Pharmacognosy Reviews, 2023; 17(34):262-275.
www.phcogrev.com

Review Article

The Brazilian Ethnoveterinary Analyzed by the *One World-One Health*^{TM} Perspective

Ivana Barbosa Suffredini[1,2,*] José Rodrigo de Arruda[1], Catharina Andrade Fróes Serra Toledo Peres Rodrigues[1], Beatriz Regina Rodrigues Carvalho[1], Karla Fernanda Sanches Rodrigues[1], Leoni Villano Bonamin[1]

[1]Graduate Program in Environmental and Experimental Pathology, Vice-Dean Office of Post-Graduation and Research, Paulista University, UNIP, São Paulo, BRAZIL.
[2]Center for Research in Biodiversity, Paulista University, UNIP, São Paulo, BRAZIL.

ABSTRACT

The research and development of herbal medicines used in Veterinary Medicine are still incipient. The present study pursued the status of ethnoveterinary research in Brazil based on a narrative review of the literature. Medicinal plants, animals, and minerals are used to treat companion and production animals in urban and rural areas. In urban areas, using plants to treat infectious diseases and digestive problems in companion animals is frequent. In contrast, plants to treat livestock are accessed to control bacteria involved in cattle mastitis and pathogens involved in hemorrhagic enteritis in small ruminants, such as *Haemonchus* spp. Nonetheless, reports describing the use of animal tissues as fat, animal products as honey, and mineral products were described and commented on. Much has yet to be done in terms of systematizing ethnoveterinary in Brazil so that the therapeutic potential of the fauna and flora of Brazil can be accessed. Brazil has the most extraordinary biodiversity in the world, and it is the country that has enormous potential for the development of medicines obtained from natural sources to be used in veterinary, in addition to human medicine, despite being one of the most significant animal protein exporting countries. The *One World, One Health* concepts are fundamental to support the development of ethnoveterinary, to effectively contribute to building the necessary knowledge to sustain animal welfare, which is essential for the development of a sustainable world based on the preservation of natural resources associated with the promotion of global health.

Keywords: Ethnoveterinary, Medicinal plants, Veterinary phytotherapy, Zootherapy, Mineralotherapy.

Correspondence

Dr. Ivana Barbosa Suffredini
Professor, Center for Research in Biodiversity, UNIP, São Paulo-01310-100, BRAZIL.
Email: ivana.suffredini@docente.unip.br

Received: 01-02-2023;
Revised: 22-02-2023;
Accepted: 16-03-2023.

INTRODUCTION

Since the nineteenth century, it has been known that pathological processes in animals and humans are similar. However, therapeutic procedures have been developed separately depending on the characteristics of each species. During a period spanning from the late nineteenth century and the beginning of the twentieth century, some scholars, including the German physician Dr. Rudolf Virchow, observed the existence of diseases transmissible from animals to humans, such as trichinellosis (*Trichinella spiralis*), which was transmitted from pigs to humans. The term "zoonosis", still used today to define transmissible diseases between animal species, was coined by the same German researcher. During this period, other researchers, such as the Canadian Willian Osler, emphasized the importance of studying animal and human diseases and their inter relationships. After the period of the two World Wars, in the twentieth century, the concept related to epidemics of zoonotic diseases was solidly established, in addition to the idea that the health of animals directly implied public health, in particular with regards to diseases such as rabies, brucellosis, salmonellosis, Q fever, bovine tuberculosis and leptospirosis.[1]

From the point-of-view of epidemiology, the studies related to parasitic zoonotic diseases made by Calvin Schwabe had a fundamental importance in the mid-1960s, when he coined the term *One medicine* in a work in which he proposed that human doctors and veterinarians work together in the fight against these diseases. In 2004, the globalization process was in full swing, and the increase in connections between countries and borders pointed to the fact that the health of animals, humans, and wildlife would be a matter of concern in a globalized world. During this period, the "One World, One Health^{TM}" concepts were established in the document describing the Manhattan Principles.[1]

Cases of avian flu (H5N1) in Southeast Asia and some other countries in 2005 caused alerts worldwide regarding the pandemic danger of zoonoses. In 2008, the fundamentals related

DOI: 10.5530/phrev.2023.17.6

to "*One World, One Health*™" were recommended by more than 120 countries and more than 20 organizations to be incorporated as a strategic basis of public policies, which takes into account the trilogy animal, the human being, and the environment,[1,2] adopted by 71 countries at the International Ministerial Convention on Avian Influenza and Pandemic Influenza, in Hanoi, Vietnam, in 2010. Subsequent conferences approaching the theme of *One Health* were made in later years.

Still in the early 2000s, a new zoonosis emerged in China, whose etiological agent was called severe acute respiratory syndrome coronavirus (SARS-CoV), which infected approximately 8,000 people, of which 700 have died. Ten years later, in 2012, the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) caused a similar syndrome in the Middle East region, when 2,500 cases and 800 deaths.[3] Although these data were frightening at the time and left the world in a state of alert regarding zoonoses, there was no comparison with the recent pandemic caused by the severe acute respiratory syndrome coronavirus, SARS-COV-2, which originated in the city of Wuhan, also in China, whose disease was perpetuated under the name of COVID-19.[4]

By September 2022, this virus had already been responsible for more than 612,236,677 confirmed cases, which include 6,514,397 deaths worldwide, according to the World Health Organization.[5] The zoonotic character of COVID-19 is still under scrutiny.[6,7] However, there are records of the manifestation of the viral infection in domestic animals, wild animals residing in zoos, as well as the transmission of the disease between individuals of the same species,[8] which may characterize these animals as reservoirs of the infection transmission to domestic and wild animals from humans, which can strongly influence the origin of possible variants.[9,10]

The advent of the pandemic taught that the focus on the study of One Health is fundamental and strategic for the consolidation of a healthy future for the coming years. We also have learned that the cost of developing effective tools to combat pandemics is very high and focuses primarily on protecting humans, fundamentally by countries that can afford the purchase of vaccines and supportive drugs. Developing countries are left to depend on the benevolent action of the rich through the free distribution of vaccines for equal access to needy populations, which will be highly operative in 2023.[11]

The study of zoonoses is an excellent example of the importance of animal and environmental health care. Brazil has one of the largest populations of cattle and other production animals, including chickens, goats, sheep, and pigs,[12] and companion animals, particularly dogs, cats, and birds.[13] The growth in the use of herbal medicines among humans is reflected in the demand for these products for veterinary use. The area of science that conducts research aimed at developing phytotherapeutics and zootherapeutics based on observational behavioral studies of animals is called "ethnoveterinary medicine." Ethnoveterinary medicine is defined as the systematic development of science which is based on popular knowledge and beliefs, practices, technologies and resources, social organization, and everything that involves animal health among species created by human beings.[14]

For some decades, the demand for quality herbal products, as well as the rational use of medicinal plants, has grown, which led to the regulation of the pharmaceutical market for this area, as well as the formation of public policies aimed at the prescription and distribution of herbal medicines by the Brazilian Unified Health System (SUS). To offer a legal basis for distributing such medication, the "National Policy for Integrative and Complementary Health Practices" was created to serve the SUS,[15] which included Phytotherapy and 28 other therapeutic practices such as Homeopathy, Acupuncture, Reflexology, Chiropractic, and Traditional Chinese Medicine. In 2008, the National Program of Medicinal and Herbal Medicines, or *Programa Nacional de Plantas Medicinais e Fitorerápicos, RENAME*,[16] was approved. Its objective was to select medicinal plants and include them in the *RENAME*-National List of Essential Medicines, to make possible their free distribution through the SUS in the entire national territory. Based on the prerogatives for human medicine, there is a lack of legal basis for veterinary therapies.

The guidelines for using new veterinary drugs, whether conventional, herbal, zootherapeutic, or even therapeutic tools, are legally established by the Ministry of Agriculture, Livestock and Supply, *MAPA*.[17] It is observed that there is a demand on the part of tutors and breeders for accessible medicines with less risk of adverse effects, such as those originating from plants, animals, and minerals, for the treatment of diseases in companion and production animals. Consequently, there is an increased demand for knowledge related to the use of herbal medicines as a veterinary therapeutic tool.

Within the context, this narrative literature review aims to understand the current status of ethnoveterinary in Brazil, to access what has been proposed as a treatment for companion and production animals, and to suggest perspectives based on scientific knowledge.

METHODOLOGY

For the development of this narrative literature review, a systematic review was carried out from the PUBMED, SCIELO, PERIÓDICOS CAPES, SCIENCE DIRECT, WILEY, WEB OF SCIENCE, CLARIVATE, SCOPUS, SCHOLAR and SPRINGER LINK databases. There was no year limitation. Papers written in Portuguese and English were included. Survey-type scientific articles, literature reviews, original *in vitro* or *in vivo* research articles, clinical research, and case studies were considered. Books, theses, websites, and legal documents were not included. The keywords considered were ethnoveterinary and Brazil

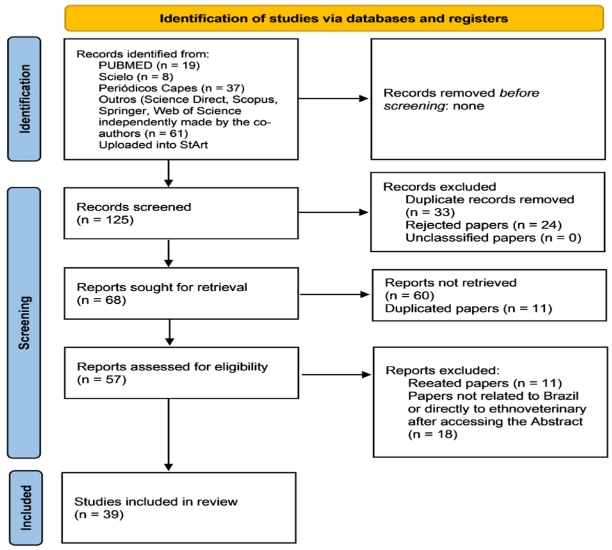

Figure 1: PRISMA Flow Chart.

and their versions in the indicated foreign language. For the selection and classification of the articles, the program State of the Art Through Systematic Review-StArt version 3.4 Beta (lapes.dc.ufscar.br) and the Teams environment (Microsoft) were used to manage and administer the flow of information, whose schematic representation is found in the PRISMA flowchart,[18] in Figure 1.

Each author carried out an independent search of the scientific articles, and after a first round of literature review, it was observed that some themes were more frequent. In a second round of literature search, each author was responsible for prospecting articles related to a specific theme to understand better its extension within the range of papers related to the main subject, ethnoveterinary medicine in Brazil. Articles were selected based on their titles. After choosing the documents, each author included their search result in a StArt file, used to manage the total number of selected articles and refine the selection. From this step, only one author was responsible for refining the articles' selection, classified as accepted, not accepted, or duplicated.

Then, the articles selected in this first stage were again evaluated by StArt by considering the abstract content and the scientific approach. The final list of articles, with data on the authors, volume, number, pages, and year of publication, as well as the DOI, ISSN, and URL of the journal, were displayed in an Excel spreadsheet. Then, one author was responsible for gathering the articles according to the themes and distributing each set of articles to a determined co-author to read and remove the necessary information to compose the review. A flowchart (Figure 1) based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) was made to expose the algorithm used in this work.

In the articles, information on the use of medicinal plants related to their traditional or popular use by companion or production animals was considered, as well as information regarding the use of these plants by their tutors or breeders. During the bibliographic research, articles reporting the use of animal and mineral products for the treatment of animals were also considered in this review.

RESULTS

From the listed databases, 125 complete articles were separated. They were included in the StArt, of which 33 were duplicates, 24 were rejected, and 68 were selected for evaluation according to the inclusion and exclusion criteria considered in this review. In a second evaluation, 11 articles of the 68 selected ones were still repeated, and 18 were withdrawn because they did not refer to the main subject proposed, resulting in 39 papers included in this document. Another 63 additional documents were used to support the Introduction and Discussion.

DISCUSSION

Ethnoveterinary and animals to treat animals

There is an immediate need to document the traditional, cultural and environmental knowledge related to popular veterinary medicines since the passing of time is detrimental to the popular retention of information.[19] Since the beginning of the twentieth century, popular knowledge has been considered relevant in several areas of the natural sciences, including those related to traditional cultures, such as ethnobotany, ethnozoology, and ethnoveterinary.[20]

Plants and animals are traditionally used as sources of medicine in several cultures, both for treating humans and animals. Plants, in particular, comprise the most significant therapeutic element in traditional practices aimed at animal health.[19] The use of biological materials for medicinal purposes has been unrestricted to humans for a long time since they are also used against diseases that affect animals. The domestication of animals, whether for companionship, as sources of protein, or the work animals, has led to increased concern about animal health.[19,20]

The therapeutic medical use of animals and their products has been observed since ancient times. It is described in documents such as the Ebers Papyrus, the oldest medical treatise in the world, or historical sources such as the Indian Ayurveda system, as well as archives and ancient writings, such as the famous Chinese work Pen Ts'ao.[21]

One of the oldest cultural legacies in history is the development of a close relationship between men and animals, which has led to the use of nature derivatives as sources of medicine for treating human diseases,[21] including animal parts, such as honey, fat, wax, among others also considered as food.[22] The use of animals and their derivatives as treatments is observed in urban and semi-urban locations in different parts of the Latin America,[23,24] particularly in Brazil.[25] Registers as old as the Ebers Papyrus describe the use of sperm whale, deer glands, honey, and lizard blood as medicine, while the book *De Materia Medica*, written by Pedanius Dioscorides, describes more than 10% of animal derivatives that were used as medicines.[26]

Currently, approximately 80% of the world's population supports traditional medicine and uses it to treat human and veterinary diseases, which happens because of limited access to drugs, particularly in developing countries, whose governments do not provide enough medicines to be distributed to the population, and even less for animal care.[27] As a fightback, the use of plants and animal derivatives as medicines has become the primary therapeutic tool source in some areas in developing countries.

Sheep fat is commonly used to treat human diseases such as rheumatism and pain.[27-29] Residents of the semi-arid region of Paraíba administered fish tallow (Selecta Genera et Species *Piscium brasiliensium*) in the wounds of their domestic animals, such as dogs and cattle, to stimulate the healing process and the anti-inflammatory effect (Souto *et al.* 2011b).[29] A survey was carried out in the *Caatinga* in which they reported the popular use of animal derivatives such as bees, reptiles, mammals, and birds as medicine, whose data represent, in a way, the acceptance of animals as a source of therapy by local residents.[28]

With the advancement of medicine, traditional medicines began to be replaced by industrialized ones, often becoming inaccessible to large-scale consumption due to the costs, regardless of being for human and veterinary use.[19] As a result, knowledge of ethnoveterinary medicine proves to be relevant, especially in rural areas, where veterinary services are sometimes inaccessible. Also, access to specific medications is usually more restricted, particularly to small producers, whose production may need to be improved by the low milk productivity or low animal protein quality.[19]

Although the resumption of popular knowledge linked to the use of medicinal plants as a therapeutic tool to be applied in veterinary medicine has recently been highlighted, at the same time that popular information must be rescued and studied, the development of therapeutic tools to be used in animal care must continue to be done. Although popular knowledge transmitted through generations is a rich source of information on ways to treat diseases of veterinary interest, the use of drugs developed specifically for use in veterinary medicine is sometimes more effective because they were developed based on scientific evidence,[19,20] which makes more in-depth research on herbal veterinary medicines urgent.

Survey-like studies in Brazil support popular knowledge about the medical-veterinary use of plants, animals, and minerals

One of the main foundations of ethnopharmacology seeks to relate scientific processes to traditional empirical knowledge.[30] Within a broader context, studies on ethnopharmacology and related areas such as ethnobiology, ethnoveterinary, and ethnozoology, among others, are more extensive in Brazil than in Latin American countries,[23] the number of publications dedicated exclusively to ethnoveterinary medicine (five publications) and ethnozoology (26 publications) is still deficient, concerning the total (289 publications).

The field studies are based on observational processes carried out with the animals and their guardians or breeders; that is, they are based on the methods adopted by the guardians when caring for their animals and on animal behavior when looking for plants for self-consumption in the search for getting cured of the disease. Sedimented concepts from the area of ethnopharmacology end up being adopted for ethnoveterinary medicine,[31] such as those focused on the area of biology (botany, zoology, ecology), anthropology (behavior, society and human customs adopted for animals), specific ethnomedical issues, quantification and analysis of the information adopted, both in experimental and applied research. From studies previously carried out with the application of structured and unstructured questionnaires and reports of pre-clinical and clinical experiments, it is possible to outline the profile of ethnoveterinary medicine in Brazil, as described below.

Brazil is a cosmopolitan, diverse country. In terms of land extension is one of the largest in the world. The most significant extension of the largest tropical forest in the world, the Amazon, is within its territory, in addition to other very important biomes, classified as hot spots due to the biodiversity and the presence of animals and plants that are in danger of extinction, such as the *Cerrado* and the Atlantic Forest. The relevance of conservation of Brazilian biomes is directly related to the climate and the regulation of rainfall, which is fundamental for supplying freshwater reservoirs. Biomes such as the *Cerrado*, the Pampas, and the Pantanal, specifically in their forest characteristics, share space with areas destined for agriculture and livestock, which is also very important for Brazil as it is responsible for a considerable slice of the trade balance.[32] Brazil is one of the largest exporters of animal protein. Its trading partners are mainly in Europe, China, and the Middle East, each of which has legislation regarding the quality of products containing antimicrobial agents. The introduction of alternative products, such as herbal medicines for treating animals, is essential to expand the market and satisfy commercial partners.

In 2021, Brazil had 149,530 million pets, most of them dogs, cats, birds, and fish,[33] which makes it the second country that most consumes pet products, with expenses of up to US$ 7.2 billion,[34] whose forecast increase is 14% for the year 2022,[35] or something around R$ 58.9 billion, together with the increase in human consumption of alternative therapies, including herbal medicines, whose market reached BRL 2.3 billion in 2018.[36]

Semi-structured interviews were applied to residents of different regions of Brazil, both in rural and urban areas. Of the 13 articles referring to an ethnoveterinary survey, one reports the use of medicinal plants in the metropolitan territory, while eight report data obtained in a rural environment.

One of the works was carried out in three veterinary clinics in São Paulo city,[37] in which 273 people were interviewed. The article reports that approximately 17% of owners use medicinal plants to treat their pets. The most used are *boldo-de-Jardim* (*Plectranthus barbatus* Andrews), chamomile (*Matricaria chamomilla* L, or *Chamomilla recututa* (L.) Rauschert), and fennel (*Foeniculum vulgare* Mill.), fed to dogs and cats orally, as indicated for human use.

Seven articles report the use of medicinal plants in animals in rural areas, such as the one carried out in the state of Pará, on the Ilha de Marajó, in which[38] 50 semi-structured questionnaires assessed the use of plants used in ethnoveterinary medicine, and reported the use of 50 species, including *andiroba* (*Carapa guianensis* Aubl.), *copaiba* (*Copaifera martii* Hayne), cabaceira (*Crescentia cujete* L.), ironwood (*Caesalpinia ferrea* Mart.); Mastruz (*Chenopodium ambrosioides* L. or *Dysphania ambrosioides* (L.) Mosyakin and Clemants), pinhão-de-purga (*Jatropha curcas* L.) and melon (*Momordica charantia* L.).

On Ilha de Colares, located in the continental part of the state of Pará, in Marajó Bay,[39] a study was carried out based on 72 semi-structured questionnaires which, after being evaluated, reported the use of 56 plants, including *tinhorão* (*Caladium bicolor* (Aiton) Vent.), annatto (*Bixa orellana* L.), andiroba, pinhão-de-purga and lemongrass (*Cymbopogon citratus* DC. Stapf), in addition to describing the use of homemade animal products such as lard (*Sus scrofa*) and chicken fat (*Gallus domesticus*), and fat from wild animals such as *paca* (*Cuniculus* sp.), chameleon (*Iguana* sp.) and opossum (*Didelphis* sp.), as anti-inflammatory products and healing agents, in addition to mineral products such as salt, kerosene, and gasoline, especially for dermatological problems, used together with plant products.

Five out of seven studies that report the use of plants in ethnoveterinary medicine were carried out in states in the Northeast of Brazil.

In a study conducted in the city of Bom Príncipe do Piauí, Piauí,[40] 38 participants answered a standardized questionnaire whose analysis resulted in the relationship of 112 species of plants used in the treatment of cattle, horses, and dogs, among the more relevant in ethnobotanical terms are the backwoods mastic (*Myracrodruon urundeuva* Allemão), mentruz or mastruz and amburana-de-cheiro or Northeastern cumaru (*Amburana cearensis* (Allemão) A.C.Sm.).

The use of structured questionnaires was also carried out in the study on the use of plants in ethnoveterinary medicine, in the community of Várzea Comprida dos Oliveiras, in Pombal, Paraíba.[41] In this study, the questionnaire was applied to 40 people, including 20 men and 20 women, most between 31 and 50 years of age, who answered ten questions on the subject. This study identified three plant species and their used organs: garlic bulb (*Allium sativum* L.), lemon fruit (*Citrus* spp.), and mastruz leaves. The main health problems reported were respiratory, digestive, and inflammatory processes.

The knowledge regarding two plant species, *aroeira-do-sertão* and *angico* (*Anadenanthera colubrina* (Vell.) Brenan), in the northeastern semi-arid region, in Pernambuco, in two communities called "Riachão" and "Ameixas," was assessed.[42] In the first community, 101 people were interviewed, and in the second village, 55 were. Both communities had the same type of knowledge regarding the medicinal application of these two species, with aroeira-do-sertão most used in respiratory problems and angico for issues in the skin and subcutaneous tissues and undefined pain. In both cases, the peels are used as a syrup or decoction.

In the semi-arid region of the Bahia state, researchers assessed the knowledge related to ethnomedicine in the *Salamina Putumuju Quilombola* community.[43] So, 74 participants, 37 men and 37 women, were submitted to semi-structured interviews in which they reported the use of 118 medicinal plants. The list includes two species, the *batata-de-purga* (*Mirabilis jalapa* L.) and the croton (*Codiaeum* sp.).

In the semi-arid region, work was carried out in Alagoas next to a rural settlement in an area with remnants of Caatinga, the region's typical vegetation.[44] Thirty participants were interviewed, 20 men and ten women, and 54 plant species were listed as the basis for treating 33 veterinary diseases. *Aloe vera* (*Aloe vera* (L.) Burm.f.), fish fruit (*Guapira graciliflora* (Mart. ex. J.A.Schmidt) Lundell), garlic, lemon (*Citrus limon* L.) and Brazilian lemongrass (*Lippia alba* (Mill.) N.E.Br). The community is well-established and has areas producing cattle, poultry, pigs, sheep, goats, horses, and mules. The most cited applications for these plants are dermatological, gastric, and multisystemic problems related to inflammatory processes.

Most of the species used have applications in both human and veterinary diseases. The popular knowledge related to the self-use of medicinal plants by men favors the application in the production and companion animals, despite species differences. It means that studies pertaining to medicinal plants, herbal medicines, and plant or animal derivatives in animals must be intensified.

Ethnoveterinary and microbial infection

Bacteria

The use of medicinal plants as antimicrobial and antiparasitic agents is millenary. Recently, the study focused on veterinary care has been done intensively and begins with collecting popular information, as seen above. There is a growing number of studies concerning verifying the antimicrobial and antiparasitic chemotherapeutic potential of plants and animal derivatives to be used in diseases of veterinary importance.[45]

Brazil is one of the largest producers and exporters of animal protein, and mastitis is one of the most prevalent diseases in cattle. It is an infection of the mammary glands in dairy cows, resulting from the invasion of the teats by *Staphylococcus aureus, Staphylococcus agalactiae, Mycoplasma bovis*, and *Corynebacterium bovis*, with consequent contamination of the milk. Financial losses related to mastitis occur for both the subclinical and clinical stages of the disease. They include the disposal of contaminated milk, transient reductions in the yield of milk produced, and premature culling of infected cattle. Traditional treatment methods involve the direct application of antibiotics to the cows' teats, which has been a relevant issue since it may favor the emergence of bacterial resistance.[46]

Sanitary management programs aimed at preventing and controlling mastitis recommend using antiseptic and disinfectant agents to prevent the occurrence and transmission of micro-organisms, which reduces the use of antibiotics; therefore, these drugs become administered only in severe cases of the disease (Avancini *et al*. 2008).[45] Even so, since establishing stricter international standards regarding the use of antibiotics by production animals, the introduction of alternative agents that control the pathogenic bacterial load in these animals has become particularly relevant (Rochford *et al*. 2008).[47]

The antibacterial potential of decoctions obtained from popularly used plant species, such as penicillin (*Alternanthera brasiliana* (L.) Ktze.), fennel (*Foeniculum vulgare* Mill.), aloe or aloe (*Aloe arborescens* Mill.), novalgin (*Achillea millefolium* L.), gorse (*Baccharis trimera* (Less.) DC.), Brazilian arnica (*Solidago chilensis* Meyen), comfrey (*Symphythum officinale* L.), elderberry (*Sambucus nigra* L.), lemongrass, mastruz (*C. ambrosioides*), peppermint (*Mentha* sp.), basil (*Ocimum basilicum* L.), red angico (*Parapiptadenia rigida* (Benth.) Brean), garlic (*Allium sativum* L.), *sete-sangrias* (*Cuphea carthagenensis* (Jacq.) Macbr.), guanxuma (*Sida rhombifolia* L.), umbu (*Phytolacca dioica* L.) and fumeiro-bravo (*Solanum mauritianum* Scop.), was assessed against *Staphylococcus aureus* and *Salmonella choleraesuis*, two microorganisms involved in mastitis.[45] The study was conducted with *in vitro* methods, such as agar dilution, used in the analysis. The authors identified decoctions made with penicillin, *novalgina*, gorse, and Brazilian arnica as active against *S. aureus*. At the same time, comfrey, elderberry, mint, basil, angico-vermelho, and sete-sangrias were active against both microorganisms.

Fungi and yeast

Veterinary mycology has a very relevant importance in epidemiology since several groups of fungi and yeasts make up zoonotic diseases, such as malasseziosis, caused by *Mallassezia furfur* and *M. pachydermatis*, which mainly affects dogs,[48] but which occurs in other species, including wild animals, dermatophytoses caused by *Microsporum* sp. and *Tricophyton* sp, which affect dogs and cats,[49] sporotrichosis, caused by *Sporothrix schenckii* and mainly affects cats,[50] candidiasis caused by *Candida albicans, C. tropicalis, C. parapsilosis*, which affects several types of animals, including birds,[51] and cryptococcosis, caused by *Cryptococcus neoformans* or by C. *gattii*, which cause fungal diseases in cats, dogs, birds and wild animals.[52] As they are zoonoses, these diseases can be transmitted to humans, who are more susceptible in conditions of immunosuppression, pregnancy, early or advanced age, or affected by other diseases.

Traditional or popular knowledge regarding managing animal mycoses has been explored in Brazil through studies of the antifungal activity of pharmacological agents in *in vitro* methodologies. Plants popularly known as *quitoco* (*Pterocaulon* spp.) were used to treat skin mycoses.[53] Extracts obtained from Organs aerial organs of three plant species were used, *Pterocaulon alopecuroides* (Lam.) D.C, *P. balansae* Chodat. and *P. polystachyum* D.C, from the Asteraceae family, tested against *Microsporum gypseum, Trichophyton rubrum, Trichophyton mentagrophytes, Cryptococcus neoformans, Aspergillus flavus, Aspergillus niger*, and *Aspergillus fumigatus* species, in susceptibility models. The authors found that the hexane and dichloromethane extracts obtained from *P. alopecuroides* were active against two species of *Tricophyton*, the hexane extract from *P. interruptum* was active against *Microsporum* sp, and the hexane extract of *P. polystachyum* was active against a species of *Tricophyton*. This same group studied some components present in active extracts, such as coumarins, prenyletine, and prenyletine methyl ether, which were responsible for the observed antifungal activity.[54]

The methanolic extract of *P. alopecuroides* was tested against many strains of fungi *Fonseacea pedrosoi, Cladophialophora carrioni, Rhinocladiella aquaspersa, Exophiala jeanselme*, and *Phialophora verrucosa*, agents of chromoblastomycosis.[55] They observed that the antifungal concentrations observed for these microorganisms are higher than those obtained for fungi related to dermatomycosis. However, the result is significant for the treatment of chromoblastomycosis but resistant.

The methanolic extracts obtained from the aerial organs of different species of *Pterocaulon* were tested against some fungi.[56] The extracts demonstrated important antifungal activity against clinical isolates of *Sporothrix schenckii*, a pathogenic agent related to sporotrichosis, the most active being that obtained from aerial organs of *P. polistachyum*.

Ethnoveterinary and helminths

Livestock breeders in many countries face numerous diseases that ultimately limit productivity, many of which are caused by infestations of ticks and parasitic worms such as helminths.[57,58] Many studies have been conducted to find alternative and ecologically friendly treatments to control helminth infestation, as well as those seeking to prevent drug resistance development. So, popular knowledge regarding using natural sources as a medicine has been highly considered and scientifically validated after a series of *in vivo* and *in vitro* tests.[57]

In a classic ethnopharmacology study, the use of exotic plant species in treating diseases for which there are no known treatments using native plant species is discussed.[59] It seeks to understand the role of these exotic species in the traditional medical system. The researchers conducted survey-like studies in two rural communities in the Brazilian Northeast. The investigations concerned the use of known exotic and native species related to treating endo and ectoparasites in animals and humans and the acaricidal activity of certain extracts. The results indicated that the native plant species *Aspidosperma pyrifolium* Mart.; *Anthurium affine* Schott; *Bidens bipinnata* L.; *Melocactus zehntneri* (Britton and Rose) Luetzelb.; *Senna spectabilis* var. excelsa (Schrad.) H.S. Irwin and Barneby, among others, were used in the treatment of ectoparasites and the exotic species *Chenopodium ambrosioides* L.; *Annona squamosa* L, *Calotropis procera* (Aiton) W.T. Ailton, and *Helianthus annuus* L. The researchers observed that the exotic species presented effective results similar to those observed for the native species in relation to endoparasitosis. They also observed overlapping results between exotic and native species with therapeutic purposes on diseases linked to ticks. Concerning acaricidal activity, only two species (*Nicotiana glauca* Graham, and *Croton blanchetianus* Baill.) showed positive results but were insignificant. The researchers concluded that the data obtained do not support the suggested hypotheses since the versatility of exotic species was not used exclusively in treating human and animal parasitic diseases; they also concluded that the results regarding plants with acaricidal potential could have been more interesting.

The leaves and roots of *Turnera ulmifolia* L, leaves and seeds of *Parkia platycephala* Benth, and leaves and bark of *Dimorphandra gardneriana* Tul, plant species that are the staple diet of goats in the Brazilian Cerrado, were used in *in vitro* tests against *Haemonchus contortus*.[60] Hydroacetone and hydroalcoholic extracts were evaluated in models using egg incubation, larval inhibition, and larval development assays. A second assay was carried out to assess the influence of polyphenols on the anthelmintic effects. At the end of the tests, all extracts showed inhibitory activity for at least one of the life stages of *H. contortus* analyzed. Therefore, the researchers concluded that these plant species have a promising potential for use in controlling helminth infections in small ruminants.

The anthelmintic action of *Operculina hamiltonii* (G. Don) D.F. Austin and Staples (batata-de-purga), *Momordica charantia* L. (melão-de-são-caetano), and 0.2% moxidectin were analyzed in 40 female goats aged 6 and 12 months that were naturally infected in the Paraíba semi-arid region (known locally as *sertão da Paraíba*).[61] For the experiment, the animals were divided into four groups formed according to the application of different treatments for three days (G1: negative control-distilled water; G2: alcoholic extract of *O. hamiltonii*; G3: alcoholic extract of *M. charantia*; G4: positive control moxidectin 0.2%). After treatment, feces were collected from these animals on days 0, 30, and 60 to count eggs per gram of feces and perform a larval culture. At the end of the analyses, it was observed that all samples tested positive for larvae of the Trichostrongyloidea superfamily (except for G4 on days 30 and 60), in which *Haemonchus* was the predominant genus of this superfamily in the analyzed feces cultures. The authors concluded that using alcoholic extracts of *Operculina hamiltonii* (G. Don) D.F. Austin and Staples, and *Momordica charantia* are efficient in reducing gastrointestinal helminth eggs found per gram of feces in goats, being characterized as alternatives for controlling such parasites.

Studies carried out in the Paraíba semi-arid showed a significant difference in combating larvae or in their development regarding the use of medicinal plants typical of the region, such as *melão-de-são-caetano* and potato-de-purga, which caused the reduction of several gastrointestinal helminth eggs present in the feces of the analyzed goats.[61]

The effects of Essential Oil (EO) from *Mentha villosa* Hubs and *M.* x *piperita* L. (carvone and limonene) collected in Santa Catarina, Brazil, was determined against Larvae (L3) of *Haemonchus* spp. and *Trichostrongylus* spp.[62] The analyzes showed that the larvae of *Haemonchus* spp. and *Trichostrongylus* spp. did not develop in the presence of *M. villosa* Hubs, *M.* x *piperita*, and the bioactive carvone, in the *in vitro* tests against gastrointestinal nematodes.

The anthelmintic activity (*in vitro* and *in vivo*) of the essential oil of *Thymus vulgaris* L. was assessed against *Haemonchus contortus*.[63] The relative ineffectiveness of the essential oil was found in *in vivo* tests. Still, the authors point out that such ineffectiveness can be corrected after improvement in extraction techniques so that the bioavailability of the oil is increased. The *in vitro* results legitimized the anthelmintic action of the popular use of *T. vulgaris* oil against *H. contortus*. Both the oil and its main compound, thymol (50.22% of the total composition of the oil), proved to be efficient in the three main stages of development of *H. contortus*; both products were able to inhibit egg hatching, growth, and motility of larvae and adults during the first 8 hr of experimentation. Given these results, the authors point out that it is possible to assume that thymol is the main compound responsible for the essential oil's anthelmintic effect since it is this extract's main component. They conclude that these results are of extreme ethnopharmacological importance in the development of new drugs, including herbal medicines.

Brazil leads the research of ethnoveterinary interest in ruminants, mainly concerning studies focused on the anthelmintic activity of herbal medicines to replace synthetic drugs.[64] The problem of indiscriminate use of synthetic drugs to control parasitism has been highlighted.[65] Aiming the anthelmintic drugs generate residues excreted by animals that are released into the environment, causing damage not only to the production animal and its derivatives but also to the ecosystem itself, which becomes a relevant issue due to drug resistance that requires an increase in the dose dispensed to the animal. In this research, alternative means were raised to control the helminths, such as using herbal medicines of ethnoveterinary interest, which can bring natural and safe benefits for goats and the environment.

Haemonchus contortus is described as one of the primary gastrointestinal nematodes that affect goats and sheep in Brazil and cause a significant loss in the production of these animals.[66] The search for alternative medicines of natural origin has grown among producers, and based on this, *Pterogyne nitens* Tul. has been tested as an anthelmintic. From this species, the compounds were isolated to discover which would have the best effect on the pathogen. As a result, extracts containing phenolic acids were more effective against hatching eggs. In a research previously done,[67] the efficacy of ethyl extracts obtained from *Jatropha curcas* seeds was demonstrated, which showed not only the inhibition of egg hatching but also the inhibition of larval development.

Another test demonstrated the effectiveness of the essential oil of *Eucalyptus staigeriana* F. Muell. ex F.M. Bailey in reducing the development of eggs and larvae by 76.57% on the 15th day of administration to goats submitted to the anthelmintic activity efficacy test.[68] The effectiveness of the decoction prepared with the aerial parts of *Spigelia anthelmia* L. on the control of *Haemonchus contortus* was assessed by an *in vitro* test, and the plant was considered effective in inhibiting the hatching of eggs with 99.3% effectiveness and 97.8% and larval growth.[69] The toxic effect was previously tested in mice to guarantee a safe dose to be administered to the sheep. The extract obtained from the fruits of *Piper cubeba* L. f. and lignans was tested for anthelmintic activity and a considerably high effect on the studied activity was achieved.[70]

The control of parasitism caused by *Haemonchus contortus* is frequently explored. The effectiveness of the infusion of *Artemisia annua* L. in the control of *Toxoplasma gondii* was assessed.[71] The authors presented satisfactory results regarding the inhibitory effects in up to 75% and safely and effectively, which places the therapeutic product as a potential agent to control this pathogen.

RECOMMENDATIONS

Ethnoveterinary science has recently developed in Brazil, where there is enormous potential for growth once the population of companion and production animals is among the largest in the world. Efforts have been made to register the popular knowledge regarding the use of herbal and zootherapeutic medicines aiming veterinary practices, which are stimulated by increasing demand for such products and by the concept, sometimes distorted depending on the species used as medicine, that medicines obtained from natural sources have fewer side effects and are more affordable.

Surveys have been structured in Brazil within the concepts involved in ethnopharmacological sciences. They are fundamental instruments for triggering the development of specific herbal medicines for veterinary use, even though most plant species are also used by humans, which means that there is already scientific knowledge added to the plant's crude material.

It is observed that only some clinical studies directed at companion or production animals have been developed with phytotherapeutics, even less with zootherapeutics. Most of the works assessed in this review described *in vitro* studies in models that mainly cover skin diseases, such as mycoses, and those linked to the digestive system, such as parasitic or even microbial ones. Thus, the field of studies to be explored in ethnoveterinary medicine is vast and encompasses the expansion of prospecting and collection of popular information regarding the use of natural sources as medicines, the increase in the evaluation of the effectiveness of plants and animals against a more significant number of microorganisms in *in vitro* models, as well as the introduction of toxicological and pharmacological studies, both preclinical and clinical, of potential drugs.

Policies to encourage the conduct of quality veterinary clinical trials, which meet international guidelines such as those

Table 1: Lists the plant species mentioned in this review and provides the popular name, scientific name, family, popular use, and the occurrence of the species in the National List of Plants of Interest to SUS (RENISUS).

Popular name	Scientific name	Family	Popular/traditional use	Presence in RENISUS 2021[72]	References
Alfavaca/basil	*Ocimum basilicum* L.	Lamiaceae	Gastrointestinal symptoms	No	[73]
Alho/garlic	*Allium sativum* L.	Alliaceae	Cardiovascular effects, antioxidant, antimicrobial, neuroprotection	Yes	[74,75]
Amburana-de-cheiro, cumaru-nordestino	*Amburana cearensis* (Allemão) A.C.Sm.	Fabaceae	Breathing problems	No	[76]
Amendoim-bravo/yvyraro	*Pterogyne nitens* Tul.	Fabaceae	Antimicrobial	No	[77]
Andiroba	*Carapa guianensis* Aubl.	Meliaceae	Antimicrobial	Yes	[78]
Angico	*Anadenanthera colubrina* (Vell.) Brenan	Fabaceae	Breathing problems and others	No	[79]
Angico-vermelho ou angico-gurucaia/angico	*Parapiptadenia rigida* (Benth.) Brean	Fabaceae	Depurative, hemostatic	No	[80]
Antúrio/anthurium	*Anthurium affine* Schott	Araceae	Diabetes, cardiac diseases	No	[81]
Arapabaca, erva-lombrigueira/ wormbush	*Spigelia anthelmia* L.	Loganiaceae	Vermifuge	No	[82]
Arnica-brasileira/Brazilian arnica	*Solidago chilensis* Meyen	Asteraceae	Anti-inflammatory	No	[83]
Aroeira-do-sertão	*Myracrodruon urundeuva* Allemão	Anacardiaceae	Anti-inflammatory, antimicrobial	No	[84]
Artemísia/artemisia	*Artemisia annua* L.	Asteraceae	Antimalarial, and other several uses	No	[85]
Babosa ou aloe/aloe	*Aloe vera* (L.) Burm.f, *Aloe arborescens* Mill.	Berberidaceae	Immunomodulatory	Yes	[74]
Batata-de-purga/Marvel of Peru	*Mirabilis jalapa* L.	Nyctaginaceae	Anti-inflammatory	No	[86]
Batata-de-purga	*Operculina hamiltonii* (G. Don) D.F. Austin and Staples	Convolvulaceae	Depurative, laxative	No	[87]
Cabaceira/calabash tree	*Crescentia cujete* L.	Bignoniaceae	Breathing problems	No	[88]
Camomila/chamomile	*Matricaria chamomilla* L, ou *Chamomilla recututa* (L.) Rauschert	Asteraceae	Anti-inflammatory, digestive problems	Yes	[74]

Popular name	Scientific name	Family	Popular/traditional use	Presence in RENISUS 2021[72]	References
Capim-limão/lemon grass	*Cymbopogon citratus* DC. Stapf.	Poaceae	Digestive stimulant	No	[74]
Carqueja/gorse	*Baccharis trimera* (Less.) DC.	Asteraceae	Digestion problems	Yes	[74]
Cássia-do-nordeste/ American cassia	*Senna spectabilis* var. *excelsa* (Schrad.) H.S. Irwin and Barneby	Fabaceae	Laxantive	No	[89]
Charuteira/tree tobacco	*Nicotiana glauca* Graham	Solanaceae	Anti-parasitic, insecticide	No	[90]
Ciumeira, saco-de-velho/the apple of sodom	*Calotropis procera* (Aiton) R. Br.	Apocynaceae	Anti-ulcer, healing	No	[91]
Confrei/comfrey	*Symphytum officinale* L.	Boraginaceae	Anti-inflammatory	No	[92]
Copaíba/copaiba	*Copaifera martii* Hayne	Fabaceae	Various popular uses	Yes	[93]
Coroa-de-frade/melocactus	*Melocactus zehntneri* (Britton and Rose) Luetzelb.	Cactaceae	Breathing problems, anti-inflammatory	No	[94]
Cubeba/tailed pepper	*Piper cubeba* L. f.	Piperaceae	Antiseptic and expectorant	No	[93]
Erva-cidreira-brasileira/ Brazilian lemon grass	*Lippia alba* (Mill.) N.E. Br. ex Britton and P. Wilson	Verbenaceae	Various popular uses	No	[93]
Eucalipto/eucalyptus	*Eucalyptus staigeriana* F. Muell. ex F.M. Bailey	Myrtaceae	Upper airway disorders	No	[93]
Faveira, fava-de-boi	*Parkia platycephala* Benth.	Fabaceae	Anthelmintic, antimicrobial	No	[95]
Faveiro, fava-d'anta/Virgin's bark	*Dimorphandra gardneriana* Tul.	Fabaceae	Anthelmintic	No	[60]
Flor-do-guarujá/yellow alder	*Turnera ulmifolia* L.	Passifloraceae	Tonic, diuretic, among others	No	[93]
Fruta-de-peixe, pau-piranha/pirana wood	*Guapira graciliflora (*Mart. ex. J.A.Schmidt) Lundell	Nyctaginacee		No	
Fruta-do-conde, pinha/ custard apple	*Annona squamosa* L.	Annonaceae	Upper airway disorders, insecticide	No	[93]
Fumeiro-bravo/earleaf nightsade	*Solanum mauritianum* Scop.	Solanaceae	Anti-inflammatory	No	[96]
Funcho/fennel	*Foeniculum vulgare* Mill.	Apiaceae	Antiphlogistic	Yes	[74]
Girassol/sunflower	*Helianthus annuus* L.	Asteraceae	Anti-inflammatory	No	[93]

Popular name	Scientific name	Family	Popular/traditional use	Presence in RENISUS 2021[72]	References
Guanxuma/arrowleaf sida	*Sida rhombifolia* L.	Malvaceae	Catarrh, emollient	No	[93]
Hortelã, menta/mint	*Mentha villosa* Hubs, *M. x piperita* L.	Lamiaceae	Antiseptic, anti-inflammatory	Yes	[74]
Limão/lemon	*Citrus limon* L.	Rutaceae	Various popular uses	No	[93]
Marmeleiro-preto	*Croton blanchetianus* Baill.	Euphorbiaceae	Analgesic	No	[96,97]
Mastruz, mentruz ou erva-de-santa-maria/ Mexican tea	*Chenopodium ambrosioides* L. ou *Dysphania ambrosioides* (L.) Mosyakin and Clemants	Amaranthaceae	Insecticide	Yes	[93]
Melão-de-são-caetano/bitter melon	*Momordica charantia* L.	Cucurbitaceae	Various popular uses	Yes	[98]
Novalgina/common yarrow	*Achillea millefolium* L.	Asteraceae	Various popular uses	Yes	[93]
Pau-ferro/ironwood	*Caesalpinia ferrea* Mart.	Fabaceae	Airway disorders, anti-inflammatory	No	[93]
Penicilina/metal weed	*Alternanthera brasiliana* (L.) Kuntze.	Verbenaceae	Anti-inflammatory, febrifuge	No	[93]
Peroba, peroba-rosa/pereiro	*Aspidosperma pyrifolium* Mart.	Apocynaceae	Antiplasmodic	No	[99]
Picão/Spanish needles	*Bidens bipinnata* L.	Asteraceae	Antioxidant	No	[100]
Pinhão-de-purga/physic nut	*Jatropha curcas* L.	Euphorbiaceae	Various popular uses	No	[93]
Sabugueiro/American black elderberry	*Sambucus nigra* L.	Viburnaceae	Various popular uses	No	[74]
Sete-sangrias/Colombian waxweed	*Cuphea carthagenensis* (Jacq.) J.F. Macbr.	Lythraceae	Action on angiotensin, diuretic, anti-inflammatory, laxative, antihypertensive	No	[101]
Tinhorão/angel wings	*Caladium bicolor* (Aiton) Vent.	Araceae	Use in sores, rheumatism, leprosy, emetic, purgative	No	[93]
Tomilho/thyme	*Thymus vulgaris* L.	Lamiaceae	Gout, chronic rheumatism, healing	No	[93]
Umbu/Ombú	*Phytolacca dioica* L.	Fabaceae	Antimicrobial	No	[102]
Urucum/achiote	*Bixa orellana* L.	Bixaceae	Various popular uses	No	[93]

described for humans, but are adaptable to the veterinary area, such as CONSORT (Consolidated Standards of Reporting Trials),[103] must be implemented to achieve FAO's demands on the reduction of antimicrobial resistance, one of the priorities of this century within the scope of *One Health*. Ethnoveterinary knowledge plays a determinant role in that scenario.

Ethnoveterinary is a science concerned with animal welfare that has expanded its role due to the involvement of companion animals, production animals, and wild animals as hosts of pathogens related to zoonotic diseases concerning the use of medicines obtained from natural sources for veterinary therapeutic care. Therefore, Brazil is among the countries that have enormous potential for the development of drugs obtained from natural sources to be used in veterinary medicine , as those reported in Table 1, and to effectively contribute to the consolidation and application of the *One Health* concepts, so fundamental for the development of a world sustainable for future generations from the preservation of natural resources.

ACKNOWLEDGEMENT

The authors are indebted to *Conselho Nacional de Desenvolvimento Científico e Tecnológico* (CNPq; grants#309628/2021-0 and304699/2018-7) and Paulista University–UNIP for the Amazon Expedition infrastructure support.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

REFERENCES

1. CDC [cited Dec 10 2022]. Available from: https://www.cdc.gov/onehealth/basics/history/index.html.
2. Mackenzie JS, Jeggo M. The One Health Approach-why is it so important? Trop Med Infect Dis. 2019;4(2):88. doi: 10.3390/tropicalmed4020088, PMID 31159338.
3. Mayo Clinic [cited Dec 10 2022]. Available from: https://www.mayoclinic.org/coronavirus-covid-19/history-disease-outbreaks-vaccine-timeline/sars-mers.
4. Temmam S, Vongphayloth K, Baquero E, Munier S, Bonomi M, Regnault B, *et al*. Bat coronaviruses related to SARS-CoV-2 and infectious for human cells. Nature. 2022;607(7920):330-6. doi: 10.1038/s41586-022-04532-4. Erratum in: Nature. 2022;607(7920):E19. doi: 10.1038/s41586-022-05048-7, PMID 35798954.
5. WHO [cited Dec 10 2022] Available from: https://covid19.who.int/.
6. Domingo JL. An updated review of the scientific literature on the origin of SARS-CoV-2. Environ Res. 2022;215(1):114131. doi: 10.1016/j.envres.2022.114131, PMID 36037920.
7. Thakur N, Das S, Kumar S, Maurya VK, Dhama K, Paweska JT, *et al*. Tracing the origin of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2): A systematic review and narrative synthesis. J Med Virol. 2022;94(12):5766-79. doi: 10.1002/jmv.28060, PMID 35945190.
8. Sharun K, Dhama K, Pawde AM, Gortázar C, Tiwari R, Bonilla-Aldana DK, *et al*. SARS-CoV-2 in animals: Potential for unknown reservoir hosts and public health implications. Vet Q. 2021;41(1):181-201. doi: 10.1080/01652176.2021.1921311, PMID 33892621.
9. Voskarides K. SARS-CoV-2: Tracing the origin, tracking the evolution. BMC Med Genomics. 2022;15(1):62. doi: 10.1186/s12920-022-01208-w, PMID 35303887.
10. Amoutzias GD, Nikolaidis M, Tryfonopoulou E, Chlichlia K, Markoulatos P, Oliver SG. The remarkable evolutionary plasticity of coronaviruses by mutation and recombination: insights for the COVID-19 pandemic and the future evolutionary paths of SARS-CoV-2. Viruses. 2022;14(1):78. doi: 10.3390/v14010078, PMID 35062282.
11. Padma TV. COVID vaccines to reach poorest countries in 2023—despite recent pledges. Nature. 2021;595(7867):342-3. doi: 10.1038/d41586-021-01762-w, PMID 34226742.
12. USDA [cited Nov 29 2022] Available from: https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Livestock%20and%20Products%20Annual_Brasilia_Brazil_08-15-2020.
13. IBGEa [cited Nov 29 2022]. Available from: File:///C:/Users/ibsuf/Downloads/ibge-populacao-de-animais-de-estimacao-no-brasil.pdf.
14. McCorkle CM. An introduction to Ethnoveterinary research and development. J Ethnobiol. 1986;6:129-49.
15. Habimorad PHL, Catarucci FM, Bruno VHT, Da Silva IBD, Fernandes VC, Demarzo MMP, *et al*. Implementation of Brazil's National Policy on Complementary and Integrative Practices: Strengths and weaknesses. Cien Saude Colet. 2020;25(2):395-405. doi: 10.1590/1413-81232020252.11332018, PMID 32022181.
16. Rename [cited Dec 10 2022]. Available from: https://www.gov.br/saude/pt-br/composicao/sctie/daf/pnpmf/orientacao-ao-prescritor/fitoterapicos-e-homeopaticos-na-rename.
17. MAPA [cited Nov 29 2022]. Available from: https://www.gov.br/agricultura/pt-br/.
18. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, *et al*. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. BMJ. 2021;372:n71. doi: 10.1136/bmj.n71, PMID 33782057.
19. Confessor MV, Mendonça LE, Mourão JS, Alves RRN. Animals to heal animals: Ethnoveterinary practices in semi-arid region, Northeastern Brazil. J Ethnobiol Ethnomed. 2009;5:37. doi: 10.1186/1746-4269-5-37, PMID 19941663.
20. Barboza RDB, Souto WMS, Mourão JS. The use of zootherapeutics in folk veterinary medicine in the district of Cubati, Paraíba State, Brazil. J Ethnobiol Ethnomed. 2007;3:1-14.
21. Alves RR, Neta RO, Trovão DM, Barbosa JE, Barros AT, Dias TL. Traditional uses of medicinal animals in the semi-arid region of Northeastern Brazil. J Ethnobiol Ethnomed. 2012;8:41. doi: 10.1186/1746-4269-8-41, PMID 23050756.
22. Alves RR, Oliveira TP, Rosa IL. Wild animals used as food medicine in Brazil. Evid Based Complement Alternat Med. 2013;2013:670352. doi: 10.1155/2013/670352, PMID 23986785.
23. Albuquerque UP, Silva JS, Campos JL, Sousa RS, Silva TC, Alves RR. The current status of ethnobiological research in Latin America: Gaps and perspectives. J Ethnobiol Ethnomed. 2013;9:72. doi: 10.1186/1746-4269-9-72, PMID 24131758. PMCID PMC4015921.
24. Alves RRN, Alves HN. The faunal drugstore: Animal-based remedies used in traditional medicines in Latin America. J Ethnobiol Ethnomed. 2011;7:9. doi: 10.1186/1746-4269-7-9, PMID 21385357.
25. Alves RR. Fauna used in popular medicine in Northeast Brazil. J Ethnobiol Ethnomed. 2009;5:1. doi: 10.1186/1746-4269-5-1, PMID 19128461.
26. Quave CL, Pieroni A. Mediterranean zootherapy: A historical to modern perspective. In: Alves RRN, Rosa IL, editors. Animals in traditional folk medicine. New York: Springer; 2013;303-16.
27. Souto WMS, Barboza RRD, Rocha MSO, Alves RRN, Mourão JS. Animal-based medicines used in Ethnoveterinary practices in the semi-arid region of Northeastern Brazil. An Acad Bras Ciênc. 2012;84(3):669-78. doi: 10.1590/S0001-37652012005000038, PMID 22751649.
28. Souto WM, Mourão JS, Barboza RR, Alves RR. Parallels between zootherapeutic practices in Ethnoveterinary and human complementary medicine in Northeastern Brazil. J Ethnopharmacol. 2011a;134(3):753-67. doi: 10.1016/j.jep.2011.01.041, PMID 21291986.
29. Souto WM, Mourão JS, Barboza RR, Mendonça LE, Lucena RF, Confessor MV, *et al*. Medicinal animals used in Ethnoveterinary practices of the 'Cariri Paraibano', NE Brazil. J Ethnobiol Ethnomed. 2011b;7:30. doi: 10.1186/1746-4269-7-30, PMID 21985401.
30. Etkin NL. Anthropological methods in ethnopharmacology. J Ethnopharmacol. 1993;38(2-3):93-104. doi: 10.1016/0378-8741(93)90003-n, PMID 8510473.
31. Heinrich M, Edwards S, Moerman DE, Leonti M. Ethnopharmacological field studies: A critical assessment of their conceptual basis and methods. J Ethnopharmacol. 2009;124(1):1-17. doi: 10.1016/j.jep.2009.03.043, PMID 19537298.
32. IBGEb. Available from: https://brasilemsintese.ibge.gov.br/agropecuaria.html \h. Available from: https://brasilemsintese.ibge.gov.br/agropecuaria.htmlhttps://brasilemsintese [cited Sep 20 2022]. Available from: http://ibge.gov.br/agropecuaria.html.
33. IBP [cited Sep 20 2022] Available from: http://institutopetbrasil.com/fique-por-dentro/amor-pelos-animais-impulsiona-os-negocios-2-2/.
34. FORBES [cited Sep 20 2022] Available from: https://forbes.com.br/outros_destaques/2015/12/10-maiores-mercados-para-pets-do-mundo/.
35. CNN [cited Sep 20 2022] Available from: https://www.cnnbrasil.com.br/business/mercado-pet-deve-ter-crescimento-de-14-em-2022-projeta-instituto/.
36. Anvisa [cited Sep 20 2022]. Available from: https://www.gov.br/anvisa/pt-br/centraisdeconteudo/publicacoes/medicamentos/cmed/anuario-estatistico-2019-versao-para-impressao.pdf.
37. Antonio RL, Souza RM, Furlan MR, Pedro CR, Cassas F, Honda S, *et al*. Investigation of urban Ethnoveterinary in three veterinary clinics at East Zone of São Paulo city, Brazil. J Ethnopharmacol. 2015;173:183-90. doi: 10.1016/j.jep.2015.07.026, PMID 26205641.
38. Monteiro MVB, Bevilaqua CML, Palha MdDC, Braga RR, Schwanke K, Rodrigues ST, *et al*. Ethnoveterinary knowledge of the inhabitants of Marajó Island, eastern Amazonia, Brazil. Acta Amaz. 2011;41(2):233-42. doi: 10.1590/S0044-59672011000200007.

39. Ritter RA, Monteiro MV, Monteiro FO, Rodrigues ST, Soares ML, Silva JC, *et al*. Ethnoveterinary knowledge and practices at Colares Island, Pará state, eastern Amazon, Brazil. J Ethnopharmacol. 2012;144(2):346-52. doi: 10.1016/j.jep.2012.09.018, PMID 23000170.
40. Castro KNC, Wolschick D, Leite RRS, De Andrade IM, Magalhães JA, Mayo SJ. Ethnobotanical and Ethnoveterinary study of medicinal plants used in the municipality of Bom Princípio do Piauí, Piauí, Brazil. J Med Plants Res. 2016;10(23):318-30.
41. Andrade SEO, Maracajá PB, Silva RA, Freires GF, Pereira AM. Estudo etnoveterinário de plantas medicinais na comunidade Várzea Comprida dos Oliveiras. Pombal: Paraíba, Brasil. Rev Verde Agroecol Desenvolv Sust. 2012;7(2):193-8.
42. Monteiro JM, De Albuquerque UP, Lins-Neto EM, De Araújo EL, De Amorim EL. Use patterns and knowledge of medicinal species among two rural communities in Brazil's semi-arid northeastern region. J Ethnopharmacol. 2006;105(1-2):173-86. doi: 10.1016/j.jep.2005.10.016, PMID 16298502.
43. De Santana BF, Voeks RA, Funch LS. Ethnomedicinal survey of a maroon community in Brazil's Atlantic tropical forest. J Ethnopharmacol. 2016;181:37-49. doi: 10.1016/j.jep.2016.01.014, PMID 26802786.
44. Silva JG, Grandi A, De Almeida Caetano R, Dos Santos Rodrigues L, Carnaúba AF, Santos AMS, *et al*. Are medicinal plants an alternative to the use of synthetic pharmaceuticals in animal healthcare in the Brazilian semi-arid? Ethnobot Res Appl. 2020;19:1-20.
45. Avancini C, Wiest JM, Dall'Agnol R, Haas JS. Antimicrobial activity of plants used in the prevention and control of bovine mastitis in Southern Brazil. Lat Am J Pharm. 2008;2008;27(6):894-9.
46. Mushtaq S, Shah AM, Shah A, Lone SA, Hussain A, Hassan QP, *et al*. Bovine mastitis: An appraisal of its alternative herbal cure. Microb Pathog. 2018;114:357-61. doi: 10.1016/j.micpath.2017.12.024, PMID 29233776.
47. Rochfort S, Parker AJ, Dunshea FR. Plant bioactives for ruminant health and productivity. Phytochemistry. 2008;69(2):299-322. doi: 10.1016/j.phytochem.2007.08.017, PMID 17919666.
48. Coutinho SDA. Malassezia *pachydermatis*: Enzymes production in isolates from external ear canal of dogs with and without otitis. Arq Bras Med Vet Zootec. 2005;57(suppl 2):149-53. doi: 10.1590/S0102-09352005000800003.
49. Neves JJA, Paulino AO, Vieira RG, Nishida EK, Coutinho SDA. The presence of dermatophytes in infected pets and their household environment. Arq Bras Med Vet Zootec. 2018;70(6):1747-53. doi: 10.1590/1678-4162-9660.
50. Silva FS, Cunha SCS, Moraes VA, Leite JS, Ferreira AMR. Refractory feline sporotrichosis: A comparative analysis on the clinical, histopathological, and cytopathological aspects. Pesq Vet Bras. 2022;42:e06923. doi: 10.1590/1678-5150-PVB-6923.
51. Vieira RG, Coutinho SDA. Phenotypical characterization of *Candida* spp. isolated from crop of parrots (*Amazona* spp.). Pesq Vet Bras. 2009;29(6):452-6. doi: 10.1590/S0100-736X2009000600002.
52. Araújo Júnior EC, Táparo CV, Uchida CY, Marinho M. *Cryptococcus*: Isolamento ambiental e caracterização bioquímica. Arq Bras Med Vet Zootec. 2015;67(4):1003-8. doi: 10.1590/1678-4162-7451 and DOI:10.1590/1678-4162-7451.
53. Stein AC, Sortino M, Avancini C, Zacchino S, Von Poser G. Ethnoveterinary medicine in the search for antimicrobial agents: Antifungal activity of some species of *Pterocaulon* (Asteraceae). J Ethnopharmacol. 2005;99(2):211-4. doi: 10.1016/j.jep.2005.02.011, PMID 15894129.
54. Stein AC, Alvarez S, Avancini C, Zacchino S, Von Poser G. Antifungal activity of some coumarins obtained from species of *Pterocaulon* (Asteraceae). J Ethnopharmacol. 2006;107(1):95-8. doi: 10.1016/j.jep.2006.02.009, PMID 16574360.
55. Daboit TC, Stopiglia CD, Von Poser GL, Scroferneker ML. Antifungal activity of *Pterocaulon alopecuroides* (Asteraceae) against chromoblastomycosis agents. Mycoses. 2010;53(3):246-50. doi: 10.1111/j.1439-0507.2009.01704.x, PMID 19302459.
56. Stopiglia CD, Da Rocha VD, De Carvalho MG, Teixeira H, Von Poser GL, Scroferneker ML. Antifungal activity of *Pterocaulon* species (Asteraceae) against *Sporothrix schenckii*. J Mycol Méd. 2011;21(3):169-72. doi: 10.1016/j.mycmed.2011.07.002, PMID 24451558.
57. Adenubi OT, Fasina FO, Mcgaw LJ, Eloff JN, Naidoo V. Plant extracts to control ticks of veterinary and medical importance: A review. S Afr J Bot. 2016;105:178-93. doi: 10.1016/j.sajb.2016.03.010.
58. Cunha MPV, Alves Neto AF, Suffredini IB, Abel LJC. Avaliação da atividade anti-helmíntica de extratos brutos de plantas da Floresta Amazônica e Mata Atlântica brasileira sobre *Haemonchus contortus*. Arq Bras Med Vet Zootec. 2014;66(2):374-80. doi: 10.1590/1678-41626313.
59. Silva Fdos S, Albuquerque UP, Costa Júnior LM, Lima Ada S, Do Nascimento AL, Monteiro JM. An ethnopharmacological assessment of the use of plants against parasitic diseases in humans and animals. J Ethnopharmacol. 2014;155(2):1332-41. doi: 10.1016/j.jep.2014.07.036, PMID 25072360.
60. Oliveira AF, Costa JLMC, Lima AS, Silva CR, Ribeiro MNS, Mesquista JWC, *et al*. Anthelmintic activity of plant extracts from Brazilian savanna. Vet Parasitol. 2017;236:121-7. doi: 10.1016/j.vetpar.2017.02.005, PMID 28288755.
61. Brito-Junior Ld, Silva MLCR, Lima FHd, Athayde ACR, Silva WW, Rodrigues OG. Estudo comparativo da ação anti-helmíntica da batata de purga (*Operculina hamiltonii*) e do melão de são Caetano (*Mormodica charantia*) em caprinos (*Capra hircus*) naturalmente infectados. Ciênc. agrotec. 2011;35(4):797-802. doi: 10.1590/S1413-70542011000400020.
62. Bortoluzzi BB, Buzatti A, Chaaban A, Pritsch IC, Dos Anjos A, Cipriano RR, *et al*. *Mentha villosa* Hubs, *M*. Vet Parasitol. 2021;289:109317. doi: 10.1016/j.vetpar.2020.109317, PMID 33246235.
63. Ferreira LE, Benincasa BI, Fachin AL, França SC, Contini SSHT, Chagas ACS, *et al*. *Thymus vulgaris* L. essential oil and its main component thymol: Anthelmintic effects against *Haemonchus contortus* from sheep. Vet Parasitol. 2016;228:70-6. doi: 10.1016/j.vetpar.2016.08.011, PMID 27692335.
64. Torres-Fajardo RA, Higuera-Piedrahita RI. *In vivo* anthelmintic activity of terpenes and essential oils in small ruminants. MVZ cordoba. Rev MVZ Córdoba. 2021;26(3):e2317. doi: 10.21897/rmvz.2317.
65. Molento MB. Parasite control in the age of drug resistance and changing agricultural practices. Vet Parasitol. 2009;163(3):229-34. doi: 10.1016/j.vetpar.2009.06.007, PMID 19560869.
66. Lima CS, Pereira MH, Gainza YA, Hoste H, Regasini LO, Chagas ACdS. Anthelmintic effect of *Pterogyne nitens* (Fabaceae) on eggs and larvae of *Haemonchus contortus*: Analyses of structure-activity relationships based on phenolic compounds. Ind Crops Prod. 2021;164:113348. doi: 10.1016/j.indcrop.2021.113348.
67. Monteiro MV, Bevilaqua CM, Morais SM, Machado LK, Camurça-Vasconcelos AL, Campello CC, *et al*. Anthelmintic activity of *Jatropha curcas* L. seeds on *Haemonchus contortus*. Vet Parasitol. 2011;182(2-4):259-63. doi: 10.1016/j.vetpar.2011.04.010, PMID 21890274.
68. Macedo IT, Bevilaqua CM, De Oliveira LM, Camurça-Vasconcelos AL, Vieira Lda S, Oliveira FR, *et al*. Anthelmintic effect of *Eucalyptus staigeriana* essential oil against goat gastrointestinal nematodes. Vet Parasitol. 2010;173(1-2):93-8. doi: 10.1016/j.vetpar.2010.06.004, PMID 20609526.
69. Ribeiro WLC, André WPP, Cavalcante GS, De Araújo-Filho JV, Santos JML, Macedo ITF, *et al*. Effects of *Spigelia anthelmia* decoction on sheep gastrointestinal nematodes. Small Rumin Res. 2017;153:146-52. doi: 10.1016/j.smallrumres.2017.06.001.
70. De Paula CMS, Féboli A, De Laurentiz AC, Da Silva Filardi R, De Oliveira AHP, Andrade E, *et al*. *In vitro* anthelmintic activity of the crude hydroalcoholic extract of *Piper cubeba* fruits and isolated natural products against gastrointestinal nematodes in sheep. Vet Parasitol. 2019;275:08932.
71. De Oliveira TC, Silva DAO, Rostkowska C, Béla SR, Ferro EAV, Magalhães PM, *et al*. *Toxoplasma gondii*: Effects of *Artemisia annua* L. on susceptibility to infection in experimental models *in vitro* and *in vivo*. Exp Parasitol. 2009;122(3):233-41. doi: 10.1016/j.exppara.2009.04.010.
72. RENISUS. Access in 11/30/2022; 2021. Available from: https://www.gov.br/saude/pt-br/composicao/sctie/daf/pnpmf/ppnpmf/arquivos/2014/renisus.pdf.
73. IAC [cited Nov 30 2022] Available from: https://www.iac.sp.gov.br/imagem_informacoestecnologicas/40.pdf.
74. Brasil. Farmacopeia Bras. 2019;II. Plantas Medicinais.
75. Marmitt DJ, Goettert MI, Rempel C. Recent scientific production of garlic (*Allium sativum* L.) confirms important therapeutic properties / A recente produção científica de alho (*Allium sativum* L.) confirma importantes propriedades terapêuticas. Braz J Dev. 2021;7(5):51030-55. doi: 10.34117/bjdv.v7i5.30140.
76. Albuquerque UP, Brito AL, Nascimento ALB, Oliveira AFM, Quixabeira CMT, Dias Dde Q, *et al*. Medicinal plants and animals of an important seasonal dry forest in Brazil. Ethnobiol Conserv. 2020;9:1-53.
77. Regasini LO, Pivatto M, Scorzoni L, Benaducci T, Fusco-Almeida AM, Giannini MJSM, *et al*. Antimicrobial activity of *Pterogyne nitens* Tul., Fabaceae, against opportunistic fungi. Rev bras farmacogn. 2010;20(5):706-11. doi: 10.1590/S0102-695X2010005000017.
78. Meccia G, Quintero P, Rojas LB, Usubillaga A, Velasco J, Diaz T, *et al*. Chemical composition of the essential oil from the leaves of *Carapa guianensis* collected from Venezuelan Guayana and the antimicrobial activity of the oil and crude extracts. Nat Prod Commun. 2013;8(11):1641-2. doi: 10.1177/1934578X1300801135, PMID 24427961.
79. Delices M, Muller JAI, Arunachalam K, Martins DTO. *Anadenanthera colubrina* (Vell) Brenan: Ethnobotanical, phytochemical, pharmacological and toxicological aspects. J Ethnopharmacol. 2023;300:115745. doi: 10.1016/j.jep.2022.115745. PMID 36162548.
80. Carvalho PER. Access in 01/12/2022; 2022. Available from: https://ainfo.cnptia.embrapa.br/digital/bitstream/item/231656/1/Especies-Arboreas-Brasileiras-vol-1-Angico-Gurucaia.pdf.
81. Lima ÉRd, Silva RADd, Pereira GM, Moreira FGL, Silva AdNE, Lichston JE. *Anthurium affine* Schott (Araceae): Análise anatômica e histoquímica para identificação de estruturas secretoras. Rev Ibero Am Ciênc AMB. 2020;11(2):92-8. doi: 10.6008/CBPC2179-6858.2020.002.0011.
82. Araújo SA, Soares AMDS, Silva CR, Almeida Júnior EB, Rocha CQ, Ferreira ATDS, *et al*. *In vitro* anthelmintic effects of *Spigelia anthelmia* protein fractions against *Haemonchus contortus*. PLOS ONE. 2017;12(12):e0189803. doi: 10.1371/journal.pone.0189803:0.1371. PMID 29244856.
83. Valverde SS, Santos BCS, De Oliveira TB, Gonçalves GC, De Sousa OV. Solidagenone from *Solidago chilensis* Meyen inhibits skin inflammation in experimental models. Basic Clin Pharmacol Toxicol. 2021;128(1):91-102. doi: 10.1111/bcpt.13479, PMID 32780565.
84. Figueiredo YG, Corrêa EA, De Oliveira Junior AH, Mazzinghy ACDC, Mendonça HDOP, Lobo YJG, *et al*. Profile of *Myracrodruon urundeuva* volatile compounds ease of extraction and biodegradability and *in silico* evaluation of their interactions with

COX-1 and iNOS. Molecules. 2022;27(5):1633. doi: 10.3390/molecules27051633, PMID 35268733.

85. Al-Khayri JM, Sudheer WN, Lakshmaiah VV, Mukherjee E, Nizam A, Thiruvengadam M, *et al*. Biotechnological approaches for production of artemisinin, an anti-malarial drug from *Artemisia annua* L. Molecules. 2022;27(9):3040. doi: 10.3390/molecules27093040, PMID 35566390.
86. Walker CI, Trevisan G, Rossato MF, Silva CR, Pinheiro FV, Franciscato C, *et al*. Antinociceptive effect of *Mirabilis jalapa* on acute and chronic pain models in mice. J Ethnopharmacol. 2013;149(3):685-93. doi: 10.1016/j.jep.2013.07.027, PMID 23906783.
87. Moreno-Velasco A, Flores-Tafoya PJ, Fragoso-Serrano M, Leitão SG, Pereda-Miranda R. Resin glycosides from *Operculina hamiltonii* and their synergism with vinblastine in cancer cells. J Nat Prod. 2022;85(10):2385-94. doi: 10.1021/acs.jnatprod.2c00594, PMID 36162138.
88. Volpato G, Godínez D, Beyra A, Barreto A. Uses of medicinal plants by Haitian immigrants and their descendants in the Province of Camagüey, Cuba. J Ethnobiol Ethnomed. 2009;5:16. doi: 10.1186/1746-4269-5-16, PMID 19450279.
89. Silva FdO, Oliveira ÍRd, Silva MGdV, Braz-Filho R Constituintes químicos das folhas de *Senna spectabilis* (DC) Irwin and Barneby var. excelsa (Schrad.) Irwin and Barneby. Quim Nova. 2010;33(9):1874-6. doi: 10.1590/S0100-40422010000900010.
90. Schorderet WS, Kaminski KP, Perret JL, Leroy P, Mazurov A, Peitsch MC, *et al*. Antiparasitic properties of leaf extracts derived from selected *Nicotiana* species and *Nicotiana tabacum* varieties. Food Chem Toxicol. 2019;132:110660. doi: 10.1016/j.fct.2019.110660, PMID 31276744.
91. Costa NDJ, Oliveira SFC, Silva JN, Pacheco ACL, Abreu MC, Cavalcante AACM, *et al*. Potencial terapêutico e tecnológico da planta *Calotropis procera*. RGEINTEC. 2015;5(3):2222-36. doi: 10.7198/S2237-0722201500030001.
92. Staiger C. Comfrey: A clinical overview. Phytother Res. 2012;26(10):1441-8. doi: 10.1002/ptr.4612, PMID 22359388.
93. Revilla J. Plantas úteis da Bacia Amazônica. mais v.2. Manaus: INPA; 2002;1:858 p.
94. Nunes M, Lucena C, Da Costa FE, Carvalho T, Pedrosa K, Nascimento A, *et al*. Utilização medicinal de espécies da família Cactaceae no semiárido do Brasil: Um estudo de caso na Paraíba. Rev Bras Gestão AMB Sustent. 2021;8(18):593-609. doi: 10.21438/rbgas(2021)081839.
95. Silva RRS. O uso da lectina de *Parkia platycephala* como moduladora da atividade antibiótica e no controle de nematóides gastrointestinais de ruminantes. Masters in Science. Available from: https://tedebc.ufma.br/jspui/handle/tede/tede/3276 [dissertation]. São Luís, Brazil: Universidade Federal do Maranhão; 2020.
96. Coradin L, Siminski A, Reis A. Espécies nativas da flora. Valor econômico atual ou potencial. *EMBRAPA*. 2011. https://www.alice.cnptia.embrapa.br/bitstream/doc/906729/1/6526.pdf. Available from: Brasileira.de.
97. De Oliveira AM, Widmer R, Do Nascimento MF, Costa WK, Paiva PMG, Napoleão TH. Flavonoid-rich fraction from *Croton blanchetianus* (Euphorbiaceae) leaves exerts peripheral and central analgesic effects by acting via the opioid and cholinergic systems. Chem Biodivers. 2022;19(3):e202100853. doi: 10.1002/cbdv.202100853, PMID 34990049.
98. Xu B, Li Z, Zeng T, Zhan J, Wang S, Ho CT, *et al*. Bioactives of *Momordica charantia* as potential anti-diabetic/hypoglycemic agents. Molecules. 2022;27(7):2175. doi: 10.3390/molecules27072175, PMID 35408574.
99. Ceravolo IP, Zani CL, Figueiredo FJB, Kohlhoff M, Santana AEG, Krettli AU. *Aspidosperma pyrifolium*, a medicinal plant from the Brazilian caatinga, displays a high antiplasmodial activity and low cytotoxicity. Malar J. 2018;17(1):436. doi: 10.1186/s12936-018-2568-y, PMID 30477525.
100. Yang X, Bai ZF, Zhang Y, Cui H, Zhou HL. Flavonoids-rich extract from *Bidens bipinnata* L. protects pancreatic β-cells against oxidative stress-induced apoptosis through intrinsic and extrinsic pathways. J Ethnopharmacol. 2021;275:114097. doi: 10.1016/j.jep.2021.114097, PMID 33823164.
101. Santos MC, Toson NSB, Pimentel MCB, Bordignon SAL, Mendez ASL, Henriques AT. Polyphenols composition from leaves of *Cuphea* spp. and inhibitor potential, *in vitro*, of Angiotensin I-converting Enzyme (ACE). J Ethnopharmacol. 2020;255:112781. doi: 10.1016/j.jep.2020.112781, PMID 32209389.
102. Di Liberto M, Svetaz L, Furlán RL, Zacchino SA, Delporte C, Novoa MA, *et al*. Antifungal activity of saponin-rich extracts of *Phytolacca dioica* and of the sapogenins obtained through hydrolysis. Nat Prod Commun. 2010;5(7):1013-8. doi: 10.1177/1934578X1000500705, PMID 20734930.
103. Sargeant JM, Plishka M, Ruple A, Selmic LE, Totton SC, Vriezen ER. Quality of reporting of clinical trials in dogs and cats: An update. J Vet Intern Med. 2021;35(4):1957-71. doi: 10.1111/jvim.16204, PMID 34184331.

Cite this article: Suffredini IB, Arruda JR, Rodrigues CAFSTP, Carvalho BRR, Rodrigues KFS, Bonamin LV. The Brazilian Ethnoveterinary Analyzed by the *One World-One Health™* Perspective. J. Sm. Pharmacog Rev. 2023;17(34):262-75.