Berhan International Research Journal of Science and Humanities (BIRJSH), 2021, 5(1), 47-72

Journal homepage: www.journals.dbu.et *ISSN: 2414-2794*

Ethnozoology: Fauna and Their Products as Traditional Curative, protective, and preventive medicines and Prospection of Animal Conservation

Mastewal Hailemariam[1*] and Sefi Mekonen [2]

1Department of Biology, College of Natural and Computational Sciences, Debre Berhan University, Debre Berhan, Ethiopia

[2]Department of Fisheries and Aquatics Sciences, College of Agriculture and Environmental Sciences, Bahir Dar University, Bahir Dar, Ethiopia

Abstract

Across the globe, the traditional medicinal knowledge of indigenous people has played an important role in identifying living organisms endowed with medicinal values for treating human and livestock health problems. An increased understanding of medical systems in a historical context can potentially bring new insights into the medical significance of fauna in the past and open new therapeutic perspectives in the future. This review paper explores the existing sources and research papers on the medicinal use of animals to provide a summary of the historical context in which zootherapy developed in the world, document remedies and treatments currently used, and highlight the contributions made by the field of ethnozoology. Beyond using animals for traditional medicine, ethnology is increasingly becoming more relevant to discussions on conservation biology, cultural development, economic development, medical value, and sanitary value. Despite their importance, studies on the therapeutic uses of animals and their body parts have been neglected compared to plants. Therefore, several steps should be taken towards improving understanding of the use of animals in traditional medicine and improving the management and regulation of the traditional medicine network for the conservation and sustainability of animals.

Keywords: Biodiversity; Conservation; Ethnobiology; Indigenous knowledge; Zootherapy

[*]Corresponding author email: *mastewalhmariam@gmail.com*

Article information: Received 05 February 2021; Revised 10 August 2021; Accepted 20 October 2021

Introduction

Traditional medicinal knowledge and their practice continue to receive high patronage across the globe (Negi *et al*., 2007; Soewu, 2008), which is used in identifying living organisms that are endowed with medicinal values and the treatment of various human and livestock diseases (Mishra *et al*., 2011; Yirga *et al*., 2011). Over 70% of many developing nations depend solely on traditional medicines to meet their basic and primary health care need (Elujoba *et al*., 2005; Salome *et al*., 2018). Traditional medical practitioners made new

findings that have healed major illnesses (Salome *et al*., 2018) and they eliminated dangerous diseases like epilepsy, cancer, convulsion, paralysis, snake bites, mental illness (Soewu, 2008), and other hereditary diseases (Salome *et al*., 2018).

Different animals and their body parts have played a significant role in the practices of healing medicines of societies all over the world too (Alves *et al*., 2013; Borah and Prasad, 2017; Salome *et al*., 2018). As the World Health Organization (WHO) estimated, out of the 252 essential chemicals discovered from natural products, about 9% came from animals (Zootherapy) (Dedeke *et al*., 2006). Zootherapy/animal therapy is a process of healing human ailments by using medicines prepared from different animals or animal derivative products (Salome *et al*., 2018). It creates a significant auxiliary for other known therapies practiced (Alves and Rosa, 2005). Traditional healing methods involve hundreds of invertebrate and vertebrate animal species (Lev, 2003; Alves *et al*., 2007; Meyer-Rochow, 2017).

Since ancient times, this zoological animal and their products have served as medicinal foods, especially in European and African cultures (Lev, 2003; Alves *et al*., 2013b; Salome *et al*., 2018). In recent years, the awareness has grown that the unsustainable use of medicinal animals contributes to the risk of extinction of certain species (Alves *et al*., 2007), yet the links between that body of knowledge and concerns about public health, harvesting impacts, and stakeholders' involvement remain understudied. For example in Ethiopia, 70% of human and 90% of livestock health depend on traditional medicine (Kendie *et al*., 2018), although the vast knowledge of the traditional uses of animal species of therapeutic value is not well documented in the country (Birhanu, 2013). In Ethiopia, animal species have been used medicinally by indigenous societies for millennia, but little attention has been paid to zootherapeutic and its cultural, medical, economic, and ecological significance due to insufficient ethnozoological studies (Kendie *et al*., 2018; Birhanu, 2013).

Increased understanding of medical systems in a historical context can potentially bring new insights into the medical significance of fauna in the past, as well as open new therapeutic perspectives in the future and sustained use of naturally occurring compounds (Alves *et al*., 2013b). This review paper explores the survey of existing sources and research papers on the medicinal use of animals to provide a summary of the historical context in which zootherapy developed in the world and Ethiopia, knowledge and document remedies and treatments currently used in the country, and highlight the contributions made by the field of ethnobiology. The objectives of this thematic review are: (1) to increase our understanding of the connection between humans and nature, and particularly, of traditional medical systems worldwide, (2) to assist in the construction of a national data bank of animal-derived remedies that can be used in conservation and management initiatives and (3) to document the traditional medicinal knowledge of communities that are rapidly losing certain of their socioeconomic and cultural characteristics.

Concepts and History of Ethnozoology and Traditional Medicine

Ethnobiology and Traditional Medicine

Ethnobiology is the branch of biology that deals with the dynamic relationships among peoples, biota, and environments (Sinha and Sinha, 2005; Anderson *et al*., 2011). However, Ethnomedicine is the study of traditional medicines (TM) in which

the healer's knowledge and practices have been transmitted orally (Erickson 2008; Riccucci, 2012). According to the WHO definition, traditional medicine is health practices, approaches, knowledge, and beliefs incorporating plant, animal, and/or mineral-based medicines, spiritual therapies, manual techniques, and exercises applied singularly or in combination to maintain well-being, as well as to treat, diagnose or prevent illness (WHO, 2002).

There is historical evidence that ancient people used plants, animals, and minerals for combatting diseases. For instance, until around 12,000 years ago humans derived food and raw materials from wild animals and plants (Waters *et al.* 2011), humans engaged in Mastodon hunting since at least 13,800 years ago (Alves *et al*., 2013b) According to WHO, between 75 and 80% of the world's population uses traditional folk medicines (Alves and Rosa 2005; Millennium Ecosystem Assessment 2005). In Africa up to 80% of the population uses TM, in China, the percentage is around 40%. There is also a growing interest in many developed nations: 48% of people in Australia, 70% in Canada, 42% in the USA, 38% in Belgium, and 75% in France have used TM at least once (WHO, 2002; Riccucci, 2012).

The history of medicine is closely connected to the use of medicinal animals. According to Taylor and Tweed, (1975 cited in Alves *et al*., 2013b), the term "medicine" originated from honeybees, who created the word "mead," an alcoholic beverage made from honeycomb. Snakes are another significant animal group in the history of medicine (Lev, 2003; Voultsiadou, 2010; Alves *et al*., 2013b). Animals, their parts, and products have been used as therapeutic agents in various cultures for centuries, and these practices continue to play a crucial role in global healthcare (Lev 2003; Alves and Rosa, 2005; Newman *et al*., 2008; Jaroli *et al*., 2010).

Ethnobiological research has traditionally focused on ethnobotanical topics (Alves and Sout, 2015), but recent studies have expanded to include ethnozoology. Ethnobotanical investigation is a significant scientific endeavor, but ethnozoology has received less attention (Herbert *et al*., 2003). The vast amount of information about animals is intertwined with cultural factors (Alves *et al*., 2012, Alves and Souto, 2015). Zootherapy, the use of animal treatments to cure human illnesses, is widely used in curative treatments, magical rituals, and religious humanities worldwide (Costa-Neto, 2005; Kendie *et al.*, 2018).

Zootherapy offers a unique alternative to traditional therapeutic methods, using body parts and byproducts from wild and domestic animals for curative, protective, and preventive medicines since ancient times (Kang, 2003; Lev 2003; Alves *et al*., 2007; Alves 2009; Kendie *et al*., 2018). This practice, characterized by its geographical spread and deep historical roots, offers a significant alternative to traditional therapeutic approaches in today's society (Alves and Rosa, 2005).

Ethnozoology is a branch of ethnoscience that studies the healing of human ailments using therapeutics derived from animal bodies, metabolic products, or non-animal materials (Jaroli *et al*. 2010; Alves and Souto, 2015). Over 1,500 animal species have been documented and utilized as therapeutic ingredients (Chan, 2005). Ethnozoology focuses on how cultures have interpreted and interacted with faunal resources throughout history (Alves & Souto, 2015). The term "ethnozoology" was first coined in 1899 by Mason in an essay titled Aboriginal American Zoötechny. The term was mostly forgotten until the 1920s (Alves and Souto,

2015). Ethnozoology studies existing societies and their interactions with animals in their surroundings, as per Henderson and Harrington (1914).

The word ethnozoology evolved progressively over time. According to Overal (1990), ethnozoology is the study of humans' understanding of animal uses. Marques (2002) defined it as a trans-disciplinary study of the thoughts and perceptions (knowledge and beliefs), sentiments (affective representations), and behaviors (attitudes) that mediate the relationships between human populations and animal species in the surrounding ecosystems (Alves and Souto 2015).

Prominent of Ethnozoology

Ethnozoology is a field that combines scientific and social sciences to study human relationships with their environments. Researchers in zoology, anthropology, and ecology aim to understand the complexity of these relationships (Alves and Souto, 2015). Ethnozoology is divided into sub-disciplines based on human interactions with animal taxa, such as insects, fish, birds, mammals, reptiles/amphibians, and primates. This hybrid approach aims to complement and understand the complex nature of human relationships with their environments (Alves and Souto, 2015).

According to Alves and Souto (2015), currently, ethnozoological studies are focusing on: a) cultural perception and ethnozoological classification systems; b) importance and presence of animals in stories, myths, and beliefs; c) biological and cultural aspects of animal use by human societies; d) methods of obtaining and preparing organic substances extracted from animals (for cosmetic, ritualistic, medicinal, or food uses, etc.); e) Domestication, which investigates the cultural bases and biological consequences of long-term faunal resource management; f) biological heterogeneity and the cognitive processes involved in natural resource management and conservation; and g) collection techniques and their effects on animal populations.

Significance of Medicinal animals and Ethnozoology beyond Medicine

The use of animals for medical purposes is a traditional knowledge that is increasingly relevant in discussions about conservation biology, public health policy, sustainable natural resource management, biological prospection, and patents.

Biodiversity conservation

Traditional ecological knowledge is crucial for conservation and is a characteristic of communities with long-term resource use practices (Mekonen, 2017). These communities serve as natural resource managers (Alves and Rosa, 2005) and role models for biodiversity strategies (Alves *et al*., 2013a, 2010d; Alves and Rosa, 2013; Hanazaki *et al*., 2009; Mourão *et al*., 2006; Souto *et al*., 2011). Ethnobiological research indicates that native communities possess extensive knowledge of nature and biological resources, which has gained global attention as it complements scientific knowledge in areas like environmental impact evaluation, resource management, and sustainable development. Ethnobiology can significantly contribute to natural resource management and conservation (Alves *et al*., 2015).

Medicinal animals are valuable resources that connect people to the environment and foster traditional mythology (Alves and Rosa, 2005). To ensure future applications, a transdisciplinary approach is needed to combine the ecological and social components of zootherapy. It is crucial to chronicle the historic usage of animal species and

include the cultural and biological components in a larger discourse that includes conservation, cooperative management, and sustainability. This approach should focus on ensuring future applications and incorporating the cultural and biological aspects of animal species (Alves and Rosa, 2005).

Public animal markets offer valuable knowledge about the origins of animals and animal parts, which can be useful for assessing conservation strategies for natural resources (Alves and Rosa 2007). Vendors can provide information on exotic and native fauna in a region, while healers and indigenous people have collected remedies from local plants and animals for generations without compromising species population dynamics due to low harvesting levels (Alves and Pereira Filho 2007; Alves and Rosa 2008; Alves and Santana 2008).

In general, ethnozoology is a significant instrument for performing faunal inventories, zoological and ecological research programs, and biodiversity protection, as follows:

- Its information has helped in zoological research, including taxonomy, inventories, regional distributions, and the identification of new species (Sillitoe, 2006; Zuercher *et al*., 2003).
- It is beneficial for estimating wild animal populations quantitatively (Anadon *et al*., 2010).
- This method provides important biological data at a cheaper cost and faster rate than typical field research methodologies (Silvano *et al*., 2006; Lopes *et al*., 2010).
- Investigating regional animal uses can evaluate the ecological, economic, and social value of regional fauna, aiding in environmental management and species conservation plans that consider the social and economic realities of affected human populations (Alves and Nishida 2003; Rocha-Mendes *et al*., 2005).
- Conservation initiatives involve collecting biological specimens, obtaining environmental information, fostering cooperation, and identifying common research areas, as highlighted by Alves and Rosa (2005).
- According to Alves and Rosa (2005), long-term observations may be a valuable addition to academic research as they are cost-effective, assist in detecting environmental problems, and engage local communities.

Cultural Development

Ethnozoology examines ethnozoological occurrences in our culture (Overall, 1990), derived from the material or spiritual connections between humans and regional wildlife. This information, along with academic knowledge, is obtained from systematic observation of nature and interpretation in different cultural settings (Alves and Nishida 2002; Kimmerer 2002). It is crucial to chronicle human groups' traditional knowledge to preserve biodiversity and understand socioeconomic and cultural traits in many communities (Alves and Rosa, 2005).

Public markets provide valuable opportunities for ethnozoological studies in urban areas due to their diverse range of live animals and animal-derived products (Alves and Rosa, 2008; Fernandes-Ferreira *et al*., 2012; Ferreira *et al*., 2013), as well as their traditional role in exchanging and acquiring cultural information (Alves and Rosa, 2005).

Economic development and medical value

Over half of commercially marketed medications are derived from bioactive chemicals from nonhuman animals, often resulting from scientific research into traditional treatments (Grifo *et al*., 1997). Pharmaceutical corporations have extensively studied animals as drug sources for modern medical research, with a high percentage of animal sources used in creating important medications (Alves and Rosa, 2005). Of the 252 important compounds identified by the WHO, 11.1% are derived from plants and 8.7% from animals (Alves and Rosa, 2005). According to the World Resources Institute (2000), 27 of the 150 prescription medications in the United States are animal-derived.

The trade-in wildlife body parts and products, including traditional medicine, is worth billions of dollars annually. The value of animals sold for therapeutic purposes increases with each level of commerce, and dealers' socioeconomic profiles change proportionally (Alves and Rosa, 2005).

Medicinal Animal Species and Conservation Concerns

The medical use of animal products in traditional medicine should be reconsidered due to the rarity of certain species, unnecessary suffering during harvesting, and potential health hazards. Collaborative research programs should involve specialists in ecology, languages, sociology, and anthropology. Zootherapy should be considered within the multidimensionality of sustainable development to ensure the survival of medicinal faunistic resources, as it is a critical component in ensuring the survival of medicinal resources (Costa-Neto, 2004).

Overexploitation of animal species for Traditional Medicine (TM) medicines has led to reduced or endangered populations (Table 1). Sustainability has become the driving paradigm for biological conservation (Costa-Neto, 2005). The rapidly expanding TM trade has led to illegal hunting and trade, making it difficult to determine its true role in species reduction. The extinction of every living thing is a significant loss for future generations (Chivian and Bernstein 2008). Only a small proportion of species or animals have been studied for natural compounds used as medications, and many potentially life-saving treatments may have been lost before their identification (Still 2003; Riccucci 2012).

Table 1. Distribution and ethnomedical uses of different medicinal animal species

Common Name	Scientific Name	Parts used	Disease Ethnomedical uses	Country	Status	Ethnomedical uses
Elephant	*Elephas maximus*	Skin	Conservation	Herpes, back pai
		wounds,				
		Bile	IUCN Red List	Kidney failure
Barn owl/Bird of wisdom	*Tyto alba*	Feather,	beautification	Salome *et al*., 2018, Nigeria	Bone	Least Concern	Herpes and diarrh
		Tooth,	ward off evil attacks		Ivory		Herpes
		Beak	Hung on the wall for decoration		Urine		Herpes, u disorder
Cameroon hoopoe	*Upupa epops*	Feather	Increase wisdom and enhance intelligence.	Salome *et al*., 2018, Nigeria	Skin; Hair; Tooth	Least Concern	skin rashes; Prep a charm for self-
Hare	*Lepus nigricollis*	Blood	Asthma	Negi *et al*., 2007, India		Least Concern	against adulter promiscuity; W
Frog	*Rana tigrina*	Whole body	Wounds due to burn	Negi *et al*., 2007, India		Least Concern	amulet on wri waist
Garden lizard	*Calotis versicolor*	Whole body	heal wounds on cattle's body	Negi *et al*., 2007, India	Bile		Epilepsy
Millipede	*Spirobolus spp.*	Whole body	Piles	Negi *et al*., 2007, India	Meat		For STDs, anemi Children
Horse	*Equus cabals*	meat	the promoter of corpulence, strength, and eyesight	Negi *et al*., 2007, India	Brain tissue and meat	Not extinct	Epilepsy, disorder
Ass	*Equus spp.*	meat	the promoter of strength and virility	Negi *et al*., 2007, India	Bile	not endangered	Toothache, eye p and internal probl
Leopard	*Panthera pardus*	meat	a promoter of strength and virility	Negi *et al*., 2007, India	Urine and milk	Vulnerable	TB
		Bone	Aphrodisiac		Bone		Epilepsy and bad
		fat	body pain		Skin		evil eye and labor, commu
		hair	foot and mouth disease				diseases, and bad
Rat	*Rattus rattus*	meat	promoter of semen	Negi *et al*., 2007, India, Kendie *et al*., 2018, Ethiopia		Least Concern	Anti-snake Treatment convulsion; body weakness
African Elephant	*Loxodonta Africana*	Dung (feces)	Remedy for nose bleeding	Salome *et al*., 2018, Nigeria		Vulnerable	
			Migraine headache	Yirga *et al*., 2011, Ethiopia	Liver		Infection of skin
		Tusk	Treatment for headache and toothache	Salome *et al*., 2018, Nigeria	Bile		Erythroblastosis and nightmare
		Skin/Meat Bones	For strength and stamina		Meat		For swollen sex Tuberculosis epilepsy and aner
					Lip		Sexual attraction
Bear	*Melursus ursinus*						
Vervet monkey	*Chlorocebus pygerythrus*						
Common fox	*Canis spp.*						
Giraffe	*Giraffa camelopardalis*						
Spotted hyena	*Crocuta crocuta*						

Leopard	*Felis pardus*	Hair; Thorn; Head	Wards off evil spirits; skin rashes; respiratory problems and cold	Salome *et al*., 2018, Nigeria	Not extinct
Four-toed hedgehog	*Atelerix albiventris*	Shell	Treatment for ulcer, hypertension; Rheumatism and internal diseases	Salome *et al*., 2018, Nigeria	Least Concern
Giant African snail	*Archachatina marginata*	Honey/bee wax	snake bites; Heal burns, hair loss, and hemorrhoids; Treatment for arthritis; coughs, eye disease. Sore throat, flu, shortness of breath, cough, tuberculosis	Salome *et al*., 2018, Nigeria	
Honey Bee	*Apis mellifera*	Honey	Earache, menstrual cramps, Wart, asthma, diarrhea, throat pain, stomachache, cough, TB, mumps, heart failure	Salome *et al*., 2018, Nigeria; Mahawar and Jaroli, 2006, India; Yirga *et al*., 2011, Ethiopia; Kendie *et al*., 2018, Ethiopia	Not extinct
		Larvae	Stomach disorder	Kendie *et al*., 2018, Ethiopia	
Field cricket	*Gryllus campestris*	Whole body	Eye disease	Kendie *et al*., 2018, Ethiopia	Not extinct
Gnat (small insect)	*All spp.*	Honey	Stomachache, eye disorder, and coughing	Kendie *et al*., 2018, Ethiopia	Not extinct
Ticks	*All tick spp.*	Blood	Fungal disease on the skin	Kendie *et al*., 2018, Ethiopia	Not extinct
Bumble bee	*Bombus spp.*	Honey	Coughing, malaria, and stomachache	Kendie *et al*., 2018, Ethiopia	Not extinct
Leeches	*All spp.*	Head	Rheumatism	Kendie *et al*., 2018, Ethiopia	Not extinct
A stingless Bee	*Partamona cupira*	Honey	Sore throat, flu, earache, hoarsenes	Alves *et al*., 2012, Brazil	Threatened
Jandaíra	*Melipona subnitida*	Honey	Earache, sore throat	Alves *et al*., 2012, Brazil	Threatened
Abelha mosquito	*Tetragonisca angustula*	Honey	Sore throat, nervous problems	Alves *et al*., 2012, Brazil	Least Concern
Abelha	*Cephalotrigona*	Whole	Bronchitis, whooping	Alves *et al*., 2012,	Least Concern

mumbles	*capita*	animal	cough
Termite	*Nasutitermes macrocephalus*	Abdomen	Erysipelas
Toad	*Rhinella jimi*	Fat	Swelling, sore flu, stuffy nose
Geoffroy's side-necked turtle	*Phrynops geoffroanus*	Fat/ meat	Sore throat, thron
Teju lizard	*Tupinambis merianae*	Fat	Rheumatism, ski eye problems, pla fasciitis, Swellin in general, hoarse
South American rattlesnake	*Crotalus durissus*	Fat	Rheumatism, sw herniated interver disk, bone fractur
Boa	*Boa constrictor*	Whole animal	Sore throat
Lizard	*Tropidurus hispidus*	Gizzard, fat, egg shells, egg yolk, meat	Indigestion, s shortness of bronchitis, r problems, rheur stuffy nose, weak flu, weakness, throat, furuncle
Helmeted Guineafowl	*Numida meleagris*	Eggs	Weakness
Duck	*Anas platyrhynchos*	Gizzard	Asthma
White-naped Jays	*Cyanocorax cyanopogon*	Fat	Headache, rheur corporal lesions
Manatee	*Trichechus manatus*	Meat, tail	Backache, snake
Nine-banded armadillo	*Dasypus novemcinctus*	Meat	Rheumatism
Striped hog-nosed skunk	*Conepatus semistriatus*	Meat	accelerate recove parturition, we thrombosis
Rock cavy	*Kerodon rupestris*	Liver, horn, marrow,	Anaemia, the ev nervous pr

		milk, urine, butter, hoof, proteins	whooping cough, weakness, eye problems, sore throat, baldness, tuberculosis			Oil		Used as a treatm stop nightmares applied in food c and ingested oral
Domestic cattle	*Bos taurus*	Fat	Osteoporosis	Tropical burrowing snake	*Typhlops reticulatus*	Abyssinian, Brazil	Skin	Least Concern	Prepared as a ch strength;
capybara	*Hydrochoerus hydrochaeris*					Alves *et al*., 2012, Brazil	Venom	Least Concern	Treat in (sleeplessness) A on snake bite
		Skin/Bones	Treatment against stiffness of joints and bone dislocation;	Viper	*Crotalus basilicus*		Head/Skin/Tail		Epithet applied long-suffering
Nile crocodile	*Crocodylus niloticus*	Tooth	Worn during battle as an amulet around waist. Epilepsy			Salome *et al*., 2018, Nigeria		Least Concern	Applied topicall also ingested oral
							Skin/head		teething sickne children. Treat communicable di
		Skin	Concoction preparation						
		Bile	Coughing, TB, teeth Rheumatism			Kendie *et al*., 2018,			
				Iguana lizard	*Iguana iguana*	Ethiopia	Tooth		Prepared as a cha worn as an am the waist and nec
		Bone	Communicable disease						
		Venom	To treat rheumatism.			Kendie *et al*., 2018,			
				Bosch monitor lizard	*Varanus niloticus*	Ethiopia	Head		Treatment for cough
Python	*Python spp.*	Bone	Rabies and swelling			Kendie *et al*., 2018,		Least Concern	
		Tail and bone	Cancer and swelling			Ethiopia	Tail		Treatment of chest pain
		Fat	Wound and ear disease	Red lizard	*Agama agama*		Shell		To tame a w woman
		Meat	Rabies, foot crack, and ear disorder				Head/Shell		Decoration ornaments
Black cobra	*Najanigri Collis*	Oil	blood pressure, skin rashes, eczema, arthritis, hypertension, and rheumatoid.	Tortoise	*Aldabrachelys gigantean*	Nigeria	Feather		Used to enhance
							Head		Wards off evil pe
					Testudo graeca		Teeth	Least Concern	Swelling
		Teeth	Worn as an amulet on neck, waist, and wrist to stop nightmares.				Shell		Trypanosomiasis, nosebleeding
		Skin/oil	backache; Spinal cord disorders	Chameleon	*Chamaeleo chamaeleon*		Whole body		Cancer, body fatt
		Meat	charm	Ground hornbil	*Bucorus abyssinicus*		Meat		Serve as a sou food
Rock python	*Python sebae*	Tooth	Worn as an amulet to scare away snakes			Salome *et al*., 2018, Nigeria		Least Concern	
		Venom	snake bites/poisoning				Head/Feather		Prepared as cha renewal of streng

			endurance; Worn as talisman		Butter	Headache and infection
		Egg	For renewal of skin. Superstitious belief for regeneration		Bone	Breast sw sunburn, and body fracture
African crowned Eagle	*Stephanoeatus coronatus*	Dung	Jaundice.	Salome *et al*., 2018, Nigeria	Blind skin/skin	Broken/misplaced and wound/burnin
		Urine	Weakness due to fever. Given to cure cancer			
Indian ass	*Equs hemionus*	Dung + Milk	Muscle pain	Mahawar and Jaroli, 2006, India		and HIV/AIDS
Cow	*Bos indicus*	Ghee	neutralize snake poison			used as antisep wound healing
		Urine	Used as eardrop for curing earache.			Treat wart
		Faeces	Measles			with water
Dog	*Canis familiaris*	Bone	Epilepsy	Mahawar and Jaroli, 2006, India	Least Concern	and this essence is used in ear infections
		Urine	tuberculosis	Kendie *et al*., 2018, Ethiopia		
	Canis lupus	Excreta	Soars/wound	Alves *et al*., 2012, Brazil		headache
Ethiopian hare	*Lepus fagani*	Meat	Cattle disorder, epilepsy	Kendie *et al*., 2018, Ethiopia	Least Concern	
		Fat	Wart		Antler	eye ailments
		Leg	Epilepsy		Meat and egg	Muscle strain
Vulture	*Gyps spp.*	Meat	Mental disorder		Least Concern	broken bone paralysis
		Meat	coughing and fattening			
Groundhog	*Marmota monax*	Meat	Hepatitis, mental disorder	Kendie *et al*., 2018, Ethiopia	Least Concern	wound
Bat	*Cynopterus sphinx*	Bile	Syphilis	Kendie *et al*., 2018, Ethiopia	Least Concern	pneumonia
Goat	*Capra indicus*	Milk	Eye disease, gastritis, wound, headache, measles, TB, eye disorder, vomiting, snake poison, and rheumatism	Mahawar and Jaroli, 2006, India	Least Concern	Epilepsy, body fr whooping cough
		Fat	Wound and Toothache	Yirga *et al*., 2011; Kendie *et al*., 2018,		Skin fungus
		Liver	Trachoma			
				Hippopotamus *Hippopotamus amphibius*	Meat	Rabies preventi dogs
				Olive baboon *Papio anubis*	Urine/stool	
				Indian Peafowl *Pave cristatus*	Meat	Rheumatism
				Pig *Sus scrofa*	Blood	Skin infection
				Ostrich *Struthio camelus*	Whole body	For physical inju
				Hen *Gallus gallus domesticus*	Liver and fat	Swelling
				Osprey *Pandion haliaetus*	Meat	Internal problem
				Erckel's francolin *Pternistis erckelii*	Bile	STDS

Red billed Oxpecker	*Buphagus erythrorhynchus*	Blood	Skin fungus		*africanus*	Kendie *et al*., 2018, Ethiopia	Skin	Least Concern	Herpes
							Bile		AIDS
Bald eagle	*Haliaeetus Leucocephalus*	Milk	Used as massage cream in muscular pain Treat Malaria			Kendie *et al*., 2018, Ethiopia	Butter	Least Concern	Malaria and paral
							Milk		Rabies and TB
Sambhar	*Cervus unicolor*	Fat , suet	Rheumatism, inflammations, swelling, nervous problems, furuncle, one fractures,			Mahawar and Jaroli, 2006, India	Blood	vulnerable	Arthritis
				Cow	*Bos taurus*		Urine		Malaria
							Spleen		Anemia, malari trachoma
	Cervus elaphus	Urine	Urinary retention			Yirga *et al*., 2011, Ethiopia	Omasum	Least Concern	Gastritis
							Liver		Anemia
Sheep	*Capra sp.*	Fecal	constipation and Dandruff,			Mahawar & Jaroli, 2006, India; Kendie *et al*., 2018, Ethiopia; Yirga *et al*., 2011, Ethiopia	Blood	Least Concern	Wart
							Skin		Hemorrhage
							Milk		Headache, rheum malaria and diarr
				Cheetah	*Acinonyx jubatus*		Meat		Swelling, TB, he
		Fresh blood	paralysis			Alves *et al*., 2012, Brazil			AIDS, rheumatism, g
House sparrow	*Passer domesticus*	Flesh	To attain early puberty girls, Mental disorder, body fracture, and heart failure			Mahawar and Jaroli, 2006, India		Least Concern	and hypertension
				Camel	*Camelus dromedarius*		Bile		Asthma/diabetes, stomach scramble
							Milk		Stanbic pain
Pigeon	*Columba livia*	Carapace	lung diseases as cough, asthma, T. B. etc.			Mahawar and Jaroli, 2006, India;	Whole body	Least Concern	Migraine headach
				Dumu	*Felis domesticus*	Kendie *et al*., 2018, Ethiopia	Urine		Goiter
		meat	paralysis		*Paraechinus aethiopicus*	Negi *et al*., 2007, India	Stomach		Abdominal cramp
							Bile		Diarrhea
Collared dove	*Streptopelia sp.*	Shell	acne to cure			Mahawar and Jaroli, 2006, India	Bile	Vulnerable and Least Concern	Abdominal cramp Diarrhea and diab
				Porcupine	*Hystrix spp.*		Stomach/ intestine		
Hardshelled Turtle	*Kachuga tentoria*	Meat	Rheumatism, syphilis, stomachache, and malaria			Mahawar and Jaroli, 2006, India		Least Concern	Stomach dis asthma
							Thorn/spine		Wound and broke
Bivalves	*Mactra sp.*	Teeth	Swelling, toothache, wart and rheumatism			Mahawar and Jaroli, 2006, India	Liver	Least Concern	Diabetes disease
							Milk		Measles,
Wild boar	*Sus scrofa*	Blood	Malaria, asthma, and rheumatism			Kendie *et al*., 2018, Ethiopia		Least Concern	trachoma/rabies, internal problem
Common	*Phacochoerus*	Horn	Swelling			Kendie *et al*., 2018,	Meat	Least Concern	Intestinal disease
				Cat	*Felis domesticus*		Whole		arthritis.

		animal		India	
Martens	*Martes flavigula*	bone	cure wounds	Negi *et al*., 2007, India	Least Concern
Donkey	*Equus africanus*	Foot	Nightmare	Kendie *et al*., 2018, Ethiopia	Critically Endangered
Monkey Snake	*Macaca mulatta* *Naja naja* *Vipera russelli*, *Ptyas mucosus*, *Ancistrodon Himalayans*	Meat	rheumatism, asthma, adiposity, anemia and parasitic infestation.	Negi *et al*., 2007, India Kendie *et al*., 2018, Ethiopia	Least Concern, Critically Endangered
		Venom	Malaria and snake bite		
		Head	Diarrhea, evil eye, and headache		
		Meat	Promote eyesight and facilitates the elimination of urine, stool and flatus.	Negi *et al*., 2007, India	
Monkey	*Macaca mulatta*	skin	foot and mouth disease of cattle	Negi *et al*., 2007, India	Least Concern
Fish	*Any fish spp.*	Meat	Rheumatism, Eye disorder	Kendie *et al*., 2018, Ethiopia	
Scorpion	*Palamnaeus Swammerdami*	Meat	Scorpion bite		Least Concern

Conclusion and Future Recommendations

Traditional medicine research and development are globally relevant because animal-based treatments are widely used. Historical records show that various animal taxa have been used as therapeutic options throughout history. Many of these animals are still used in traditional practices in various regions. However, research on animal medicinal applications has received less attention than on plants. To improve knowledge of animal use in traditional medicine and enhance management and control, recommendations are offered to enhance the conservation and sustainability of the traditional medicine network:

- Research on traditional therapeutic applications of animals and their products is a valuable addition to the corpus of knowledge.
- Continued research and monitoring to address knowledge gaps.
- Publish and disseminate key documents on medicinal animals to inform government policy and international authorities.
- Support conservation and development activities for medicinal animal species. - Strengthen national legislation related to traditional medicine.
- Ensure agencies responsible for traditional medicine management have clear roles and capacities.

Conflict of interest

The authors declares that there is no conflict of interest.

References

Alves RRN, Alves HN. (2011). The faunal drugstore: animal-based remedies used in traditional medicines in Latin America. *J Ethnobiol Ethnomed*; 7:1–43.

Alves RRN, Oliveira TPR, Rosa IL. (2013). Wild animals used as food medicine in Brazil. Evid Based Complement Alternat Med; 2013:1–12; doi:10.1155/2013/670352

Alves RRN, Rosa IL (2008) Use of Tucuxi Dolphin Sotalia fluviatilis for Medicinal and Magic/Religious Purposes in North of Brazil. *Human Ecology* 36:443–447

Alves RRN, Rosa IL, Santana GG. (2007). The role of animal-derived remedies as complementary medicine in Brazil. *Bio Sci*; 57(11):949–55.

Alves RRN, Rosa IL. (2005). Why study the use of animal products in traditional medicine? *J Ethnobiol Ethnomed*; 1:1–5.

Alves RRN, Souto WMS (2015). Ethnozoology: a brief introduction. *Ethnobiol Conserv*.;4:1–13.

Alves RRN, Vieira WLDS, Santana GG. (2008). Reptiles used in traditional folk medicine: conservation implications. *Biodiv Conserv*; 17:2037–49.

Alves, N., Neta, S., Trovão, M., Barbosa, L., Barros, T. and Dias, P. (2012). Traditional uses of medicinal animals in the semi-arid region of northeastern Brazil. *Journal of Ethnobiology and Ethnomedicine*, 8:41.

Alves, R.R.N., Medeiros, M.F.T., Albuquerque, U.P. and Rosa, I.L. (2013b). From Past to Present: Medicinal Animals in a Historical Perspective. R. R. N. Alves and I. L. Rosa (eds.), Animals in Traditional Folk Medicine, DOI: 10.1007/978-3-642-29026-8_2, Springer-Verlag Berlin Heidelberg 2013.

Anderson E. N., Pearsall D., Hunn E. & Turner N. (eds.), (2011). Ethnobiology. Wiley-Blackwell, Hoboken, 420 pp

Anyinam C. (1995). Ecology and Ethnomedicine: Exploring Links Between Current Environmental Crisis and Indigenous Medical Practices. *Soc Sci Med*, 40(3):321-329.

Birhanu Z. (2013). Traditional use of medicinal plants by the ethnic groups of Gondar Zuria District, North-Western Ethiopia. *J Nat Rem.*;13(1):2320–3358

Borah MP, Prasad SB. (2017). Ethnozoological study of animals based medicine used by traditional healers and indigenous inhabitants in the adjoining areas of Gibbon Wildlife Sanctuary, Assam. *India J Ethnobiol Ethnomed*; 13(39):1–13; doi:10.1186/s13002-017-0167-6

Chan K., (2005) Chinese medicinal materials and their interface with Western medical concepts. *Journal of Ethnopharmacology*, 96: 1–18.

Chivian E. & Bernstein A. (eds.), (2008). Sustaining Life. How Human Health Depends on Biodiversity. Oxford University Press, Oxford, 568 pp.

Costa-Neto E., (2005). Animal-based medicines: biological prospection and the sustainable

use of zootherapeutic resources. *Anais da Academia Brasileira de Ciências*, 77(1): 33–43.

Dedeke GA, Soewu DA, Lawal OA, Ola M. (2006). Pilot survey of ethnozoological utilization of vertebrates in southwestern Nigeria. *Afr J Indigenous Knowl Syst*; 5:87–96.

Elujoba AA, Odeleye OM, Ogunyemi CM. (2005). Traditional medicine development from medical and dental primary health care delivery system in Africa. *J. Tradition. Med.CAM*; 2:46-61

Erickson P. I., (2008). Ethnomedicine. Waveland Press, Inc., Long Grove, Illinois, 124 pp.

Fernandes-Ferreira H, Mendonça SV, Albano C, Ferreira FS, Alves RRN (2012). Hunting, use and conservation of birds in Northeast Brazil. *Biodiversity and Conservation*, 21 (1): 221-244.

Ferreira FS, Fernandes-Ferreira H, Leo Neto N, Brito SV, Alves RRN (2013) The trade of medicinal animals in Brazil: current status and perspectives. *Biodiversity and Conservation* 22:839-870.

Grifo F, Newman D, Fairfield AS (1997). The origins of prescription drugs.In Biodiversity and human health Edited by: Grifo F, Rosenthal J. Washington, DC: Island Press;:131-163.

Henderson J, Harrington JP (1914). Ethnozoology of the Tewa Indians. Bulletin 56, Smithsonian Institution, Bureau of American Ethnology,

Herbert D.G., Hamer, M.L., Mander, M., Mkhize, N., Prins, F. (2003). Invertebrate animals as a component of the traditional medicine trade in KwaZulu-Natal, South Africa. *African Invertebrates*; **44** (2) : 00–00

Jaroli D. P., Mahawar M. M. & Vyas N., (2010). An ethnozoological study in the adjoining areas of Mount Abu wildlife sanctuary, India. *Journal of Ethnobiology and Ethnomedicine*, 6: 6.

Kang SP. (2003). Question of attitude: South Korea's traditional medicine practitioners and wildlife conservation. Hong Kong: TRAFFIC East Asia; 2003.

Kendie, F.A., Andualem, S.M. and Andargie, M.D. (2018). Ethnozoological study of traditional medicinal appreciation of animals and their products among the indigenous people of Metema Woreda, North-Western Ethiopia. *Journal of Ethnobiology and Ethnomedicine* 14:37.

Lev E. (2003). Traditional healing with animals (zootherapy): Medieval to present-day Levantine practice. *Journal of Ethnopharmacology* 86:107–118.

Mahawar, M.M. and Jaroli, D.P. (2006). Animals and their products utilized as medicines by the inhabitants surrounding the Ranthambhore National Park, India. *Journal of Ethnobiology and Ethnomedicine*, 2:46 doi:10.1186/1746-4269-2-46

Mekonen, S. (2017). Roles of Traditional Ecological Knowledge for Biodiversity Conservation. *Journal of Natural Sciences Research* **7**(15) 21-27.

Meyer-Rochow VB. (2017). Therapeutic arthropods and other, largely terrestrial, folkmedicinally important invertebrates: a comparative survey and review. *J Ethnobiol Ethnomed.*; 13:9.

Mishra N, Rout SD, Panda T. (2011). Ethno-zoological studies and medicinal values of Similipal Biosphere Reserve, Orissa, India.

Afr J Pharm Pharmacol; 5(1):6–11.

Negi CS, Palyal VS. (2007). Traditional uses of animal and animal products in medicine and rituals by the Shoka Tribes of District Pithoragarh, Uttaranchal, India. *Stud Ethno Med*; 1(1):47–54.

Newman D. J., Kilama J., Bernstein A. & Chivian E., (2008). Medicines from nature. Chapter 4. Pp.: 117–161. In: chIvIAn E. & beRnsteIn A. (eds.): Sustaining Life: How Human Health Depends on Biodiversity. Oxford University Press, New York, 542 pp.

Overal WL (1990). Introduction to ethnozoology: what it is or could be. In: Posey DA, Overal WL (eds) Ethnobiology: implications and applications. MPEG, Belém, Brasil, pp. 127-129.

Riccucci M. (2012). Bats as materia medica: an ethnomedical review and implications for conservation Vespertilio 16: 249–270

Salome K. Timothy, Danmalam U. Habib, Ayeni E. Ayodeji (2018). Survey of zoological materials used in traditional medicine in Sabon Gari and Zaria Local Government Areas, Kaduna State, Nigeria. Journal of Complementary Medicine Research, 8 (1): 32–39 10.5455/jcmr.20180329091359

Sinha R. K. and Sinha S., (2005). Ethnobiology (Role of Indigenous and Ethnic Societies in Biodiversity Conservation, Human Health Protection and Sustainable Development). Surabhi Publications, Jaipur, xv+335 pp.

Soewu D. A., (2008). Wild animals in ethnozoological practices among the Yorubas of southwestern Nigeria and the implications for biodiversity conservation. *African Journal of Agricultural Research*, 3: 421–427

Voultsiadou, E. (2010). Therapeutic properties and uses of marine invertebrates in the ancient Greek world and early Byzantium. *J Ethnopharmacol* 130(2):237–247

Waters MR, Stafford TW Jr, McDonald HG, Gustafson C, Rasmussen M, Cappellini E, Olsen JV, Szklarczyk D, Jensen LJ, Gilbert MTP (2011). Pre-Clovis Mastodon Hunting 13,800 Years Ago at the Manis Site Washington. *Science* 334(6054):351–353.

WHO, (2002). Traditional Medicine Strategy 2002–2005. World Health Organization, Geneva, 74 pp.

World Resources Institute (2000) . World Resources Report 2000–2001. People and ecosystems the fraying web of life, Washington D.C.: World Resources Institute 2000; pp, 389.

Yirga G, Teferi M, Gebreslassea Y. (2011). Ethnozoological study of traditional medicinal animals used by the people of Kafta Humera District, Northern Ethiopia. *Int.J. Med. Med. Sci*.; 3(10): 316-320.