Animal-based remedies as complementary medicines in Santa Cruz do Capibaribe, Brazil

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Abstract

Background: The use of animal products in healing is an ancient and widespread cross-cultural practice. In northeastern Brazil, especially in the semi-arid region, animals and plants are widely used in traditional medicine and play significant roles in healing practices. Zootherapies form an integral part of these cultures, and information about animals is passed from generation to generation through oral folklore. Nevertheless, studies on medicinal animals are still scarce in northeastern Brazil, especially when compared to those focusing on medicinal plants. This paper examines the use and commercialization of animals for medicinal purposes in Brazil's semi-arid caatinga region.

Methods: Data was obtained through field surveys conducted in the public markets in the city of Santa Cruz do Capibaribe, Pernambuco State, Brazil. We interviewed 16 merchants (9 men and 7 women) who provided information regarding folk remedies based on animal products.

Results: A total of 37 animal species (29 families), distributed among 7 taxonomic categories were found to be used to treat 51 different ailments. The most frequently cited treatments focused on the respiratory system, and were mainly related to problems with asthma. Zootherapeutic products are prescribed as single drugs or are mixed with other ingredients. Mixtures may include several to many more valuable medicinal animals added to other larger doses of more common medicinal animals and plants. The uses of certain medicinal animals are associated with popular local beliefs known as 'simpatias'. We identified 2 medicinal species (Struthio camelus and Nasutitermes macrocephalus) not previously documented for Brazil. The use of animals as remedies in the area surveyed is associated with socio economic and cultural factors. Some of the medicinal animal species encountered in this study are included in lists of endangered species.

Conclusion: Our results demonstrate that a large variety of animals are used in traditional medicinal practices in Brazil's semi-arid northeastern region. In addition to the need for pharmacological investigations in order to confirm the efficiency of these folk medicines, the present study emphasizes the importance of establishing conservation priorities and sustainable production of the various medicinal animals used. The local fauna, folk culture, and monetary value of these activities are key factors influencing the use and commercialization of animal species for therapeutic purposes.
Background
Plants and animals have been used as medicinal sources since ancient times [1-4], and even today animal and plant-based pharmacopeias continue to play an essential role in world health care [5]. The use of biological resources for various therapies has been documented in many different parts of the world – but largely in remote regions, where traditional medicines provide a de facto alternative to “modern” health care systems [6-12]. Recent studies, however, have highlighted the relevant role also played by traditional medicine in urban areas [13-19] where health care needs are generally met by mainstream services such as hospitals and allopathic pharmacies [16].

Although plants and plant-derived materials make up the majority of ingredients used in most traditional medical systems, whole animals, animal parts, and animal-derived products (e.g., urine, fat, etc.) also constitute important elements of the folk pharmacopoeia throughout the world. Indeed, zootherapy (the use of animal products in healing) is an ancient and widespread practice across most cultures [3,20]. Traditional medicine still makes use of animals and products derived from animal organs [1], and examples of the use of animal-derived remedies can currently be found in many urban, semi-urban, and more remote localities in all parts of the world [9,10,21-26].

Biological remedies are openly commercialized in essentially all of the towns and cities in Brazil, principally in public markets. It is common to find specific places in these markets where plants and animals are sold for medicinal purposes – locations that serve to unite, maintain, and diffuse empirical knowledge from different regions and of different origins [11,13,16,18,19,22,24,25,27-30]. The on-going search for natural products, as part of a collective social strategy, emphasizes the importance of these traditional centers. However, despite their cultural relevance, few ethnomedical and ethno-zoological studies have focused on herbal vendors in public and/or open markets [9,31]. Almeida and Albuquerque [22] have pointed out that the information obtained in these markets concerning the exotic and the native flora and fauna may aid in formulating conservation strategies for commercialized natural resources.

In northeastern Brazil, especially in the semi-arid region, animals and plants are widely used in traditional medicine and play a significant role in healing practices there [9,10,16,24]. Zootherapies form an integral part of the local culture, and information about animals and their uses are passed from generation to generation through oral folklore. Studies on medicinal animals, however, are still scarce when compared to those focusing on medicinal plants. The present work therefore sought to contribute to our knowledge of the medicinal animals used by the inhabitants of the caatinga region in northeastern Brazil. The caatinga is a highly threatened biome covering a vast area of Brazil, and is the source of many little-known natural resources [32,33]. About 15% of the Brazilian population (more than 25 million people [34] lives in the caatinga region and the rural populations there are characterized by extreme poverty [35]. Because of the adverse environmental condition in the region the local populations have developed unique social-environmental structures as well as strong relationships with the natural resources available in the region, including those used for medicinal purposes.

The use of medicinal plants and animals in the semi-arid region has a strong relation with socioeconomic factors, as a large part of the human populations living there do not have access to adequate health services and use phytotherapeutic and zootherapeutic products as easily accessible and low-cost alternatives to medicines sold in commercial pharmacies [11,36]. The gathering and selling of these products is also compatible with popular traditions, and can even generate some income.

In this context, the present study surveyed the medicinal animals sold in public markets in Santa Cruz do Capibaribe, Pernambuco State, in the semi-arid region of northeastern Brazil. The study primarily focused on field surveys to address the following questions: which animal species are used for medicinal purposes? Which animal body parts are used to prepare these remedies? What are the illnesses treated by these remedies? By highlighting the role played by animal-based remedies in Brazil’s semi-arid northeastern region we hope to increase awareness about zootherapeutic practices and contribute to the conservation of both cultural and biological diversity.

Methods
Study site
The municipal district of Santa Cruz do Capibaribe (07° 57’ 27” S x 36° 12’ 17” W) is located in Pernambuco State, Brazil, in the microregion of Alto do Capibaribe (Figure 1). The municipality has an area of about 336 km² and is located 194 km from the state capital of Recife. According to the Brazilian Institute of Geography and Statistics (IBGE), the population there was 59,048 inhabitants in 2000, with 57,226 living in the urban zone, and 1,822 in rural areas. Recent data indicates that the population has increased to about 73,700 inhabitants [37], however, and according to the IBGE this city grew more than any other in the state during the last ten years. The principal economic activities in the municipality are manufacturing and commerce, with a major potential for growth in garment production. The health services in the municipality include two hospitals and 32 Community Health Agents.
According to the Brazilian Ministry of Mines and Energy (MME) the regional vegetation is basically composed of hyperxerophilous caatinga, with some remnant patches of deciduous forest. The climate there is tropical semi-arid with summer rains [38]. The city is located in the Capibaribe River basin (the most important in Pernambuco State).

**Procedures**

Fieldwork was carried out during the period from May 2007 to October 2007, when public markets were visited in Santa Cruz do Capibaribe. We interviewed 16 merchants (9 men and 7 women) about the use and commercialization of medicinal animals (essentially all of the merchants dealing with animals for medicinal purposes in the city). The sampling method was non-random, and the interviewees were pre-selected [39]. The interviewees ranged in age from 46 to 65 years (average age 56) and all had low degrees of formal education. Essentially all of the interviewees acknowledged earning the Brazilian minimum wage (R$ 380 = USD 211) or less. The collected data through semi-structured interviews was complemented by free-interviews [40], and the informants were requested to furnish the vernacular name, folk use, parts used, and the mode of preparation as well as administration of the remedies made from each type of animal they sold. The ethical approval for the study was obtained from the Ethics committee of Paraiba University State.

Vernacular names of the species cited were carefully noted during the interviews. Zoological material was identified with the aid of specialists through (a) the examination of voucher specimens donated by the interviewees or purchased at the surveyed markets, or (b) photographs of the animal species or their parts taken during interviews. Whenever necessary, procedures (a) and (b) were supplemented by checking the vernacular names provided by the shop owners against scientific names indicated by taxonomists familiar with the study area. Voucher specimens and/or photographs were deposited with the Department of Systematics and Ecology, Universidade Federal da Paraíba.

**Results and Discussion**

Animals have been used for medicinal purposes since colonial times in Brazil [11] and they still play a significant role in current folk healing practices. Various publications have shown the importance of zootherapy to traditional communities in various socio-cultural environments in Brazil [11,41-44], and the commercialization of the medicinal animals in various Brazilian cities has been documented by numerous authors [16,18,22,24,45,46].

In Santa Cruz do Capibaribe, as in other cities in Brazil, plants and animals are sold for medicinal purposes in traditional public markets. Table 1 summarizes the names (vernacular and scientific) of medicinal animals, the parts used, ailments treated, and the mode of preparation and/
Table 1: Animals species used in popular medicine in the municipality of Santa Cruz do Capibaribe, Pernambuco State, Brazil.

| Family/species/local name | Number of citation | Part used and mode of administration | Disease (or illness) |
|---------------------------|--------------------|--------------------------------------|---------------------|
| **Insects**               |                    |                                      |                     |
| Apidae                    |                    |                                      |                     |
| *Apis mellifera* (Linnaeus, 1758) – Africanised honey bee, "abelha italiana" | 1 | Honey (3) | Cough, catarrh |
| *Frieseomelitta vono* (Lepeletier, 1836) – Bee, "Abelha moça branca" | 1 | Honey (4) | Gonorrhea |
| *Melipona scutellaris* (Laserre, 1811) – a stingless bee, "uruçu" | 3 | Honey (3, 4) | Fatigue (3, 4), Cancer (3), Weakness (3), Sexual problems (3), Cough (3) |
| *Partamona cupira* (Smith) – a stingless Bee, "Abelha cupira" | 3 | Honey (1, 4), Bee wax (11) | Leucoma, "Slightly clean", Cuts, Wounds, Cough, Catarrh, "toady" (Fungal buccal Infection), Sinusitis, Effusion (11) |
| *Scaptotrigona* sp. – Bee, "Abelha canudo" | 1 | Honey (3) | Hernia |
| *Tetragonisca angustula* Laterille, 1811 – Bee, "Abelha jati" | 1 | Honey (1) | "Ervilhida" (Leucoma) |
| *Trigona spinipes* (Fabricius, 1793) – a stingless bee, "arapuá" | 3 | Honey (4) | Fatigue, effusion |
| **Termitidae**            |                    |                                      |                     |
| *Nasutitermes macrocephalus* (Silvestri, 1903) – Termite, "Cupim de aroeira" | 1 | Whole animal (3) | Asthma |
| **Blattidae**             |                    |                                      |                     |
| *Periplaneta americana* (Linnaeus, 1758) – American cockroach, "barata" | 1 | Whole animal (17) | Avoiding pregnancy |
| **Muscidae**              |                    |                                      |                     |
| *Musca domestica* (Linnaeus, 1758) – House fly, "Mosca" | 1 | Whole animal (16) | Hair erysipelas |
| **Echinoderms**           |                    |                                      |                     |
| *Oreaster reticulatus* (Linnaeus, 1758) – Starfish, "estrela-do-mar" | 1 | Whole animal (12) | Asthma |
| **Fish**                  |                    |                                      |                     |
| *Hoplias malabaricus* (Bloch, 1794) – Trahira, "traíra" | 1 | Fat (4) | Sore throat |
| *Hippocampus reidi* (Ginsburg, 1933) – Longsnout seahorse, "cavalo-marinho" | 2 | Whole animal (12, 19) | Asthma |
| **Amphibians**            |                    |                                      |                     |
| *Rhinella jimi* (Stevaux, 2002) | 2 | Secretions (14), Fat | Gastritis (14), cancer (4, 14) |
| **Reptiles**              |                    |                                      |                     |
| *Caiman latirostris* (Daudin, 1801) – Cayman, "jacaré-do-papo-amarelo" | 1 | Leather (13) | Epilepsy |
| *Chelidae*                |                    |                                      |                     |
| *Iguana iguana* (Linnaeus, 1758) – Common Iguana, "Camaleão" | 2 | Fat (1) | Body aches, wounds |
| *Teiidae*                 |                    |                                      |                     |
| *Tupinambis merianae* (Duméril & Bibron, 1839) – Teju lizard, "tegu", "tejuaçu" | 5 | Fat (1, 4) | Wounds (1), sore throat (1,4), earache (1), perforation (1) |
| *Testudinidae*            |                    |                                      |                     |
| *Chelonoidis denticulata* (Linnaeus, 1766) – Yellow-footed tortoise, "jabuti" | 1 | Urine (1), Fat (4) | Ear ache (1), asthma (4), pains (1) |
| *Viperidae*               |                    |                                      |                     |
| *Crotalus durissus Linnaeus, 1758 – South American rattlesnake, "Cascavel" | 6 | Fat (1, 4) | Rheumatism, swellings, Cancer, Bone aches, Gastritis, eczema, wounds, backache |
| **Birds**                 |                    |                                      |                     |
| *Anas platyrhynchos* Linnaeus, 1758 – Mallard, "Pata" | 1 | Eggs (6) | General weaknesses, Sexual weakness, nervous disturbances |
| *Ciconiidae*              |                    |                                      |                     |
| *Coragyps atratus* (Bechstein, 1793) – Black vulture, "Urubu" | 1 | Feather and liver (15) | Alcoholism |
Table 1: Animals species used in popular medicine in the municipality of Santa Cruz do Capibaribe, Pernambuco State, Brazil.

(Continued)

| Family – Not Identified | Number | Used For                                      |
|-------------------------|--------|----------------------------------------------|
|                       |        | Beliefs ("simpatia") (20) Asthma             |

Mammals

Bovidae

- Bos taurus Linnaeus, 1758 – Domestic cattle, "Boi" 1
- Ovis aries Linnaeus, 1758 – Sheep, "Carneiro" 5

Canidae

- Canis dingo (Linnaeus, 1766) – Crab-eating Fox, "Raposa" 1

Caviidae

- Cavia porcellus Linnaeus, 1758 – Rock cavy, "Mocó" 1

Dasyppodidae

- Euphractus sexcinctus (Linnaeus, 1758) – Six-banded Armadillo, "Tsatu-peba" 1

Equidae

- Equus asinus Linnaeus, 1758 – Donkey, "burro" 1

Erethizontidae

- Coendou prehensilis (Linnaeus, 1758) – Brazilian porcupine, "Espinho de Gandú", "Porco-espinho" 1

Mephitidae

- Conepatus semistriatus (Boddart, 1785) – Striped hog-nosed skunk, "Tatu-peba" 2

Legend: (1) Rubbed on the affected area; (2) ingestion of the roasted animal (or parts of it); (3) a beverage ("lambédo") prepared by mixing medicinal plants with honey; (4) ingestion; (5) tea; (6) beverage (energetic drink) obtained by mixing 1 egg of Anas platyrhynchos, 1 pinch of cinnamon, 4 spoonfuls of Uruçú honey (a species of stingless bee), and 1 cup of guarana. The drink should be consumed during 9 days; (7) Mixed with coffee; (8) Put inside half of a bell pepper and then placed on the area to be treated; (9) Scratch the ear with an armadillo tail; (10) This material is prepared by mixing feathers with the cupira wax to be used as incense that will emit "medicinal" odors; (11) Similar to the item 10, but the incense is made only inside half of a bell pepper and then placed on the area to be treated; (12) Toasted and macerated in order to produce a "powder" to be mixed with honey (of any bee) and then applied on the offended area; (13) The rasps should be ingested; (14) Extracted from the poison glands, and 1 teaspoon is taken (approximately 5 ml) everyday in the morning; (15) It is believed that the feather quill (calamin) toasted together with the animal’s liver and then eaten will inhibit the consumption of alcoholic beverages; (16) Mixed with the coconut oil (Cocos nucifera L) and applied to the affected area; (17) Toasted and macerated in order to produce a "powder" to be mixed with honey (of any bee) and then ingested; (18) Start speaking (18), rheumatism, "water in the knee" or use. A total of 37 species distributed among 29 families were reported as having medicinal value by the shop owners. The taxonomic group with the largest number of animal species was insects (with 10 species), followed by birds (9), mammals (8), and reptiles (6). Other groups mentioned by the interviewees were fish (2), echinoderms (1), and amphibians (1).

The number of species mentioned in this study was quite expressive, nearing or exceeding the numbers of species sold for medicinal purposes in studies undertaken in other regions of Brazil. Almeida and Albuquerque [22] registered 19 medicinal species in research carried at in Caruaru, Pernambuco; Silva et al. [24] reported the trade of 18 medicinal animals in Recife, Pernambuco, and Costa-Neto [27] and Andrade and Costa-Neto [47] reported the trade of raw materials derived from 16 species in Feira de Santana, Bahia. In the public markets of Maceió, Alagoas State, Freire [48] encountered 17 reptile species commercialized for medicinal purposes (this author worked exclusively
with that group). In work carried out in metropolitan areas of northern and northeastern Brazil, Alves and Rosa [16] reported the use and trade of 50 medicinal animal species in Belém (Para State), 61 in São Luís (Maranhão State), 27 in Teresina (Piauí State), and 28 in João Pessoa (Paraiba State). These results indicate that the use of medicinal animals is widespread in probably all urban areas of Brazil.

Most of the animals cited are species native to the caatinga biome (only 6 were domestic), demonstrating the importance of the local fauna to regional zootherapeutic practices. This observation is in agreement with previous studies carried out in Brazil that demonstrated that the diversity of medicinal animals used by human populations is influenced by animal diversity in the regional environment [9,10,16]. A similar situation was observed in an examination of the trade in medicinal plants in Witwatersrand, South Africa, where there was found to be a greater use and trade of species collected in biomes near the public markets and of species common in biomes familiar to the commercial gatherers. These authors concluded that the use and trade of medicinal species tends to be proportional of their availability [49].

Only two of the medicinal species cited, the sea horse Hippocampus reidi (Ginsburg, 1933) and the star-fish Oreaster reticulatus (Linnaeus, 1758), do not occur in the area near Santa Cruz do Capibaribe. The use of an oceanic species in the midst of the semi-arid region indicates existence of trade routes for medicinal animals, a situation previously reported by Alves and Rosa [16] for cities in northern and northeastern Brazil. The existence of trade routes is reinforced by the fact that many of the species registered in this study are known to be commercialized in other cities in the country [22,24,27,48]. The present work also identified two medicinal species (Strathio camelus Linnaeus, 1766 and Nasutitermes macrocephalus (Silvestri, 1903) not previously documented as being used in Brazil. The toasted egg shells of S. camelus are used to treat osteoporosis, and the termite N. macrocephalus is used to treat asthma.

The interviewees indicated that the following animal parts/products are used as folk remedies: honey, bee wax, fat, secretions, leather, urine, eggs, feathers, nests, blood, marrow, horns, suet, manure, hooves, spines (from porcupines), and meat. A considerable number of species (17) have multiple therapeutic uses, and were prescribed to treat various ailments. The fat of the Tupinambis merianae (Duméril & Bibron, 1839), for instance, is indicated for treating four health problems (wounds, sore throats, earaches, perforations). The fat of Crotalus durissus Linnaeus, 1758, is indicated for treating rheumatism, swelling, cancer, bone pain, gastritis, eczema, wounds, and backaches; while the chicken fat of Gallus gallus domesticus (Linnaeus, 1758) was mentioned as being useful for treating renal calculi, headaches, throat inflammations, nasal congestion, fevers, and general swelling. Similar usages have been reported in other traditional medicine systems as, for example, the carapace and tail of the armadillo Dasypus novemcinctus (Linnaeus, 1758) are used to treat diarrhea, tuberculosis, and whooping cough, and to accelerate parturition in Mexico [26]. The fat, skin, and bile ducts of the land monitor Varanus bengalensis (Daudin, 1758) are used for treating piles, rheumatism, burns, and spider and snake bites in India [50]. In Bolivia, products derived from the Agouti paca (Linnaeus, 1766) are used as remedies for general body pain, leishmaniasis, snakebites, rheumatism, heart pain, bone pain, liver pain, fever, and to alleviate pain during childbirth [23].

Honey bee products and fats (and/or suet) are the most frequently used natural resources, although there have been no reports emphasizing the intensive use of fats and suet as zootherapeutic medicines. This may be due to the fact that the animals used for medicinal purpose are generally vertebrates with significant amounts of fatty tissue that is easy to obtain, store, and transport.

According to the interviewees, zootherapeutic products are used to treat at least 51 different maladies. The most frequently cited treatments are therapies for the respiratory system – and are mainly related to asthma. A similar situation was described by Costa-Neto [27] with regards to the use of medicinal animals in Feira de Santana, Brazil, where animal-based remedies are frequently used to treat respiratory diseases (asthma and bronchitis). Alves and Rosa [51] likewise pointed out that at a minimum of 113 animal species are used in Brazilian traditional medicine for treating asthma. A similar trend in relation to medicinal plants was observed in Pernambuco, where the two most frequent use-categories referred to gastrointestinal and respiratory diseases [52].

The interviewees described many different ways of preparing and administering animal-based remedies. Hard parts generally were sun-dried, grated, and crushed to a powder, to be administered in teas or eaten during meals. Fats, body secretions, and oils were ingested directly or used as ointments. Zootherapeutic products can be prescribed as single-ingredient drugs or mixed with other ingredients. In mixtures, several to many of the more valuable medicinal animal components are mixed with other more available medicinal animal or plant ingredients in more liberal quantities.

The use of some medicinal animals is associated with popular beliefs locally known as ‘simpatias’. These ‘simpatias’ are often secretive in nature, so that the people receiv-
ing the treatment cannot know what that they are taking, otherwise the remedy will not be effective. This popular belief is commonly associated with the use of medicinal animals in Brazil [11]. Other interesting examples recorded in present study are associated with the use of the tail of *Euphractus sexcinctus* (Linnaeus, 1758) to cure deafness – by simply scratching the ear with the tail; and the use of a living specimen of *Cyanocorax cyanopogon* (Wied-Neuwied, 1821) to ingest left-over food from an asthmatic patient, who will then be cured, according to a local belief. This observation is in line with information provided by Alves et al. [11] who pointed out that traditional Brazilian medicine is often associated with local belief systems of *símpatias*, and these popular beliefs may have different implications depending on the manner in which the animal species are used (either dead or alive) and the community’s traditions.

Some of the medicinal species cited by interviewees in Santa Cruz do Capibaribe have also been recorded in more distant regions. The honey of *Apis mellifera* (Linnaeus, 1758), for example, is indicated for treating coughs in Brazil and is used for the same purpose in Sudan [53]. Lev [1] reported that the honey of *Apis mellifera* (Linnaeus, 1758) is used in the traditional medicine of Israel as a purgative, and to treat eye inflammations, sore throats, burns, and coughs. Honey from *Melipona scutellaris* Latreille, 1811, was mentioned as a treatment for cancer, fatigue, sexual problems, coughs, and general weakness. This same product was also reported by Costa-Neto [54] as being used as a tonic by residents of Bahia State, Brazil. In Paraíba State in northeastern Brazil, the fat of *Iguana iguana* (Linnaeus, 1758) is used for treating wounds in the local traditional of veterinary medicine [55]. *Ovis aries* (Linnaeus, 1758), a species broadly utilized by the population of Santa Cruz for treating various illnesses, was also previously reported by Costa-Neto and Oliveira [56], Almeida and Albuquerque [22] and Alves and Rosa [9,10]. These examples confirm the knowledge and use of zootherapeutics in different parts of Brazil and around the world.

The present study also noted that some endangered species of medicinal animals (e.g. *H. reidi*) are widely traded. As such, the social use of the biodiversity in mega-diverse countries such as Brazil is crucial to considerations of conservation biology, public health policies, sustainable management of natural resources, and biological prospecting [10] – and there is a great need to stimulate local populations, herbalists, and medicinal animal merchants to adopt conservation measures that avoid over-exploitation, so that the use of these species will not lead to their extinction and the permanent loss of access to their medicinal products.

**Conclusion**

Our studies indicated that 37 medicinal animals were being traded in the public markets of Santa Cruz do Capibaribe, and that the zootherapeutic products extracted from them are used to treat 51 ailments – thus indicating the very rich ethnomedical knowledge of the local population in relation to zootherapy. Zootherapy represents an alternative to official medicinal practices in the semi-arid region of northeastern Brazil, and has also become part of urban popular medicine. The local fauna, folk cultures, and the commercial value of these activities are key factors in maintaining and driving the use and commerce of animal species for therapeutic purposes. The lack of monitoring programs or any sort of regulation of this industry in troublesome, however, and argues for undertaking multidisciplinary studies to investigate the social, cultural, economic, clinical, and environmental aspects of these activities to increase our understanding of the use of these medicinal animals and help establish workable management strategies to conserve these zootherapeutic resources.

**Competing interests**

The authors declare that they have no competing interests.

**Authors’ contributions**

RRNA, AV, RRDB and WMSS – Writing of the manuscript, literature survey and interpretation; HNL and MCT- Ethnozoological data, literature survey and interpretation; RRNA and AV – Analysis of taxonomic aspects. All authors read and approved the final manuscript.

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**References**

1. Lev E: Traditional healing with animals (zootherapy): mediev al to present-day Levantine practice. *Journal of Ethnopharmacology* 2003, 85:107-118.
2. Yesilada E: Past and future contributions to traditional medi cine in the health care system of the Middle-East. *Journal of Ethnopharmacology* 2005, 100(1–2):135-137.
3. Alves RRN, Rosa IL: Why study the use of animal products in traditional medicines? *Journal of Ethnobiology and Ethnomedicine* 2005, 1:1-5.
4. Alves RRN, Rosa IL: Biodiversity, traditional medicine and public health: where do they meet? *Journal of Ethnobiology and Ethnomedicine* 2007, 3:1-9.
5. Chivian E: Biodiversity: Its Importance to Human Health. Cambridge, USA: Center for Health and the Global Environment. Harvard Medical School; 2002.
6. Robineau L, Soejarto DD: TRAMIL: a research project on the medicinal plant resources of the Caribbean. In Medicinal Resources of the Tropical Forest: Biodiversity and Its Importance to Human Health 1st edition. Edited by: Balick MJ, Elisabetsky E, Laird SA. New York: Columbia University Press; 1996:317-325.
7. Agra MF, Baracho GS, Núrit K, Basilio JLD, Coelho VPM: Medicinal and poisonous diversity of the flora of “Cariri Paraibano”, Brazil. *Journal of Ethnopharmacology* 2007, 111:383-395.
8. Uniyal SK, Singh KN, Jamwal P, Lal B: Traditional use of medicinal plants among the tribal communities of Chhota Bhangal, Western Himalaya. Journal of Ethnobiology and Ethnomedicine 2006, 2:1-8.

9. Alves RRN, Rosa IL: From cnidarians to mammals: The use of animals as remedies in fishing communities in NE Brazil. Journal of Ethnopharmacology 2006, 107:259-276.

10. Alves RRN, Rosa IL: Zootherapeutic practices among fishing communities in North and Northeast Brazil: A comparison. Journal of Ethnopharmacology 2007, 111:82-103.

11. Alves RRN, Rosa IL, Santana GG: The Role of Animal-derived Remedies as Complementary Medicine in Brazil. Biological Science 2007, 57:99-105.

12. Alves RRN, Pereira Filho GA, Lima YCC: Snakes used in ethnomedicine in Northeast Brazil. Environment, Development and Sustainability 2007, 9:455-464.

13. Albuquerque UP, Lucena RFP: Medicinal and 'ethnomedicinal' fishes in a public market in northeastern Brazil. Journal of Ethnopharmacology 2007, 110:76-91.

14. Balick MJ, Kronenberg F, Osofski AL, Reiff M, Fugh-Berman A, O’Connor B, Roble M, Lohr P, Atia D: Medicinal plants used by Latino healers for women’s health conditions in New York City. Economic Botany 2007, 54:344-357.

15. Balick MJ, Reiff M, O’Connor B, Kronenberg F, Lohr P, Roble M, Fugh-Berman A, Johnson KD: Ethnomedicine in the urban environment: Dominican healers in New York City. Human Organization 2003, 62:1226.

16. Alves RRN, Rosa IL: Zootherapy goes to town: The use of animal-based remedies in urban areas of NE and N Brazil. Journal of Ethnopharmacology 2007, 113:541-555.

17. Maca MJ, Garcia E, Vidaloure P: An ethnobotanical survey of medicinal plants commercialized in the markets of La Paz and El Alto, Bolivia. Journal of Ethnopharmacology 2005, 97(2):337-350.

18. Alves RRN, Santana GG: Use and commercialization of Podocnemis expansa (Schweiger 1812) (Testudines: Podocnemididae) for medicinal purposes in two communities in North Brazil. Journal of Ethnobiology and Ethnomedicine 2008, 4(3):1-6.

19. Alves RRN, Rosa IML: Use of tucuxi dolphin Sotalia fluviatilis for medicinal and magic religious purposes in North of Brazil. Human Ecology 2008, 37:443-447.

20. Alves RRN, Pereira-Filho GA: Zootherapy: a worldwide review. [http://libdoc.who.int/hq/2001/WHO_EDM_TRM_2001.2.pdf]

21. Sodeinde OA, Soewu DA: Pilot study of the traditional medicine trade in Nigeria. Traffic Bulletin 1999, 18(1):35-40.

22. Almeida CFCBR, Albuquerque UP: Uso e conservação de plantas e animais medicinais no Estado de Pernambuco (Nordeste do Brasil): Um estudo de caso. Intercoce 2002, 27:276-285.

23. Apaza L, Godoy R, Willkie D, Byron E, Huanca O, Leonard WL, Peréz E, Reyes-García V, Vázquez V: Markets and the use of wild animals for traditional medicine: a case study among the Tsimane’ Amerindians of the Bolivian rain forest. Journal of Ethnobiology 2003, 23:47-64.

24. Silva MLV, Alves AGC, Almeida AV: A zooterapia no Recife (Pernambuco): uma falaçia entre as prácticas e a historia. Biotemas 2004, 17:95-116.

25. Alves RRN, Pereira-Filho GA: Commercialization and use of snakes in North and Northeastern Brazil: implications for conservation and management. Biodiversity and Conservation 2007, 16:269-295.

26. Vázquez PE, Méndez RM, Guisacon OGR, Piñeira EJN: Uso medicinal de la fauna silvestre en los Altos de Chiapas, México. Intercoce 2006, 31:491-499.

27. Costa NETO EM: Healing with animals in Feira de Santana City, Bahia, Brazil. Journal of Ethnopharmacology 1999, 65:225-230.

28. Dourado ER, Doca KNP, Araujo TCC: Comercialização de plantas medicinais por “raizeiros” na cidade de Anápolis-GO. Revista Eletrônica de Farmácia 2005, 2(2):67-69.

29. Heiden G, Macías L, Bobrowski VL, Ignaci JRV: Comercialização de carqueja por ervateiros da zona central de Pelotas, Rio. Revista de Biologia e Ciências da Terra 2006, 6:50-57.

30. Alves RRN, Silva AAG, Souto WMS, Barboza RRD: Utilização e Comércio de Plantas Medicinais em Campina Grande, PB, Brasil. Revista Eletrônica de Farmácia 2007, 4:175-198.

31. Jain SK: Human aspects of plant diversity. Economic Botany 2000, 54:459-470.

32. Albuquerque UP, Andrade LHC: Uso de recursos vegetais da caatinga: o caso do Agreste do Estado de Pernambuco (Nordeste do Brasil). Intercoce 2002, 27:336-346.

33. Araújo EL, Castro CC, Albuquerque UP: Dynamics of Brazilian Caatinga – A Review Concerning the Plants, Environment and People. Ecological Systems and Communities 2007, 1:15-28.

34. Mittermeier RA, Mittermeier CG, Robles Gil P, Pilgrim J, Fonseca GAB, Brooks T, Konstant WR, Eds: Wilderness: earth’s last wild places. 2nd edition. Mexico City: Cemex; 2002.

35. Sampaio Y, Batista JEM: Desenvolvimento regional e pressões antrópicas no bioma Caatinga. In Biodiversidade do Caatinga: áreas e ações prioritárias para a conservação Edited by: Silva JM, Tabarelli M, Fonseca MT, Lins LV. Brasilia, Brazil: Ministério do Meio Ambiente; 2004:311-324.

36. Brasil: Ministério do Meio Ambiente: Sertão do baixo São Francisco sergipano. Ministério do Meio Ambiente; 2007.

37. Brazilian Institute of Geography and Statistics (IBGE) – Canal cidades [http://www.ibge.gov.br/cidadesat/default.php]

38. Ministry of Mines and Energy of Brazil (MME) – Diagnóstico do Mundo de Santa Cruz do Capibaribe [http://www.cprm.gov.br/rehi/atlas/pernambuco/relatorios/SCDC134.pdf]

39. Albuquerque UP, Lucena RFP: Seleção e escolha dos informantes. In Métodos e Técnicas na Pesquisa Etnobotânica 1st edition. Edited by: Albuquerque UP, Lucena RFP. Recife: NUPEEA/Livro Rápido; 2004:19-33.

40. Huntington HP: Using Traditional Ecological Knowledge in Science: Methods and Applications. Ecological Applications 2000, 10:1270-1274.

41. Branch L, Silva MF: Folk medicine in Alter do Chão, Pará, Brazil. Acta Amazônica 1983, 13:733-737.

42. Beassoni A, Braza FMS: Food taboos and folk medicine among fishermen from the Tocantins River. Amazoniana 1992, 12:101-118.

43. Marques JGQ: Pescando Pescadores: Etnoecologia abrangente no baixo São Francisco Alagoano São Paulo: NUPAUB/USP; 1999.

44. Moura FBP, Marques JGQ: Zooterapia popular na Chapada Diamantina: uma Medicina incidental? Ciência & Saúde Coletiva 2007 [http://www.abrasco.org.br/cienciaesaudecoletiva/artigos/artigo_int.php?id_artigo=1395]

45. Tovar NL, Ortega JR: El ‘bicho’ que cura: os animais e a medicina ‘folk’ em Belém do Pará. Boletim do Museu Paraense Emílio Goeldi 1994, 10:75-91.

46. Pinto AAC, Maduro CB: Produtos e subprodutos da medicina popular comercializados na cidade de Boa Vista, Roraima. Temas em Antropologia 2003, 6:177-180.

47. Andrade JN, Costa-Neto EM: O comércio de produtos zooterápicos na cidade de Feira de Santana, Bahia, Brasil. Scientibus 2006, 6:373-437.

48. Freire FCJ: Rêpteis utilizados na medicina popular no Estado de Alagoas. In Theories of specialization course Universidade Federal de Alagoas, Departamento de Biologia; 1996.

49. Williams VL, Balkwill KJ, Witskowski ET: Unraveling the commercial market for medicinal plants and plant parts on the Witwatersrand, South Africa. Economic Botany 2000, 54:310-327.

50. Kakati LN, Ao B, Douv S: Indigenous knowledge of Zootherapeutic Use of Vertebrate Origin by the Ao Tribe of Nagaland. Human Ecology 2006, 19:163-167.

51. Alves RRN, Rosa IL: Medicinal animals for the treatment of asthma in Brazil. J Altern Complement Med 2008, 14(4):350-351.

52. Guzzanoa LCS, Lucena MF, Almeida AV: Knowledge and use of medicinal plants by local specialists in an region of Atlantic Forest in the state of Pernambuco (Northeastern Brazil). Journal of Ethnobiology and Ethnomedicine 2005, 1:11-8.

53. Kamali HR: Folk medicinal use of some animal products in Central Sudan. Journal of Ethnopharmacology 2000, 72:279-282.

54. Costa-Neto EM: The Use of Insects in Folk Medicine in the State of Bahia, Northeastern Brazil, With Notes on Insects Reported Elsewhere in Brazilian Folk Medicine. Journal of Ethnopharmacology 2002, 491-499.

55. Barboza RRD, Souto WMS, Mourão JS: The use of zootherapeutics in folk veterinary medicine in the district of Cubati, Paraíba State, Brazil. Journal of Ethnobiology and Ethnomedicine 2007, 3:14.
56. Costa-Neto EM, Oliveira MVM. Cockroach is Good for Asthma: Zootherapeutic Practices in Northeastern Brazil. Human Ecology Review 2000, 7:41-51.

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