

Traditional knowledge of *sertanejos* about Zootherapeutic practices used in ethnoveterinary medicine of NE Brazil

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The present paper analyzes animal-based remedies used in ethnoveterinary medicine in a semi-arid area of Paraíba State (Caatinga biome) in NE Brazil. Information was obtained through semi-structured questionnaires applied to 32 local residents (24 men and 8 women) concerning animal species used as remedies, the body parts used, and the illnesses for which these remedies were prescribed. It is recorded the use of 13 animal species (of which 7 were non-domestic) recommended for treating 18 illnesses. Ram (*Ovis aries* Linnaeus, 1758), rattlesnakes (*Crotalus durissus* Linnaeus, 1758), and “teju” lizards (*Tupinambis merianae* (Duméril & Bibron, 1839)) were important medicinal resources for the community studied. The examination of folk knowledge and animal health practices gives us a better understanding of human interactions with their local environment and aids in formulating appropriate strategies for natural resource conservation.

Keywords: Ethnoveterinary medicine; Traditional medicine; Ethnozoology; Caatinga biome; Conservation

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Animal husbandry is an economic activity closely linked to the needs of local consumption and trade, which significantly influences the political, social and economic contexts in Latin America¹. The occupation of Brazil by Europeans (especially in the northeastern region) starting in the first half of the 16th century was marked by the transmigration of numerous elements of the European fauna and flora², including cattle, goats and horses³. Through the centuries, the local descendants of Amerindians, Africans, and Europeans learned to use the native natural resources of the Caatinga (dryland) biome but also imported resources from the Old World to use in treating illnesses or infirmities in themselves and their livestock. This symbiosis of traditional knowledge has generated a rich and invaluable source of knowledge in relation to both human ethnomedicine and ethnoveterinary⁴.

Ethnoveterinary medicine (EVM, or folk veterinary medicine) encompasses knowledge, skills, methods, practices, and beliefs about animal care^{5,6}. Ethnoveterinary medicinal research is a holistic and

interdisciplinary examination of local knowledge and of the socio-cultural structures and environment factors associated with animal health-care and husbandry⁷. In developing countries folk veterinary medicine is particularly important because conventional remedies for animal health care are inaccessible or unaffordable to poor rural farmers⁸. These high costs and inaccessibility, together with other problems associated with western-style healthcare systems, have helped maintain traditional treatment practices in these countries and fostered research on this subject⁹.

In recent years, increasing attention has been paid to ethnoveterinary knowledge and local veterinary practices¹⁰, and studies of EVM have increased dramatically^{9,11-18} together with research examining the importance of plants in ethnoveterinary medicine¹⁸⁻²³. However, in spite of the worldwide prevalence of traditional medical practices, research on medicinal animals has often been neglected in comparison to medicinal plants^{24,25}. Moreover, although a number of ethnobiological inventories concerning the use of medicinal animals in human

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health care have been compiled in Brazil^{4,26-32} and other countries^{33,34}, zootherapeutic practices in ethnoveterinary medicine (EVM) are poorly described and neglected in favor of human ethnomedicine³⁵⁻³⁷.

In this sense, the present study was conducted among residents of an area inside the semi-arid of NE Brazil, where local residents known as '*sertanejos*' still maintains a historical culture of breeding from the seventeenth century, despite the growing rural exodus and growing influence of other aspects related to urbanization. In this region, folk knowledge is rapidly disappearing -with traditional medicine being set aside in favor of modern medical practices, and veterinary drugstores are now frequently found in formerly isolated areas³⁵, thus documentation on zootherapeutic practices can assist in protecting traditional knowledge, and in ensuring that future users recognize the contributions made by local communities, the current custodians of traditional knowledge. Besides, the study of traditional medicinal practices is the basis for conducting research that aim to verify the validity or possible adverse effects of traditional drugs locally used.

Methodology

Study site

The municipality of Sousa is located in the *Sertão* mesoregion of western Paraíba State, NE Brazil (06° 45' 33" S x 38° 13' 41" W) (Fig. 1) and covers an area of 842 km²³⁸. The climate is semi-arid with an annual rainfall of 431.8 mm limited to a rainy season between November and April. The local vegetation is composed of spiny deciduous and semi-deciduous species characteristic of this semi-arid *Caatinga* region³⁹.

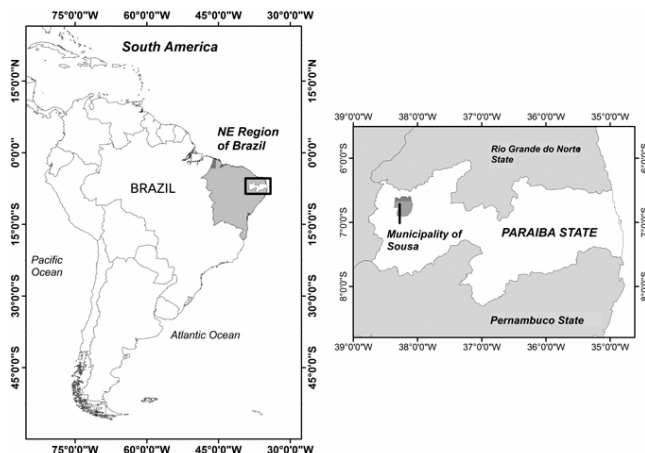


Fig. 1 —Map of study area

The total population of the municipality is approximately 63 800, of which 73.8% live in urban areas⁴⁰. This population has a Human Development Index (HDI) of 0.658⁴⁰. The principal economic activities of the municipality are subsistence agriculture (mainly bananas, sweet potato, beans and cassava) and livestock comprising cattle (22,000 heads), goats (4,500 heads), sheep (6,600 heads)⁴¹.

Procedures

Field research was conducted between January and February 2008. Open as well as semi-structured interviews were conducted with 32 people (24 men and 8 women) between the ages of 24 to 90 years (mean: 52.9). Most interviewees (86%) had a monthly income of no more than US\$230. In the studied area, livestock breeding is a predominantly male activity.

Informants were selected from a wide pool of individuals casually encountered in the community, as well as from a smaller group of "local specialists". A specialist is defined as a person recognized within the community as having exceptional knowledge about zootherapeutics⁴². We informed the interviewees about our research goals before initiating the interviews and questionnaires. The questionnaires were based on Barboza et al.³⁵ and Alves and Rosa²⁹ and encompassed the following subjects: which animals (zootherapeutics) were used for producing medicines; what were the purposes of those medicines; and how were they used.

The names of the zootherapeutic animals, and the symptoms and/or treated diseases were recording using the terminology employed by the interviewees themselves. Zoological material was identified with the aid of specialists through: (1) examination of specimens in the study area; (2) photographs (taken during interviews) of the animals or their parts; (3) vernacular names, with the aid of taxonomists familiar with the fauna in the study area.

Data analysis

To determine the relative importance of each locally known species, their use-values were calculated (adapted from the proposal of Phillips et al.⁴³) using the following formula: $UV = \sum U/n$, where: **UV** is the use-value of a species; **U** the number of citations of that species; and **n** the number of informants. The use-value of each species is based only on the importance attributed by each informant and does not depend on the opinion of the researcher.

Results and discussion

In present work, we recorded the use of 13 animal species (5 mammals, 5 reptiles, and 3 birds) for 18 veterinary purposes (Table 1). The most important medicinal species (UV>0.5) were ram (*Ovis aries* Linnaeus, 1758) (UV=0.94), rattlesnakes (*Crotalus durissus* Linnaeus, 1758) (0.63), and “teju” lizards (*Tupinambis merianae* [Duméril & Bibron, 1839]) (0.5). Most of the species mentioned (84.6%) were also recorded in other localities in Paraíba State^{35,44} and in many cases there was overlap in terms of their ethnoveterinary medicinal use. Barboza *et al.*³⁵, for instance, recorded the same use of *Iguana iguana* fat (Linnaeus, 1758) for treating wounds, and feathers of *Nothura maculosa cearensis* Naumburg, 1932 for

treating snake bites in livestock as in the present study. However, the ethnoveterinary use of products derived from two other animal species as reported here had not been previously registered: the horns of the gray brocket deer, *Mazama gouazoubira* (G. Fischer, 1814) that are used to treat snake bites in cats, calves, cattle, dogs, goats, horses, mules, pigs and sheep; and the viscera of the lizard *Tropidurus hispidus* (Spix, 1825) that were used to remove embedded splinters from those same animals. All of the species cited by informants in the present study had previously been recorded for use in folk-treatments of human diseases (Alves *et al.*^{4,45}; Alves and Pereira-Filho⁴⁶; Alves and Rosa^{29,47}; Costa-Neto²⁶; Costa-Neto and Oliveira²⁷; Lev⁴⁸).

Table 1-Zootherapeutics resources used in Ethnoveterinary medicine in municipality of Sousa, semi-arid region, NE Brazil

Family/species/local name	Number of mentions	UV	Parts used and way of administration ^a	Disease (or illness)	Animals ^b
REPTILES					
Chelidae					
<i>Phrynops geoffroanus</i> (Schweigger, 1812) - Geoffroy's side-necked turtle, “cágado”	7	0.22	Fat (1)	Rheumatism, swellings	ct, ho
Iguanidae					
<i>Iguana iguana</i> (Linnaeus, 1758) - Common Green Iguana, “Camaleão”	8	0.25	Leather (1) Fat (1)	“Estrepes” (suck a splinter out of skin), wounds “Estrepes”, wounds, rheumatism in cattle and horses, swellings	do, ca, ct, go, ho, mu, pi, sh do, ca, ct, go, ho, mu, pi, sh
Teiidae					
<i>Tupinambis merianae</i> (Duméril & Bibron, 1839) - Lizard teju, “tegu”, “tejuaçú”	16	0.50	Fat (1, 2) Leather (1)	“Throat inflammation”, snake bite, wounds, “estrepes” “Estrepes” (suck a splinter out of skin), wounds	do, ca, ct, go, ho, mu, pi, sh do, ca, ct, go, ho, mu, pi, sh
Tropiduridae					
<i>Tropidurus hispidus</i> (Spix, 1825) - Lizard, “lagartixa”, “catenga”	1	0.03	Viscera (1)	“Estrepes” (suck a splinter out of skin)	do, ca, ct, go, ho, mu, pi, sh
Viperidae					
<i>Crotalus durissus</i> Linnaeus, 1758 - South American rattlesnake, “Cascavel”	20	0.63	Fat (1)	Wounds, rheumatism in livestock cattle and in horses, swellings, harmed areas	do, ca, ct, go, ho, mu, pi, sh
MAMMALS					
Bovidae					
<i>Bos taurus</i> Linnaeus, 1758 - Domestic cattle, “Vaca”	8	0.25	Milk (3, 4, 5) Milk cream (6)	Weakness, “cow hooves disease”, worms (intestinal parasites), fractures, fracture bones Mastitis	do, ca, ct, go, ho, mu, pi, sh ct
<i>Ovis aries</i> Linnaeus, 1758 -Ram, “Carneiro”	30	0.94	Castrated ram suet (1, 7)	“Oca” (Bovine Gangrenous Coryza), “Estrepes”, scabies, wounds, rheumatism in livestock and in horses, swellings	do, ca, ct, go, ho, mu, pi, sh
Cervidae					
<i>Mazama gouazoubira</i> (G. Fischer, 1814) – Gray brocket, “veado-catingueiro”	1	0.03	Horns (8)	Snake bite	do, ca, ct, go, ho, mu, pi, sh

(Contd)

Table 1-Zootherapeutics resources used in Ethnoveterinary medicine in municipality of Sousa, semi-arid region, NE Brazil—Contd

Family/species/local name	Number of mentions	UV	Parts used and way of administration ^a	Disease (or illness)	Animals ^b
Hominidae					
<i>Homo sapiens</i> Linnaeus, 1758 - Human	2	0.06	Milk (1)	Oxen eyes inflammation	ct
Suidae					
<i>Sus scrofa domesticus</i> Linnaeus, 1758	5	0.16	Fat (1)	"Estrepes", scabies, "control hair loss", eyes inflammation	do, ca, ct, go, ho, mu, pi, sh
BIRDS					
Meleagrididae					
<i>Meleagris gallopavo</i> Linnaeus, 1758 - turkey, "peru"	2	0.06	Fat (1)	"Estrepe", torsions	do, ca, ct, go, ho, mu, pi, sh
Phasianidae					
<i>Gallus gallus domesticus</i> (Linnaeus, 1758) - Domestic chicken, "Galinha"	8	0.25	Fat (1) Eggs (3)	Wounds, "estrepes", expectorant, cattle earache Weakness in calves	do, ca, ct, go, ho, mu, pi, sh cl
Tinamidae					
<i>Nothura maculosa cearensis</i> Naumburg, 1932 - Spotted Nothura, "Codorniz"	1	0.03	Feather (8)	Snake bite	do, ca, ct, go, ho, mu, pi, sh

Legend ^aWay of administration: (1) Application on the affected area, (2) ingestion of the melted fat, (3) ingestion, (4) for "cow hooves disease" treatment in cattle hooves, the cow milk is mixed with the residual wood ash used in traditional firewood ovens, locally call "pucumã", and applied on the affected area, (5) For the treatment of worms and problems in the osteomuscular system (fractures, broken bones), mixed with *Chenopodium ambrosioides* L. and taken as a drink, (6) Applied on the cows' mammas, rubbing the affected area, (7) For the treatment of Bovine Gangrenous Coryza, the informers used to cut the oxen or cow horn and fill out the inner cavity with the castrated ram suet, (8) after dry, toasted and triturated, the powder is applied on the affected area. ^bAnimals: ca, cats; cl, calves; ct, cattle; do, dogs; go, goats; ho, horses; mu, mules; pi, pigs; sh, sheep.

Animal-derived products used as folk-medicines included eggs, fat, feathers, leather, milk, suet, and viscera. Zootherapeutics are usually applied in simple ways, mostly through ingestion or direct application to the affected area - and usually not in association with other animal-derived ingredients. In some cases, however, an association with medicinal plants is observed as, for example, a drink prepared from a mixture of cow's milk and *Chenopodium ambrosioides* L. used to treat intestinal parasites in NE Brazil⁴⁹ and to treat bone fractures in livestock in the municipality of Cubati, Paraíba, southern Brazil³⁵. The use of suet from castrated ram (*O. aries*) as well as "teju" lizard (*T. merianae*) and rattlesnake fat (*C. durissus*) in the present study area corroborated other surveys that indicated these same species as significant zootherapeutic medicinal resources in the semi-arid region of NE Brazil (Alves et al.⁴⁵; Alves and Rosa⁴⁷; Barboza et al.³⁵; Costa-Neto and Oliveira²⁷).

In several instances the treatment of animal diseases was based on healing similar human illnesses, as confirmed by the interviewees and also as

reported in the literature. For instance, the use of fat from the common green Iguana (*Iguana iguana* Linnaeus, 1758) to treat embedded splinters in humans or the use of horns from *M. gouazoupira* to treat snake bites was first documented in reports of folk-medicinal practices in Brazil³⁵. These results are consistent with the viewpoint that parallels between human and animal ethnomedicine are myriad, spanning not only health care concepts, beliefs, and practitioners, but also nearly all known modes of administration of remedies⁵⁰. The use of folk remedies to treat diseases or ailments in animals based on similar or identical illness that attack human was denominated 'human models for animal diseases' by Barboza et al.³⁵. The relationships between ethnoveterinary and human ethnomedicine can be easily explained in this perspective, as the main stock animals (e.g. cattle, sheep, goats, pigs, among others) are mammals³⁷, which often have health problems that are similar to humans with identical symptoms; these similarities have been noted by many different communities⁵¹. Recently, Souto et al.³⁶ concluded that ethnoveterinary practices in NE Brazil have probably

evolved based on traditional human medicine practices. This results were together based on the high similarity (Spearman correlation, $r_s = 0.7859$, $t(n-2) = 32.2$, $p < 0.001$) between the zootherapeutic species used in the treatment of same categories of diseases to humans and animals.

Considering the multiple aspects of Zootherapy and its general acceptance in popular folk-medicine, the use of animals to produce medicinal products almost certainly puts pressure on the natural populations of these species⁵². The utilization of wild species from the *Caatinga* region for ethnoveterinary purposes (e.g. *Crotalus durissus* Linnaeus, 1758; *Iguana iguana* (Linnaeus, 1758); *Mazama gouazoubira* (G. Fischer, 1814); *Nothura maculosa cearensis* Naumburg, 1932; *Phrynosoma geoffroanus* (Schweigger, 1812); *Tupinambis merianae* (Duméril & Bibron, 1839); *Tropidurus hispidus* (Spix, 1825)) must be taken into account in planning for the management and sustainable use of these animals. The *Caatinga* region has undergone, and is still experiencing, extensive alteration and environmental deterioration due to unsustainable utilization of its natural resources^{39,53,54} and, in this perspective, documentation of the animal-based medicines and of the traditions that rural communities have established in regards to their local faunal resources can contribute to future management and conservation programs⁵⁵.

Holmstedt and Bruhn⁵⁶ observed that a great number of useful products have been identified from scientific studies of remedies traditionally employed by various cultures, and the conservation of folk knowledge may be able to contribute to the discovery of new drugs^{48, 57}. However, this traditional knowledge is eroding under the influence of rapid urbanization, easy access to the modern health cares, the expansion of modern agriculture, and the acculturation of indigenous peoples⁵⁸⁻⁶⁰, indicating an urgency to document ethnoveterinary practices of human cultures throughout the world. Finally, there is a need for follow-up studies to confirm the real efficiency of these zootherapeutics remedies and to record the full range of traditional knowledge, while at the same time promoting the conservation of natural resources and the culture integrity of these local populations.

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References

- 1 Astudillo VM, Zottele AC & Dora F, Livestock development and animal health in Latin America, *Bol Centr Panam Fiebre Aftosa*, 57 (1991) 15-22.
- 2 Guedes PHMQ, *A colonização do sertão da Paraíba: agentes produtores do espaço e contatos interétnicos (1650 – 1730)*, (MSc Thesis, Centro de Ciências Exatas e da Natureza, Programa de Pós-Graduação em Geografia, Universidade Federal da Paraíba), 2006.
- 3 Andrade MC, A Pecuária e a Produção de Alimentos no Período Colonial, In: *História Econômica do Período Colonial*, edited by T Szmrecsanyi, (Editora HUCITEC–Fapesp, São Paulo, Brasil), 1996, 99-109.
- 4 Alves RRN, Rosa IL & Santana GG, The Role of Animal-derived Remedies as Complementary Medicine in Brazil, *Bio Science*, 57 (11) (2007) 949-955.
- 5 McCorkle CM, An introduction to ethnoveterinary research and development, *J Ethnobiology*, 6 (1) (1986) 129-149.
- 6 Deshmukh RR, Rathod VN & Pardeshi VN, Ethnoveterinary medicine from Jalna district of Maharashtra state, *Indian J Trad Knowl*, 10 (2) (2011) 344-348.
- 7 McCorkle CM, Mathias-Mundy E & van Veen TWS, *Ethnoveterinary Research and Development*, (ITDG Publications, Londres, Inglaterra), 1996.
- 8 McGaw LJ, Van der Merwe D & Eloff JN, In vitro anthelmintic, antibacterial and cytotoxic effects of extracts from plants used in South African ethnoveterinary medicine, *The Vet J*, 173 (2007) 366-372.
- 9 Muhammad G, Khan MZ, Hussain MH, Iqbal Z, Iqbal M & Athar M, Ethnoveterinary practices of owners of pneumatic-cart pulling camels in Faisalabad City (Pakistan), *J Ethnopharmacol*, 97 (2005) 241-246.
- 10 Matekaire T & Bwakura TM, Ethnoveterinary Medicine: A Potential Alternative to Orthodox Animal Health Delivery in Zimbabwe, *Intern J Appl Res Vet Med*, 2 (4) (2004) 269-273.
- 11 Fajimi AK & Taiwo AA, Herbal remedies in animal parasitic diseases in Nigeria: a review, *Afr J Biotechnol*, 4 (4) (2005) 303-307.
- 12 Iqbal Z, Jabbar A, Akhtar MS, Uhammad G & Lateef M, Possible Role of Ethnoveterinary Medicine in Poverty Reduction in Pakistan: Use of Botanical Anthelmintics as an Example, *J Agr Soc Sci*, 1 (2) (2005) 187-195.
- 13 Jegede OC, Ikani IE, Dafwang II, Bolorunduro PI & Annatte AI, Traditional animal healthcare practices in disease prevention and control by small ruminant farmers in Oyo State, Nigeria, *J Food Agric Environ*, 5 (3-4) (2007) 163-164.

- 14 Lans C, Turner N, Khan T, Brauer G & Boepple W, Ethnoveterinary medicines used for ruminants in British Columbia, Canada, *J Ethnobiology Ethnomedicine*, 3 (11) (2007) 22.
- 15 Lans C, Georges K & Brown G, Non-experimental validation of ethnoveterinary plants and indigenous knowledge used for backyard pigs and chickens in Trinidad and Tobago, *Trop Anim Health Pro*, 39 (2007) 375–385.
- 16 Pieroni A, Howard P, Volpato G & Santoro RF, Natural Remedies and Nutraceuticals used in Ethnoveterinary Practices in Inland Southern Italy, *Vet Res Commun*, 28 (2004) 55-80.
- 17 Pieroni A, Giusti ME, Pasquale C, Lenzarini C, Corsorii E, Gonzáles-Tejero MR, Sánchez-Rojas CP, Ramiro-Gutiérrez JM, Skoula M, Johnson C, Sarpaki A, Della A, Paraskeva-Hadjichambi D, Hadjichambis A, Hmamouchi M, El-Jorhi S, El-Demerdash M, El-Zayat M, Al-Shahaby O, Houmani Z & Scherzed M, Circum-Mediterranean cultural heritage and medicinal plant uses in traditional animal healthcare: a field survey in eight selected areas within the RUBIA project, *J Ethnobiology Ethnomedicine*, 2 (16) (2006) 12.
- 18 Viegi L, Pieroni A, Guarrera PM & Vangelisti R, A review of plants used in folk veterinary medicine in Italy as basis for a databank, *J Ethnopharmacol*, 89 (2003) 221-244.
- 19 Koné WM & Atindehou KK, Ethnobotanical inventory of medicinal plants used in traditional veterinary medicine in Northern Côte d'Ivoire (West Africa), *S Afr J Bot*, 74 (2008) 76-84.
- 20 Lans C, Turner N, Brauer G, Lourenco G & Georges K, Ethnoveterinary medicines used for horses in Trinidad and in British Columbia, Canada, *J Ethnobiology Ethnomedicine*, 2 (31) (2006) 20.
- 21 Akereta S, Calvo MI & Cavero RY, Ethnoveterinary knowledge in Navarra (Iberian Peninsula), *J Ethnopharmacol*, 130 (2) (2010) 369-378.
- 22 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*, 99 (2005) 211-214.
- 23 Sori T, Bekana M, Aduugna G & Kelbessa E, Medicinal Plants in the Ethnoveterinary Practices of Borana Pastoralists, Southern Ethiopia, *Intern J Appl Res Vet Med*, 2 (3) (2004) 220-225.
- 24 Alves RRN & Rosa IL, Why study the use of animal products in traditional medicines?, *J Ethnobiology Ethnomedicine*, 1 (5) (2005) 1-5.
- 25 Alves RRN, Barbosa JAA, Santos SLDX, Souto WMS & Barboza RRD, Animal-based Remedies as Complementary Medicines in the Semi-arid Region of Northeastern Brazil, *Evid-Based Compl Alt*, (2011) 1-15.
- 26 Costa-Neto EM, Healing with animals in Feira de Santana City, Bahia, Brazil, *J Ethnopharmacol*, 65 (1999) 225-230.
- 27 Costa-Neto EM & Oliveira MVM, Cockroach is Good for Asthma: Zootherapeutic Practices in Northeastern Brazil, *Human Ecol Rev*, 7 (2) (2000) 41-51.
- 28 Alves RRN & Rosa IL, From cnidarians to mammals: The use of animals as remedies in fishing communities in NE Brazil, *J Ethnopharmacol*, 107 (2006) 259–276.
- 29 Alves RRN & Rosa IL, Zootherapeutic practices among fishing communities in North and Northeast Brazil: A comparison, *J Ethnopharmacol*, 111 (2007) 82–103.
- 30 Alves RRN, Animal-Based Remedies as Complementary Medicine in Brazil, *Forsch Komplementmed*, 15 (4) (2008) 226-227.
- 31 Alves RRN, Fauna used in popular medicine in Northeast Brazil, *J Ethnobiology Ethnomedicine*, 5 (1) (2009) 1-30.
- 32 Ferreira FS, Brito S, Ribeiro S, Almeida W & Alves RRN, Zootherapeutics utilized by residents of the community Poco Dantas, Crato-CE, Brazil, *J Ethnobiology Ethnomedicine* 5 (1) (2009) 1-21.
- 33 Mahawar MM & Jaroli DP, Traditional zootherapeutic studies in India: a review, *J Ethnobiology Ethnomedicine*, 4 (1) (2008) 17.
- 34 Quave CL, Pieroni A & Bennett B, Dermatological remedies in the traditional pharmacopoeia of Vulture-Alto Bradano, inland southern Italy, *J Ethnobiology Ethnomedicine*, 4 (1) (2008) 1-5.
- 35 Barboza RRD, Souto WMS & Mourão JS, The use of zootherapeutics in folk veterinary medicine in the district of Cubati, Paraíba State, Brazil, *J Ethnobiology Ethnomedicine*, 3 (32) (2007) 1-14.
- 36 Souto WMS, Mourão JS, Barboza RRD & Alves RRN, Parallels between zootherapeutic practices in Ethnoveterinary and Human Complementary Medicine in NE Brazil, *J Ethnopharmacol*, 134 (2011) 753–767.
- 37 Confessor M, Mendonca L, Mourao J & Alves RRN, Animals to heal animals: ethnoveterinary practices in semi-arid region, Northeastern Brazil, *J Ethnobiology Ethnomedicine*, 5 (1) (2009) 1-37.
- 38 The Brazilian Institute of Geography and Statistics. (2011). (http://www.ibge.gov.br/brasil_em_sintese/tabelas/territorio.htm). (accessed May 1, 2011).
- 39 Ministério do Meio Ambiente, Avaliação das ações prioritárias para a conservação da biodiversidade da Caatinga, (FPE/FAD/CI do Brasil, Fundação Biodiversitas, EMBRAPA-Semi-Árido, MMA/SBF, Brasília, DF), 2002, 36.
- 40 United-Nations-Development-Programme. (2004) <http://www.pnud.org.br/atlas/>. (accessed June 15, 2011)
- 41 IBGE.(2008).(<http://www.ibge.gov.br/cidadesat/default.php>). (accessed June 13 2011).
- 42 Gazzaneo LRS, Lucena RFP & Albuquerque UP, Knowledge and use of medicinal plants by local specialists in an region of Atlantic Forest in the state of Pernambuco (Northeastern Brazil), *J Ethnobiology Ethnomedicine*, 1 (9) (2005) 8.
- 43 Phillips O, Gentry AH, Reynel C, Wilkin P & Galvez-Durand B C, Quantitative Ethnobotany and Amazonian Conservation, *Conserv Biol*, 8 (1) (1994) 225-248.
- 44 Souto WMS, *Animais de uso etnoveterinário no semi-árido paraibano: implicações para conservação e sustentabilidade*, (MSc. Thesis, Programa de Pós-Graduação em Desenvolvimento e Meio Ambiente, Universidade Federal da Paraíba/Universidade Estadual da Paraíba), 158.
- 45 Alves RRN, Pereira Filho GA & Lima YCC, Snakes used in Ethnomedicine in Northeast Brazil, *Environ Dev Sust*, 9 (4) (2006) 455-464.
- 46 Alves RRN & Pereira Filho GA, Commercialization and use of snakes in North and Northeastern Brazil: implications for conservation and management, *Biodivers Conserv*, 16 (2007) 969–985.
- 47 Alves RRN & Rosa IL, Zotherapy goes to town: The use of animal-based remedies in urban areas of NE and N Brazil, *J Ethnopharmacol*, 113 (2007) 541-555.

- 48 Lev E, Traditional healing with animals (zootherapy): medieval to present-day Levantine practice, *J Ethnopharmacol*, 85 (2003) 107-118.
- 49 Agra MF, Baracho GS, Nurit K, Basílio IJLD & Coelho VPM, Medicinal and poisonous diversity of the flora of "Cariri Paraibano", Brazil, *J Ethnopharmacol*, 111 (2007) 383-395.
- 50 McCorkle CM & Martin M, Parallels and potentials in animal and human ethnomedical technique, *Agr Hum Values*, 15 (1998) 139-144.
- 51 Alves RRN, Barboza RRD & Souto WMS, Plants Used in Animal Health Care in South and Latin America: An Overview, In: *Ethnoveterinary Botanical Medicine: Herbal Medicines for Animal Health*, edited by RD Katerere & D Luseba, (CRC Press, New York, USA), 2010, 231-256.
- 52 Almeida CFCBR & Albuquerque UP, Uso e conservação de plantas e animais medicinais no Estado de Pernambuco (Nordeste do Brasil): Um estudo de caso, *Interciencia*, 27 (6) (2002) 276-285.
- 53 Leal IR, Tabarelli M & Silva JMC, Ecologia e Conservação da Caatinga: Uma Introdução ao Desafio, In: *Ecologia e Conservação da Caatinga*, edited by IR Leal, M Tabarelli & JMC Silva, (Ed. Universitária da UFPE, Recife, Brasil), 2003, XIII-XVI
- 54 Leal IR, Silva JMCDA, Tabarelli M & Lacher Jr. TE, Changing the Course of Biodiversity Conservation in the Caatinga of Northeastern Brazil, *Conserv Biol*, 19 (3) (2005) 701-706.
- 55 Alves RRN, Souto WMS & Mourão JS, A Etnozoologia no Brasil: Importância, Status atual e Perspectivas, (NUPEEA, Recife, PE, Brazil), 2010, 550.
- 56 Holmstedt B & Bruhn JG, Ethnopharmacology-A challenge, *J Ethnopharmacol*, 8 (3) (1983) 251-256.
- 57 Mathias E & McCorkle CM, Traditional livestock healers, *Rev Sci Tech Off Int Epiz*, 23 (1) (2004) 277-284.
- 58 Ali ZA, Folk veterinary medicine in Moradabad (Uttar Pradesh) District Uttar Pradesh, India, *Fitoterapia*, 70 (1999) 340-347.
- 59 Bonet MÀ & Vallès J, Ethnobotany of Montseny biosphere reserve (Catalonia, Iberian Peninsula): Plants used in veterinary medicine, *J Ethnopharmacol*, 110 (2007) 130-147.
- 60 Jacob MO, Farah KO & Ekaya WN, Indigenous Knowledge: The Basis of The Maasai Ethnoveterinary Diagnostic Skills, *Human Ecology*, 16 (1) (2004) 43-48.