharmacological scientific evidence for the promise of tribulus terrestris. *IRJP*. **2012**;3:403-406.
7. Ștefănescu R, Tero-Vescan A, Negroiu A, Aurică E, Vari CE. A Comprehensive Review of the Phytochemical, Pharmacological, and Toxicological Properties of Tribulus terrestris L. *Biomolecules.* **2020**;10:752.
8. Singh S, Nair V, Gupta YK. Evaluation of the aphrodisiac activity of Tribulus terrestris Linn. in sexually sluggish male albino rats. *J Pharmacol Pharmacother*. **2012**;3:43-7.
9. Iacono F, Prezioso D, Ruffo A, Di Lauro G, Romis L, Illiano E. Analyzing the efficacy of a new natural compound made of the alga Ecklonia bicyclis, Tribulus terrestris and BIOVIS in order to improve male sexual function. *J Womens Health* **2011**; 8: 282-287.
10. Kadry H, Abou Basha L, El Gindi O, Temraz A. Antioxidant activity of aerial parts of Tribulus alatus in rats. *Pak J Pharm Sci.* **2010**;23:59-62.
11. Fernández-Lázaro D, Seco-Calvo J, Pascual-Fernández J, Domínguez-Ortega C, Del Valle Soto M, Mielgo-Ayuso J. 6-Week Supplementation with Tribulus terrestris L. to Trained Male CrossFit® Athletes on Muscle, Inflammation, and Antioxidant Biomarkers: A Randomized, Single-Blind, Placebo-Controlled Trial. *Int J Environ Res Public Health.* **2022**;19:16158.
12. Jindal A, Kumar P. Singh G. In vitro antimicrobial activity of Tribulus alatus L. Int J Pharm Pharm Sci. **2012**;4:270-272.
13. Di Sansebastiano Gp, De Benedicts M, Carati D, Lofrumento D, Durante M, Montefusco A, Zuccarello V, Da Lessandro G, Piro G. Quality and efficacy of Tribulus terrestris as an ingredient for dermatological formulations. *The Open Dermatol J.* **2012**;6:42-48.
14. Kim HJ, Kim JC, Min JS, Kim MJ, Kim JA, Kor MH, Yoo HS, Ahn JK. Aqueous extract of Tribulus terrestris Linn induces cell growth arrest and apoptosis by down-regulating NF-κB signaling in liver cancer cells. *J Ethnopharmacol*. **2011**;136:197-203.
15. Asadmobini A, Bakhtiari M, Khaleghi S, Esmaeili F, Mostafaei A. The effect of Tribulus terrestris extract on motility and viability of human sperms after cryopreservation. *Cryobiology*. **2017**;75:154-159.
16. de Souza KZ, Vale FB, Geber S. Efficacy of Tribulus terrestris for the treatment of hypoactive sexual desire disorder in postmenopausal women: a randomized, double-blinded, placebo-controlled trial. *Menopause.* **2016**;23:1252-1256.
17. Gama CR, Lasmar R, Gama GF, Abreu CS, Nunes CP, Geller M, Oliveira L, Santos A. Clinical Assessment of Tribulus terrestris Extract in the Treatment of Female Sexual Dysfunction. *Clin Med Insights Womens Health.* **2014**;7:45-50.
18. Tian C, Chang Y, Zhang Z, Wang H, Xiao S, Cui C, Liu M. Extraction technology, component analysis, antioxidant, antibacterial, analgesic and anti-inflammatory activities of flavonoids fraction from Tribulus terrestris L. leaves. *Heliyon*. **2019**;5:e02234.
19. Neychev V, Mitev V. Pro-sexual and androgen enhancing effects of Tribulus terrestris L.: Fact or Fiction. *J Ethnopharmacol*. **2016**;179:345-55.
20. Pichini S, Pacifici R., Tribulus terrestris. In *Smart Drugs*, National Institute of Health, Rome, Italy, 2016; pp. 141–143 (link: https://www.iss.it/documents/20126/2344091/Smart_Drugs.pdf/96a7029d-d1ef-4fb0-4c81-f5b34619d868?t=1575737099067)
21. Minervini L, Antonielli Romanini F, Solmi M, Passamani A, Sferrazza E, Schifano F. Acute psychotic episode associated with the intake of a testosterone-enhancer herbal mixture purchased online. *Psychother Psychosom.* **2012**;81:248-9.
22. Pokrywka A, Obmiński Z, Malczewska-Lenczowska J, Fijałek Z, Turek-Lepa E, Grucza R. Insights into Supplements with Tribulus Terrestris used by Athletes. *J Hum Kinet.* **2014**;41:99-105.

 doi:10.20944/preprints202511.0004.v1

23. Fernández-Lázaro D, Fernandez-Lazaro CI, Seco-Calvo J, Garrosa E, Adams DP, Mielgo-Ayuso J. Effects of Tribulus terrestris L. on Sport and Health Biomarkers in Physically Active Adult Males: A Systematic Review. *Int J Environ Res Public Health.* **2022**;19:9533.
24. Talasaz AH, Abbasi MR, Abkhiz S, Dashti-Khavidaki S. Tribulus terrestris-induced severe nephrotoxicity in a young healthy male. *Nephrol Dial Transplant*. **2010**;25:3792-3.