Chapter 3
Medicine from the Wild: An Overview of the Use and Trade of Animal Products in Traditional Medicines

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Abstract The use of animals, plants, and fungi as a major source of local medicine for people's well-being in rural areas has been documented in different parts of the world, and has also been recorded in urban environments. In urban settings, the trade of wildlife-based medicinal products is concentrated in local and traditional markets, where various species of medicinal plants and animals are commercialized. The commercialization and use of biological resources as remedies encompass cultural, social, and economic aspects and bear important implications for conservation, especially in relation to the most heavily exploited species. This chapter reviews the literature on commercialization of medicinal animals in local markets, focusing on urban zootherapy and on the social actors involved in these practices. In doing so, we hope to highlight the importance of further research on the topic and to explore ways through which conservation and management initiatives can improve dialog with resource users and traders.

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3.1 Introduction

Human populations engage in hunting and fisheries to meet diverse nutritional, economic, medicinal, cultural, and recreational needs (Alves and Souto 2010; Bennett and Robinson 2000; Nooren and Claridge 2001), and these extremely close connections of dependence and co-dependence have existed between humans and animals throughout history (Alves and Souto 2010). The use of biological resources (animals, plants, and fungi) as a major source of local medicine for people's well-being in rural areas has been documented in different parts of the world (Alves 2009; Alves and Rosa 2007a, b; Alves et al. 2007; Heinrich et al. 1998; Kültür 2007; Mahawar and Jaroli 2008; Melo et al. 2009; Oliveira et al. 2007; Parveen et al. 2007), and has also been recorded in urban environments (Alves and Alves 2011; Alves and Rosa 2010; Monteiro et al. 2010). As a large amount of the world's population is concentrated in urban areas, there are changes in the relationship between human activities and biodiversity, and consequently in the way we should think about biodiversity conservation policies (Puppim de Oliveira et al. 2011).

Expanding urban populations in most of the world continue to supplement limited public health facilities and more expensive commercially produced medications with popular remedies (Srivastava et al. 1996), and this has led to an increasing demand for wildlife products for medicinal purposes in urban areas.

Historically used as raw materials in traditional medicine systems, especially by traditional health practitioners, medicinal plants have entered the formal and informal markets worldwide (Bussmann et al. 2007; Cunningham 1993; Laird 1999; Loundou 2008; Monteiro et al. 2010; Oliveira et al. 2010), and as pointed by Cunningham (1997), stimulated by high population growth rates, rapid urbanization, rural unemployment, and the value placed on traditional medicines, commercial trade in traditional medicines is now greater than at any time in the past.

In cities, the trade of medicinal products (plants and animals), especially as raw materials, is concentrated in local and traditional markets (e.g. Albuquerque et al. 2007; Alves and Alves 2011; Alves and Rosa 2010; Monteiro et al. 2010; Van der Berg 1984; Vázquez et al. 2006), which in this text encompasses various denominations used in the literature, such as traditional markets, fairs, open markets (Monteiro et al. 2010). Local markets generally have specific sections where plants and animals are sold for medicinal purposes, and these locales serve to unite, maintain, and diffuse empirical knowledge from different regions and of different origins. The ongoing search for natural products, as part of a collective social strategy, increases the importance of these traditional centers (Albuquerque et al. 2007, 2010).

Although medicinal plant markets have drawn the attention of many ethnobotanists (e.g. Albuquerque et al. 2007; Mati and de Boer 2011; Monteiro et al. 2010; Williams et al. 2000, 2005), the trade in animals for medicinal purposes has been largely overlooked in the literature; only recently that form of trade has attracted the interest of researchers (Alves and Pereira Filho 2007; Alves and

Rosa 2007b, 2010; Ashwell and Walston 2008; Oliveira et al. 2010; Van and Tap 2008; Vázquez et al. 2006; Ferreira et al. 2012), whose studies have revealed that the extensive medicinal use of animal parts and products is sustained by a thriving trade in medicinal animals, mainly conducted by herbalists in markets.

Trade in wildlife products employed in traditional medicines is growing throughout the developing world, resulting in numerous species becoming locally or regionally extinct in the wild (Alves and Rosa 2007a; Marshall 1998a; Olsen 1998). Some authors suggest that commercial demand for traditional medicines is correlated with increasing urbanization, poverty, and related social problems (Alves and Rosa 2010; Cunningham 1992). There is also recognition that health care services are precarious in most developing countries, where many have no access to health care (Smith et al. 2001). On the other hand, Vandebroek and Calewaert (2004) considered that urbanization and the consequent access to services and goods reduces demand for resources, and also negatively affects transmission of traditional botanical knowledge.

Given the conservation status of many of the animal species sold for medicinal use (Alves and Rosa 2005; Alves et al. 2008a, b, c, 2010), the ecological, cultural, social, and public health implications associated with their use, as well as more complete inventories of the species used are urgently needed (Ferreira et al. 2009). An increased understanding of the various facets involved in the medicinal uses of animals is central to better assess how they impact wild populations, and to explore ways through which conservation and management initiatives can improve dialog with resource users and traders. In this context, this chapter reviews the literature on the trade of medicinal animals in local markets, focusing on urban zootherapy and on the social actors involved in these practices. In doing so, we hope to highlight the importance of further research on the topic, and to explore ways through which conservation and management initiatives can improve dialog with resource users and traders.

3.2 Commercialization Points and Traders

Animals used for medicinal purposes are openly traded, in conjunction with medicinal plants, in booths located in specific sectors of the local markets (Alves and Rosa 2007b, 2010; Vázquez et al. 2006; Whiting et al. 2011). In addition to formal markets (Fig. 3.1), trade is also conducted through itinerant merchants selling both animals and medicinal plants in stalls located on squares or on the street (Figs. 3.1 and 3.2). In China, Thailand, and Vietnam, where traditional and allopathic medical care systems are closely integrated, large hospitals commonly use both plant and animal products for health care (Fig. 3.3a). In China, there is also extensive trade and price monitoring through the Internet (Fig. 3.3c). Occasionally, medicinal animals or their parts can be found for sale in small dry-goods stores, fish markets, and shops specializing in religious articles (Alves and Rosa 2010).

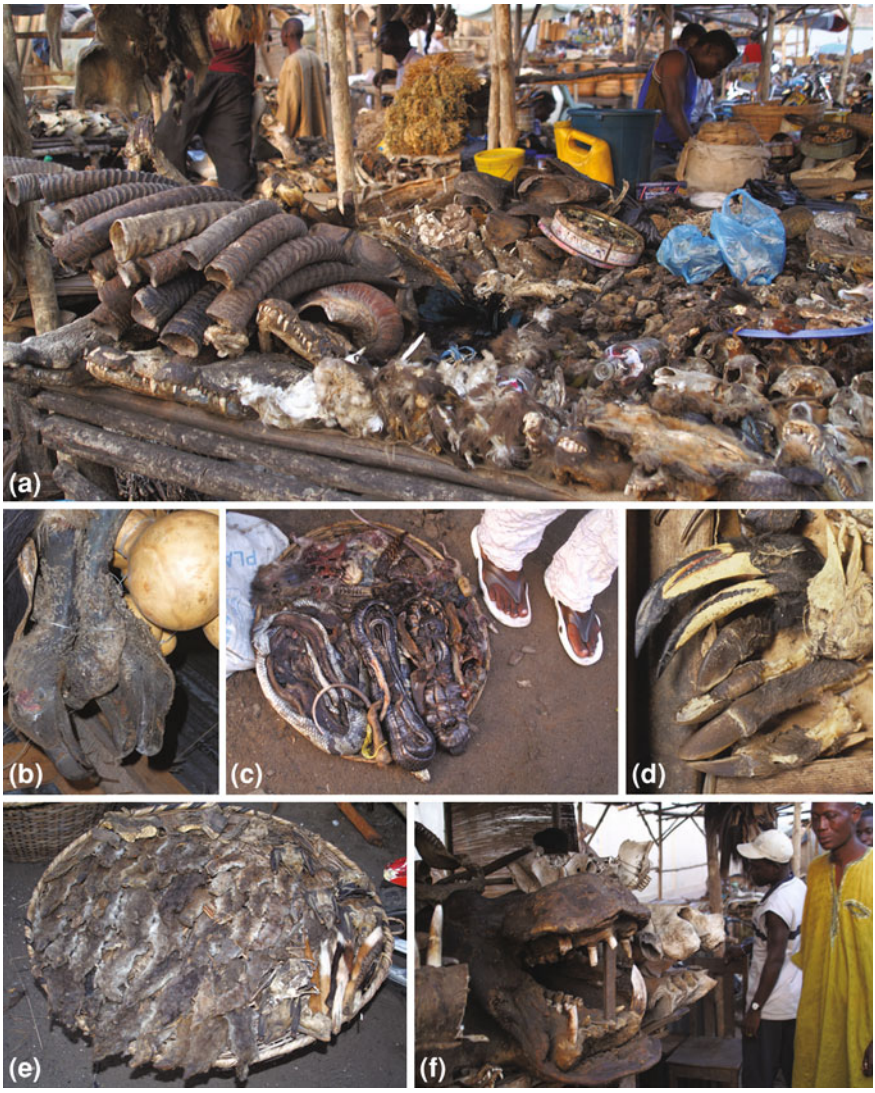

Fig. 3.1 Informal sector markets characterize the animal medicines trade in Africa. **a** Stalls selling antelope horns, crocodile skulls, and a diversity of carnivore and non-human primate skulls for sale in Benin. Typical animals traded across West and southern Africa are: **b** Vulture heads (Xipamanine market, Mozambique); **c** Pythons (whole, the fat, or the skins) (Benin); **d** Hornbill heads and aardvark claws (Cote d'Ivoire); **e** Small mammals and bats (in this case, *Eidolon helvum*) and **f** Hippopotamus (*H. amphibious*) fat and skin is commonly sold, but in this case, several hippo skulls are displayed in this market in Benin

Besides being the primary source of medicines, medicinal resources are increasingly being harvested for income generation, unemployment, and poverty being among the driving factors for the trade (Alves and Rosa 2005; Alves et al.

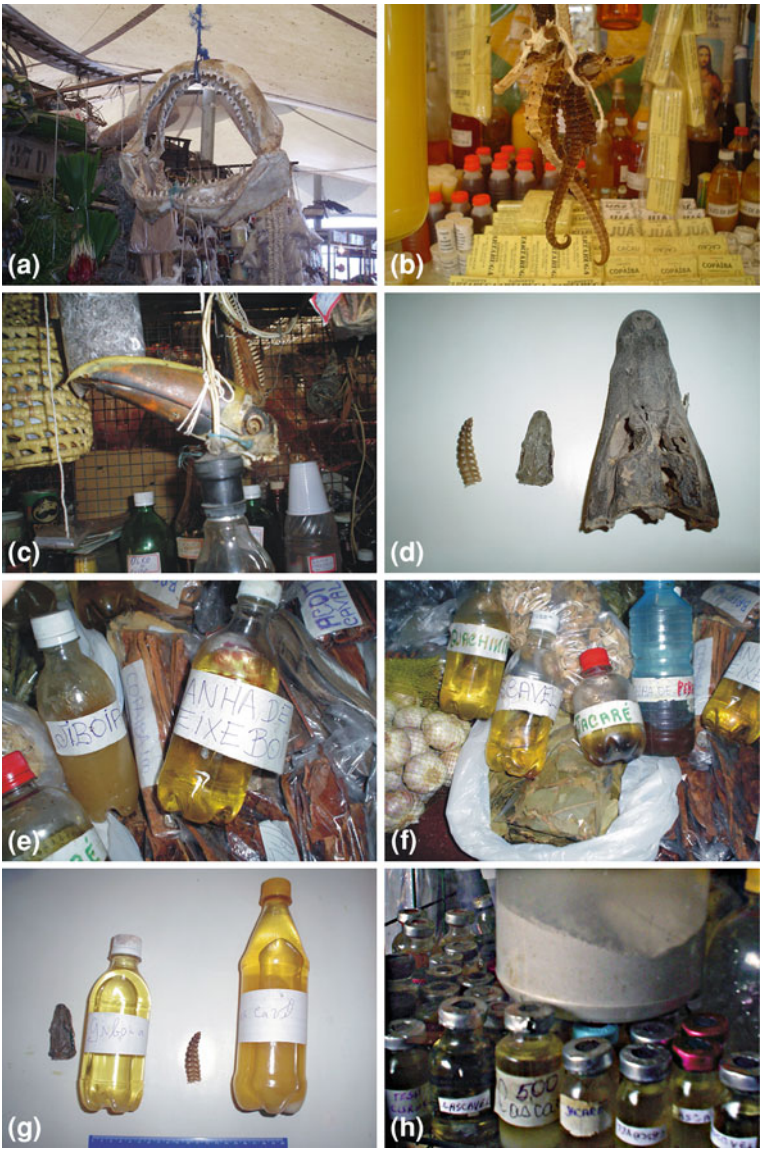

Fig. 3.2 Medicinal animal products sold in Brazilian cities. **a** Shark jaws and teeth; **b** Dried seahorse and soap produced from honeybee and fat of turtle (*P. expansa)*; **c** Beak of *Ramphastos tucanus* (tucano); **d** Rattle of rattlesnake (*Caudisona durissa*), boas' head (*Boa constrictor*) and cayman's head (*Cayman* sp.); **e** Fat extracted from boa (*Boa constrictor*) and manatee (*Trichecus* sp.); **f** Bottled raccoon fat (*Procyon cancrivorus*), rattlesnake (*Caudisona durissa*), cayman (*Paleosuchus palpebrosus* or *Cayman crocodilus*) and armadillo (*Euphractus sexcintus*); **g** Head and fat of boa (*B. constrictor*) and rattle and fat of rattlesnake (*C. durissa*); **h** Oyster powder (*Crassostrea rhizophorae*) and fats from various species

Fig. 3.3 With thousands of years of documented use, traditional and modern medical systems are closely integrated in Asia. **a** A hospital in Xi'an, Shaanxi, that integrates both health care systems; **b** The Hehuachi traditional medicine market in Chengdu, Sichuan, China; **c** Interior of the market, which also conducts Internet-based trade; **d** Deer antlers and penises; **e** Ground beetles; **f** Starfish and **g** *Cordyceps sinensis* infected Hepailid moth caterpillars, which sell for US$12,000 per kg

2008b; Loundou 2008; Mander 1998). The high rate of urbanization, resulting in high demand for medicinal plants, combined with the high rate of unemployment, has favored the involvement of commercial gatherers (Cunningham 1993), and as

this informal market grows, more and more stakeholders are attracted (Mander 1998). A number of commercial harvesters, mostly unemployed and from poor social strata, are generating income from the informal trade of medicinal plants (Loundou 2008). In Brazil, for instance, traders of zootherapeutic products have a low education level, and this aspect exerts a direct influence on the recruitment of new traders to that activity, which does not require formal education (Alves et al. 2008b). Cultural motivations can also be important determinants for involvement in the trade of medicinal animals. As an example, in NE Brazil a strong family tradition focusing on animal-based remedies persists, as well as the figure of the *doutor de raiz* (roots' doctor)—a popular specialist who not only trades medicinal animal products, but also prescribes and produces various remedies. Although increasingly becoming rare, when present roots' doctors render the local markets interesting places for ethnopharmacological or ethnomedicinal investigations. The impacts of a growing urbanization and the need to generate a cash income, however, seem to be progressively eroding tradition. Cunningham (1992) highlighted that in the past traditional medicines in Africa were predominantly administered by specialized herbalists, a niche now occupied by thousands of non-specialized gatherers operating in the informal economy, who collect plants to supply urban traders or sell directly to subsistence sector consumers (Fig. 3.1). In Brazil, animal-based remedies have become part of a regular business that may involve advertising, the use of books describing, for example, the posology of the remedy, as well as pre-packaged medicines. Nevertheless, such practices are generally looked down upon by traditional traders of folk medicine, who feel proud of their knowledge of the raw materials and remedies (Alves and Rosa 2007b).

3.3 Animal Medicinal and Zootherapeutical Products

Recent investigations have revealed that a large number of animal species are traded for medicinal purposes in urban areas worldwide, particularly in African, Asian, and Latin American countries, with many similarities as well as significant differences in the categories of animals selected. Examples of surveys that have documented the diversity of animals sold for traditional medicine are: El-Kamali (2000), who identified 23 animal species, whose products were commercialized in traditional medicine in Central Sudan; Sodeinde and Soewu (1999), who recorded the use of 45 medicinal species in Nigerian markets; Simelane and Kerley (1998), whose results showed that 44 species (eight reptiles, six birds, 30 mammals) were sold in 19 herbalist shops in the Eastern Cape Province of South Africa; Cunningham and Zondi (1991), who examined the trade in animals for traditional medicine in KwaZulu–Nata Province and reviewed the literature reports for South Africa, recording at least 79 species of vertebrate (18 reptiles, 16 birds, 45 mammals), excluding domestic mammals and various marine invertebrates and fishes. More recently, Ngwenya (2001) recorded 132 species of vertebrates

(21 reptiles, 32 birds, 79 mammals) in trade across KwaZulu–Natal Province, of which 50 species were in high demand, especially vultures, chacma baboon, green mamba, southern African python, Nile crocodile, puff adder, striped weasel, and black mamba. Whiting et al. (2011) identified 147 vertebrate species representing about 9% of the total number of vertebrate species in South Africa and about 63% of the total number of documented species (excluding domestic animals) traded in all South African traditional medicine markets. Surveys carried out in 15 Brazilian cities revealed that at least 180 animal species are traded for medicinal purposes (Alves 2010). Ashwell and Waltson (2008) recorded at least 47 animal species being traded for medicinal purposes in Cambodian markets, while Van and Tap (2008) recorded 100 different medicinal products from 68 animal species traded in Ho Chi Minh City, mainly sold as dried products (either the whole animal or parts), soaked in rice wine, or as a gel product which remains after boiling animal remains slowly in water.

The great variety of useful animals encountered in some local markets have been attributed to several factors: Alves and Rosa (2007b) highlighted that the main determinants of the number of animals used for medicinal purposes appear to be the local faunal and cultural diversity, and the size of the regional market. Other authors (e.g. Bolze et al. 1998; Marshall 1998b) have suggested that market expansion induces people to make greater use of wild animals for traditional medicine, and that the practice has spread in developed nations of Asia and the Pacific (e.g. Taiwan, Australia), although there is also evidence that the increasing use of animals for traditional medicine can take place without economic prosperity. As an example, Kritsky (1987) reported that the use of insects for traditional medicine in China increased during the Cultural Revolution. In that same direction, based on an ethnozoological survey of the use of medicinal birds, Joseph (1990) concludes that the use of birds to treat human ailments increased in Madhya Pradesh, Central India, because people could not afford modern treatments.

The indigenous fauna represents most of the species traded in local or even regional markets, and this highlights the role of local biodiversity in furnishing folk medicine, as well as the need for further assessments of the contribution of locally caught species to the medicinal fauna commercialized at the markets. Although there is evidence that the faunal composition, accessibility, and availability directly influence the types of zootherapeutic items used in any given region, studies on market dynamics, socioeconomic and conservationist implications of the use of local resources (either locally or regionally) are virtually nonexistent. Moura and Marques (2008) suggested that the use of medicines derived from animal parts that are not consumed as food and would otherwise be discarded (e.g. teeth, skin, horns), is a means of maximizing the productivity of local ecosystems, while Apaza et al. (2003) remarked that the use of the local fauna generally reduces the cost of acquiring animal products in regions with abundant fauna.

The high number of species involved in medicinal trade reveals that the animals are therapeutic resources culturally important in urban areas. Nevertheless, the lack of zootherapeutic studies has contributed to an underestimation of the

importance of zootherapeutic resources. Alves and Rosa (2010) pointed that one of the factors that certainly contribute to the scarcity of information on the subject is the often semi-clandestine or clandestine nature of the trade and use of medicinal animals, which generally results in users and traders being more resistant to provide information—a situation driven by the fact that most medicinal animals are wild-caught and protected by law; some figure in official lists of threatened species.

In contrast to what is observed with medicinal plants, most traders of medicinal animals in Brazil do not directly expose animals or animal parts for public viewing. Whole animals or their parts are generally kept out of sight in shops in closed bags or plastic receptacles that are brought out only when requested by a potential buyer. This is done to avoid the risk of environmental officers seizing specimens, and is related to the fact that traders are aware of the illegality of the trade in wild animals (Alves and Rosa 2007b, 2010).

A similar trend was observed by Whiting et al. (2011), in their study of the medicinal animal at the Faraday market in South Africa, where establishing the impact of traditional medicine on wildlife is notoriously difficult because traders are reluctant to reveal the source of their stock. Miththapala (2006) highlighted that obtaining data on the trade in animals and plants for medicinal purpose and its impacts on biodiversity is difficult because: (1) trade may take place without proper documentation and data are simply lacking in most areas; (2) for threatened species trade is often illegal and therefore there is great secrecy surrounding trade and reliable information is difficult to obtain. This way, as discussed by Padoch (1992), because of the difficulty in obtaining reliable data from market vendors, middlemen, exporters, and local governments, the trade in medicinal plants (and animals) still remains a 'hidden harvest' in many countries. Specifically in the case of the trade in animals for medicinal purposes, the illicit nature of the activity can certainly lead to an underestimation of the number of species commercialized both in rural and urban settings.

Padoch et al. (2008) highlighted that the increasing mobility of human populations globally has enhanced trade of forest goods as people's customs and traditions follow them. As an example, Alves and Rosa (2007) recorded the use of similar resources as medicines in more remote and urban areas of Brazil, and suggested that zootherapeutic practices may function as a social conduit which, in conjunction with other factors, helps to maintain the connections between rural and peasant people living in cities and their own traditional culture and values. Such findings corroborated the studies of Belluck (1996) and O'Connor (1998) who found that within urban centers, members of immigrant and ethnic minority groups typically use a variety of traditional healing resources in conjunction with conventional medicine care. Moreover, as remarked by Cocks (2006), even people who have migrated to (peri) urban areas and have become involved in modern economic sectors still perform certain cultural practices for maintaining a sense of well-being and expressing their identity.

More specifically, it indicates the potential for exchange of materials and information about illnesses and treatments between more remote and urban

communities. In recent years, there has been a marked increase in the number of discussions regarding traditional communities in cities. Significant are indigenous populations and other traditional populations living in urban centers (Almada 2011), and many of these try to preserve some of their customs and values, including the use of plants and animals as the basic ingredients of their medical practices. Migration from more remote/rural areas to cities, therefore, has also played a significant role in knowledge transmission of ingredients used in traditional medicine in urban settings, as well as in creating a demand for specific products in local markets.

The prices of the medicinal wildlife items traded showed great variation and reflected various criteria, including species traded, rarity, demand, and size. Larger wild animals, which generally achieved the highest prices, were mainly species especially vulnerable to overhunting, and with limited capacity to recover from population declines (Adeola 1992; Alves et al. 2008a; Ashwell and Walston 2008; Sodeinde and Soewu 1999; Van and Tap 2008; Yinfeng et al. 1997). Modern marketing trends are also reflected in the presentation of some zootherapeutic products, which were either manufactured or pre-packaged. In India, where the Ayurvedic industry is worth an estimated US $1 billion per year, 7500 factories produce thousands of Ayurvedic and Unani formulae (Bode 2006). In China, clinical trials for traditional preparations are now frequent and there are plans to establish standards for these products and a competitive, modern industry in traditional Chinese medicine. Industrial processes and packaging are included for deer products imported from New Zealand and seal and ginseng (*Panax ginseng*) extracts (Fig. 3.4). Seal penises from managed culling of Cape fur seals in Namibia are exported to China.

In Latin America, examples of industrial packaging are the fat extracted from the manatee (*Trichecus* sp.), sold as tablets, and the fat of Amazon River turtle (*Podocnemis expansa* (Schweiger, 1812)—Podocnemididae) sold as manufactured soap in Brazil (Fig. 3.2b) (Alves and Rosa 2007b).

3.4 Cultural and Socioeconomics Aspects of Urban Zootherapy

The socioeconomic aspects, the popular culture, and commercial considerations are factors that maintain and drive the market for therapeutic animal products. Recent studies have highlighted the relevant role played by Traditional Medicine in cosmopolitan areas (Botha et al. 2004; Macía et al. 2005; Reiff et al. 2003), where health care needs generally are met by mainstream services, such as hospitals and allopathic pharmacies (Alves and Rosa 2007b). Overall, the urban milieu can contribute to higher levels of chronicity of illness, and low confidence in, or commitment to modern medicine. Quite apart from social or cultural functions, urban folk medicine may offer the most convenient, affordable health care. Folk curers tend to concentrate in ethnic and lower income neighborhoods

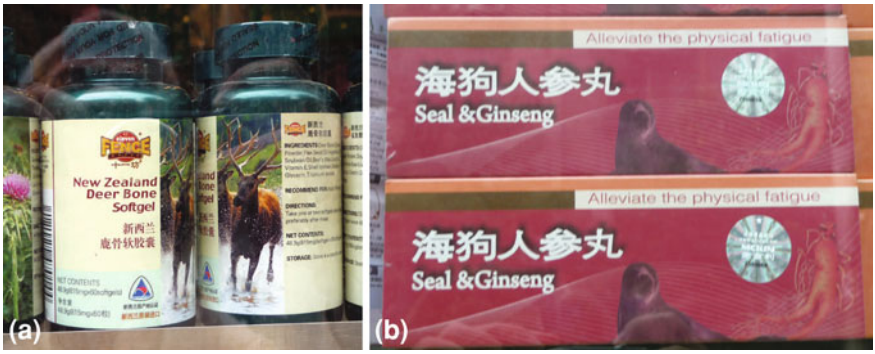

Fig. 3.4 Industrial processes and packing of medicinal animal products is common in China. **a** Red deer products imported from New Zealand and **b** Seal and ginseng (*Panax ginseng*) extracts

and can be seen after work hours. Further, curers and folk remedies are generally cheaper than physicians and prescription drugs. Even where costly, curers may ritualize fees in such a way as to lower patient resistance to payment (Press 1971). In addition, western-type medical facilities have not been able to cope with the rapidly growing urban population.

Animals provide the raw materials for remedies prescribed using the clinical method and are also used in the form of amulets and charms in magic-religious diagnosis (Alves and Rosa 2006). These characteristics, found in various traditional medical systems, can boost the commercialization of animals for treating or illnesses (both physical and spiritual) in urban areas, as observed with plants. Cunningham (1993) highlights that in the stressful environment which is a feature of many urban areas in Africa, it is not surprising that demand has increased for traditional medicinal plant and animal materials which are believed to have symbolic or psychosomatic value. Traditional plant or animal materials which bring luck in finding employment, which guard against jealousy (such as that engendered when one person has a job while his/her peer group are unemployed), or love-charms and aphrodisiacs to keep a wife or girlfriend are popular. A similar trend was observed in Brazil by Alves et al. (2007) and Albuquerque et al. (2007), where different animal and plant species are used in magical-religious practices of Afro-Brazilian cults in the context of rituals that emphasize the holistic nature of traditional medicine and that are designed to address spiritual, physical, and social-psychological problems.

The notable use and commercialization of medicinal animals to alleviate and cure health problems and ailments in the cities reveals the resilience of that therapeutic alternative, in spite of the influence of western medicine. In urban areas, the people brought from their villages to the cities much valuable knowledge of animal-based remedies that is rarely studied.

3.5 Sanitary Concerns

The use of medicinal animals is often considered healthy by urban consumers, nevertheless, zoonotic diseases (a still poorly studied topic) have been increasingly mentioned in the literature (van Vliet and Mbazza 2011), as exemplified by Schnurrenberger and Hubbert (1981), who drew attention to the possibility of transmission of serious and widespread zoonotic diseases such as tuberculosis or rabies, an aspect that should be considered whenever animal tissues from unknown sources are handled and used as remedies.

Moreover, the stability and hygiene of medicinal products commercialized in markets is unknown, but probably varies enormously between traders and traditional healers (Mander et al. 2007). In Brazil, Alves and Rosa (2007b) ranked the sanitary conditions of the zootherapeutical products as poor; in the same direction, a study on the commercialization of medicinal plants in São Luís city, NE Brazil (Amaral et al. 2003), revealed that 81.5% of the material analyzed were contaminated by bacteria. In Ouagadougou market, Burkina Faso, traditional healers have been recorded selling animal parts from trophy animals prepared by taxidermists (Fig. 3.5). As this process can use toxic chemicals such as arsenic, this also raises health concerns.

Those observations highlight the need for further assessments of the sanitary conditions of the medicinal products commercialized, as well as for the implementation of measures to address the sanitary aspects of the trade of animals or their parts for medicinal purposes.

Broad categories of sanitary and phytosanitary regulatory measures are recognized for the food trade: (1) information measures which restrict the behavior of suppliers only to the extent that they are required to disclose specified facts about their products; (2) measures that impose prior approval certifying that their products have met some pre-specified safety criteria before they can be released onto the market; and (3) measures that allow suppliers to sell products without any prior official approval but imply that an offense is committed if the products fail to meet certain minimum safety standards (Henson and Heasman 1998). The implementation of equivalent sanitary measures to the trade of animals or their parts for medicinal purposes, however, faces considerable challenges, among them ensuring adequate participation of all stakeholders involved, monitoring of the activity, and combating illegal, unreported, and unregulated trade (Alves and Rosa 2005).

3.6 Conservation Implications

Wildlife trade is central to the relationship between sustainable development and biodiversity conservation (Broad 2001). Rapid urbanization and greater demand for traditional medicines result in an increase in harvesting of medicinal plants and

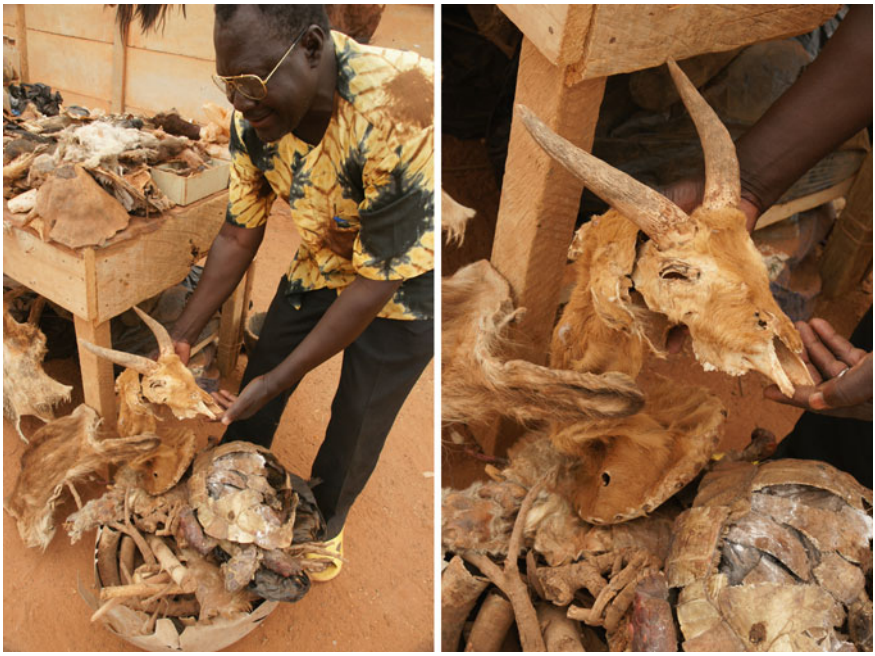

Fig. 3.5 An old mounted head of an antelope that is being "recycled" in the traditional medicines market of Ougadougou, Burkina Faso, West Africa

animals from rural areas, leading to a depletion of the rural resource base where certain species are vulnerable to over-exploitation, and consequent problems for primary health care (Cunningham 1997).

There is still much that is not known about the wildlife medicinal trade and its impacts, and research will be required on many levels (Marshall 1998b), although assessing the impact of traditional medicine on wildlife is notoriously difficult because this commercialization is often clandestine or semi-cladenstine (Alves and Rosa 2007b, 2010). In this sense, ethnozoological inventories of local markets can provide important information about species that are susceptible to destructive exploitation, species that are exceptionally expensive or hard to find (which may indicate that their natural reserves are becoming exhausted), and species with increased collecting or buying frequencies (which might indicate greater demand) (see for example the chapter on African bird use in this volume). In this context, local markets can provide managers and policy-makers with useful information to assist in the establishment of dialog with users and traders of wildlife, as well as for the implementation of conservation strategies. Ethnozoological studies, however, need to go beyond inventories, and should also test hypotheses about the factors that affect, regulate, and maintain the processes of knowledge transmission, product demand, and particularly of the ecosystems that provide the medicinal products. Identification and characterization of the stakeholders involved in the

system of use and trade of wildlife for medicinal products will certainly increase our understanding of such practices.

Wild populations are the principal sources of raw materials for the medicinal animals commercialized in local markets. In addition, many medicinal species are protected by law and/or figure in official lists of threatened species. The case of large, terrestrial animals (e.g. tigers, bears, rhinos, turtles, snakes, tokay geckos, pangolins, monkeys and swiftlets tigers, rhinoceros, bears) threatened by trade for traditional medicine, especially traditional Chinese medicine, is well known. Nevertheless, the list of wild animals believed to have medicinal and curative properties and commercialized is long and the actual number of animal species commercialized in traditional medicine remains unknown (Alves and Alves 2011). There is a growing need for baseline data, for proper quantification of the trade in animal parts for traditional medicine, and for further assessments to evaluate whether this trade makes significant use of species of conservation concern (Whiting et al. 2011).

The reasons for consumption of medicinal animals are complex and integrate economic, cultural, and social reasons that should not be disregarded in efforts to promote the sustainable trade of wildlife. Many people are economically dependent on the traditional commerce of medicinal species. Nevertheless, in countries such as Brazil, the trade of animals for medicinal purposes has had little impact on the socioeconomic conditions of collectors, who generally are illiterate, underpaid, and perceive their activity as clandestine or semi-clandestine. The monetary value of animals sold for medicinal purposes in the country increases at each level of trade, and the socioeconomic profile of traders varies accordingly (Alves and Rosa 2005).

Conservation practices tend to focus on arresting or ameliorating habitat destruction because biodiversity is conserved as a by-product. What has received far less attention from ecologists and conservation biologists is the harvest of animals for use in traditional medicine (Whiting et al. 2011). The commercialization of animals for medicinal purposes is a widespread phenomenon, with significant implications for their conservation and sustainable use. Since this threat is a multi-factorial one, involving the complex socioeconomic conditions in which users and traders and their families live, conservation programs have to be applied within an organizational framework of the social factors involved, and must be based on clearly stated priorities and goals. In this sense, there is an urgent need to (1) increase our understanding of the harvesting and trade of those species; (2) assess the impacts caused by the commercial exploitation; (3) adopt conservation measures as necessary, so that over-collection of such species will not lead to their extirpation and consequently to the loss of source medicinal material.

The cultural context for urban zootherapy comprises a complex network of dynamic interactions between societal elements. The extensive consumptive use of wildlife in the context of a modern-day economy requires the development of conservation strategies that (1) go beyond existing laws that are seldom enforced, and (2) foster dialog among different stakeholders to address issues such as the need for elimination of the illicit aspects of the trade, and the development of some

form of collaborative resource management. Furthermore, given the recognition that habitat loss and landscape alterations pose a serious threat to the survival of wildlife, and that species loss may lead to a loss of knowledge regarding their potential value (see Anyinam 1995), the connections between the trade in medicinal animals and ecosystem conservation should be further explored.

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