DOI: https://doi.org/10.17921/2447-8938.2022v24n1p47-51

Heteropterys tomentosa and Interactions with the Musculoskeletal System: Systematic Review

Heteropterys tomentosa e Interações com o Sistema Musculoesquelético: Revisão Sistemática

Flávia Heloísa da Silva[a]; Camila Moreira*[b]; Gladson Ricardo Flor Bertolini[b]

[a]Instituto Federal do Paraná. PR, Brazil.
[b]Unioeste, Stricto Sensu Graduate Program in Biosciences and Health. PR, Brazil.
*E-mail: ca-m@bol.com.br

Abstract

Although Brazil is a country with the greatest plant biodiversity, there are still shortcomings regarding phytotherapy studies and their practical application. In Brazil alone there are 65 plants with psychoactive principles, and Heteropterys tomentosa, from the ethnobotanical point of view, is one of the most famous plants in the Midwest region, it is known for its aphrodisiac, physical and mental invigorating and depurative properties. The objective of this review was to point out the number of scientific articles published about the benefits of using the plant H. aphrodisiac in interactions with the musculoskeletal system. A consultation was performed in 10 databases: Embase, Scopus, Pubmed, Livivo, Science Direct, Web of science, Cochrane, Koreamed, Lilacs and Clinical trials for the elaboration of a systematic review, for this there was no limitation of time, language or type of study. Results: the search described found 111 articles, all primary studies; of these only 5 original studies (4.5%) were included in the review. Positive adaptations were observed in bones, tendons, muscles and hormone release, which resulted in improvements in exercise time and load, delaying fatigue and increasing functional capacity. However, the scarcity of studies, pointed out several gaps, opening space for other works.

Keywords: Exercise. Muscle, Skeletal. Phytotherapy.

Resumo

Embora o Brasil seja um país com a maior biodiversidade vegetal, ainda existem carências com relação a estudos fitoterápicos e sua aplicação prática. Só no Brasil existem 65 plantas com princípios psicoativos, e a Heteropterys tomentosa, no ponto de vista etnobotânico, é uma das plantas mais famosas da região Centro-Oeste, ela é conhecida por propriedades afrodisíacas, de revigorante físico e mental, e depurativa. O objetivo desta revisão foi apontar a quantidade de artigos científicos publicados sobre os benefícios da utilização da planta H. aphrodisiaca em interações com o sistema musculoesquelético. Foi realizada uma consulta em 10 bases de dados, sendo elas: Embase, Scopus, Pubmed, Livivo, Science Direct, Web of science, Cochrane, Koreamed, Lilacs e Clinical trials para a elaboração de uma revisão sistemática, para isso não houve limitação de tempo, de língua ou tipo de estudo. A busca descrita encontrou 111 artigos, sendo todos estudos primários; destes apenas 5 estudos originais (4,5%) foram incluídos na revisão. Foram observadas adaptações positivas em ossos, tendões, músculos e liberação hormonal, que acarretaram melhorias no tempo e carga de exercício, retardando a fadiga e aumentando a capacidade funcional. Contudo, a escassez de estudos, apontou diversas lacunas, abrindo espaço para outros trabalhos.

Palavras-chave*: Exercício Físico. Músculo Esquelético. Fitoterapia.*

1 Introduction

Since antiquity, man has used resources derived from nature to improve his life condition and chances of survival. Peoples like the Romans, Hebrews, Indians, Greeks, Chinese, Arabs and Egyptians already used plants for the treatment of human diseases[1]. The use of medicinal plants in developing countries is of great therapeutic importance, namely: tonic, fortifying or purifying are very common practices in popular medicine in these countries, including Brazil[2].

With international recognition, Brazil is the country with the largest biodiversity in the world, with more than 46 plant species spread over 6 biomes[3]. The potential of this flora has been highlighted in the scientific environment, with an increasing interest in discovering new substances that can be used in medicine [4].

In the Brazilian cerrado, due to its floristic and ethnocultural diversity, the use of plants as tonic is quite common, among them is Heteropterys tomentosa A. Juss, initially catalogued as *Heteropterys aphrodisiaca*, but also known as: *Heteropterys spectabillis, Heteropterys verbascifolia* and *Heteropterys nudicauli*s S. Moore. It is a native plant in Brazil, but it can be found in other countries such as Bolivia, Paraguay and Peru[5].

This plant obtained its aphrodisiac property registered by Hoehne in 1920, and is popularly known in this region as: *nó de cachorro, raiz de Santo Antônio, nó de São Francisco*[6,7] and its main use is as a stimulant in the treatment of weaknesses of the central nervous system and as aphrodisiac tonic, for the treatment of fatigue and for "cleaning" blood[8].

Plants with an adaptive characteristic should be innocuous and cause minimal disturbance in the physiological functions

of an organism, and have nonspecific actions, i.e. increase resistance to adverse influences of a wide range of physical, chemical and biological factors[9]. The use of H. tomentosa is mentioned in the literature, in the published studies this plant shows to be effective as aphrodisiac stimulant, in the memory of elderly rats, decrease in anxiety, among other purposes[10-17]. One of the properties of H. tomentosa that needs further research is its ability to offer changes in the musculoskeletal system.

In view of this, the objective of this research is to elaborate a systematic review of published scientific articles on the use of *the H. aphrodisiaca plant* in interactions with the musculoskeletal system, published on 10 bases, namely: Embase, Scopus, Web of Science, Science Direct, Koreamed, Livivo, Cochrane, Lilacs, Pubmed, Clinical Trials.

2 Material and Methods

This research was developed as a systematic review about the use and effectiveness of the plant Heteropterys tomentosa t in musculoskeletal system adaptations. For this purpose, scientific articles published in the databases consulted were analyzed. The research question was established through the strategy PICO[18].

In the research, all scientific articles made available as full text and free of charge in the research bases were considered, regardless of language, year of publication and type of study. The search for manuscripts took place in a single day. The descriptors used in the consultation were: "Heteropterys tomentosa" [All Fields] OU "Heteropterys aphrodisiaca" [All Fields] OU ("heteropterys" [All Fields] E "spectabillis" [All Fields]) OU ("heteropterys" [All Fields] E "verbascifolia" [All Fields]) OR ("heteropterys" [All Fields] AND "nudicaulis" [All Fields]) OR ("nó de cachorro" [All Fields]), being that the descriptors *Heteropterys spectabillis, Heteropterys verbascifolia, Heteropterys nudicaulis* obtained no result.

Data analysis was performed by one of the authors, and two other authors responsible for reviewing the selected articles and deleting the repeated ones. The analysis of the collected articles was carried out in three stages. First, the texts were evaluated regarding the title, in which only those articles with terms related to some use of *the H. aphrodisiaca* plant were selected.

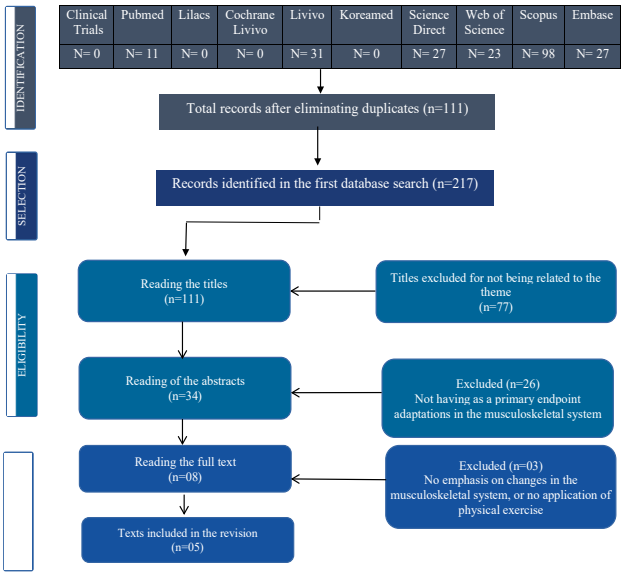
In the second stage, the abstract of the articles selected in the first evaluation was read, among which only the articles that mentioned some type of therapeutic treatment were selected based on the use of the plants of interest. And in the third, the full text of the articles selected in the second stage was evaluated, with the objective of selecting the articles that had as their main outcome the use of H. tomentosa in musculoskeletal system adaptations.

For full text access, the link available directly in the selected database was accessed. The search for productions initially resulted in the following numbers in the databases: Embase 27, Scopus 98, Web of Science 23, Science Direct 27, Koreamed 0, Livivo 31, Cochrane 0, Lilacs 0, Pubmed 11, Clinical Trials 0.

After selecting the articles, the analysis of these articles was performed. The articles that mentioned some form of adaptation in the musculoskeletal system associated with the use of *Heteropterys aphrodisiaca*. The articles were read in full and evaluated with the objective of proving the efficacy of the plant and obtaining a quantitative analysis.

Review articles and studies addressing chemical constituents of plants were excluded, without the intention of demonstrating therapeutic potential. Articles that mentioned only the empirical use of plants were also excluded. And articles that did not demonstrate the effect of the plant under the musculoskeletal system. It is noteworthy that only once the repeated articles were counted in the databases. Figure 1 shows the search strategy flow chart.

Figure 1 - Search strategy flow chart



Source: Research data.

The databases consulted showed that the beginning of the publications occurred in 2002 in Embase, Livivo, Pubmed, Science Direct and Web of science, while in Scopus the first Article was published in 2012, with an increasing number, however taking into account the objective of the present research, the number of articles found was scarce, with no time limitation, language, or type of research.

3 Results and Discussion

The research strategy described found 111 articles, all of which were primary studies; of these 95.5% were about cultivation, planting, properties, composition, extraction form, either on the use, however, in the latter, there were no physical tests as a form of intervention, or it was not directed to adaptations in the musculoskeletal system. In the end, 5 original studies (4.5%) were included in the review. All the selected articles conducted resistance training test to evaluate the effect of the plant on the chosen tissue.

Table 1 - Parts included in the review

Author/Year Variables	Monteiro et al. (2010)	Gomes et al. (2011)	Monteiro et al. (2011)	Pirovani et al. (2016)	Fraga et al. (2017)
Sample	Adult Male Wistar rats	Adult Male Wistar rats	Adult Male Wistar rats	Adult Male Wistar rats	Adult Male Wistar rats
(n) - age	(32) – 90 days	(40) -90 days	(48) – 90 days	(24) – 90 days	(20) – 85 +/- 10 days
Intervention	Trade Mill Running	Trade Mill Running	Trade Mill Running	Trade Mill Running	Swimming with load
Duration	8 weeks	8 weeks	8 weeks	8 weeks	30 days
Dose of Solution	25g/100ml	25g/100ml	25g/100ml (104ml/ day)	25g/100ml (104ml/ day)	25, 100 and 400 mg / kg
Structure Studied	Bones	Testicle/ Hormone	Tendons	Muscles	Aerobic system
Result Positive	Yes	Yes	Yes	Yes	Yes
Base	Scopus	Pubmed	Web of Science	Web of Science	Livivo

Source: Research data.

The studies that met the inclusion criteria in this review used the root of the plant by extraction, which compromises the population of this botanical material, however, Coelho et al.[6] analyzed the chemical composition of other parts of the plant, such as branches and leaves, and found no great differences among the quantity of saponins, hydrolysable tannins, flavonoids, polyphenols, triterpenes and nitrogen.

The study carried out by Monteiro et al.[12], used extract of 25mg compound was used for 100 ml of water, dividing the sample into 4 groups, with and without ingestion of the substance, sedentary and trained. Bone resistance was evaluated by means of the 3-point flexion test, as well as its morphological changes after the infusion of the plant and resistance training simultaneously. It is known that physical exercises result in a mechanical strength in bone tissues and provide an increase in bone mineral density, remodeling the bones through the mechanotransduction effect[19,20]. Monteiro et al.[12], point out that the group of mice in which resistance exercise was associated with the plant presented a significantly greater flow load and tension than the other groups, suggesting that bone tissue remodeling process was in progress. However, it was not possible to evaluate changes in morphometric measurements, collagen content, stiffness and elasticity module of the trained and treated animals. What points to the need to conduct research with longer training time.

In the study carried out by Fraga et al.[5], the adaptogen effects were evaluated by swimming exercise with load until exhaustion and the toxicological effects were performed by oral administration, after obtaining the extract with hydro alkyl solution dissolved in distilled water at the time of use. Efficacy was confirmed in both tests, presenting longer exhaust time and greater load support for the group that ingested the lowest dosage of the substance (25mg/kg). Although the hormonal blood test was not performed in this study, the authors suggest that the adaptations caused by the physical stimulus in line with the 25mg/kg ingestion of the compound provided an improvement in the physical performance, based on the studies by Chieregatto[21] and Gomes et al.[22], in which the increase in the quantity of Leydig cells responsible for the production and release of testosterone was increased in the first study for the group that ingested the substance associated with physical exercise. Whereas in the second study, there was an increase in sperm yield, testosterone secretion and spermatogonial behavior, with mitosis induction in the trained group and submitted to H. tomentosa.

The study by Piovani et al.[17] tested the effect of muscle resistance through treadmill running training associated with plant infusion. Muscle evaluation was performed by histochemical, molecular and structural analyzes, in addition to blood testosterone analysis. One of the results of this study was the significant increase in the cross-sectional area of the muscle of the trained and treated animals. In addition, the study presented an increase in the mean area of oxidative muscle fiber, mitochondrial increase and increase in capillary volume density. This suggests an increase in the potential for resistance capacity, as also observed by Fraga et al.[5]. On the other hand, the increase in serum testosterone and androgenic receptors was observed in the groups of ingestion of H. tomentosa and sedentary individuals treated with the root of the plant.

The study carried out by Gomes et al.[22], tried to analyze the efficacy of the plant infusion associated with the exercise of resistance in the increase of the stimulating effect. Thus, this study was aimed at hormone release, germinal cell count and nucleoli of Sartori, as well as alterations in the seminiferous epithelium. The result pointed out that the plant infusion increased the testosterone secretion and spermatogonial behavior, inducing mitosis and increasing sperm yield, the substance also has the capacity to protect the seminiferous epithelium after exposure of cyclosporin A and preservation of Leydig cells, presented in other studies.

Cyclosporin A has testicular toxicity, which may lead to infertility due to the seminiferous epithelium degeneration, vacuolization of Sertoli cells, abnormalities in the sperm cells and accumulation of residual cytoplasm. However, the study

by Monteiro et al.[11], pointed out by the analysis of testicular morphometry and transmission electron microscopy, that the use of H. tomentosa reduces the lesions induced by the substance, protecting this tissue. In another study, Monteiro et al.[13] investigated the effects of plant infusion, along with resistance training in Achilles tendon and rats' extracellular matrix. The association of resistance training with H. tomentosa resulted in a more organized collagen, more resistant bundles and tendons, to support higher loads of intense muscle contractions, and also an increase in proteoglycans and hydroxyproline was observed, which are fundamental substances for the connective tissue formation.

Observed the results of the studies, regarding the adaptations to the musculoskeletal system, it was observed that the substance present in the root of the tomentous Heteropterys has androgenic characteristics that allow the increase of blood testosterone[23], reflects on the regulation of the muscular protein metabolism[17], in sexual[17,21,22], and cognitive functions, with improvement in learning and memory[15,24]. In addition to what was mentioned by Mattei et al.[14] who detail oxidative stress in the brain of young and elderly rats, with inhibition of lipoperoxidation.

Despite all the findings presented above, there are still gaps to be filled by future studies, which the authors themselves discuss in their studies, due to the scarcity of material produced and the diversity of existing ethnographic material. Still, few research groups study the interaction of H, tomentosa with the musculoskeletal system, and although the quality of the publications is eminent, this review pointed to the need for further studies covering the national flora, and the phytotherapy properties of the plants used by the regional cultures, including studies covering other parts of the plant, thus avoiding its depletion in the ecosystem. This being said, cultural responsibility is observed, about the extraction of materials, since, when done indiscriminately, it may compromise the existence of this species, because the part of the plant used is the root, which makes replanting impossible.

As for the studies reviewed, much has to be studied on the subject, with the interaction of other parts with the locomotor system, observing changes in substrate dosages, duration, interval and type of exercises, age of the samples, adding other types of intervention, as post-injury recovery in structures belonging to the locomotor system, among others. Thus, different results can be obtained by crossing the findings and gaps indicated by the authors of the studies reviewed in this study.

4 Conclusion

The results obtained, through the selected studies, allow us to conclude that the resistance training associated with H. tomentosa infusion increases the resistance properties in skeletal muscle tissue, bringing organic adaptations that allow the reduction of fatigue and improve physical and mental exhaustion, improvement of physical performance and storage power without significant side or toxicological effects. However, it should be noted that the number of publications is still scarce, especially in clinical studies.

References

1. Macedo W de LR. Uso da fitoterapia no tratamento de doenças crônicas não transmissíveis: revisão integrativa. ReBIS 2019;1(3):36-43.
2. Calixto JB. Twenty-five years of research on medicinal plants in Latin America: A personal view. J Ethnopharmacol 2005;100(1/2):131-4. doi: 10.1016/j.jep.2005.06.004
3. Brasil. Biodiversidade. 2021 [acess in 15 Jan 2021]. Available from: https://www.gov.br/mma/pt-br/assuntos/biodiversidade
4. Malafaia O, Campos ACL, Torres O, Goldenberg S. Os fitoterápicos e seu potencial na cicatrização em cirurgia. Acta Cir Bras 2006;21(suppl 3). doi: 10.1590/S0102-86502006000800001.
5. Fraga GA, Balogun SO, Della Pascqua E, de Oliveira RG, Botelho G, Pavan E, et al. Heteropterys tomentosa A. Juss: Toxicological and adaptogenic effects in experimental models. Nutr Health 2017;23(4):289-98. doi: 10.1177/0260106017729908.
6. Coelho MFB, Jorge SA, Macedo M, Nogueira Borges HB, Spiller C. Nó-de-cachorro (Heteropterys tomentosa A. Juss.): espécie de uso medicinal em Mato Grosso, Brasil. Rev Bras Plantas Med 2011;13(4):475-85. doi: 10.1590/S1516-05722011000400013.
7. Ferreira ALS, Pasa MC, Nunez CV. A etnobotânica e o uso de plantas medicinais na Comunidade Barreirinho, Santo Antônio de Leverger, Mato Grosso, Brasil. Interações (Campo Gd) 2020;817-30. doi: 10.20435/inter.v21i4.1924
8. Bieski IGC, Rios Santos F, De Oliveira RM, Espinosa MM, MacEdo M, Albuquerque UP, et al. Ethnopharmacology of medicinal plants of the pantanal region (Mato Grosso, Brazil). Evidence-based Complement Altern Med 2012;272749. doi: 10.1155/2012/272749
9. Panossian A, Brendler T. The role of adaptogens in prophylaxis and treatment of viral respiratory infections. Pharmaceuticals 2020;13(9):236. doi: 10.3390/ph13090236
10. Vila Verde GM, Paula JR, Caneiro DM. Levantamento etnobotânico das plantas medicinais do cerrado utilizadas pela população de Mossâmedes (GO). Rev Bras Farmacogn 2003;13:64-6. doi: 10.1590/S0102-695X2003000300024
11. Monteiro JC, Predes FS, Matta SLP, Dolder H. Heteropterys aphrodisiaca infusion reduces the collateral effects of cyclosporine a on the testis. Anat Rec 2008;291(7):809-17. doi: 10.1002/ar.20709
12. Monteiro JC, Gomes MLM, Nakagaki WR, Tomiosso TC, Sbervelheri MM, Dolder H. Does Heteropterys aphrodisiaca administration and endurance training alter bones of mature rats? J Morphol Sci 2010;27(2):67-73.
13. Monteiro JC, Gomes MLM, Tomiosso TC, Nakagaki WR, Sbervelheri MM, Ferrucci DL, et al. More resistant tendons obtained from the association of Heteropterys aphrodisiaca and endurance training. BMC Complement Altern Med 2011;11:51. doi: 10.1186/1472-6882-11-51
14. Mattei R, Barros MP, Galvo SMP, Bechara EJH, De Carlini ELA. Heteropteris aphrodisiaca O. Machado: Effects of extract BST 0298 on the oxidative stress of young and old rat brains. Phyther Res 2001;15(7):604-7. doi: 10.1002/ptr.838

15. Galvão SMP, Mendes FR, Oliveira MGM de, Mattei R, Mello JCP de, Roman Júnior WA, et al. Memory retrieval improvement by Heteropterys aphrodisiaca in aging rats. Brazilian J Pharm Sci 2011;47(4):825-32. doi: 10.1590/S1984-82502011000400020

16. Farias DM, Ostetto MS, Colleti R, Barbosa T, Barros JA, Machado S, et al. Effect of Heteropterys aphrodisiaca on anxiety and male exposure of female mice with advanced age. Curr Clin Pharmacol 2018;12(2):106-12. doi: 10.2174/1574884712666170622085129

17. Pirovani JCM, Gomes MLM, da Silva FOC, Campos GER, Dolder H. Heteropterys tomentosa Improves the endurance capacity of skeletal muscles in trained rats. IOSR J Pharm Biol Sci 2016;11(04):39-45. doi: 10.9790/3008-1104033945

18. Akobeng AK. Principles of evidence based medicine. Arch Dis Child 2005;90(8):837-40. doi: 10.1136/adc.2005.071761

19. Herrmann M, Engelke K, Ebert R, Müller-Deubert S, Rudert M, Ziouti F, et al. Interactions between muscle and boné: where physics meets biology. Biomolecules 2020;10(3):1-30. doi: 10.3390/biom10030432

20. Scott A, Khan KM, Duronio V, Hart DA. Mechanotransduction in human bone: In vitro cellular physiology that underpins bone changes with exercise. Sport Med 2008;38(2):139-60. doi: 10.2165/00007256-200838020-00004

21. Chieregatto LC. Efeito do tratamento crônico com extratos de Heteropterys aphrodisiaca O. Mach. E Anemopaegma arvense (Vell.) Stellf. no testículo de ratos wistar adultos. Viçosa: Universidade Federal de Viçosa; 2005.

22. Gomes MLM, Monteiro JC, Freitas KM, Sbervelheri MM, Dolder H. Association of the infusion of Heteropterys aphrodisiaca and endurance training brings spermatogenetic advantages. Biol Res 2011;44(3):235-41. doi: 10.4067/S0716-97602011000300004

23. Kam P, Yarrow M. Anabolic steroid abuse: physiological and anaesthetic considerations. Anaesthesia 2005;60(7):685-92. doi: 10.1111/j.1365-2044.2005.04218.

24. Galvão SMP, Marques LC, Oliveira MGM, Carlini EA. Heteropterys aphrodisiaca (extract BST0298): a Brazilian plant that improves memory in aged rats. J Ethnopharmacol 2002;79(3):305-11. doi: 10.1016/S0378-8741(01)00402-0.