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Study of the Bionomy and the Therapeutic Potential of a Substance Obtained from Spider Venom (Arthropoda: Araneae)

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Abstract: Venom is present in most spiders in the world, only two groups of venomous spiders are known and their chemical composition varies greatly between species. The vast majority have venom that is not very toxic to the human body, as is the case with crabs. However, the venom of other spiders affects humans more seriously. This manuscript aims to verify the bionomics of spiders and their therapeutic potential (Arthropoda: Araneae). Regarding the type of research source, As for the type of research source, it was worked with scientific articles published in national and international magazines. This type of production is commonly the most valued in all bibliographic production and is the easiest to access. Access to articles was through virtual libraries such as SciELO, the University of São Paulo, Latin American Literature, and the University of Brasília. This library has a specific section for Hymenoptera, with journals and article texts available in full. Considering only this section constitutes a limitation of the study since articles belonging to journals that are part of other sections of the electronic library could also contribute to the discussion of the production of knowledge. However, in principle, within these articles, there could not necessarily be a discussion focused on biology, ecology, and taxonomy.

Keywords: Diseases, Polyamine, Molecules, Toxins, Poison.

RESEARCH PAPER

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1. INTRODUCTION

Spiders are arthropods, with a body divided into a cephalothorax and abdomen, eight legs, two pedipalps, and no antennae. All spiders produce silk, but not all spiders produce webs. Webs can be used to capture food. Spiders are carnivorous animals. All spiders produce venom, but not all cause accidents (Chaim, 2011; Branco and Cardoso, 2020; Biernath, 2024; Coelho and Nishida, 2024; Robert, 2024; Silva, 2024).

The chelicerae, in general, are hook-shaped and very tapered. They are associated with the poison glands used by the animal to capture its prey. Spiders use pedipalps for defense, reproduction, feeding, and sensitivity. In most spiders, breathing occurs through structures known as foliaceous lungs. Spiders are carnivorous animals, that is, they feed on other animals. To feed, they place digestive juices on their prey and, later, absorb the broth that forms. In addition to sucking this liquid, some spiders can eat small pieces of their prey (Figure 1) (Chaim, 2011; Benhadi-Marin *et al.*, 2013; Aguilera *et al*., 2019; Branco and Cardoso, 2020; Robert and Thomas, 2022; Biernath, 2024; Coelho and Nishida, 2024; Robert, 2024; Silva, 2024).

1.1. "Poisonous Spiders Funnel Web Spider"

Two spiders are the main candidates for the title of most venomous spider in the world: spiders of the genus *Phoneutria* Perty, 1833 (Araneae: Ctenidae) and funnel web spiders, among which are the Sydney funnel-web spiders *Atrax robustus* Simon, 1892 (Araneae: Hexathelidae). Funnel-web spiders are aggressive and have very dangerous venom for humans. The toxin against monkeys, which, like humans, are very sensitive to funnel web spider venom, as little as 5 micrograms per kilogram of body weight produced significant effects and as little as 30 micrograms per kilogram of body weight was enough to be fatal (Figure 2) (Chaim, 2011; Aguilera *et al.*, 2019; Branco and Cardoso, 2020; Biernath, 2024; Coelho and Nishida, 2024; Robert, 2024; Silva, 2024).

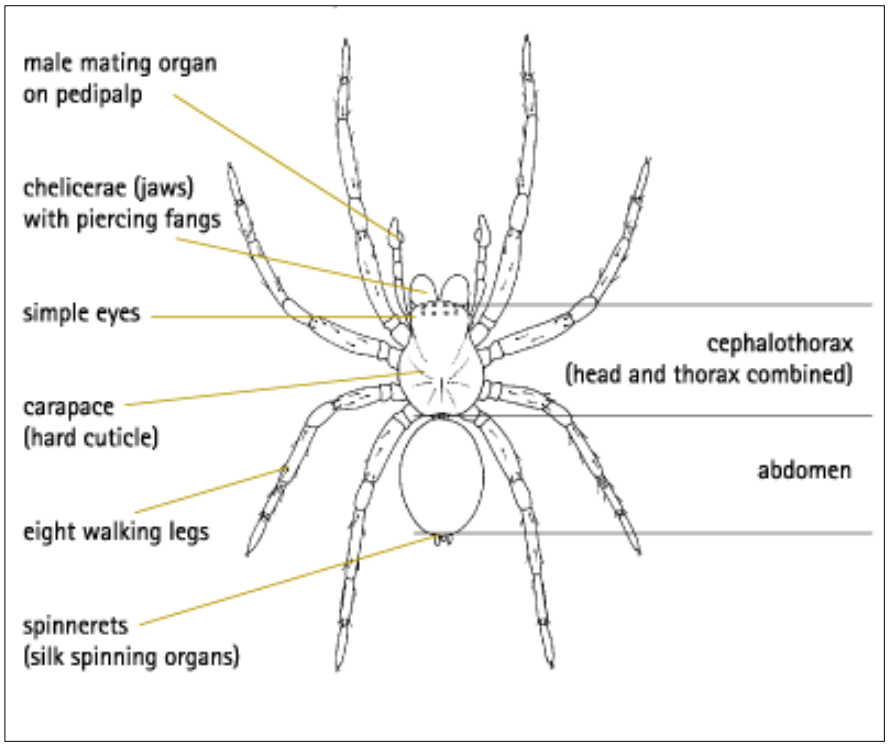

Figure 1: Male spider. https://spectrumpestmanagement.com/spider1.s.html.

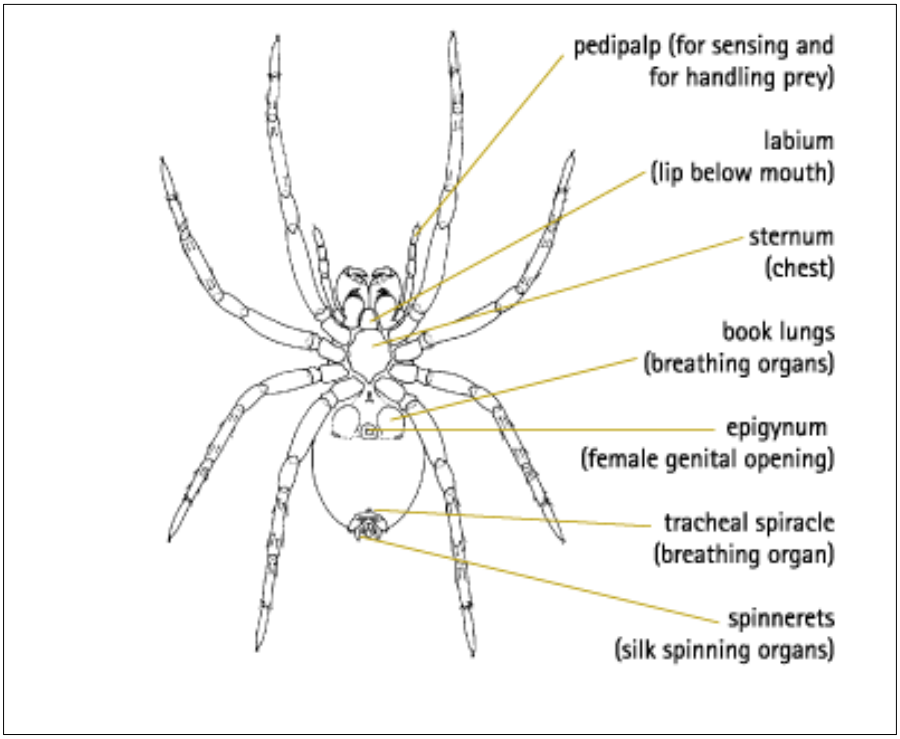

Figure 2: Female spider. Source: https://spectrumpestmanagement.com/spiders.html

1.2. "Mouse Spiders"

Mouse spiders *Missulena* sp. They have very toxic venom and are often confused with funnel web spiders. Although mouse spider bites do not occur frequently, some have caused serious effects in humans, triggering symptoms like funnel web spider poisoning (Chaim, 2011; Branco and Cardoso, 2020; Biernath, 2024; Coelho and Nishida, 2024; Robert, 2024; Silva, 2024).

1.3. "Sand Spiders"

Sand spiders belong to the genus *Sicarius* Walckenaer, 1847, and are known for their habit of hiding in the sand. They have venom like that of the brown spider's genus *Loxosceles* Heineken & Lowe,

1832, however, they pose less danger as they generally live in areas away from human contact (Chaim, 2011; Benhadi-Marin *et al.*, 2013; Aguilera *et al.*, 2019; Branco and Cardoso, 2020; Biernath, 2024; Coelho and Nishida, 2024; Robert, 2024; Silva, 2024).

1.4. "Australian Black Widow"

The Australian black widow *Latrodectus hasselti* Thorell, 1870, is a hazardous species and has a bite that can even cause death. The venom acts directly on the nerves and more than 250 cases receive antivenom each year (Benhadi-Marin *et al.*, 2013; Aguilera *et al*., 2019).

1.5. "Violin Spider"

Loxosceles reclusa (Gertsch & Mulaik, 1940), is an aggressive species and its venom in large quantities can kill a person. To give you an idea, just 0.006 mg of its poison is enough to kill a rat. Cases of people dying from spider venom have been reported, including in Brazil. Currently, there is already an antidote against the venom of this very dangerous spider. Several species of armored spiders are found in South America. In Brazil, it is one of the spiders that causes the most accidents. (Chaim, 2011; Benhadi-Marin *et al.*, 2013; Aguilera *et al*., 2019; Branco and Cardoso, 2020; Biernath, 2024; Coelho and Nishida, 2024; Robert, 2024; Silva, 2024).

1.6. "The Brown Spider"

It is not aggressive, but its venom can kill. The brown spider belongs to the genus *Loxosceles* Heineken & Lowe, 1832 (Araneae: Sicariidae), of which eight species occur in Brazil. Sometimes a brown spider bite can go unnoticed until changes are noticed in the affected area, such as wounds, swelling, redness, and blisters. Necrosis may occur at the site of the bite and tissue death. Despite not being an aggressive spider, cases of accidents with humans have already been reported. The most common thing is to be surprised by the presence of the spider in a domestic environment, where it is found inside shoes or mixed in with bedding (Figure 3) (Biernath, 2024; Coelho and Nishida, 2024; Instituto Vital Brasil, 2024; Robert, 2024; Silva, 2024).

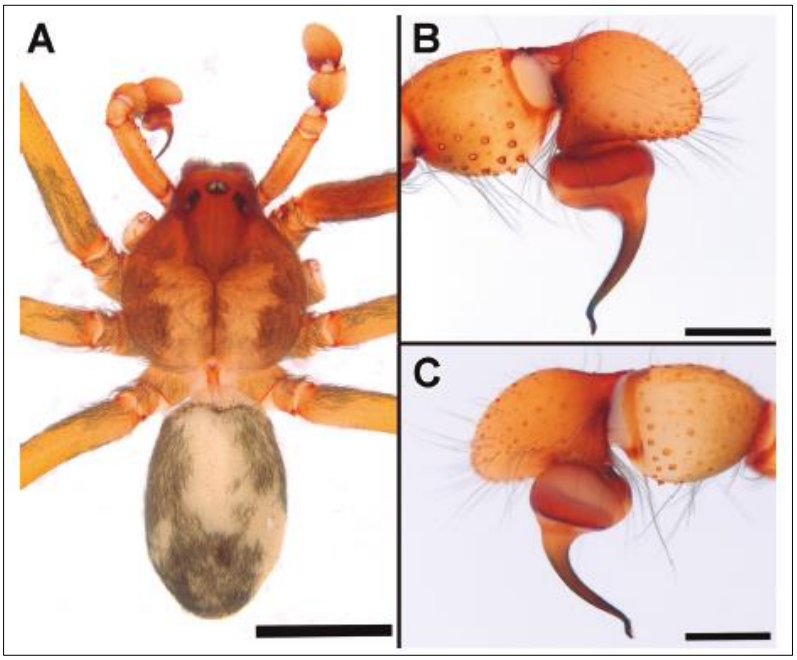

Figure 3: ***Loxosceles* Heineken & Lowe, 1832 (Araneae: Sicariidae). (A) habitus; (B) palp, retrolateral view; (C) palp, prolateral view. Scale bars: A, 3 mm; B-C, 2 mm. Source: https://www.scielo.br/j/paz/a/mzGdHLqMVvRgvS3VCm466Pd/?lang=en#ModalFigf1**

1.7. The "Black Widow"

The *Latrodectus curacaviensis*. (Müller, 1776) (Araneae: Theridiidae) is a small and shy spider measuring around one centimeter, with long and fragile legs. Its color is metallic black, with a rounded abdomen and several bright red designs, sometimes decorated with thin white lines. Its web is made up of a network of disordered threads, in which it remains facing downwards, capturing its food. When knocked down, the spider pretends to be dead or tries to escape, dragging its heavy abdomen; however, when disturbed excessively or pressed against the body for example, inside clothes, or on sheets during sleep, it can sting relatively easily. "Black widow" venom is very toxic to humans. It attacks the nervous system, causing very intense muscle pain, nausea, headache, and cardio-respiratory changes, being more serious in children and can cause fatal accidents in sensitive people (Figure 4) (Chaim, 2011; Benhadi-Marin *et al.*, 2013; Aguilera *et al.*, 2019; Branco and Cardoso, 2020; Silva, 2022; Biernath, 2024; Coelho and Nishida, 2024; Instituto Vital Brasil, 2024; Robert, 2024; Silva, 2024).

Figure 4: *Latrodectus curacaviensis* (Müller, 1776) (Araneae: Theridiidae). Source: https://arachnoboards.com/gallery/latrodectus-curacaviensis.70544/

They are found in roadside ravines, under coconut shells or dry leaves, empty cans in coastal sandbanks, they are very abundant in the vegetation known as salsas having been considered a public health pest in Niterói during the 1960s. Although abundant on the coast, these spiders were also captured in the interior of Rio de Janeiro, Minas Gerais, Goiás, São Paulo, and Rio Grande do Sul (Biernath, 2024; Coelho and Nishida, 2024).

1.8. "Brown Spider"

Genus *Loxosceles* are very small spiders: no more than 4 cm in wingspan. They live in dark and dry environments where they weave irregular webs, very similar to cotton lint, in which they capture their food composed of insects such as flies, beetles, and cockroaches in nature, brown spiders are found under tree bark, under rocks, and inside caves. In cities, these animals proliferate inside human homes, where they create webs behind furniture, pictures, piles of wood, and construction material. They are very shy spiders and have nocturnal habits. Accidents occur when they are pressed against the body inside clothes, towels, and bedding (Figure 5) (Aguilera *et al*., 2019; Branco and Cardoso, 2020; Silva, 2022; Biernath, 2024; Coelho and Nishida, 2024; Robert, 2024; Silva, 2024).

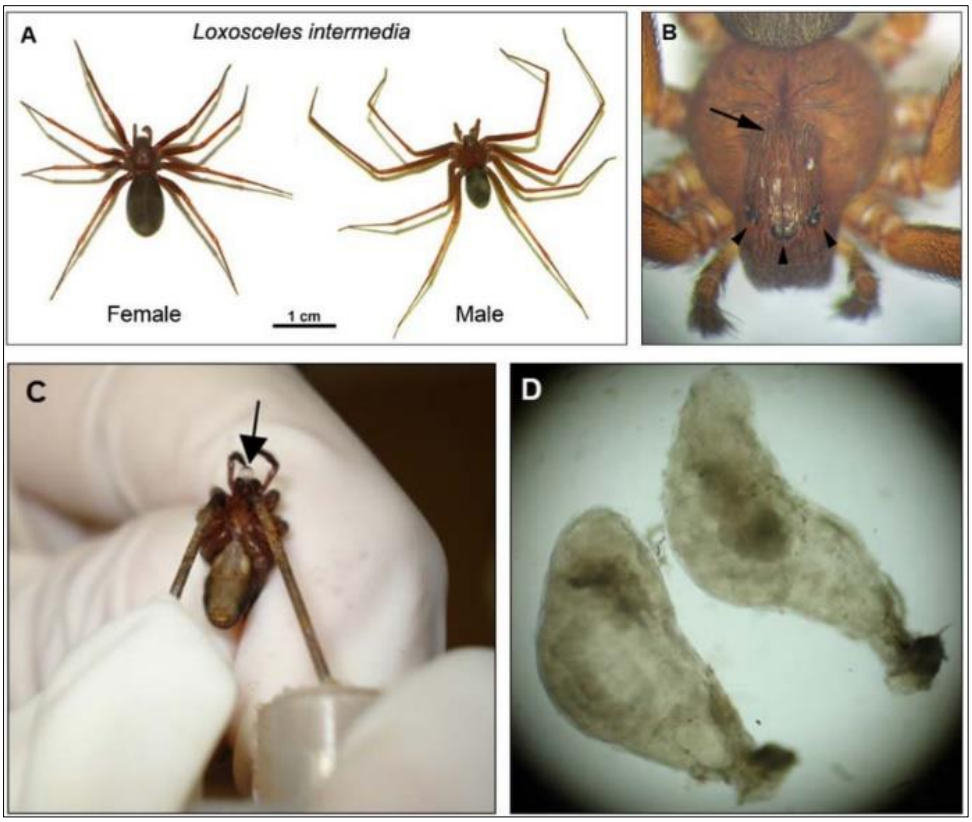

Figure 5: Brown spider aspects. (A) *Loxosceles intermedia* Mello-Leitão (1934) (Araneae: Sicariidae) adult specimens—female and male. (B) Violin-shaped pattern (arrow) on the dorsal surface of the cephalothorax from *L. intermedia* adult spider, and its six eyes arranged in pairs as a semi-circle (arrowheads). (C) Venom harvesting by electric shock applied to the cephalothorax. Arrow points for a drop of *L. intermedia* venom. Briefly, venom is extracted using an electric shock of 15 V applied to the cephalothorax of the spider, and the venom from the tips of the fang is collected and diluted in phosphate-buffered saline (PBS) or dried and stored at -80º C until use. (D) Brown spider venom glands of *L. intermedia* observed by stereo dissecting microscope (40X). Venom can be harvested directly from venom glands: The removed glands are washed in PBS and the venom is obtained by gentle compression of the glands. Source: https://www.mdpi.com/2072-6651/3/3/309

1.9. *Lycosa erythrognatha* Lucas, 1833 (Araneae: Lycosidae)

In Brazil, the name tarantula is attributed to a spider whose venom has low toxicity and is also known as the "garden spider". Garden spiders are easily identified by the black, arrow-shaped spot on their abdomen. The body is covered with few hairs and is not robust. When adults, they measure approximately 6 cm in length (Figure 6) (Bertani *et al*., 2000; Branco and Cardoso, 2020; Biernath, 2024; Coelho and Nishida, 2024; Robert, 2024; Silva, 2024).

Figure 6: *Lycosa erythrognatha* Lucas, 1833 (Araneae: Lycosidae). Source: Photo 2123651, (c) Nicolas Olejnik, some rights reserved (CC BY-NC), uploaded by Nicolas Olejnik

1.10. *Grammostola* Simon, 1892

The "crabs" are robust and hairy. These spiders can reach an average of up to 22 cm in length. It has a densely hairy body. The crab venom, useful in catching their prey, is of no medical interest. The problem with crabs is the stinging hairs on their abdomen. When it feels threatened, it "slams" its hind legs against its abdomen and releases its hair, which if inhaled, can cause a respiratory allergy (Figure 7) (Branco and Cardoso, 2020; Biernath, 2024; Coelho and Nishida, 2024).

Figure 7: *Grammostola* Simon, 1892
Source: https://www.megacurioso.com.br/animais/59857-5-fatos-sobre-a-vida-de-uma-tarantula-que-talvez-voce-desconheca.htm

1.11. Diseases Caused by Spiders

Although many spiders are harmless as mentioned above, some species can cause a series of problems for humans, mainly allergic skin reactions. In more critical cases, anaphylactic shock and dermatitis may occur. If you observe any of these behaviors, seek medical assistance (Lubin, 1978; Van der Hammen, 1983; Jocqué *et al*., 2005; Benamú, 2013; Ferraz and Cupo, 2024).

1.12. Keep Spiders Away from Your Home

The first sign that there are spiders in your home is the formation of webs. Keep an eye. - Keep yards and gardens clean and avoid accumulating objects that attract spiders, such as dry leaves. - If you live in a wooded area, close doors, and windows at dusk, as it is after the sun sets that spiders leave their homes. - Pay attention to whether any work is carried out near you or whether there are vacant lots. These places are suitable for spiders. - Seal windows and door sills to prevent spiders from entering. - When handling objects in your home that have been stored for a long time, check for spiders. - Before putting on clothes, check if there are spiders or other insects inside the clothes. - Find out more about the product that will keep spiders out of your home (Lubin, 1978; Van der Hammen, 1983; Jocqué, *et. al*., 2005; Benamú, 2013; Ferraz and Cupo, 2024).

1.13. OBJECTIVE: This manuscript aims to verify the bionomics of spiders and their therapeutic potential (Arthropoda: Araneae).

2.0. METHODS

This manuscript aims to verify the bionomics of spiders and their therapeutic potential (Arthropoda: Araneae). As for the type of research source, it was worked with scientific articles published in national and international magazines scientific articles published in national and international journals. This type of production is commonly the most valued in all bibliographic production and is the easiest to access. Access to articles was through virtual libraries such as SciELO, the University of São Paulo, Latin American Literature, and the University of Brasília. This library has a specific section for Hymenoptera, with journals and article texts available in full. Considering only this section constitutes a limitation of the study since articles belonging to journals that are part of other sections of the electronic library could also contribute to the discussion of the production of knowledge. However, in principle, within these articles, there could not necessarily be a discussion focused on biology, ecology, and taxonomy.

3. SELECTED STUDIES

3.1. The Use of Recombinant Mutated FLDs as Immunogens

Loxoscelism is a necrotic-hemolytic syndrome caused by the bite of a brown spider, which, in rare cases, can lead to death. *Loxosceles* venom is made up of a complex mixture of toxins and is rich in proteins, enzymes, and peptides. Among these enzymes, phospholipases-D (FLD), or dermo necrotic toxins, stand out; Alone they can experimentally reproduce most of the symptoms of loxoscelism (Bode *et al*., 2001; Novak, 2001; Heinen and Veiga, 2011; Nyffeler and Dries, 2020; Fioratti and Rufino, 2024; Instituto Vital Brasil, 2024; Polli, 2024).

The use of recombinant mutated FLDs as immunogens for a vaccine compound capable of protecting rabbits and mice against the venom of *Loxosceles* species. The recombinant mutated proteins chosen as antigens for the vaccine formulation (Y228A *Loxosceles gaucho* Gertsch, 1967 and H12A/H47A *Loxosceles laeta* (Nicolet, 1849) showed high immunogenic potential, loss of sphingomyelinase activity, and the ability to develop dermo necrotic. Next, tests were carried out to evaluate the protective effect promoted by these antigens against loxoscelic venom (Novak, 2001; Heinen and Veiga, 2011; Nyffeler and Dries, 2020; Silva, 2022; Fioratti and Rufino, 2024; Polli, 2024).

The venom is extremely toxic to the human body, and the bite site may present blisters; swelling; an increase in temperature, and hemorrhagic lesions, with or without burning pain. The absence of pain means that the injured person takes a long time to seek medical help, which can complicate treatment. After a few days, the bite area presents necrosis, leaving an ulcer that is difficult to heal (Figure 8) (Heinen and Veiga, 2011; Candek *et al.*, 2019; Nyffeler and Dries, 2020; Fioratti and Rufino, 2024; Polli, 2024).

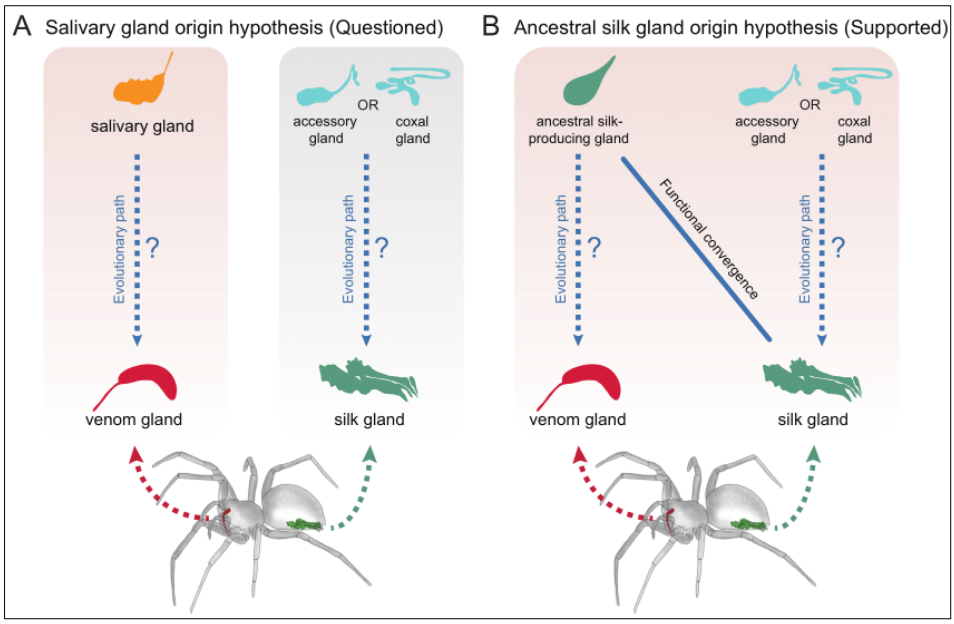

Figure 8: Hypotheses regarding the evolutionary derivation of spider venom glands. a Salivary gland origin hypothesis. We challenge this hypothesis based on the comparison results of module preservation, GO semantic similarity, and DUG similarity analyses. Ancestral silk gland origin hypothesis. Our analyses prefer to support the concept that venom glands are likely derived from silk-producing glands present in early chelicerates. Previous assumptions were that spider silk glands evolved from accessory glands or were derived from coxal glands. Modern spider silk glands may generate functional convergence with ancestral silk-producing glands, in turn resulting in high transcriptional similarities between spider venom glands and silk glands. Source: https://www.researchgate.net/figure/Hypotheses-regarding-the-evolutionary-derivation-of-spider-venom-glands-a-Salivary-gland_fig2_370001504

Other changes that may appear in the event of brown spiders are high fever in the first 24 hours, headache; generalized itching; muscle pain; nausea; vomiting; blurred vision; diarrhea; somnolence; irritability, and, in severe cases, coma. In a certain number of accidents, complications may occur due to the action of the poison on blood cells, causing anemia, bruising, and bloody urine, which can lead to acute kidney failure and death. Venom is present in most spiders worldwide; only two groups of spiders without venom are known, and their chemical composition varies greatly between species. The vast majority have venom that is not very toxic to the human body, such as crabs. However, the poison of others affects humans more seriously. When they feel threatened, spiders bite to defend themselves (Coddington and Levi, 1991; Heinen and Veiga, 2011; Nyffeler and Dries, 2020; Fioratti and Rufino, 2024; Polli, 2024).

3.2. The Therapeutic Potential of a Substance Obtained from Spider Venom- Oncology Medicine

The therapeutic potential of a substance obtained from spider vein São Paulo evaluates the therapeutic potential of a substance obtained from *Vitalius wacketi* (Mello-Leitão, 1923 (Araneae: Theraphosidae), a spider that inhabits the coast of São Paulo. The candidate for an oncology medicine, however, is not made directly from the venom: the molecules were isolated, purified, and synthesized in the laboratory, using techniques developed and patented by Brazilian experts. In initial research, the molecule under test showed promise in combating leukemia, the tumor type affecting some blood cells themselves (Coddington and Levi, 1991; Heinen and Veiga, 2011; Nyffeler and Dries, 2020; Fioratti and Rufino, 2024; Polli, 2024).

3.3. Neuromuscular Activity was found in The Venom of Spiders of the Genus *Vitalius* Lucas, Silva & Bertani, 1993. The Toxin Responsible for this Effect was A Large and Unstable Polyamine

The polyamines mentioned by the researcher are molecules present in the organisms of plants, animals, and microorganisms. It was possible to synthesize it, and an identical chemical version was created, without the need to extract it directly from the spider substance that underwent in vitro tests. On the laboratory bench, it was placed next to cancer cells, to see what action it would have. This is because the drug candidate caused the death of cancer cells through a process called apoptosis generally, more traditional oncological treatments cause necrosis (Figure 9) (Coddington and Levi, 1991; Novak, 2001; Fioratti and Rufino, 2024; Polli, 2024; Robert *et al*., 2024; Rodrigues, 2024; Silva *et al*., 2024).

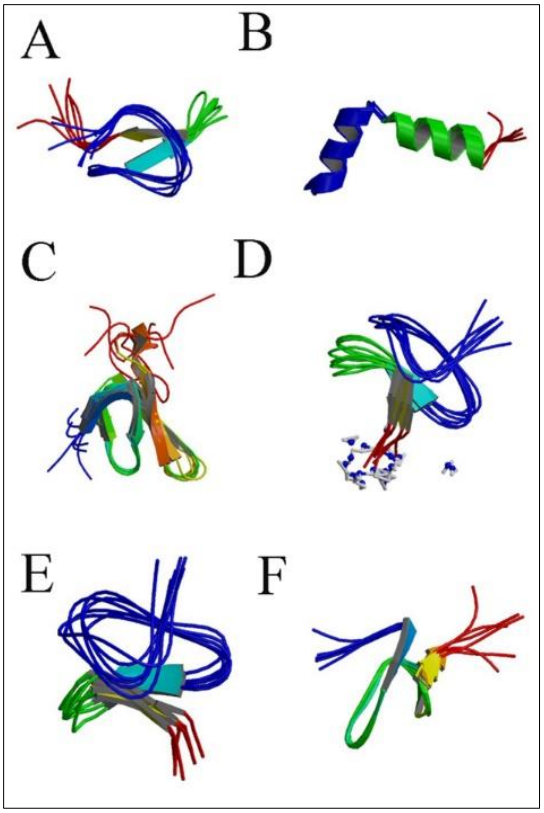

Figure 9: Antitumor peptides from spider venom. The 3D structure of spider venom peptides. (A), PcTx1(Psalmotoxin1, PDB ID: 1LMM); (B), Latarcin 2a (PDB ID: 2G9P); (C), ω-agatoxin-IVA (PDB ID: 1IVA); (D), HNTX-IV (Hainantoxin-IV, PDB ID: 1RYG); (E), HWTX-IV (Huwentoxin-IV, PDB ID: 1MB6); (F), ProTx-II (PDB ID: 2N9T). Source: doi: 10.1590/1678-9199-JVATITD-14-63-18. PMID: 31210759; PMCID: PMC6551028

In apoptosis, the immune system acts on the collapse of these cells and this generates a much more controlled reaction, without major impacts on other organs and tissues. There are even therapeutic options capable of causing apoptosis in cancer cells this is the case with monoclonal antibodies. However, these drugs are more difficult to produce and tend to have a high price. The molecule developed from spider venom is synthetic, which facilitates manufacturing and reduces costs. It has some physicochemical characteristics that make it easier for it to remain in the blood and then be easily excreted by the kidneys. It also presented some strategic advantages when compared to currently available methods to treat this disease, such as chemotherapy (Figure 10) (Coddington and Levi, 1991; Novak, 2001; Wang *et al*., 2014; Nyffeler and Dries, 2020; Fioratti and Rufino, 2024; Polli, 2024; Robert *et al*., 2024; Rodrigues, 2024; Silva *et al*., 2024; Wu *et al*., 2024).

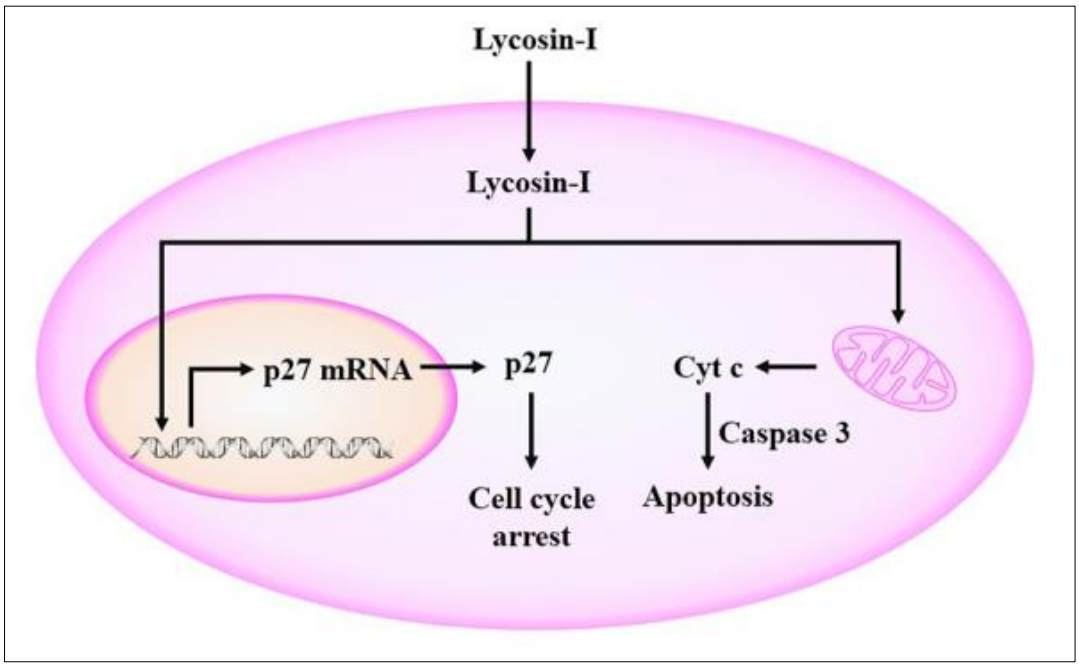

Figure 10: The anti-tumor mechanism of Lycosin-I. Lycosin-I penetrates cytoplasm and upregulates p27 mRNA and protein expression to inhibit the cell cycle. Lycosin-I can bind with the mitochondria membrane and promote a mitochondria-mediated death pathway to induce tumor cell apoptosis. Cyt c: cytochrome c. Source:). Source: doi: 10.1590/1678-9199-JVATITD-14-63-18. PMID: 31210759; PMCID: PMC6551028

3.4. The therapeutic potential of a substance obtained from spider venom. Sexual impotence.

***Phoneutria nigriventer* (Keyserling, 1891) (Araneae: Ctenidae)**

Popularly known as banana spider or armadeira. This spider toxin, identified as dangerous, could result in a new medicine. In seeking to understand, from a pharmacological point of view, the mechanisms that generate priapism caused by armored spider venom, in the study. The toxin was developed in the laboratory into a synthetic molecule with promising properties for the development of an innovative and safe substance to treat sexual impotence. To date, the peptide, called BZ371A, has already generated 22 international patents and nine applied (Coddington and Levi, 1991; Novak, 2001; Pinheiro, 2007; Souza, 2013; Wang *et al*., 2014; Januzzi, 2023).

3.5. The Therapeutic Potential of a Substance Obtained from Spider Venom – Analgesic

In the future, transform the poison of *P. nigrivente* into a pain medicine. The therapeutic activity of the spider venom toxin PnTx3-5. The venom functionally inhibits the TRPV1 receptor. The term TRP defines a subfamily of transient receptors that are activated by changes in ambient temperature, from intense cold to excessive heat. Dysfunction of these receptors contributes to various pathological states, such as pain resulting from physiological events, which can be divided into acute and chronic, inflammatory, and neuropathic (Figure 11) (Coddington and Levi, 1991; Novak, 2001; Pinheiro, 2007; Souza, 2013; Wang *et al*., 2014; Januzzi, 2023).

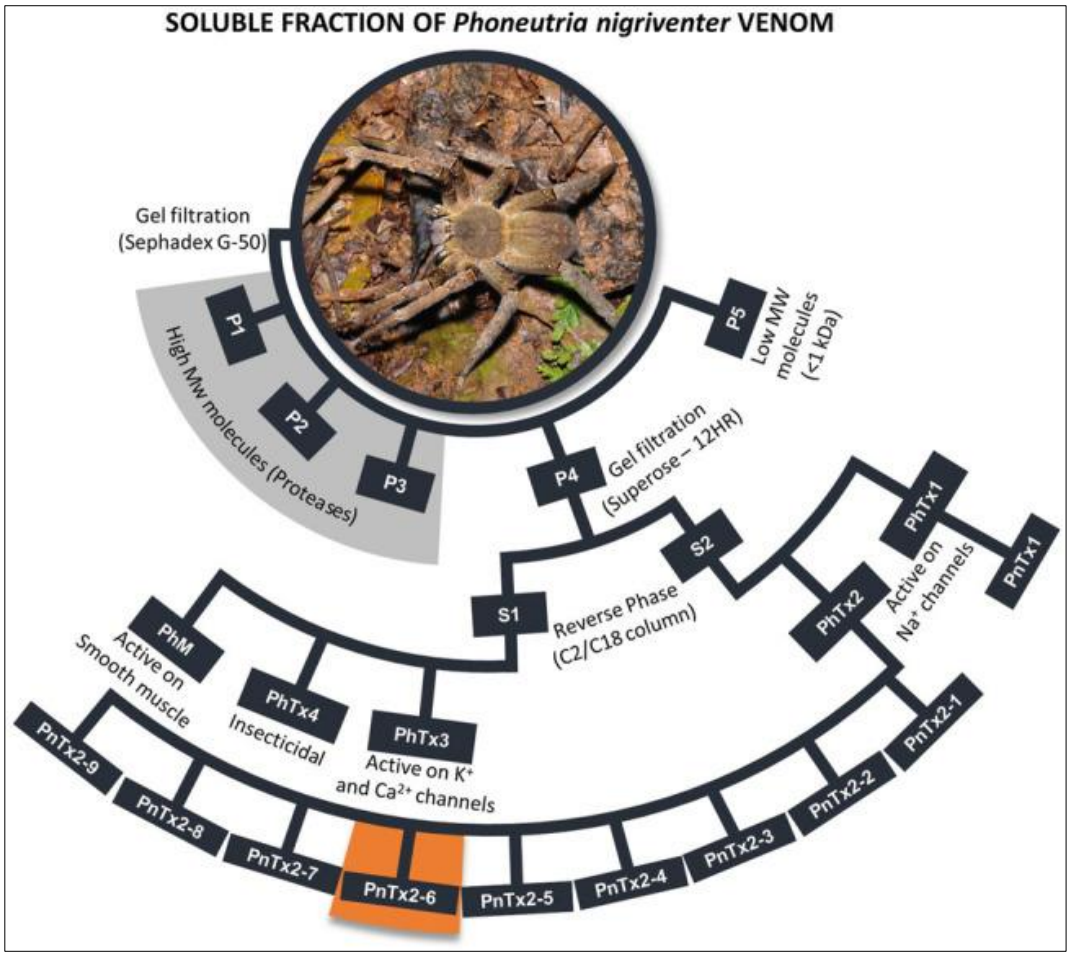

Figure 11: Purification scheme for the venom of the spider *Phoneutria nigriventer* (Keyserling, 1891) (Araneae: Ctenidae). Summarizing the general activities of each fraction. All toxins obtained from the PhTx2 fraction were shown, including PnTx2-6 highlighted in orange. The names of the toxins are presented as in the first purification of the poison. Suggested nomenclature for these toxins can be found in the Arachnoserver database. Source: (https://www.uniprot.org/database/DB-01450), King *et al*., 2008 and Peigneur *et al*., 2018. Photo credit: R. B. Aronson, Florida Tech (United States)

3.6. The Therapeutic Potential of a Substance Obtained from Spider Venom: Extraction of Enzymes Directly from Spider Gastric Material with Possible Biotechnological Applications

In the process, the researchers identified an enzyme called sphingomyelinase D, considered an enzyme exclusive to venoms involved in their toxicity, especially in spiders with necrotizing venoms, such as brown *Loxosceles* spiders. Next, the team analyzed several species of spiders, with and without venom, to try to understand whether they all produced sphingomyelinase D in their digestive systems. Confirming the scientists' hypothesis, the enzyme was there. From this study, the researchers intend to analyze the possibility of extracting enzymes directly from the gastric material of spiders with possible biotechnological applications (Coddington and Levi, 1991; Novak, 2001; Pinheiro, 2007; Souza, 2013; Tan *et al*., 2013; Wang *et al*., 2014; Wu, 2019; Instituto Oswaldo Cruz, 2022; Januzzi, 2023; Samu *et al*., 2023).

3.7. The Therapeutic Potential of a Substance Obtained from Spider Venom - Regulates Blood Pressure and Artificial Bacteria Systems to Synthesize Them in the Laboratory

The poison is a composition of several toxins. The main ones are neurotoxins, which act on the nervous system. The serum is a substance that finds these toxins, binds to them, and prevents them from reaching the target. The serum is a substance that finds these toxins, binds to them, and prevents them from reaching the target. The search for an antibody that identifies the toxin most effectively and quickly. To obtain this substance, the gene from the glands responsible for producing toxins is isolated and used in artificial bacteria systems to synthesize them in the laboratory. The researchers are also working on the possibility of discovering a substance that regulates blood pressure, through the manipulation of toxins that make up the venom and that act on the calcium channel (Coddington and Levi, 1991; Novak, 2001; Reis *et al*., 2018; Wu, 2019; Chassagnon *et al*., 2019; Robert and Thomas, 2022; Januzzi, 2023;

Samu *et al*., 2023; Fioratti and Rufino, 2024; Polli, 2024).

3.8. Spider Venom Controlling Whiteflies

An artificial protein with insecticidal action can be a powerful tool in controlling whiteflies, a pest that attacks crops such as soybeans, cotton, beans, and tomatoes. Develop a protein formulated from the association of two others: one toxic and the other belonging to a begomovirus, a microorganism transmitted by the whitefly itself the artificial protein is obtained by fusing the virus's capsid protein (CP) with a toxic molecule isolated from spider venom. This molecule has a lethal and specific effect on insects if it reaches the insect's hemolymph and central nervous system, causing paralysis. In general terms, the hypothesis is that when the insect ingests the fusion protein, CP transports the toxic molecule from the digestive system to the circulatory system, and from there to the nervous system, where neurotransmitters are blocked that cause spasms in the pest insect until it causes your death (Figure 12) (Coddington and Levi, 1991; Novak, 2001; Reis *et al*., 2018; Wu, 2019; Januzzi, 2023; Samu *et al*., 2023; Fioratti and Rufino, 2024; Instituto Vital Brasil, 2024).

Figure 12: Australia's Blue Mountains funnel-web spider contains the peptide responsible for Vestaron's bioinsecticide. Source: Credit: William Bullimore/Australian Museum

The fusion protein is formulated based on the capsid protein of the begomovirus, a microorganism transmitted exclusively by whiteflies, with the specificity of the toxic action being assumed only for this insect pest. Fusion protein originated from the combination of the venom of a certain species of spider with a substance found in flowers of the Amaryllidaceae family, but at the time the control target was aphids. The effect of this fusion protein on the memory and learning capacity of beneficial and non-target insects, such as bees, was analyzed, concluding that there are no complications for these insects (Figure 13) (Coddington and Levi, 1991; Novak, 2001; Reis *et al*., 2018; Wu, 2019; Nyffeler and Dries, 2020; Januzzi, 2023; Samu *et al*., 2023; Instituto Vital Brasil, 2024).

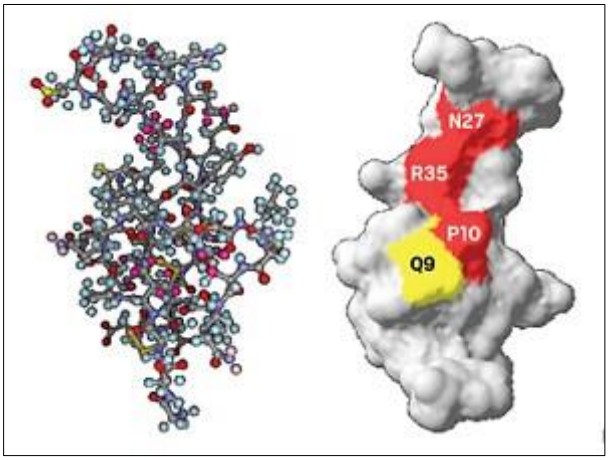

Figure 13: The minor components of spider venom have broad insecticidal activity, but no activity in mammals. The peptide is called GS-omega/kappa-Hxtx-Hv1a. The peptide blocks two ion channels in the insect's nervous system, a voltage-gated calcium channel and a calcium-activated potassium channel. This means growers can use the peptide with other products to prevent the emergence of resistant insects. Source: https://cen.acs.org/articles/95/i11/Spider-venom-insecticide-whose-time.html

4. CONCLUSION

It was analyzed that a diversity of toxins extracted from spider venom proved to be a promising activity. The purification of the molecule was possible thanks to a new chromatography technique developed specifically for polyamines. How these characteristics and abilities appear in Brazilian biodiversity to find these molecules that can help us in the future against a series of diseases.

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