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Animal-based medicines: biological prospection and the sustainable use of zootherapeutic resources

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ABSTRACT

Animals have been used as medicinal resources for the treatment and relieve of a myriad of illnesses and diseases in practically every human culture. Although considered by many as superstition, the pertinence of traditional medicine based on animals cannot be denied since they have been methodically tested by pharmaceutical companies as sources of drugs to the modern medical science. The phenomenon of zootherapy represents a strong evidence of the medicinal use of animal resources. Indeed, drug companies and agribusiness firms have been evaluating animals for decades without paying anything to the countries from where these genetic resources are found. The use of animals' body parts as folk medicines is relevant because it implies additional pressure over critical wild populations. It is argued that many animal species have been overexploited as sources of medicines for the traditional trade. Additionally, animal populations have become depleted or endangered as a result of their use as experimental subjects or animal models. Research on zootherapy should be compatible with the welfare of the medicinal animals, and the use of their by-products should be done in a sustainable way. It is discussed that sustainability is now required as the guiding principle for biological conservation.

Key words: ethnozoology, zootherapy, bioprospection, sustainability.

INTRODUCTION

Chemicals from nature have been a part of human civilization ever since our early ancestors began exploiting natural compounds to improve and enrich their own lives (Agosta 1996). A major part of these chemicals come from animals. Indeed, animals are therapeutic arsenals that have been playing significant roles in the healing processes, magic rituals, and religious practices of peoples from the five continents (Costa-Neto and Marques 2000). The healing of human ailments by using therapeutics that are obtained from animals or ultimately are derived from them is known as zootherapy. Animal-based medicines have been elaborated from parts of the animal body, from products of its metabolism (corporal secretions and excrements), or from non-animal materials (nests and cocoons).

The ample geographical distribution of zootherapy has made that Marques (1994) states that all human culture that shows a developed medical system will utilize animals as medicines. Such a statement forms the basis of what he has called as 'zootherapeutic universality hypothesis.' Because medical systems are organized as cultural systems, the use of animal substances should be understood

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according to a cultural perspective.

It is well known that the annual global trade in animal-based medicinal products accounts for billions of dollars per year (Kunin and Lawton 1996). The investigation of traditional medicines has proven a valuable tool in the developing art of bioprospecting for pharmaceutical compounds. Of the 252 essential chemicals that have been selected by the World Health Organization, 11.1% come from plants, and 8.7% from animals (Marques 1997). And of the 150 prescription drugs currently in use in the United States of America, 27 have animal origin (World Resources Institute 2000).

In order to stress how important animals were, are and can be as sources of pharmacological substances, this paper will discuss very briefly the phenomenon of zootherapy in its general terms. I hope more information can be added to fill the blank in our knowledge on the traditional and clinical use of medicinal animals. Furthermore, the material here presented aims to give a contribution for the importance of animals as sources of potential drugs, as well as to provide a wider and more critical discussion on the conservation biology and sustainable use of the involved species.

THE USE OF ANIMALS IN TRADITIONAL MEDICAL SYSTEMS

The traditional medical knowledge of indigenous peoples throughout the world has played an important role in identifying biological resources worthy of commercial exploitation. Indeed, the search for new pharmaceuticals from naturally occurring biological material has been guided by ethnobiological data (Blakeney 1999). For example, Alexiades (unpublished data) recorded the medicinal use of 50 animals by the Ese Eja people from Peru. The blood of the black caiman (*Melanosuchus niger* [Spix 1825]) is used to treat epilepsy and stroke; ants of the genus *Pseudomyrmex* are smashed ad put in toothache, or are left to bite painful joints. In the area of Sierra Madre people use to say "The more poisonous the animal, the more potent its antipoison" (Werner 1970). This author points out that various anatomical parts of the rattlesnake (*Crotalus* sp.) are used for infirmities ranging from boils to bronchitis.

El-Kamali (2000) has recorded 23 animals that are used as sources of remedies in the Sudanese traditional medicine. For example, the fresh manure of a dromedary (*Camelus dromedaries* [Linnaeus 1758]) is applied externally on the affected parts to alleviate arthritis; honey is used in the treatment of hepatic and gastrointestinal disorders, gastric ulcers, as well as to heal wounds; the fats of the lion (*Panthera leo* [Linnaeus 1758]) and hyena (*Crocuta crocuta* [Erxleben 1777]) are used topically to alleviate abdominal pains. Adeola (1992) has also recorded 23 species in three ecological zones from Nigeria. He stresses that most farmers in rural areas in Nigeria depend solely on wild animals and their by-products (hooves, tusks, bones, feathers, skins) for their daily animal protein supply and preparation of traditional medicine. For example, the tusks of hippo (*Hippopotamus amphibious* [Linnaeus 1758]) are used for aphrodisiacs and ornamentals. Other custom includes the use of fat extracted from a manatee (*Trichechus senegalensis* Link 1795) to cure rheumatism, boils, and backache. Hollow parts of the hooves of duikers (*Sylvicapra grimmia* [Linnaeus 1758]) and antelopes (*Hippotragus equines* [Desmarest 1804]) are special containers for concoctions with herbs to invoke or appease traditional gods and witches. Most Africans believe that there are some magical powers which are attached to special healing acts when wild animals by-products are used as directed by a traditional healer. Consequently the traditional medicine man, in his preparation of drugs, employs different means – including use of herbs, roots, leaves, bark, mammals, and birds. For the majority of the people both in the Sudan and in Nigeria, traditional medicine remains the main or only source of health care. However, poaching of wild animals for meat and medicinal purposes is a major problem in all the game reserves and national parks from Africa.

In China, research on medicinal uses of earthworms has a history of nearly 4,000 years (Zhang et al. 1992). *Compendium of Materia Medica* written

by Li Schizhen in 1578 AD was a comprehensive summary of pharmacological knowledge accumulated in China up to his time. According to traditional Chinese medicine, earthworms possess antipyretic, antispasmodic, diuretic, antihypertensive, antiallergic, antiasthmatic, detoxic, and spermatocidal effects. Earthworm medicines are prescribed to treat over 80 diseases (e.g., asthma, hypertension, mumps, ulcer, epilepsy, cancer, etc.). Earthworm extract is worth further study especially as a new spermatocide (Zhang et al. 1992).

Over 500 species of insects, mites, and spiders are used as medicines to cure both common and complicated ailments in Chhattisgarh, India (Oudhia 1995). For example, the oil from the red velvet mite (*Trombidium grandissimum* Koch 1867) is useful for paralysis. Also due to its ability to increase the sexual desire, these mites are named as Indian Viagra. The pod borer *Helicoverpa armigera* (Hübner 1805) alone or in combination with herbal drugs is used to treat more than 50 common diseases. Folk doctors from Chhattisgarh said that those insects with high medicinal value can be easily identified through their specific behavior and feeding habits. Indeed, insect behavior can help to discover useful compounds by leading an observer to an unusual chemical (Joyce 1991). If ants turn up their noses at a fallen leaf, or predators avoid an insect's egg when it is covered with its mother's saliva, chemistry is at work. By keeping a lookout for this kind of telltale behavior, ecologists can spot interesting compounds.

Artisanal fishermen from Siribinha Beach in the State of Bahia, Northeastern Brazil, have been using several marine/estuarine animal resources as folk medicines (Costa-Neto and Marques 2000). Twenty-four fish species were recorded as having some therapeutic use when they were questioned about their folk medicine. Although interviews focused on fish-based remedies, fifteen other animals with medicinal properties were also cited. This makes up a total of 39 resources, which are distributed in six scientific taxonomic categories, such as fish (62%), crustaceans (13%), reptiles (10%), echinoderms (8%), mollusks (5%), and mammals (2%). A total of 66 raw materials including scales, spur, shell, fat, skin, globe of the eye, tentacles, and otolith are used in the elaboration of remedies to treat locally diagnosed ailments. These folk remedies are administered to the patients in the form of plasters, teas, smokes, and food. Asthma, bronchitis, stroke, and wounds are the most usual illnesses treated by these animal-based medicines.

During his voyage through the inner of Brazil in the nineteenth century, von Martius (1939) recorded many folk uses by the Indigenous peoples. For example, a deer's *bezoar* (intestinal stones) was considered as an excellent medicine against indigestions, and the fresh fat of a caiman, when applied directly, was regarded to alleviate rheumatism. Yet today, country people use a collar made with caiman's teeth as a protective against snakebites.

In India nearly 15-20 percent of the Ayurvedic medicine is based on animal-derived substances (Unnikrishnan 1998). There are references to nearly 380 types of animal substances in *Caraka samhita*, the oldest available Ayurvedic classic. The materials used in Ayurveda include animal parts, products, and processed products. Many of the animal uses in Ayurvedic classics seem to have been incorporated from the rich folk traditions which are wide spread and carried by oral literature through generations. Folk traditions commonly use wide variety of fauna for ailments such as rheumatic conditions, asthma, piles, night blindness, paralysis, general debility, leprosy, impotence etc. History also states the use of animal organs for transplantations. The use of goat's eye and animals teeth for cosmetic purposes are examples of this. Animal parts were also used for making different instruments used for diagnostic purposes as well as surgical management. For example, horns of different animals are used for the purpose of blood letting.

ANIMAL-ASSISTED THERAPY

Animals have been shown to act as co-therapists or agents for change in several studies conducted in

institutions, such as schools, hospitals, and nursing homes. By playing with pets, children learn how to be respected, how to develop by themselves, and how to face new changes and situations (Pentenero 2001). Often a live animal may not even be present in a session, but symbols and representations will provide rich discussion and therapeutic opportunities (DePrekel 2002). Midgley (1997) says that the therapeutic effectiveness of pet-keeping, along with anthropological data showing that pets have been kept in all kinds of human societies, is gradually forcing attention to the meaning of such customs. Research has shown that petting an animal can lower the heart rate, watching fish in a tank can be relaxing, stroking an animal can be helpful occupational therapy for stroke victims, and working with and riding horses can benefit people with physical/cognitive/emotional disabilities (DePrekel 2002). Indeed, the therapeutic equitation (or hippotherapy) is a complementary therapy in which horses are used for the rehabilitation or reeducation of physical or mental handicapped individuals, such as those who have hemiplegics or paralysis, Down's syndrome, and autism. The horse answers both to physical and emotional aspects of the activities performed together with the patient, and it extends the practitioner's effort by reintegrating him to the patterns of "normality". This kind of therapy seems to be efficient especially for people who have inhibition problems. The interaction with the animal helps to strengthen the character of the young while it provides an activity that is both a sport and an entertainment (Francis 1996).

THE THERAPEUTIC POTENTIAL OF INVERTEBRATES

Leeches are undergoing a triumphant resurgence in medicine, particularly in microsurgery. Traditionally, leeches are usually used in conditions like abnormal swellings, piles, inflammatory abscess, skin diseases, rheumatoid arthritis, eye diseases, poisonous bites, erysipelas etc. The revival of interest in leech therapy was caused due to the unsatisfactory results of conventional treatment of many cardiovascular diseases, and to new findings about the leech salivary components and its influence on the human organism. Leech compounds under study include an anticoagulant, a local anesthetic, a vasodilator and an antibiotic, all of which are useful to their producer's blood-sucking propensities and capable of being turned to therapeutic advantage. Indeed, *Hirudo medicinalis* Linnaeus 1758 has been described as a slithering pharmacopoeia (Huxtable 1992). The leech agents are more effective than heparin at inhibiting fibrin formation because, being smaller, they penetrate the clot more effectively. Also, whereas heparin acts indirectly by activating the anticoagulant antithrombin III, leech anticoagulants inhibit specific steps in the coagulation cascade.

Insects have proven to be very important as sources of drugs for modern medicine since they have immunological, analgesic, antibacterial, diuretic, anesthetic, and anti-rheumatic properties (Yamakawa 1998). In fact, antimicrobial peptides were first discovered in insect larvae by Dr. Hans Boman of the Karolinska Institute (Diamond 2001). Chemical screening applied to 14 insect species has confirmed the presence of proteins, terpenoids (triterpenoids and steroids, carotenoids, iridoids, tropolones), sugars, polyols and mucilages, saponins, polyphenolic glycosides, quinones, anthraquinone glycosides, cyanogenic glycosides, and alkaloids (Andary et al. 1996). Chitosan, a compound derived from chitin, has been used as an anticoagulant and to lower serum cholesterol level, as well as to repair tissues, and even in the fabrication of contact lenses (Goodman 1989). Kunin and Lawton (1996) have recorded that promising anticancer drugs have been isolated from the wings of Asian sulfur butterflies (*Catopsilia crocale* Cram. 1775) and from the legs of Taiwanese stag beetles (*Allomyrina dichotomus* [Linnaeus 1771]). Oldfield (1989) records that about 4% of the extracts evaluated in the 1970s from 800 species of terrestrial arthropods (insects included) showed some anticancer activity.

The major component of bee venom, the tetrameric polypeptide melittin, may be responsible for

the often-reported anti-arthritic and anti-inflammatory effects (Bisset 1991). He comments that a toxin named margatoxin has been isolated from the venom of the scorpion *Centruroides margaritatus* (Gervais 1841). This chemical compound blocks lymphocyte activation and the production of interleukin-2 by human T-lymphocytes. The Merck Company has filed a patent application for the use of margatoxin as an immunosuppressant, which may be potentially useful in treatment of autoimmune diseases or in preventing the rejection of organ transplants.

The use of animal toxins to determine nerve action mechanisms could prove to be the starting point for designing new treatments for Alzheimer's disease (Phillipson 1989). Konno et al. (1998) state that the venoms of the solitary wasps, *Anoplius samariensis* (Pallas 1771) and *Pseudagenia* (*Batozonellus*) *maculifrons* Smith, may be useful not only for basic neuroscience research but also for the development of therapeutic agents of neurological disorders.

The marine environment is a rich source of biologically active natural products of diverse structural types, many of which have not been found in terrestrial sources (Carté 1996). The sponge *Luffariella variabilis* (Poléjaeff 1884) produces relatively large amounts of a chemical with anti-inflammatory activity known as monoalide. It was found that monoalide inhibits the action of an enzyme called phospholipase A_2. The powerful immunosuppressive agent discodermolide originates from another sponge, *Discoderma* sp. (Faulkner 1992). Fusetani (1996) has isolated a novel sterol sulfate named halistanol sulfate as an antimicrobial metabolite from a species of *Halichondria* collected in Ishigaki Island, Japan. As he says, sponges have been a prime target for anticancer discovery program, which led to isolation of such important antitumor agents as halichondrin B and spongistatins/altohyrtins. Carté (1996) stresses that an increasing number of novel marine metabolites are reported in the literature every year, indicating that the marine environment is likely to continue to be a prolific source of new natural products for many years to come.

Jones (1998), when discussing the medically important toxins in the saliva of blood-sucking animals, points out that "the wide variety of bioactive molecules apparently contained in the saliva of blood-sucking arthropods is of general clinical therapeutic interest." For example, an anticoagulant from tick saliva is being used to determine the nature of blood afflictions in clinical settings. And a tick salivary anticoagulant has also been explored as a model agent to prevent undesired blood clotting during open-heart surgery.

THE THREATENING STATUS OF THE MEDICINAL ANIMALS

In the Lan Ong Street area of Hanoi, the capital of Viet Nam, one can buy deer antlers to cure backache, tiger *Pathera tigris* (Linnaeus 1758) bones which are often boiled into a concentrate to cure rheumatism or backache, monkey skeletons to relieve general pains, pangolin scales to cure skin diseases, and dried geckos as aphrodisiacs (Martin 1992). This author says that unless the Vietnamese vigorously strengthen their environmental laws, endangered species such as the Javan rhino *Rhinoceros sondaicus* (Desmarest 1822), white-headed leaf monkey *Trachypithecus leucocephalus* (Pousargues 1898), and Siamese Eld's deer *Cervus eldi siamensis* Lydekker 1915, may be extirpated in the wild because of habitat destruction and their use in commercial trade.

The Chinese have used rhino horns traditionally for ornamental, magical, and medicinal purposes. The 16th-century pharmacist Li Shih Chen stated that the main ailments treatable with this horn included snakebites, hallucinations, typhoid, headaches, carbuncles, boils, fever, vomiting, food poisoning, and "devil possession". Li Shih Chen's 50-volume pharmacology work contains the classic text on preparation and use of the rhino horn, and many pharmacists still use his text when they prescribe it today. (Blouin 1991). Chinese pharmacists currently prescribe rhino horn primarily to reduce

fever, and three researchers at the Chinese University at Hong Kong have shown that rhino horn does lower fever in rats. The same research revealed that saiga antelope horn and water buffalo horn also reduce fever in the animals, but the scientists suggest that further studies are needed to determine the effects of the different horns on humans (Blouin 1991). Many people still covet rhino horns as status symbols, powerful medicines, and aphrodisiacs. The Zulus of South Africa still use the horn for many purposes: a man may carry a piece of rhino horn in his pocket as a good charm. In Yemen, wealthy nobles covet rhino horn hilts for ceremonial daggers, known as *jambias*, for centuries.

In many Asian countries a bear's bladder is considered very powerful against digestive illnesses. It is estimated up to US$ 64.000. Besides hunting, there is the practice of raising puppies to be sold, after they are grown, because of their skin, bladder, and meat (Balzar 1992).

Although the hunting, slaughtering, and trading of wild animals have been prohibited in Brazil by federal law since 1967, they continue to be used both nutritionally and medicinally in a clandestine way. Costa-Neto and Oliveira (2000) investigated the use of 34 animals which are prescribed as folk medicines, cosmetics, and charms in the county of Tanquinho, northeastern of the State of Bahia. Of the total of species recorded, 24 (71%) are not under extinction risk. On the other hand, *Myrmecophaga tridactyla* (Linnaeus 1758), *Coendou* cf. *prehensilis* (Linnaeus 1758), *Dusicyon* sp., *Mazama* cf. *Americana* (Erxleben 1777), *Rhea americana* (Linnaeus 1758), and *Crypturellus noctivagus zabele* (Spix) 1825, which are officially considered as threatened species by the Brazilian Institute of Environment and Renewable Natural Resources (1989), were found among the set of faunistic resources prescribed as medicines at the time of this research. At least three species are insufficiently known and thus they are referred as to be threatened. These include *Tayassu tajacu* (Linnaeus 1758) and *T. pecari* (Link 1795) and tortoise (*Geochelone* cf. *carbonaria* [Spix 1824]). Finally, *Phrynops* is a little known genus that is believed to include threatened species.

Globally, seahorses and their pipefish relatives are threatened directly by a rapidly expanding trade for traditional medicines, aphrodisiacs, aquarium fishes, foods and curious and indirectly by the destruction of their seagrass, mangrove and coral reef habitats (Vincent 1999). In Indonesia the population of some species has dropped to half since 1990, with pregnant males being the most common prey.

ZOOTHERAPY AND ITS SUSTAINABILITY

The record of over 180 medicinal animals only in the State of Bahia, along with studies conducted in other parts of Brazil and foreign countries, represent a strong evidence of the medicinal use of wildlife resources (Costa-Neto 2004). Oldfield (1989) argues that many animal species have been overexploited as sources of medicines for the folk medicine trade. In addition, she also attests that animal populations have become depleted or endangered as a result of their use as experimental subjects or animal models. For this reason, sustainability is now required as the guiding principle for biological conservation. According to the IUCN draft *Guidelines* (Glowka et al. 1994), the exploitation of a given species is likely to be sustainable if:

a) It does not reduce the future use potential of the target population or impair its long-term viability;

b) It is compatible with maintenance of the long-term viability of supporting and dependent ecosystems; and

c) It does not reduce the future use potential or impair the long-term viability of other species.

But the zootherapeutic activity, weather properly managed, can be compatible with an environmental conservation program in which the use of natural resources can and must occur in such a way that human needs and protection of biodiversity be guaranteed (Andriguetto-Filho et al. 1998). For

this reason, zootherapy should be viewed within its cultural dimension (Costa-Neto 1999a). This cultural perspective includes the way people perceive, use, allocate, transfer, and manage their natural resources (Johannes 1993). Since people have been using animals for a long time, suppression of use will not save them from extinction. In accordance with Kunin and Lawton (1996), those species directly involved in traditional medicines should be among the highest priorities for conservation. These authors attest that some of the species are endangered precisely because they are of value to us. Since a basic principle governing the use of natural resources is that the extraction rate of a renewable resource should not exceed the renovation rate of that same resource, perhaps a suitable alternative for the diminishment of wild resources overexploitation would be through the localization of natural compounds that have been successfully tested for pharmacological action. Thus, the production of artificial substitutes in the laboratories would displace human dependency on animal medicines (Oldfield 1989).

Another alternative for the recovery of endangered species is to turn them into manageable resources in the way of traditional farming systems, where they would be reared using both folk and scientific techniques (Costa-Neto 1999b).

ANIMALS PHARMACOLOGICAL IMPORTANCE

Animals have been methodically tested by pharmaceutical companies as sources of drugs to the modern medical science (Launet 1993). The best-known example of successful drug development from a component of snake venom (*Bothrops jararaca* [Wied 1824]) is that of the inhibitors of angiotensin-converting enzyme (ACE). This enzyme is responsible for converting an inactive precursor into the locally active hormone angiotensin, which causes blood vessels to constrict and hence raises blood pressure (Bisset 1991). By pharmacologically blocking the enzyme's activity, blood pressure can be reduced, and agents with this activity are commonly used to treat people with high blood pressure (Harvey 1995). Currently, ACE inhibitors like captopril, enalapril, and lisinopril are in the top twenty best selling medicines in the world.

Regarding fish, several compounds have been extracted and these are employed as remedies in the official medicine (Hamada and Nagai 1995). Today, some of these compounds are important as tools for biochemical research or as new leads for the development of anticancer and antiviral drugs (Higa 1996). Agosta (1996) says that "one of the most promising discoveries of the 1990s is a new chemical compound derived from dogfish sharks (*Squalus acanthias* Linnaeus 1758) that kills parasites, fungi, and bacteria. This chemical helps prevent infections in wounded sharks, and someday it may do the same for us". Finkl (1984), for example, refers to *Eptatretus stoutii* (Lockington 1878), *Dasyatis sabina* (Lesueur 1824), and *Taricha* sp. as sources of cardiac stimulants, antitumors, and analgesic, respectively. Oily fish, like cod, herring, salmon, and turbot, have a great medicinal value to human beings due to a polyunsaturated compound known as OMEGA-3. This substance helps the prevention of arthritis (Adeodato 1997). The presence of an anticoagulant system in the plasma of Atlantic salmon (*Salmo salar* Linnaeus 1758) and rainbow trout (*Oncorhynchus mykiss* [Walbaun 1792]) has been confirmed, what supports similarities with the protein C anticoagulant system in mammals (Salte et al. 1996). Tetrodotoxin (TTX), a water-soluble guanidinium derivative, is an example of a bioactive compound produced by marine organisms such as puffer fish "that resembles procaine in its ability to inhibit transmission of nerve cells" (Colwell 1997). When diluted it acts as an extraordinary narcotic and analgesic (Bisset 1991).

According to McGirk (1998), Brazilian scientists are studying a type of frog which is used to cure intestinal illnesses by members of the Yawanawa Indian tribes on the banks of the Rio Grande. Indeed, amphibians have provided compounds capable of being turned to therapeutic advantage. Peptides extracted from the scraped secretions of *Phyllome-*

dusa bicolor (Boddaert 1772), for instance, are used in the treatment of depression, stroke, seizures and cognitive loss in ailments such as Alzheimer's disease (Amato 1992). Some of these compounds are important tools for biochemical research or as new leads for the development of anticancer or antiviral drugs (Lazarus and Attila 1993).

The number and diversity of compounds produced by amphibians in their granular glands is surprisingly high, even within single species. The main categories of secretions include biogenic amines, bufogenines and bufotoxins (steroids), alkaloids and peptides (including smaller oligopeptides, polypeptides and proteins) and the as yet uncharacterized zetekitoxins found in the Middle and South American harlequin frogs, genus *Atelopus*. Most alkaloids of amphibian skin appear to be sequestered from dietary arthropods (Daly 1998). Many of the compounds contained in granular gland secretions have a defensive role. Their pharmacological effects include cardiotoxic, myotoxic and neurotoxic activities, some are vasoconstrictive and hypotensive agents while others have hallucinogenic effects – all properties which would clearly adversely affect a potential predator. Dermmophin, a novel opioid heptapeptide produced in the skin of the South American leaf frogs, genus *Phyllomedusa*, has a 1000-fold greater effect than morphine at the same dosage level (Clarke 1997).

It is therefore possible that molecules derived from amphibian sources might provide useful alternative or supplementary treatments, primarily as antimicrobial (including antifungal) agents. The presence of a wide range of peptides with unknown properties enhances the prospects of using peptide vaccines for viral diseases (Clarke 1997).

CONCLUSION

Drug companies and agribusiness firms have been methodically testing animals and medicinal plants for decades without paying anything to countries where these genetic resources were found (McGirk 1998). The biodiversity treaty recognizes that, as custodians of the biosphere, indigenous people should receive some reward if, say, a drug company or an agribusiness firm develops a product based on traditional resources or wisdom. However, pharmaceutical companies rarely pass on a fair share of their profits to the countries that provide the raw genetic material.

One argument for the conservation of biodiversity is that almost any species can turn out to be useful (Beattie 1992). According to Young (1999), it is critical that the biomass diversity be maintained to provide future structural diversity and provide leads and drugs for new targets for pharmaceutical events that will emerge in the coming years. As Phillipson (1989) points out, medicine will continue to rely heavily on natural products.

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RESUMO

Os animais são utilizados como recursos medicinais para o tratamento e alívio de um gama de doenças e enfermidades em praticamente toda cultura humana. A pertinência da medicina tradicional baseada em animais, embora considerada como superstição, não deve ser negada uma vez que os animais têm sido testados metodicamente pelas companhias farmacêuticas como fontes de drogas para a ciência médica moderna. O fenômeno da zooterapia representa uma forte evidência do uso medicinal de recursos animais. De fato, as indústrias farmacêuticas e de agronegócios há décadas vêm avaliando animais sem pagar tributos aos países detentores desses recursos genéticos. A utilização de partes do corpo dos animais como remédios tradicionais é relevante porque implica pressão adicional sobre populações selvagens críticas. Discute-se que muitas espécies animais estão sendo exploradas em excesso como fontes de medicamentos para o comércio tradicional. Além disso, as populações animais ficaram exauridas ou ameaçadas como resultado do uso como objetos de experimentação ou modelos animais. A pesquisa sobre zooterapia deveria ser compatível com o bem-estar

dos animais, assim como o uso dos produtos medicinais deveria ser guiado de modo sustentável. Sabe-se que a sustentabilidade deve ser tida como um princípio orientador para a conservação biológica.

Palavras-chave: etnozoologia, zooterapia, bioprospecção, sustentabilidade.

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