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Rondoniense flora species potentially active to control parasites in *Colossoma macropomum* Cuvier

Especies de flora Rondoniense potencialmente activas para el control de parásitos en *Colossoma macropomum* Cuvier

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Abstract

Considering the economic importance of the fish sector in Rondônia (in the Western Brazilian Amazon), which has been facing losses due to parasites in production systems, the present study aimed to carry out a survey of genetic resources of the flora of Rondônia, with potential properties to control parasites in Tambaqui, the main native species cultivated in the State. Therefore, based on a semi-structured questionnaire, bioprospecting was carried out in 20 municipalities, which are the largest producers at State level. The collected botanical materials were processed according to conventional herborization techniques and taxonomically determined. A total of 54 plants from the flora of Rondônia (38 determined at the species level, 16 at the genus level), distributed in 49 genera and 30 botanical families, have alleged antiparasitic properties for use in fisheries.

Resumen

Considerando la importancia económica del sector pesquero en Rondônia (en la Amazonía occidental brasileña), que viene enfrentando pérdidas por parásitos en los sistemas de producción, el presente estudio tuvo como objetivo realizar un levantamiento de los recursos genéticos de la flora de Rondônia, con potencial propiedades para el control de parásitos en Tambaqui, la principal especie nativa cultivada en el Estado. Por lo tanto, a partir de un cuestionario semiestructurado, se realizó la bioprospección en 20 municipios, que son los mayores productores a nivel estatal. Los materiales botánicos colectados fueron procesados según técnicas convencionales de herborización y determinados taxonómicamente. Un total de 54 plantas de la flora de Rondônia (38 determinadas a nivel de especie, 16 a nivel de género), distribuidas en 49 géneros y 30 familias botánicas, tienen presuntas propiedades antiparasitarias para uso en la pesca.

Introduction

Brazil is one of the tropical countries with the greatest potential for the development of aquaculture, where it has shown remarkable growth due to the great water availability, favorable climatic conditions, enormous diversity of fish species with potential for cultivation, size of the consumer market and technologies available in most places where this activity can be developed.

As the excessive use of chemotherapeutic agents in aquaculture is questioned, it should be better evaluated and regulated [1,2] due to the risks to animal, human and aquatic ecosystem health. Thus, research has been carried out looking for alternative natural products, especially herbal medicines, for the control and prevention of diseases and parasites in fish. Among these, infestations by *Perulaernea gamitanae* and *Neoechinorhynchus buttnerae*, which affect Tambaqui, compromising the sustainability of production.

Considering that there are gaps related to ways of controlling these parasites [3] economically important due to their incidence in fish farming in the Brazilian Amazon [4], as well as the lack of knowledge about products natural plants of plant origin with antiparasitic potential, it is necessary to survey GFR (plant genetic resources), bioprospecting and evidence of associated cytotoxicity and efficacy. Bioprospecting refers to the search for genetic and biochemical resources for commercial purposes, always aiming at conservation, so that the desired resource is not depleted with the following advantages: *i*) providing knowledge of biodiversity; *ii*) supplying important substances to man; *iii*) favor economic growth; *iv*) generate jobs; *v*) create a fund for the area of conservation and the genetic resource in question; *vi*) raise the scientific level and *vii*) improve the level of life in the country with the correct use of natural resources, thus complying with the postulates for sustainable development.

When considering the Amazon mega-diversity as a genetic heritage of inestimable value, with great potential for the development of new products (drugs, cosmetics, food, insecticides, herbicides, dyes, flavorings, among others), it is necessary to propose valuation strategies that result in the its conservation. According to Astolfi et al. [5], there is a consensus that the Brazilian Amazon must be developed from a bioindustrial sector, adding value to biodiversity in a sustainable way, conserving ecosystems and in a socially fair way, both in terms of urban, traditional riverside and indigenous populations. Current bioprospecting and biotechnology procedures make it possible to efficiently discover new substances and from these, to develop new bioproducts, thus adding value to biodiversity.

In several cases, the activity of bioprospecting plant genetic resources is linked to the knowledge that local populations have about the properties and uses of such resources, which is a topic that ethnobotany deals with it [6,7]. Therefore, the present research was developed through the application of a semi-structured questionnaire, in person or remotely, with fish producers and other people linked to the aquaculture activity, to inventory knowledge about plant products (with an emphasis on natives) used in the control of fish parasites. Additionally, plant species were collected due to their traits and medicinal properties. The products of plant primary metabolism are conservative and universal, essential to all species, being responsible for cell development and maintenance. Those of secondary metabolism, common to taxonomic groups, or exclusive to a given species, offer advantages for plant maintenance and development that synthesize them, including defense processes; correspond, in other words, to medicinal plants.

Several studies have shown the efficacy of phytotherapics to control animal disease, including fish. The aqueous extract of Amendoeira (*Terminalia catappa* L.) at a concentration of 200 ppm, reduced infection caused by fungus in the tilapia of Nilo (*Oreochromis niloticus*) eggs and, at 800 ppm, eliminated Trichodina in juveniles of this species, after two days of treatment [8,9]. The garlic (*Allium sativum* L.), an easily obtained product, has been used in fish treatment against bacteria, fungi, protozoa and viruses. Its properties are due to allicin (also responsible for the characteristic odor of the plant), which should be used preferentially raw, at high denatured temperatures [10].

In this sense, Rosemary (*Rosmarinus officinalis* L.), tested on tilapia, showed immunostimulant and bacteriostatic properties, while Bermuda grass (*Cynodon dactylon* (L.) Pers.), used in the treatment of white spot virus in *Penaeus monodon* shrimp, showed virucidal activity [11]. However, Fujimoto et al. [12], used seeds of two very common botanical species (*Cucurbita maxima* Duchesne and *Carica papaya* L., respectively, pumpkin and papaya), with significant results.

Alternative products (herbal medicines, bioproducts) are a viable solution, as their use as an antiparasitic can: *i*) drastically reduce the use of chemotherapeutics and antimicrobials in fish farming, reducing production costs; *ii*) eradicate present parasites; *iii*) prevent the emergence of parasites and bacteria resistant to commonly used products, and also *iv*) minimize negative impacts on the environment [13,14]. Therefore, the present research aimed to carry out a survey of species of the Rondônia flora with potential properties to control parasites in fish, considering that fish farming is one of the most economically and socially important sectors in the State of Rondônia, Western Brazilian Amazon.

Methods

For the survey of flora species in Rondônia with antiparasitic properties, a questionnaire was applied mostly online (via email, WhatsApp), in an interactive process, especially for fish producers and other people linked to aquaculture activity. The Municipalities of the Rondônia State were Ariquemes, Buritis and Porto Velho; Ouro Preto do Oeste, Mirante da Serra, Nova União, Tarilândia and Jaru; Rolim de Moura, Ji Paraná, Presidente Médici, Alvorada d'Oeste, Novo Horizonte do Oeste, Santa Luzia d'Oeste, Primavera de Rondônia, Colorado do Oeste, Teixeirópolis, Alta Floresta d'Oeste, Cacoal and Urupá.

The questionnaire addressed several aspects of practices or knowledge about plant products (with emphasis on natives) used in the control of fish parasites, thus establishing a bridge between scientific knowledge (academy) and traditional knowledge (community), with the aim of obtaining a list of known or used species for their antiparasitic potential in fish. The scientific name with the respective botanical family of each species was consulted and validated through the Flora do Brasil 2020 platform [15] and with the support of RON specialists, when necessary. Then, the data tabulation from the questionnaires was carried out, identifying the possible plant species for collection. A team was set up for the field trips, obtaining the document that have allowed to obtain the collection of botanical material, granted by ICMBio Collections, which took place from February to June, 2022.

After each collection excursion, the botanical materials were sent to Laboratory on the campus of the Federal University of Rondônia, located at Rua da Paz, 4376, Lino Alves Teixeira neighborhood, in the city of Presidente Médici. In the laboratory, each specimen was processed following the conventional standards for specimens preparation in accordance with CRI, FLOR and HUNI instructions. Subsequently, the taxonomic determination of each specimen was carried out by specialists from RON, databases, especially from Flora do Brasil/REFLORA and a specialized literature review.

Results

With the survey carried out with representatives linked to the aquaculture activity, from 20 municipalities in Rondônia State that stand out for their fish production, plus field trips, it was possible to list 54 plant genetic resources (38 determined taxonomically at the species level, and 16 of genus), distributed in 49 genera and 30 families of Angiospermae, recognized for their antiparasitic and/or antimicrobial properties, or with potential botanical characteristics. Among these 54 RFG, collection was carried out to obtain extracts and subsequent evaluations – phytochemical and cytotoxicity tests (see table 1).

Among the 30 botanical families, the ones with the highest number of genera/species represented are Asteraceae (five); Euphorbiaceae (four); Amarylidaceae, Cucurbitaceae, Fabaceae, Lamiaceae, Solanaceae and Verbenaceae (three); Bignoniaceae, Amaranthaceae, Dilleniaceae and Rubiaceae (two) and, finally, the other families with one each (see table 2). Table 2 shows the absolute and relative frequencies of such families.

Discussion

According to Cunha [16], phytotherapy is a therapeutic modality that uses medicinal plants in the prevention or treatment of fish diseases. In view of this, the phytotherapeutic potential for the treatment of parasites in fish has been a frequent target of research, since the excessive use of chemical products in aquaculture activity may cause considerable damage to the environment and animals. This survey of plant genetic resources potentially active in the control of animal parasites and diseases, is a pioneering investigative work in the state of Rondônia, representing a significant advance in the knowledge of these species and their by-products, with bioprospecting being a strategy to conserve them. This, associated with phytochemical prospecting in search of alternative products that make viable a fish farming in Rondônia State.

Table 1 Plants of the Rondônia State flora (54; 38 determined at the species level, 16 at the genus level), distributed in 49 genera and 30 botanical families, and their possible origin (I=introduced; N=native), with supposed antiparasitic properties for use in fish

Vernacular/local name	Scientific name	Family	Origin
Abóbora	*Cucurbita* sp.	Cucurbitaceae	I
Alfazema-cabocla	*Aloysia gratíssima*	Verbenaceae	I
Algodão-do-campo	*Cochlospermum regium*	Bixaceae	N
Alho	*Allium sativum*	Amaryllidaceae	I
Bananeira	*Musa* sp.	Musaceae	I
Beldroega	*Portulaca oleracea*	Portulacaceae	I
Calêndula	*Calendula officinalis*	Asteraceae	I
Camu-camu	*Myrciaria dúbia*	Myrtaceae	N
Capim-limão	*Cymbopogon citratus*	Poaceae	I
Casca-peruana	*Cinchona succirubra*	Rubiaceae	N
Cassia	*Cassia* sp.	Fabaceae	N
Castanhola	*Terminalia catappa*	Combretaceae	I
Cebola	*Allium cepa*	Amaryllidaceae	I
Cebolinha	*Allium fistulosum*	Amaryllidaceae	I
Cipó-alho	*Mansoa alliacea*	Bignoniaceae	N
Cipó-de-fogo	*Davilla* sp. *1*	Dilleniaceae	N
Cipó-de-fogo	*Davilla* sp. *2*	Dilleniaceae	N
Cipó-de-são-joão	*Pirostegia venusta*	Bignoniaceae	N
Crajiru	*Arrabidaea chica*	Bignoniaceae	N
Cravo de urubu	*Heliotropum* cf. *indicum*	Boraginaceae	N
Cróton	*Croton* sp.	Euphorbiaceae	N
Dedo-de-anjo	*Euphorbia* sp.	Euphorbiaceae	N
Duranta	*Duranta* sp.	Verbenaceae	N
Erva-de-santa-maria	*Chenopodium ambrosioides*	Amaranthaceae	I
Girassol mexicano	*Thitonia diversifolia*	Asteraceae	I
Graviola	*Annona muricata*	Annonaceae	I
Guanxuma	*Sidrastum* sp.	Malvaceae	N
Joá	*Solanum aculeatissimum*	Solanaceae	N
Juá	*Ziziphus* cf. *joazeiro*	Rhamnaceae	N
Hortelã-pimenta	*Mentha piperita*	Lamiaceae	I
Lantana	*Lantana* sp.	Verbenaceae	N
Lobeira	*Solanum lycocarpum*	Solanaceae	N
Losna	*Artemisia absinthium*	Asteraceae	I
Mamão	*Carica papaya*	Caricaceae	I
Mamoninha-do-campo	*Mabea* sp.	Euphorbiaceae	N

Table 1 Continuation

Vernacular/local name	Scientific name	Family	Origin
Mandioca	*Manihot esculenta*	Euphorbiaceae	N
Maraca	*Crotalaria* cf. *micans*	Fabaceae	N
Maracujá-do-mato	*Passiflora foetida*	Passifloraceae	N
Margaridinha	*Tridax* cf. *procumbens*	Asteraceae	N
Tingui, timbó	*Mascagnia* sp.	Malpighiaceae	N
Melão-de-são-caetano	*Momordica charantia*	Cucurbitaceae	I
Mentrasto	*Hyptis* sp. 1	Lamiaceae	N
Mentrasto	*Hyptis* sp. 2	Lamiaceae	N
Mussambé	*Cleome* sp.	Cleomaceae	N
Neem	*Azadirachta* cf. *indica*	Meliaceae	I
Pau-tenente	*Quassia amara*	Simaroubaceae	N
Pepino	*Cucumis sativus*	Cucurbitaceae	I
Pimenta	*Capsicum chinense*	Solanaceae	N
Romã	*Punica granatum*	Lythraceae	I
Sene	*Senna* sp.	Fabaceae	I
Tanaceto	*Tanacetum vulgare*	Asteraceae	N
Terramicina	*Alternanthera brasiliana*	Amaranthaceae	N
Unha-de-gato	*Uncaria tomentosa*	Rubiaceae	N
Uxi amarelo	*Endopleura uchi*	Humiriceae	N

Table 2 Botanical families of the Rondônia State flora of cataloged with the absolute and relative frequencies of their species, with supposed antiparasitic properties for use in fish

Botanical families	Absolute frequency of cataloged species	Relative frequency (%)
Asteraceae	5	9.3
Euphorbiaceae	4	7.4
Amaryllidaceae, Bignoniaceae, Cucurbitaceae, Fabaceae, Lamiaceae, Solanaceae, Verbenaceae	3 (each) = 21	38.9
Amaranthaceae, Dilleniaceae, Rubiaceae, Annonaceae, Bixaceae, Boraginaceae, Caricaceae, Cleomaceae, Combretaceae, Humiriceae, Lythraceae, Malpighiaceae, Malvaceae, Meliaceae, Myrtaceae, Musaceae, Passifloraceae, Poaceae, Portulacaceae	2 (each) = 6	11.1
Rhamnaceae, Simaroubaceae	1 (cada) = 18	33.3
Total	**54**	**100.0**

When considering the cataloged 30 botanical families of the Rondônia State flora with the absolute and relative frequencies of their species, Asteraceae and Euphorbiaceae stand out, with five and four species, respectively. They follow, represented by three species each, Amaryllidaceae, Bignoniaceae, Cucurbitaceae, Fabaceae, Lamiaceae, Solanaceae, Verbenaceae. It is worth mentioning that families such as Lamiaceae, Verbenaceae and Amaryllidaceae, are recognized for their medicinal properties, with morphophysiological and sensory traits that corroborate such potential. Amaranthaceae, Dilleniaceae and Rubiaceae, each of them, presented two species, while the other families had only one species. Some of these families are mentioned for the first time, with potential effects on the prevention of parasites. Among the 54 species listed in the present study, most are considered native or originating from the “Amazon Forest” or “Amazon biome”; others introduced, although some may occupy the “naturalized” category, such as the herb of Santa Maria (*Chenopodium ambrosioides*), the purslane (*Portulaca oleracea* L.) and the melon of São Caetano (*Momordica charantia* L.), because they are abundant in different Brazilian regions. It should be emphasized that, among native species, the State of Rondônia is considered a center of origin and diversity of species representing the genera Manihot and Capsicum. It is also important to highlight the diversity of species recorded in terms of life form or growth habit, from herbaceous, shrubby, arboreal, to vine or liana (climber).

According to BFG [17], (2015)17, 11,896 angiosperms were recorded in the Amazon biome, of which 1900 are endemic (16.1%). Of these, in the State of Rondônia, 3290 angiosperms were registered, 41 of which are endemic (1.2%). If we consider that in 2010 the total record for the biome was equal to 11349 and 1918 (17.2%) endemic, and for the State in that same year 2,544 and 47 (1.8%), respectively [17], it is concluded that in just five years, there was a decreased genetic resources and therefore, a reduction in the genetic and sociocultural heritage, which shows the relevance and importance of knowing, valuing and conserving biodiversity as a public good for present and future generations, on which principle is based sustainable development.

Conclusion

Several genetic resources of the Rondônia State flora have the potential to be used in the control of animal parasites, constituting a viable alternative from an environmental, economic and social point of view. Bioprospecting and sustainable use, constitute a conservation strategy for such genetic resources.

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Consent for publication

The authors read and approved the final manuscript.

Competing interest

The authors declare no conflict of interest. This document only reflects their point of view and not that of the institution to which they belong.

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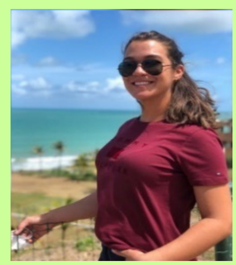

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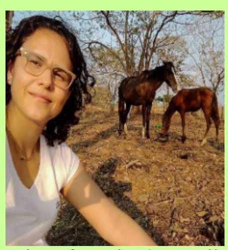

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