An ethnozoological survey of medicinal animals commercialized in the markets of Campina Grande, NE Brazil

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Abstract

Numbers of animal species are commercialized by herbalists in markets throughout Brazil. Nevertheless, there is a general lack of information about this type of trade in the country. This study aimed to obtain information on the trade of animals for medicinal purposes in the city of Campina Grande, Paraíba State. Data were obtained through semi-structured questionnaires applied to traders of medicinal animals. The trade of medicinal animals includes 32 species, which are extracted for zootherapeutic products recommended for the treatment of 25 illnesses. Interviewees described the existence of a multi-state trade network of medicinal animals. Some of the traded animals are listed in the Brazilian list of threatened species, and this shows the urgent need to consider zootherapy in the context of biodiversity conservation in Brazil. Our results reveal the importance of zootherapy as a therapeutic alternative and demonstrate the need for further studies on the subject.

Keywords: *zootherapy, medicinal animals, traditional medicine*

Introduction

Accordingly to the World Health Organization, between 75 and 80% of the world's population uses traditional folk medicines (Alves and Rosa 2005). Millions of people depend partially or completely on natural products harvested from natural areas for medicinal purposes (Millennium Ecosystem Assessment 2005) — indicating the importance of animals and medicinal plants as fundamental elements of traditional medical practices.

Animals (and derived products) have been important el-

ements of the medicinal inventory used by humans throughout the world since ancient times (Lev 2003; Alves et al. 2007; Alves 2009). In Brazil, many species of animals have been used for medicinal purposes since colonial times, with widely disseminated therapeutic alternatives available throughout the country (Alves et al. 2007; Alves and Rosa 2006; Alves and Rosa 2007a; Alves and Rosa 2007b). A recent work of this subject indicated that 290 animal species are used in traditional medicine in Brazil, although that number may be considerably larger considering that research in this area is still incomplete (Alves 2008). On the other hand, although 3722 articles have been published regarding the use of medicinal plants in Brazil (Calixto 2005) only 38 papers focusing on the use of animals for medicinal purposes have been published until now. The lack of zootherapeutic studies in Brazil (and in the world in general) has contributed to an underestimation of the importance of zootherapeutic resources in this country. Much more research on the use of animal products in folk medicine has yet to be done to evaluate its impact on the conservation of global bioresources (Singh 2007).

The use of medicinal animals is common in both rural and urban areas, and medicinal animals are sold by herb venders in public markets throughout the country (Alves and Rosa 2007b; Figueiredo 1994; Costa-Neto 1999; Almeida and Albuquerque 2002; Silva et al. 2004; Alves and Rosa, 2008; Alves and Santana 2008, Alves et al 2008). Several animal species commercialized for medicinal use are officially listed as rare or threatened — often precisely because of pressure due to excessive harvesting (Alves and Rosa 2007c). There is an urgent need to examine the ecological, cultural, social, and public health implications associated with fauna usage, including a full inventory of the animal species used for medicinal purposes and the socio-cultural context associated with their consumption.

Within that context, the present work focused on an inventory of medicinal animal species sold in public markets in Campina Grande, Paraíba State, Brazil, evaluated the sociocultural context of the use of these animals for therapeutic purposes, and discusses the implications of this harvesting on biodiversity conservation and public health.

Methods

Field research was undertaken between January and November, 2005, in the main public markets of Campina Grande where products derived from medicinal animals are openly traded (generally in association with medicinal plants). Information was gathered from interviews held with 22 merchants. Semi-structured interviews were used in the data collection phase, complemented by unstructured interviews and informal conversations (Huntington 2000; Alves and Rosa 2006). The sampling was intentionally non-random and the interviewees had been previously selected (Albuquerque and Lucena 2004) from among merchants of medicinal animals and plants. The questionnaires covered subjects including the animal species sold for medicinal use, their respective usages, preparations and techniques, and their usable parts. The information was repeatedly re-checked during the interviews, stimulating the interviewee to correct or add further information about these animals. In respect of intellectual property rights, we adopted the following field protocol: we introduced ourselves before the survey and explained the nature and objectives of our research, and then asked the respondents for permission to record the information furnished.

The animal names were noted as given by the interviewees. In many cases the identification of the animals was established by directly examining the whole animal or their usable parts during the interviews, or by consultation of specific bibliographies and specialists in those animals groups. On some occasions, the animals were acquired for later identification and to serve as voucher material (Alves and Rosa 2007c).

Results and Discussion

A total of 32 animal species (23 vertebrates and 09 invertebrates) were identified as being sold for medicinal purposes in Campina Grande, Brazil. The inventoried species comprise 06 taxonomic categories and belong to 26 Families (Table 1). The categories with the largest numbers of medicinal species were: reptiles (13), mammals (06), and insects (05). The most frequently cited species were: *Gallus domesticus* (chicken) (12 citations), *Ovis aries* (sheep) (4), *Oreaster reticulatus, Luidia senegalensis, Astropecten sp*. and *Echinaster sp*. (a starfish) (3), *Paleosuchus palpebrosus, Cayman crocodiles* and *C. latirostris* (caimans) (3), and *Tupinambis merianeae* (a lizard) (03).

All the medicinal species mentioned by the interviewees had been recorded in previous studies in Brazil (Alves et al. 2007), and in many cases there was full agreement regarding their medicinal uses. The spines of the coand˙ (*Coendou prehensilis*), for example, is known to be used to treat asthma in many localities (Alves and Rosa 2006; Costa-Neto 1999; Almeida and Albuquerque 2002; Branch and Silva 1983).

The number of medicinal species listed in this study was quite extensive, and was essentially equivalent to the numbers of species recorded in other studies in Brazil as well as in other parts of the world. Interviews with merchants in Sudan, El-Kamali (2000) identified trade involving 23 animal species used for therapeutic purposes, while Sodeinde and Soewu (1999) recorded the use of 45 medicinal species in

Nigeria markets. In Brazil, Almeida and Albuquerque (2002) reported 19 medicinal animal species sold in Caruaru, Pernambuco; Silva et al. (2004) recorded the trade of 18 medicinal animals in public markets in Recife, Piauí, and Costa-Neto (1999) reported the sale of 16 species in Feira de Santana, Bahia. Similarly studies conducted by Singh (2007) showed that the *Adi* community of East Siang district, Arunachal Pradesh, northeastern India uses 13 animal species to treat both humans and animals diseases and ailments.

When asked where the medicinal animals were collected, the interviewees in Campina Grande principally indicated natural areas such as forests and mountains, but also mentioned family farms and adjacent rural areas. Most of the animals commercialized occur in the *Caatinga* biome (where the present study was carried out) and are normally obtained through middlemen who sell zootherapeutic products to merchants in the public markets. According to Alves and Rosa (2005), the trade of animals for medicinal purposes in Brazil has had little lasting impact on the socioeconomic welfare of the primary collectors, who are usually illiterate, low-paid, and perceive their activities as being clandestine or semi-clandestine. The monetary value of the animals sold for medicinal purposes increases at each successive trade level, and the socioeconomic profile of the merchants varies accordingly. The exploitation of the regional fauna reduces the acquisition costs of the medicinal products, and Apaza et al. (2003) observed that an abundance of wild animals decreases the costs of animal products used in folk medicines.

The use of accessible local resources is closely linked to historical factors and medicinal knowledge traditionally focuses on local species, reflecting the transmission of knowledge through many generations, while financial restrictions limit access to exotic resources (Alves and Rosa 2006). A similar tendency was reported by Adeola (1992), who observed that the animals used for preventive and healing medicine were associated with the natural area in which the users live, as well as with their relative species abundance. Various ethnobotanical studies have shown that familiarity with, and use of, plant diversity by human populations is influenced by the diversity of the local flora (Bennett 1992; Phillips and Gentry 1993). Some studies have indicated the existence of informal and traditional forms of conservation and sustainable use of wild resources (both animals and plants) used in medicinal and food systems (Singh et al. 2006; Singh and Sureja 2006a).

Although Campina Grande is located 120 km from the coast, various oceanic species were cited by merchants in the present study, such as starfish (*O.reticulatus, Astropecten* sp. and *Echinaster* sp.) and seahorses (*Hippocampus reidi*). According to the interviewees, these species are provided by commercial gatherers from other regions — indicating the existence of commercial routes of zootherapeutic products through different parts of northeastern Brazil — as previously recorded by Alves and Rosa (2007b) who investigated the medicinal animal trade in metropolitan areas of north and northeastern Brazil.

Metabolic products such as honey are also included in the zootherapeutic repertory, and while medicinal animals can be used intact, they are most often divided into pieces (paws, bones, leather, leather oils, fats and spines). Alligators (*P. palpebrosus, C. crocodilus*, and *C. latirostris*), for instance, provide two widely used medicinal products — leather and fat, and these zootherapeutic products are used for treating 25 different diseases (Table 1). The majority of species (56%, n = 18) have multiple therapeutic uses. "Teju" lizards (*T. merianeae*) and turtles (*Phrynops geoffroanus*), for instance, are indicated for treating 7 and 4 illnesses, respectively. Alves et al. (2007) suggested that the overlapping therapeutic indication of different medicinal animals provides adaptive availability and accessibility to medicinal resources.

Asthma was the disability with the largest number of indicated remedies (16 different species) and Costa-Neto (1999) reported that medicinal animals are frequently used to treat respiratory illnesses (asthma and bronchitis) in Bahia State. Alves and Rosa (2008) pointed that at minimum 113 animal species were used in Brazilian traditional medicine for treating asthma. Almeida and Albuquerque (2002) in their study undertaken in Caruaru, PE, reported that the zootherapeutic category with the largest use-value was "digestive problems", following by respiratory, muscular-skeletal, and conjunctive tissue disorders. These same tendencies were corroborated in the present study.

According to the interviewees, zootherapeutic products are consumed in several ways. Constituent animal parts such as leather and spines, are usually naturally dried and then ground up, yielding a powder used in tea preparations or that is mixed with food and ingested. Honey, fats, and oils are usually massaged on the affected areas or ingested.

Some animals are utilized in combination with plants and/or other animal species, constituting the ingredients of what the interviewees call "garrafadas" — that are cooked together or extracted in drinking alcohol and used to treat several diseases. In general, the preparation procedures observed in Campina Grande are similar to those of other cities in north and northeastern Brazil where zootherapeutic resources are marketed (Alves and Rosa 2007b; Costa-Neto 1999; Almeida and Albuquerque 2002; Alves and Pereira-Filho 2007).

The uses of medicinal plants and animals overlap in many cases, as might be expected, as phytotherapy and zootherapy are well known and widely used therapeutic alternatives in contemporary societies (Alves and Rosa 2005).

Table 1. Animal species of medicinal usage commercialized in Campina Grande city, PB

Family, species, vernacular name	Part Used	Treated disease
Insecta		
Formicidae		
Dinoponera quadriceps Santschi, 1921 — ant, "formiga trinca cunhão"	Whole animal	Asthma
Apidae		
Melipona scutellaris (Latreille, 1811) — Stingless bee, "urucu"	Honey	Sexual impotence, aging, flu
Melipona subnitida (Ducke, 1910) — bee, abelha jandaíra	Honey	Sexual impotence, aging, flu
Apis mellifera (Linnaeus, 1758) — Africanised honey bee, "abelha italiana"	Honey	Sexual impotence, aging, flu
Chrysomelidae		
Coraliomela brunnea Thumberg, 1821 — barata de coqueiro	Whole animal	Asthma
Echinodermata		
Oreasteridae		
Oreaster reticulatus (Linnaeus, 1758) — Starfish, "estrela-do-mar"	Whole animal	Asthma
Astropectinidae		
Astropecten sp. — Starfish, "estrela-do-mar"	Whole animal	Asthma
Echinasteridae		
Echinaster sp. — Starfish, "estrela-do-mar"	Whole animal	Asthma
Luidiidae		
Luidia senegalensis (Lamarck, 1816) — Starfish, "estrela-do-mar"	Whole animal	Asthma
Pisces		
Syngnathidae		
Hippocampus reidi (Ginsburg, 1933) — Longsnout seahorse, "cavalo-marinho"	Whole animal	Asthma
Erythrinidae		
Hoplias malabaricus (Bloch, 1794) — Trahira, "traíra"	Fat	Wound, rheumatism, erysipelas
Reptilia		
Boidae		
Boa constrictor (Linnaeus, 1758)I — Boa, "jibóia"	Fat	Rheumatism, backache
Viperidae		
Crotalus durissus (Linnaeus, 1758)[I] — Neotropical rattlesnake, "cascavel"	Fat, leather oil	Rheumatism, backache
Bothrops sp. - Lance head, "jararaca"	Fat	Rheumatism
Epicrates cenchria (Linnaeus, 1758) — Brazilian rainbow boa, "salamanta"	Fat	Rheumatism
Colubridae		
Oxyrhopus trigeminus (Duméril, Bibron & Duméril, 1845) — Snake, "falsa coral"	Fat	Rheumatism
Alligatoridae		
Paleosuchus palpebrosus (Cuvier, 1807) — Cayman, "jacaré coroa", "jacaré"	Leather, fat	Asthma, thrombosis, rheumatism
Cayman crocodilus (Linnaeus, 1758) — Cayman, "jacaré tinga"	Leather, fat	Asthma, thrombosis, rheumatism
Cayman latirostris (Daudin, 1801) — Cayman, "jacaré-do-papo-amarelo"	Leather, fat	Asthma, thrombosis, rheumatism
Iguanidae		
Iguana iguana (Linnaeus, 1758) — Common iguana "camaleão"	Fat	Festering inflamation
Teiidae		
Tupinambis merianae (Duméril & Bibron, 1839) — Lizard, "tegu", "tejuaçú" tejuaçú	Fat	Catarrh, asthma, throat, furuncle, tonsillitis, earache
Chelidae		
Phrynops geoffroanus (Schweigger, 1812) — Geoffroy's side-necked turtle, "cágado"	Fat, hoof	Vitiligo, asthma, earache, tonsillitis
Gekkonidae		
Tropidurus semitaeniatus (Spix, 1825) — Lizard, "lagartixa-de-lajedo"	Whole animal	Pharyngitis, asthma, "throat cyst"
Tropiduridae		
Tropidurus hispidus (Spix, 1825) — Lizard, "lagartixa", "catenga"	Whole animal	Sore throat
Birds		
Phasianidae		
Gallus gallus (Linnaeus, 1758) — Domestic chicken, "galinha"	Fat	throat Inflammation, nasal obstruction
Rheidae		
Rhea americana (Linnaeus, 1758) — Greater rhea, "ema"	Fat	Cough

Table 1. Animal species of medicinal usage commercialized in Campina Grande city, PB (continued)

Family, species, vernacular name	Part Used	Treated disease
Mammallia		
Cervidae		
Mazama americana (Erxleben, 1777)[I] — Red brocket, "veado"	Tibia	Asthma
Erethizontidae		
Coendou prehensilis (Linnaeus, 1758) — Brazilian porcupine, "coandú", "porco espinho"		Spine Ulcer, asthma
Bovidae		
Ovis aries (Linnaeus, 1758) — Sheep, "carneiro"	Fat	Rheumatism, arthritis, swells
Canidae		
Cerdocyon thous (Linnaeus, 1766) — Crab-eating fox, "raposa"	Fat, bone	Earache, asthmatic bronchitis
Didelphidae		
Didelphis albiventris (Lund, 1840) — Common opossum, "timbú"	Fat	Inguinal bubo, furuncles
Bradypodidae		
Bradypus variegatus (Shinz, 1825) — Brown-throated three-toed sloth, "Preguiça pequena"		Leather, fat Ulcer, asthma

Considering the fact that the use of medicinal animals and plants is quite common in most areas of Brazil (Alves at al. 2007; Carvalho 2004; Agra et al. 2007a; Agra et al. 2007b), various overlapping usages might well be expected among traditional remedies (Almeida and Albuquerque 2002; Alves and Rosa 2006; Alves et al. 2007).

It is well known that some natural products used in folk medicine can have serious adverse effects (De Smet 1991). However, no side effects were stressed by the merchants as long as the medicines were used at their correct dosages — although the sanitary conditions under which the zootherapeutic products were stored were quite precarious, with indications of probable microbiological contamination. Research on the commerce of medicinal resources in metropolitan areas of north and northeastern Brazil revealed the generally unhealthy storage conditions of plants and medicinal animals (Alves and Rosa 2007b; Amaral et al. 2003), with obvious contamination risks to these products. These observations point to the need for sanitary measurements to be taken with medicinal animal products (Alves and Rosa 2005) and the importance of including considerations about zootherapy into public health programs.

Very little research has been undertaken to examine the clinical effectiveness of animal products used for medicinal purposes (Still 2003), although some of the animals cited by the interviewees are widely used in modern medicine. Snakes belonging to the Families Viperidae, Crotalidae and Elapidae, for instance, have an analgesic substance in their venom that is stronger than morphine and has been used in treating terminal cancer patients (Bisset 1991). Honey is another good example, for it has established clinical benefits in terms of treating wounds, ulcers, and burns, and is considered an excellent antibacterial agent (Nazrul-Islam et al. 1993). Many of the chemical constituents and pharmacological attributes of animal-derived medicinal products are well-known, but more ethnopharmacological studies are needed in order to better define their therapeutic usefulness (Alves and Rosa 2005).

Among the animal species cited by merchants, nine are included in threatened species lists. The seahorse (*H. reidi*) is listed on the Brazilian National List of species of aquatic invertebrates and fish that are endangered, overexploited, or threatened by over-exploitation (Normative Instruction no. 5, May 21, 2004). According to the International Union for the Conservation of Nature (IUCN) Red List of Threatened Animals, *H. reidi* is included in the "vulnerable" category; *P. palpebrosus, C. crocodilus* and *C. latirostris* are in the "lower risk" category (besides being included on appendix II of CITES — Convention on International Trade in Endangered Species of Wild Fauna and Flora); while *Boa constrictor* Linnaeus, 1758, *Crotalus durissus* (Linnaeus, 1758), *Epicrates cenchria* (Linnaeus, 1758), *Iguana iguana* (Linnaeus, 1758), and *T. merianae* are included in the "deficient data" category of IUCN and on appendix II of CITES — all examples of the urgent need to consider zootherapy within the context of Brazil's biodiversity conservation program.

Conclusions

Our results support the view that the use of animals for therapeutic purposes is a common urban practice in northeastern Brazil. The regional faunal composition, the local popular culture, and the animal resource's commercial value are factors that help promote and maintain the trade in animals for zootherapeutic items. The lack of any effective trade controls or regulations is alarming, and multi-disciplinary studies concerning the social, cultural, economical, clinical and environmental aspects of this widespread commerce will

be necessary to establish appropriate measures that can guarantee the sustainable use of zootherapeutic resources. Sustainability of harvesting of medicinal animals is challenged by many factors, from both social and ecological perspectives. It is important to respect differing views of the value of wildlife, while, at the same time, conserving biodiversity. Additionally, to help assure equitable benefit shares in this animal trade, there is a paramount need to implement and popularize prior informed consent (PIC) systems among the various stakeholders associated with animal-based medicines systems. A growing volume of research has shown that still there is a lacuna in terms of implementing PIC mechanisms among community members who are the primary agents of bioresource conservation (Gupta 1991; Convention on Biological Diversity 2005; Singh and Sureja 2005). Therefore, to ensure Intellectual Property Rights and the sustainable use of bioresources in traditional medicine systems, the position of the people who both harvest and can help conserve the sources of these animal-based medicines must be consolidated and improved.

Endnotes

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References

Adeola, M.O. 1992. Importance of wild Animals and their parts in the culture, religious festivals, and traditional medicine of Nigeria. *Environ. Conserv*. 19 (2): 125-134.

Agra, M.F, P.F. Freitas and J.M. Barbosa Filho JM. 2007a. Synopsis of the plants known as medicinal and poisonous in Northeast of Brazil. *Rev. Bras. Farmacog*.17: 116-155.

Agra, M.F., G.S. Baracho, K. Nurit, U.L.D. BasÌlio and V.P.M. Coelho. 2007b. Medicinal and poisonous diversity of the flora of "Cariri Paraibano", Brazil. J Ethnopharmacol 111(2): 383-395.

Albuquerque, U.P. and R.F.P. Lucena. 2004. Métodos e técnicas para coleta de dados; in Albuquerque UP, Lucena RFP (eds): *Métodos e técnicas na pesquisa etnobotânica* NUPEEA/Livro Rápido, pp. 37-62

Almeida, C.F.C.B.R. and U.P. Albuquerque. 2002. Uso de plantas e animais medicinais no Estado de Pernambuco (Nordeste do Brasil): Um estudo de caso. Interciencia 27(6): 276-284.

Alves, R.R.N. 2008. Animal-Based Remedies as Complementary Medicine in Brazil. Forsch Komplementarmed Klass Naturheilkd 4-4.

Alves, R.R.N. 2009. Fauna used in popular medicine in Northeast Brazil. *J Ethnobiol Ethnomed* 5:1.

Alves, R.R.N. and I.L.Rosa. 2005. Why study the use of animal products in traditional medicines? *J Ethnobiol Ethnomed* 1: 1-5

Alves, R.R.N. and I.L. Rosa. 2006. From cnidarians to mammals: The use of animals as remedies in fishing communities in NE Brazil. *J Ethnopharmacol*. 107: 259-276.

Alves, R.R.N., H.N. Lima, M.C. Tavares, W.M.S. Souto, R.R.D. Barboza, A Vasconcellos. 2008. Animal-based remedies as complementary medicines in Santa Cruz do Capibaribe, Brazil. *BMC Complement Altern Med* 8: 44

Alves, R.R.N., I.L. Rosa and G.G. Santana. 2007. The role of animal-derived remedies as complementary medicine in Brazil. *BioScience*. 57(11): 949-955.

Alves, R.R.N. and I.L. Rosa .2007a. Zootherapeutic practices among fishing communities in North and Northeast Brazil: A comparison. *J Ethnopharmacol*. 111 (1): 82-103.

Alves, R.R.N. and I.L. Rosa. 2007b. Zootherapy goes to town: The use of animal-based remedies in urban areas of NE and N Brazil. *J Ethnopharmacol*. 113: 541-555.

Alves, R.R.N. and I.L. Rosa. 2007c. Biodiversity, traditional medicine and public health: where do they meet?. *J Ethnobiol Ethnomed*. 3 (14): 1-9.

Alves, R.R.N. and G.A. Pereira-Filho. 2007. Commercialization and use of snakes on North and Northeastern Brazil: implications for conservation and management. *Biodivers. Conserv*. 16: 969-985.

Alves, R.R.N., I.L.Rosa. 2008. Use of tucuxi dolphin *Sotalia fluviatilis* for medicinal and magic religious purposes in North of Brazil. *Hum Ecol* 37: 443-447.

Alves, R.R.N. and G.G. Santana. 2008. Use and commercialization of *Podocnemis expansa* (Schweiger 1812) (Testudines: Podocnemididae) for medicinal purposes in two communities in North of Brazil. *J Ethnobiol Ethnomed*. 4 1-19.

Alves, R.R.N. and I.L. Rosa. 2008. Medicinal animals for the treatment of asthma in Brazil. *J Altern Complem Med*. 14(4): 350-351

Amaral, F.M.M., D.F. Coutinho, M.N.S. Ribeiro and M.A. Oliveira. 2003. Avaliação da qualidade de drogas vegetais comercializadas em São Luís/Maranhão. *Rev. Bras. Farmacog*. 13: 27-30.

Apaza, L., R. Godoy, D. Wilkie, E. Byron, O. Huanca, W.I. Leonard, E. Peréz, V. Reyes-García and V. Vadez. 2003. Markets and the use of wild animals for traditional medicine: a case study among the Tsimane' Amerindians of the Bolivian rain forest. *J Ethnobiol*. 23: 47-64.

Bennett, B.C. 1992. Plants and people of the Amazonian rainforests. The role of ethnobotany in sustainable development. *Bioscience*. 42: 599-607.

Bisset, N.G. 1991. One man's poison, another man's medicine. *J Ethnopharmacol*. 32: 71-81.

Branch, L. and M.F. Silva. 1983. Folk medicine in Alter do Chão, Pará, Brasil. *Acta Amaz*. 13(5-6): 737-797.

Calixto, J.B. 2005. Twenty-five years of research on medicinal plants in Latin America. *J Ethnopharmacol*. 100: 131-134.

Carvalho, A.R. 2004. Popular use, chemical composition and trade of Cerrado's medicinal plants (Goiás, Brazil). *Environ. Develop. Sustain*. 6: 307-316.

CBD. The Secretariat of CBD, UNO., 2005. *Contribution of the convention on biological diversity and the principle of prior informed consent*. http://www.un.org/esa/socdev/unpfil/documents/FPIC_%202005_CBD.doc.

Costa-Neto, E.M. 1999. *Healing with animals in Feira de Santana city, Bahia, Brazil. J Ethnopharmacol*. 65: 225-230.

De Smet, P.A.G.M. 1991. Is there any danger in using traditional remedies? *J Ethnopharmacol*. 32: 43-50.

El-Kamali, H.H. 2000. Folk medicinal use of some animal products in Central Sudan. *J Ethnopharmacol*. 72(1-2): 279-282.

Figueiredo, N. 1994. Os 'bichos' que curam: os animais e a medicina de 'folk' em Belém do Pará. *Bol Mus Paraen Emílio Göeldi*. 10(1): 75-91.

Gupta, A.K. 1991. Biodiversity, poverty and intellectual property rights of third world peasants: A case for negotiating global understanding, in Swaminathan MS, Jana S (eds): *Biodiversity: Implications for Global Food Security*, MacMillan Press. pp 236-256.

Huntington, H.P. 2000. Using Traditional ecological knowledge in science: Methods and applications. *Ecological Applications*. 10: 1270-1274.

Lev, E. 2003. Traditional healing with animals (zootherapy): Medieval to present-day Levantine practice. *J. Ethnopharmacol*. 86: 107-118.

Millennium Ecosystem Assessment. 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

Nazrul-Islam, S.K., A.J. Ferdous, C.M. Hassan, M. Hassan and S. Sultana. 1993. Screening of honey for its antibacterial properties against pathogenic bacteria including resistant strains of *Shigella. Fitoterapia*. 2: 176-178.

Phillips, O., A.H. Gentry. 1993. The useful plants of Tambopata, Peru. I. Statistical hypothesis tests with a new quantitative technique. *Econ Bot*. 47: 15-32

Silva, M.L.V., A.G.C. Alves, A.V. Almeida. 2004. A zooterapia no Recife (Pernambuco): *uma articulação entre as práticas e a história. Biotemas*. 17(1): 95-116

Singh, R.K., A.K. Sureja. 2005. Prior informed consent and intellectual property rights: An opinion analysis of traditional knowledge holders. Abstract, in National Seminar on Green to Evergreen-Challenges of Extension Education, organized by Indian Society of Extension Education from December 15-17, 2005 *at Division of Agricultural Extension, Indian Agricultural Institute*, Pusa, New Delhi, India.

Singh, R.K., A.K. Sureja. 2006. Community knowledge and sustainable natural resources management: Learning from the *Monpa* of Arunachal Pradesh. TD: *The J. for Transdisciplinary Research in Southern Africa*. 2(1): 73-102.

Singh, R.K., D. Singh, A.K. Sureja. 2006. Community knowledge and biodiversity conservation by Monpa tribe. *Indian Journal Traditional Knowledge*. 5(4): 513-518.

Singh, A. 2007. Traditional foods and associated knowledge systems relating to health and nutrition among Adi women of East Siang district, Arunachal Pradesh. M. Sc. Thesis (*Unpublished*), Department of Home Science, Banaras Hindu University (BHU), Varanasi, UP, India.

Sodeinde, A.O., D.A. Soewu. 1999. Pilot study of the traditional medicine trade in Nigeria. *Traffic Bulletin*. 18(1):35-40.

Still, J. 2003. Use of animal products in traditional Chinese medicine: environmental impact and health hazards. *Complement Ther Med*. 1: 118-122