Assefa *et al.*
Journal of Ethnobiology and Ethnomedicine (2025) 21:24
https://doi.org/10.1186/s13002-025-00767-3

Journal of Ethnobiology and Ethnomedicine

REVIEW

Open Access

A comprehensive review on animals and their products used in traditional folk medicine in Ethiopia

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Abstract

Background Zootherapy is the treatment of human and livestock ailments using medicines derived from animals and their products. The objective of this review paper was to compile and document ethnozoological knowledge on traditional medicinal animals used to treat various human and livestock ailments, along with the associated indigenous knowledge from different parts of Ethiopia.

Methods Scientific databases were employed to conduct an exhaustive systematic search of published articles in the English language. A collection of 21 articles focused on animals and their by-products utilized in Ethiopian traditional medicine was compiled from accessible international online databases like Scopus, Web of Science, Google Scholar, PubMed, Research Gate, and various journal Web sites.

Results According to the sources, a total 112 animal species used to treat 167 different ailments were identified. Among these, mammals are the most frequently used, followed by birds, arthropods, and reptiles. Most remedies are sourced from wild animals, with treatments for serious diseases, including HIV/AIDS and cancer, being reported. The most commonly used animal parts for medicine preparation are meat and fat, followed by internal organs, with cooking being the predominant preparation method.

Conclusion The medicinal use of animals is under threat due to illegal hunting and deforestation. The Ethiopian people possess rich indigenous knowledge of animal-based traditional medicine. To ensure the sustainable use of medicinal animals and support the development of modern medicine, further comprehensive ethnozoological research is urgently needed.

Keywords Ailment, Ethiopia, Ethnozoology, Medicinal animal, Traditional practice, Zootherapy

Background

Throughout human history, people have relied on nature for medicine, food, shelter, clothing, cosmetics, rituals, ornaments, and other essential services [1–3]. In many developing countries, traditional medicine remains the primary source of health care, with a significant portion of the population using it to treat various human and livestock ailments. It is estimated that about 80% of the world's population relies on traditional medicine, primarily derived from plants and animals [4]. Traditional medicine refers to medical practices that existed before the advent of modern medicine. It encompasses the indigenous knowledge, skills, and practices of holistic health care that are culturally accepted by communities for maintaining health and treating diseases [5].

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Many human tribes and communities around the world utilize animals as sources of medicine [6, 7]. The study of the relationship between human societies and the animals they use for medicinal purposes is known as ethnozoology. For centuries, there has been a close connection between humans and animals, with various animal parts being used in the preparation of traditional medicines [8]. Globally, out of the 252 essential chemicals recognized by the World Health Organization, 11.1% are derived from plants, while 8.7% come from animal sources [6]. Ethiopia's diverse geography, habitats, and climatic conditions contribute to its rich variety of plant and animal species. The country is also home to 85 ethno-linguistic groups, each with unique languages, cultures, and beliefs, which have fostered a high diversity of traditional knowledge and practices, particularly in the use of medicinal plants and animals for treating various diseases [8–13]. Traditional medicines are deeply integrated into Ethiopian society, with both plants and animals being used for the prevention and treatment of human and livestock ailments since ancient times [14, 15].

Due to the cultural acceptance of traditional healers, the low cost of traditional medicine and the limited access to modern health care, up to 80% of the Ethiopian population relies on traditional medicine for their daily healthcare needs [9, 16]. While Ethiopia is known for its widespread use of traditional medicine, particularly within its indigenous medical traditions, the vast knowledge of animal-based remedies remains less studied and documented compared to plant-based medicines [15, 17]. Much of the knowledge about animal-based traditional medicine is held by traditional healers and is often passed down orally through generations, putting this valuable knowledge at risk of being lost [18]. In comparison with research on medicinal plants, only a limited number of studies have focused on the use of animals in traditional medicine, despite their significant role in treating various ailments [19, 20]. To date, no comprehensive review has been published that extensively documents the use of animal-based medicines for both human and livestock ailments in Ethiopia. Therefore, the objectives this review paper was to compile and document the ethnozoological knowledge on traditional medicinal animals and their body parts or products used to treat various human and livestock ailments and related indigenous knowledge in different parts of Ethiopia that can contribute for wide-ranging scientific investigations and improve the connections with modern medicine. The paper also aimed to describe information on animal-based medicines, their preparation, and application methods used traditional healers in treating different human and human ailments.

Material and methods

This review employed a literature research approach to investigate an ethnozoological studies on traditional medicinal animals in Ethiopia. An exclusive systematic search of published articles written in English language was conducted using scientific databases. A total of 21 articles done on animals and their products used in the Ethiopian traditional folk medicines were gathered from published resources available at international online databases such as Scopus, Web of Science, Google Scholar, PubMed, Research Gate, and journal's Web sites. Moreover, the reference lists of all articles were also thoroughly reviewed to ensure no relevant data was missed. The search terms used, both individually and in combination with Boolean operators "OR" and "AND," included "zootherapy," "ailment," "animal product," "fauna," "traditional medicinal animal," "traditional medicine," "ethnomedicine," "animal-based remedies," "ethnozoology," "ethnozoological," "traditional practice," "traditional medicine practitioner," "medico-culture," and "Ethiopia." These terms were also cross-referenced with Medical Subject Heading (MeSH) terms to ensure a comprehensive search. Information regarding the animal group, species type, source, part used, disease treated, method of preparation, and way of administration was collected from the sources. All published articles that contain full ethnozoological information on the use of medicinal animals and their body parts/products for the treatment of human and animal diseases in Ethiopia were included without restriction to the study area, study subjects, methodology used, and year of publication; however, ethnozoological studies conducted out of Ethiopia were excluded.

Result and discussion

Types of medicinal animals

Similar to other parts of the continent, animals have been widely used as medicinal sources in Ethiopia since ancient times to treat various human and livestock ailments (21, 22). This review reveals that 112 animal species have been utilized in traditional medicine across Ethiopia to treat 167 ailments (Table 1). Most of these animals are locally available in different regions, suggesting that the composition, accessibility, and availability of animals in a given area influence the types of zootherapeutic items used. The use of locally available animals also reduces the cost of acquiring commercial medical agents. According to the sources, mammals, with 56 species, are the most commonly used animal group in traditional medicine, treating 141 ailments. They are followed

Table 1 List of medicinal animals, animal group, sources, body parts or products used, diseases treated, ways of medicinal use of animals used in Ethiopia

Animal group	Common name	Local name (Amharic)	Species name	Source	Parts/products used	Diseases treated	Ways of medicinal use	References
Mammal	Cat	Dimet	*Felis domesticus* Erxleben	Domestic	Urine	Goiter	Drinking	[19]
					Excrement	Relapsing fever	Wearing head	[15]
					Skin	Spiritual problem	Tying	[18, 25, 26]
					Teeth	Swelling	Tying	[13]
					Fur	Evil sprit	Fumigating	
					Bile (black cat)	Visual defect	Anointing	[25]
	Camel	Gimel	*Camelus dromedarius* Linnaeus	Domestic	Whole animal	Migraine, headache	Eating	[19]
					Milk	Stanbic pain	Drinking	
					Milk	Migraine	Drinking	[25]
					Milk	Headache, rheumatism, malaria, diarrhea	Drinking	[13, 23]
					Milk and Meat	Diabetes, stomach ache, liver infection	Drinking and Eating	[20]
					Milk	Malaria	Drinking	
					Urine	Common cold, Coughing	Drinking	
	Goat	Fiyel	*Capra aegagrus hircus* Linnaeus	Domestic	Fecal matter	Dandruff	Smearing	[19, 26]
					Meat	Fever, coughing	Eating	[15]
					Milk	Muscular pain	Massaging	
					Butter	Headache	Nasal dropping	
					Horn, hoof & liver	Irregular menstrual cycle	Powdering	
					Milk	Coughing	Drinking	[23]
					Meat and blood	Malaria	Eating and Drinking	[24]
					Milk and blood	Malaria	Drinking	[21]
					Milk	Eye disease, gastritis, wound, headache, measles, TB, vomiting, snake poison, rheumatism	Drinking	[18, 26]
					Fat	Wound, Toothache	Banding	
					Liver	Trachoma	Massaging	

Table 1 (continued)

Animal group	Common name	Local name (Amharic)	Species name	Source	Parts/products used	Diseases treated	Ways of medicinal use	References
					Butter	Headache, ear infection	Massaging	
					Tongue	Anxiety	Eating	[22]
					Bile	Febrile illness	Drinking	
					Stomach	Scabies	Anointing	
					Blood	Anemia	Drinking	[13, 22]
					Oviduct	Eye problem	Anointing	[26]
	Donkey	Ahiya	*Equus asinus* Linnaeus	Domestic	Milk	Common cold	Drinking	[19]
					Milk	Asthma, pleurisy, pneumonia	Drinking	[13]
					Nail	Typhoid		[17]
					Urine	Thorn expellant	Drinking	[15]
					Milk	Lung TB	Nasal drops	
					Hoof	Epidemic	Fumigating	
					Milk	Asthma	Drinking	[24]
					Milk	Chancroid	Drinking	[21]
					Excrement	Mad dog disease	Drinking	
					Milk	Ring worm, measles	Drinking	[22]
					Excrement	Cold in chicken, Sinusitis, bronchitis	Drinking and smeeling	[13]
			Equus africanus von Heuglin & Fitzinger	Domestic	Milk	Measles, cough, trachoma, rabies, internal problem	Drinking	[18]
	Sheep	Beg	*Ovis aries* Linnaeus	Domestic	Pancreas	Night blindness	Eating	[19]
					Haney	Heart failure	Eating	
					Milk	Coughing	Drinking	[13, 21]
					Milk	Malaria	Drinking	[18, 26]
					Bile fluid	Scabies	Bathing	[23]
					Bile	Social phobia	Drinking	[22]
					Bile	Malaria	Drinking	[26]

Table 1 (continued)

Animal group	Common name	Local name (Amharic)	Species name	Source	Parts/products used	Diseases treated	Ways of medicinal use	References
					Blood	Anemia	Drinking	[13, 22, 26]
	Cow	Lam	*Bos taurus* Linnaeus	Domestic	Urine	Malaria	Drinking	[19]
					Feces	Snake poisoning	Drinking	[17]
					Meat	Anemia/weakness	Eating	[15]
					Liver	Anemia	Eating	[22, 26]
					Liver	Anemia, night blindness	Eating	[15]
					Butter	Headache	Smearing	
					Blood	Anemia	Drinking	
					Hair	Male impotency	Tying	
					Urine	Relapsing fever	Bathing	
					Butter/cheese	Malaria	Drinking	[22]
					Horn & nail	Swelling	Anointing	
					Bone marrow	Fracture and Sprain	Messaging	
					Urine	Wound	Washing	
					Milk	Abdominal pain	Drinking	
					Milk	Gastritis, typhoid fever, weight gain, toxin, teeth strength	Drinking	[13]
					Spleen	Pleurisy, sciatica	Eating	
					Bile	Fever	Drinking	
					Pancreas	Sciatica	Eating	
					Cheese	Stomach pain	Eating	
					Digestive Juices	Throat cancer, fever	Drinking	
					Leg	Slipped disk, bone fractures, common cold	Soup drinking	[13, 26]
					Bile	Vision problem	Massaging	[26]
					Bile	Malaria	Drinking	
					Horn	Malaria	Eating	

Table 1 (continued)

Animal group	Common name	Local name (Amharic)	Species name	Source	Parts/products used	Diseases treated	Ways of medicinal use	References
					Spleen	Anemia, malaria, trachoma	Eating	
					Yoghurt	Gastritis	Eating	
					Gut content	Male impotency	Massaging	
			Bos indicus Linnaeus	Domestic	Butter	Pellagra, other skin diseases	Smearing	[21]
					Butter	Malaria, paralysis	Eating	[18]
					Milk	Rabies, TB	Drinking	
					Urine	Malaria	Drinking	
					Spleen	Anemia, malaria, Trachoma	Eating	
					Omasum	Gastric	Eating	
					Liver	Anemia	Eating	
					Yogurt	Gastric	Eating	[23]
	Dog	Wusha	*Canis familaries* Linnaeus	Domestic	Excrement	Relapsing fever	Unspecified	[15]
					Excrement	Gun wound	Smearing	[21]
					Bone	Epilepsy	Tying	[18]
					Tongue	Rabies, gastritis	Eating	[13]
					Urine	Eye disease, ear pain, skin disease, wart	Anointing	
	Human	Sew	*Homo sapiens* Linnaeus	Domestic	Urine	Wound/cut	Bathing	[13, 15]
					Milk	Eye ache	Dropping	
					Stool/feces	Baldness	Smearing/ Anointing	[15, 23]
					]Stool/feces	Wart	Anointing	[18]
					Feces	Evil eye	Burning	[22]
					Feces, urine	Wound	Anointing	
					Hair	Evil eye	Fumigating	[13]
	Horse	Feres	*Eqqus Caballus* Linnaeus	Domestic	Urine	Epilepsy	Drinking	[21]
	Crested Porcupine	Jart	*Hystrix cristata* Linnaeus	Wild	Stomach	Abdominal cramp	Eating	[19]

Table 1 (continued)

Animal group	Common name	Local name (Amharic)	Species name	Source	Parts/products used	Diseases treated	Ways of medicinal use	References
					Bile	Diarrhea	Drinking	
					Bile	Abdominal cramp	Eating	
					Liver	Hepatitis	Eating	[13, 17]
					Lung	Fattening	Eating	
					Meat	Heart failure	Eating	
					Meat	Asthma	Eating	[7, 23]
					Meat	Coughing horse, Pneumonia	Eating	[7]
					Meat	Stomach pain, rheumatism, swelling, stunting, pleurisy, weight gain		[13]
					Meat	Swelling abdomen	Eating	[24]
					Blood	Skin diseases -fungus	Smearing	[21]
					Meat	Asthma, stomach problems, urine complications	Eating	
					Meat	TB, asthma, arthritis, kidney and lung diseases	Eating	[22]
					Liver	Stomachache	Eating	[18]
					Meat	Swelling, TB, headache, HIV/AIDS, asthma, Hypertension	Eating	
					Bile	Asthma, diabetes, stomach scramble	Drinking	
					Stomach/intestine	Diarrhea, diabetes	Eating	
					Thorn/spine	Wound, broken leg	Tying	
					Liver	Diabetes disease	Eating	
					Bone	Malaise	Fumigating	[13]
					Whole animal	Paralysis and stunting	Soup drinking	
	Spotted hyena	Jib	*Crocuta crocuta* Erxleben	Wild	Meat	TB, sexual attraction	Eating	[19]
					Lip	Evil eye	Eating	

Table 1 (continued)

Animal group	Common name	Local name (Amharic)	Species name	Source	Parts/products used	Diseases treated	Ways of medicinal use	References
					Scat	Evil sprit	Fumigating	[15]
					Hair	Evil eye	Fumigating	
					Liver	Prophylaxis	Anointing	
					Bile	Prophylaxis	Anointing	
					Eyelash	Evil eye	Fumigating	[7, 24]
					Eye lash	Sleeping problem	Hanging	[13, 21, 22]
					Meat	Evil spirit	Eating	
					Liver	Evil eye	Sniffing	[22]
					Bone	Epilepsy and bad spirit	Tying	[18, 22, 26]
					Bile	Erythroblastosis, nightmare	Tying	
					Liver	Infection of skin	Banding	
					Skin	Communicable diseases	Tying	
					Meat	Epilepsy, anemia	Eating	
					Tongue	Evil eye	Eating	[13]
					Teeth	Lymphadenopathy	Anointing	
					Skin	Evil eye, bad spirit	Tying	[7, 18, 22, 26]
					Skin	Epilepsy	Fumigating	[22]
					Eye	Eye disease	Smearing	
					Left leg meat	Evil eye	Tying	
	Striped Hyena	Jib	*Hyaena hyaena* Linnaeus	Wild	Skin	Bad sprit	Tying	[23]
	Desert Warthog	Kerkero	*Phacochorus ethiopicus* Pallas	Wild	Blood	Arthritis	Drinking	[19]
					Liver	Many diseases	Eating	[17]
					Urine	Many diseases	Drinking	
					Meat	Abdominal pain	Eating	[24]
					Meat	Broken bone, bone ache, breast infestation	Soup drinking	[7]
					Meat	Swelling	Eating	[21]

Table 1 (continued)

Animal group	Common name	Local name (Amharic)	Species name	Source	Parts/products used	Diseases treated	Ways of medicinal use	References
					Teeth	Toothache	Heating and Smearing	
	Common warthog	Kerkero	*Phacochoerus africanus* Gmelin	Wild	Teeth	Swelling, toothache, Wart, rheumatism, breast pain	Heating	[13, 18, 26]
					Blood	Malaria, asthma,rheumatism	Drinking	
					Skin	Herpes	Anointing	
					Bile	HIV/AIDS	Drinking	
					Horn	Swelling	Heating	
					Meat	Bacterial infections, rheumatism	Eating	[13]
					Whole animal	Bacterial infections, common cold	Soup drinking	
	African elephant	Zehon	*Loxodonta africana* Blumenbach	Wild	Feces	Migraine headache	Smearing	[19]
						Asthma	Smoking	[7]
					Bile	Kidney failure	Drinking	[18]
					Bone	Herpes and diarrhea	Massaging	
					Ivory	Herpes	Anointing	
					Urine	Herpes, urination disorder	Drinking	
					Skin	Herpes, back pain, skin wound, trachoma	Anointing	
					Ivory	Bad sprit	Tying	[23]
	Red deer	Agazen	*Cervus elaphus* Linnaeus	Wild	Urine	Urinary retention	Drinking	[19]
					Meat	Chest pain	Eating	[24]
					Bile	Syphilis	Drinking	[18]
					Urine	Urination problem	Drinking	[18, 23]
	Grater kudu	Agazen	*Tragelaphus strepsiceros* Pallas	Wild	Meat	Broken bone	Eating	[7]
	Patas monkey	Key tota	*Erythrocebus patas* Schreber	Wild	Buttock	Muscle spasm	Tying	[19]
					Excrement	Leprosy	Smearing	[15]

Table 1 (continued)

Animal group	Common name	Local name (Amharic)	Species name	Source	Parts/products used	Diseases treated	Ways of medicinal use	References
					Dung	Broken leg	Fumigating	[24]
					Meat	Skin and internal liseases	Eating	[21]
					Blood	Epilepsy	Smearing	
	Olive baboon	Tera zinjero	*Papio anubis* Lesson	Wild	Skin	Broken/misplaced bone, wound/burning	Tying	[18, 26]
					Meat	Rabies and HIV/AIDS	Eating	[18]
					Bile	HIV/AIDS	Drinking	
					Meat	STDs, anemia	Eating	
					Lung	Pneumonia	Eating	[22]
					Fatty meat	Impotency	Eating	
					Fatty meat	Fracture	Dressing	
					Urine	Fever	Drinking	[13]
					Excrement	Fever, eye disease, evil eye	Eating	
					Excrement	Sleeping sickness	Fumigating	[26]
	Grivet monkey	Grivet tota	*Cercopithecus aethiops* Linnaeus	Wild	Hair	Black leg	Fumigating	[24]
					Meat	Common cold	Eating	[25]
	Vervet monkey	Vervet tota	*Cercopithecus pygerythrus* Linnaeus	Wild	Meat	STDs, anemia (Children)	Eating	[18]
					Liver	Body swelling	Eating	[22]
	European rabbit	Tinchel	*Oryctolagus cuniculus* Linnaeus	Wild	Hair	Burn	Smearing	[19]
					Excrement	Relapsing fever	Bathing	[15]
					Whole	Migraine	Externally (rotate)	
					Blood	Evil sprit	Sprayed	
					Hair	Fire burn	Wounding	[24]
	Rabit	Tinchel	*Lepus fagani* Thomas	Wild	Meat	Common cold	Eating	[25]
					Meat	Skin problems	Rubbing	[26]
	Abyssinian hare	Tinchel	*Lepus habessinicus* Hemprich & Ehrenberg	Wild	Blood	Asthma	Drinking	[21]

Table 1 (continued)

Animal group	Common name	Local name (Amharic)	Species name	Source	Parts/products used	Diseases treated	Ways of medicinal use	References
					Meat	Kidney infection, heart failure, cattle fattening	Eating	[7]
					Fur	Skin burn	Anointing	[7, 26]
	Ethiopian hare	Tinchel	*Lepus fagani* Thomas	Wild	Meat	Stunting in kids	Eating	[13]
					Meat	Cattle disorder, epilepsy	Fumigating, Drinking	[18]
					Fat	Wart	Anointing	
					Fur	Wound (burn)	Anointing	[13]
	Pig	Asama	*Sus scrofadomesticus* Erxleben	Wild	Blood	Trypanosomiasis	Drinking	[17]
					Meat	Rheumatism and headache	Eating	[18, 26]
					Blood	Skin infection	Anointing	
					Meat	Fever	Eating	[13]
	Wild boar	Ria	*Sus scrofa* Linnaeus	Wild	Meat	Rheumatism, syphilis, stomachache, malaria	Eating	[18]
			Phacochoerus africanus Gmelin	Wild	Teeth	Swelling, toothache, wart, rheumatism	Heating	
	Rock hyrax	Shikoko	*Procavia capensis* Pallas	Wild	Meat	Fattening	Eating	[17]
					Meat	Swelling of the abdomen	Eating	[24]
					Soup	Asthma, pneumonia	Drinking	[7]
					Whole body	Children retarded growth	Eating	[25]
	Bat	Yelelit wof	*Cynopterus sphinx* Vahl	Wild	Whole body	Bat disease	Tying	[17]
					Meat	Liver disease, Rabies	Eating	[21]
					Meat	Hepatitis, mental disorder	Eating	[18, 26]
					Whole body	Hepatiti	Eating	[23]
					Whole body	Affection	Anointing	[22]
					Meat & bone	Liver diseases	Drinking	
					Meat & blood	Skin disease	Eating, drinking	[13]
					Bone	Mental illness	Fumigating	[26]

Table 1 (continued)

Animal group	Common name	Local name (Amharic)	Species name	Source	Parts/products used	Diseases treated	Ways of medicinal use	References
	African civet	Tirigne /Zibad	*Civettictis civetta* Schreber	Wild	Musk	Headache	Sniffing	[7, 24]
	Leopard	Nebir	*Phanthera pardus* Linnaeus	Wild	Meat	Swelling of abdomen	Eating	[24]
					Tongue	Tremor	Tying	[13]
					Skin	Joint pain and rheumatism	Wearing and Tying	
					Meat	Rabies	Eating	[7]
			Phanthera tigris Linnaeus	Wild	Meat	Rabies	Eating	[22, 23]
	Cheetah	Aboshemane	*Acinonyx jubatus* Schreber	Wild	Skin	Hemorrhage	Tying	[18]
	Common duiker	Midakuwa	*Sylvicapra grimmia* Linnaeus	Wild	Blood	Heart failure	Drinking	[24]
					Meat	Leprosy	Eating	[21]
					Meat	Asthma, bone ache	Soup drinking	[7]
					Skin	Walking problem in cattle	Tying	[13]
	Common fox	Kebero	*Canis mesomelas* Schreber	Wild	Meat and brain	Epilepsy	Eating and Smearing	[21]
					Brain & meat	Epilepsy, mental disorder	Eating/drinking	[18]
	Fox	Kebero	*Vulpes vulpes* Linnaeus	Wild	Teeth	Epilepsy, mental illness	Fumigating	[22]
					Skin	Postpartum, Hemorrhage	Tying	
					Bile	Heart problem	Anointing	[26]
					Teeth	Throat problem	Tying	
					Pancreas	Spleen problem	Tying	
					Blood	Hair growth	Smearing	
					Meat and brain	Epilepsy, mental Disorders	Eating	
	Jackal	Kebero	*Canis aureus* Linnaeus	Wild	Liver	Mental disorder	Eating	[25]
	Soemmering gazelle	Yemedafiyel	*Nanger soemmerringii* Cretzschmar	Wild	Horn	Eye disease, skin disease	Smearing	[21]
					Meat	Kidney disease, rabies	Eating	[22]

Table 1 (continued)

Animal group	Common name	Local name (Amharic)	Species name	Source	Parts/products used	Diseases treated	Ways of medicinal use	References
	Bushpig	Yedur asama	*Potomochoeru sporeus* Linnaeus	Wild	Blood	Leprosy	Drinking	[21]
					Meat	Leprosy	Eating	
					Meat	Broken bone, leg & body swelling, TB	Soup drinking	[7]
	Cape bushbuck	Dikula	*Traglaphus scr Iptus* Pallas	Wild	Meat and bone	Internal body cancer	Drinking	[21]
					Meat	Broken bone	Eating	[7]
	Bushbuck	Yedur fiyel	*Artiodactyla* spp.	Wild	Meat	Cold	Eating	[13]
	Impala	Dukula	*Aepyceros melampus* Lichtenstein	Wild	Fatty meat	Infection on the sole	Eating	[22]
	Rat	Ayti	*Rattus* spp.	Wild	Meat	Intestinal disease	Eating	[13, 18]
					Foot	Nightmare	Tying	[18]
					Blood	Wart	Anointing	
	Hippopotamus	Gumare	*Hipopotamus amphibius* Linnaeus	Wild	Bone	Breast swelling, sun-burn, body fracture	Banding	
					Skin	Donkey illness	Heating & massaging	[25]
	Bear	Dib	*Melursus ursinus* Shaw	Wild	Bile	Epilepsy	Drinking	[18]
	Giraffe	Kechinie	*Giraffa camelopardalis* Brisson	Wild	Urine and milk	Tuberculosis	Drinking	
	Groundhog	Shikoko	*Marmota monax* Linnaeus	Wild	Meat	Coughing, fattening baby	Eating	[18, 26]
	Mountain Nyala	Niyala	*Tragelapus buxtoni* Lydekker	Wild	Urine	Evil eye, bad sprit	Bathing	[23]
	Buffalo	Gosh	*Syncerus caffer* Sparrman	Wild	Meat	For bush meat	Eating	[7]
	Serval cat	Dalganbesa	*Leptailurus Serval* Schreber	Wild	Excrement	Fever	Eating	[7, 13]
	Klipspringer	Ses	*Oreotragus oreotragus* Zimmermann	Wild	Liver	Heart failure	Eating	[22]
	Aardvark	Awaldgessa	*Orycteropus afer* Pallas	Wild	Excrement	Evil eye, stomach pain, sore, skin disease	Eating, drinking	[13]
	Gopher	Filfel	*Thomomys bottae* Eydoux & Gervais	Wild	Teeth	Swelling	Tying	
	Gray squirrel	Shokako	*Sciurus carolinensis* Gmelin	Wild	Meat	Trypanosomiasis	Drinking	

Table 1 (continued)

Animal group	Common name	Local name (Amharic)	Species name	Source	Parts/products used	Diseases treated	Ways of medicinal use	References
Birds	Hen	Doro	*Gallus gallus domesticus* Linnaeus	Domestic	Liver	Diarrhea	Eating	[17]
					Egg	Night blindness	Eating	[15]
					Liver	Night blindness	Eating	
					Liver	Abdominal pain	Eating	[24]
					Egg	Evil eye	Painting	[21]
					Egg	Snake bite	Drinking	
					Egg	Hear failure	Drinking yolk	[26]
					Egg	Cow and donkey disease	Drinking	[25]
					Egg	Cold, abdominal pain, gastritis, pleurisy, sciatica	Drinking	[13]
					Whole body	Physical injury, wound	Drinking	[18, 26]
					Liver and fat	Swelling wound, pneumonia	Eating	
					Abdominal fat	Ear pain	Anointing	[13]
					Liver	Burn face	Messaging	[23]
					Meat	Fracture	Drinking stew	[22, 25]
					Meat	Kidney disease	Eating	[22]
					Egg	Cough	Drinking	
					Egg shell	Eczema	Anointing	
					Excrement	Stomach pain, skin disease, sore(head)	Eating and smearing	[13, 26]
	Partridge	Kok/Qoq	*Perdx perdix* Linnaeus	Wild	Egg	Night blindness	Eating	[15, 23]
					Meat	Asthma	Eating	[21, 23]
					Meat	Night blindness	Eating	[15]
			Alectoris rufa Linnaeus	Wild	Egg	Cold	Drinking	[13]
			Pternistis erckelii Rüppell	Wild	Meat	Asthma	Drinking soup	[22]
	Guineafowl	Jigra	*Numida Meleagris* Linnaeus	Wild	Liver	Night blindness	Eating	[15]
					Meat	Spine problem	Eating	[24]
					Meat	Night blindness	Eating	[23]
					Meat, egg	Ritual purpose	Eating	[7]
	Parrot	Bekeken	Unspecified	Wild	Beak	Love poison	Unspecified	[15]
	Starling	Warri	Unspecified	Wild	Whole body	Love poison	Unspecified	

Table 1 (continued)

Animal group	Common name	Local name (Amharic)	Species name	Source	Parts/products used	Diseases treated	Ways of medicinal use	References
	Bald eagle	Chilat	*Haliaeetus leucocephalus* Linnaeus	Wild	Leg bone	Breast swelling	Powdering/smearing	
					Wing	Attack deterrent	Piece of the wing carried	
					Blood	Skin fungus	Anointing	[18]
	Vulture	Tib Ansa	*Gyps* spp.	Wild	Leg	Epilepsy	Fumigation	
					Meat	Mental disorder	Eating	
	Pigeon	Irigib	*Columba livia* Gmelin, JF	Wild	Meat	Mental disorder, body fracture, heart failure	Eating	
					Egg	Pleurisy	Drinking	[13]
		Debenie	*Columba arquatrix* Temminck	Wild	Blood	Burn	Anointing	[22]
	Red-eyed dove	Irigib	*Streptopelia semtorquata* Rüppell	Wild	Excrement	Wound healing	Anointing	[23]
	Duck	Dakye	Duck spp.	Wild	Meat	TB	Eating	[18]
	Owl	Gugut	*Nocturnalis Strigiformes* Wagler	Wild	Flesh	Cancer	Eating	[21]
					Meat	Enhance intelligence	Eating	[25]
					Beak	Evil attack	Tying	
	Crow	Kura	*Corvus splendens* Vieillot	Wild	Leg bone	Goiter	Tying	
	Ostrich	Segon	*Struthio Camelus* Linnaeus	Wild	Fat	Paralyzed leg	Smearing	[21]
					Meat and egg	Muscle strain, broken bone, paralysis	Massaging, Anointing	[18]
	Osprey	Gedie	*Pandion haliaetus* Linnaeus	Wild	Bone	Epilepsy, body fracture	Tying	
	Erckel's francolin	Koki	*Pternistis erckelii* Rüppell	Wild	Meat	Internal problem	Eating	
					Bile	STDS	Drinking	
					Meat	Asthma, coughing	Soup drinking	[7]
	Red billed oxpecker	Arechi	*Buphagus erythrorhynchus* Stanley	Wild	Blood	Skin fungal diseases	Anointing	[18, 23]
	Raven	Kura	*Corvus corax* Linnaeus	Wild	Bone	Mental illness	Fumigation	[23]
					Egg	HIV, asthma	Eating	[13]
	Black kite	Chilfit	*Milvus migrans* Boddaert	Wild	Feather	Ear infection	Cleaning	[7]
	Moorhen	–	*Paragallinula angulata* Sundevall	Wild	Blood	Bleeding skin infection	Anointing	

Table 1 (continued)

Animal group	Common name	Local name (Amharic)	Species name	Source	Parts/products used	Diseases treated	Ways of medicinal use	References
Reptiles	Snake	Ebab	*Naja naja* Linnaeus	Wild	Skin(shed)	Urinary problem	Tying	[13]
					Blood	Snake bite	Drinking	[25]
					Head part	Evil eye	Tying	
			Python molorus Linnaeus	Wild	Whole organism	Python molorus bite	Smoking	[17]
					Scale	Snake bite	Unspecified	[15]
					Scale	Rabies	Eating	[23]
					Skin	Evil sprit	Fumigating	[24]
					Whole animal	Tumor	Anointing	[22]
					Head	Mental illness, nightmare in babies	Fumigating, tying	
					Coat	Headache	Tying	[18, 26]
					Venom	Malaria, snake bite	Anointing	
					Head	Diarrhea, evil eye, headache	Tying	
	Lizard	Enshilalit	*Lacertilia spp.*	Wild	Skin	Communicable Disease (infant)	Tying	
					Whole body	Dry coughing and anemia	Drinking	[18, 26]
			Iguana iguana Linnaeus	Wild	Whole body	Cattle wound	Anointing	[25]
					Fecal matter	Skin problems	Anointing	[26]
	Monitor lizard	Arjano	*Varanus* spp.	Wild	Whole body	Anemia	Eating	[23]
					Skin	Cold, rheumatism	Tying	[13]
	Crocodile	Azo	*Crocodylus* spp.	Wild	Bile	Coughing, TB, teeth rheumatism	Drinking Anointing	[18]
					Bone	Communicable disease	Tying	
					Teeth	Epilepsy	Tying	
	Python	Zendo	*Python* spp.	Wild	Bone	Rabies, swelling	Tying	[18, 26]
					Tail & bone	Cancer, swelling	Banding	[18, 26]
					Fat	Wound, ear disease	Banding	
					Meat	Rabies, foot crack, ear disorder	Eating, anointing	
					Meat	Rabies	Eating	[23]
					Meat	Rabies	Soup drinking	[7]
					Bone	Body swelling	Anointing	

Table 1 (continued)

Animal group	Common name	Local name (Amharic)	Species name	Source	Parts/products used	Diseases treated	Ways of medicinal use	References
					Fatty meat	Tumor, swelling, wound	Anointing	[22]
					Visceral fat	Rheumatism, asthma, headache, skin disease	Eating	[13]
	Tortoise	Eli	*Testudo graeca* Linnaeus	Wild	Teeth	Swelling	Heating	[18]
					Shell	Trypanosomiasis, nose bleeding	Fumigation	
					Coat ash	Wart and leprosy	Anointing	[25]
	Chamaleon	Esist	*Chamaeleo chamaeleon* Linnaeus	Wild	Whole body	Cancer, body fattening	Tying	[18]
					Whole body	Retarded growth	Eating	[25]
					Tongue	Swelling of gland	Tying	[13]
Arthro pods	Honey bee	Nib	*Apis mellifera* Linnaeus	Domestic	Honey	Allergic	Eating	[17]
					Honey	Burn	Eating/ Smear	
					Honey	Common cold	Eating	
					Honey	Coughing	Eating	
					Honey	Coughing. abdominal pain	Eating	[25]
					Honey	Coughing	Drinking	[13, 24]
					Honey	Chills	Drinking	[22]
					Honey	Cough, asthma	Eating	[21]
					Honey	Wart, asthma, diarrhea, throat pain, stomach-ache, cough, TB, heart failure	Eating, Drinking	[18, 26]
					Honey	Diarrhea	Eating	[23]
					Larvae	Stomach disorder	Drinking	[13, 18, 26]
	Sweat bee	Tazma	*Halictus scabiosae* Rossi	Wild	Honey	Rheumatism	Eating	[13]
	German wasp	Terb	*Vespula germanica* Fabricius	Wild	Honey	Migraine	Eating	[15]
	Housefly	Zinb	*Musca domestica* Linnaeus	Wild	Whole body	Measles	Eating	
	Scorpion	Gint	*Hottentotta tamulu* Fabricius	Wild	Whole body	Poison	Eating	
					Body oil	Burn skin and wart	Heating and anointing	[25]
					Whole body	Scorpions' toxin/bite	Eating	[13, 25]
			Palamnaeus swammerdami Simon	Wild	Meat	Scorpion bite	Massaging	[18]

Table 1 (continued)

Animal group	Common name	Local name (Amharic)	Species name	Source	Parts/products used	Diseases treated	Ways of medicinal use	References
	Dragonfly	Yewuhaterb	*Sympetrum flaveolum* Linnaeus	Wild	Whole body	Swelling	Tying	[13]
	Stingless bees	Tazma nib	*Trigona spp.*	Wild	Honey	Asthma	Eating	[22, 23]
			Meliponula spp.	Wild	Honey	Stomachache, eye disorders, and coughs	Eating	[26]
	Forest honey	Tazma nib	*Apis mellifera* Linnaeus	Wild	Honey	Constipation, TB	Eating	[21]
	Beetle	Tinzeza	*Coleoptera*	Wild	Whole body	Dry cough	Drinking	
	Bomble bee	Tinzeza	*Bombus spp.*	Wild	Honey	Coughing, malaria, stomachache	Eating	[18]
	Termite (Queen)	Misit	All spp.	Wild	Whole body	Livestock fattening	Eating	[18, 23]
	Field cricket	Finta	*Gryllus campestris* Linnaeus	Wild	Whole body	Eye disease	Eating	[18]
	Gnat (small insect)	Tinign	All spp.	Wild	Honey	Stomachache, eye disorder, coughing	Eating	
	Tick	Meziger	All tick spp.	Wild	Blood	Skin disease	Anointing	[13, 18, 25]
	Spider	Shererit	Unspecified	Wild	Whole body	Poison	Unspecified	[15]
	Bug	Tihuan	*Cimex rotundatus* Linnaeus	Domestic	Blood	Ringworm	Anointing	[25]
	Butterfly	Birabiro	All spp.	Wild	Whole body	Penis enlargement	Massaging	[23]
	Great diving beetle	Tinzeza	*Dytiscus marginalis* Linnaeus	Wild	Whole body	Breast enlargement	Breast biting/massaging	
Fish	White fish	Nech assa	*Pseudobarbus Capensis* Smith	Wild	Meat	Brain development	Eating	
	Cat fish	Ambaza assa	*Clarias gariepinus* Burchell	Wild	Meat	Muscle strength	Eating	
					Meat	Rheumatism	Eating	[26]
	Nile perch	Nech assa	*Lates niloticus* Linnaeus	Wild	Meat	Common cold	Eating, soup drinking	[7]
					Meat	Rheumatism	Eating	[26]
	Fish	Assa	Any fish spp.	Wild	Meat	Bone fractures	Eating	[13]
					Meat	Heart disease	Eating	[15]
					Oil	Heart disease	Unspecified	
					Bone	Aphrodisiacs	Fumigating	
					Bile	Respiratory disease	Unspecified	
					Meat	Rheumatism	Eating	[18]
					Bile	Eye disorder	Eating	
					Meat	Rheumatism	Eating	
					Liver	Eye disease	Eating	[13]
					Whole animal	Cold, bone fractures		

Table 1 (continued)

Animal group	Common name	Local name (Amharic)	Species name	Source	Parts/products used	Diseases treated	Ways of medicinal use	References
Amphibians	Frog	Gurt	*Afrixalus enseticola* Largen	Wild	Whole animal	Loss of consciousness	Anointing	[22]
Annelids	Leech	Alekit	*Hirudinea*	Wild	Head	Rheumatism	Massaging	[18, 23, 25]

by birds, with 22 species used to treat 43 ailments, arthropods (20 species) treating 27 ailments, and reptiles (8 species) used for 32 ailments (Fig. 1). This indicates that in Ethiopia, a wide range of animals, including mammals, reptiles, birds, amphibians, insects (arthropods), fish, and annelids, are used for ethnozoological therapeutic purposes. Among these, mammals are the most commonly used animal group for preparing animal-based remedies, followed by birds, arthropods, and reptiles [17–26]. This trend holds across various regions, indicating that the choice of remedies is influenced by the local accessibility and availability of fauna. Most of these animals are locally available in different parts of Ethiopia, suggesting that the composition, accessibility, and availability of animal species in a given area play a significant role in determining the types of zoo-therapeutic items used. The predominance of mammals in traditional remedies is likely due to their higher accessibility and ease of handling compared to other animal groups. Conversely, the relatively lower use of reptiles in folk medicine may be attributed to their venomous nature and the risks involved in handling them. Factors such as accessibility, effectiveness, cultural acceptability, and cost also drive the widespread use and interest in medicinal animals in Ethiopia [21]. Both rural and urban populations commonly rely on animals found in their surroundings to treat everyday ailments [20, 23].

In Ethiopia, there is notable variation in the use of animal-based remedies across different regions and tribes, influenced by cultural practices, the geographic availability of animal species, and the specific health issues addressed by each community. A study by Dereje and Meseret [10] identified 21 animal species used to treat 46 health issues among the Kore people in southern Ethiopia, with mammals comprising the majority (66.64%) of the animals used, followed by reptiles (14.28%) and birds (19.04%). Similarly, research from Gamo zone in southern Ethiopia revealed that 51 species, including 27 mammals, 9 birds, 7 arthropods, 6 reptiles, and 1 species each of fish and annelid, were used for various ailments [26]. Other studies in regions like Benshangul Gumuz, Amhara, and Oromia have documented varying uses of animal species, with mammals consistently occupying the highest proportion across different tribes and regions [17, 20, 24, 25]. For example, in West Gojam, Amhara region, 11 mammals, 7 birds, 4 reptiles, 5 arthropods, 2 fish, and 1 annelid species were used for traditional treatments [23], and in Metema, another part of the Amhara region, 27 mammal species were used, alongside birds, arthropods, and reptiles [18]. Additionally, in northern Ethiopia's Kafta-Humera district, 16 animal species were documented as being used to treat 18 human ailments and mammals, arthropods and birds are the most widely used animals to prepare the remedies [19], and in the same region at Degu'a Tembien district, 23 animal species were recorded for treating various diseases, with mammals being the most used group, followed by birds and arthropods [15].

In pastoralist communities, such as those of the Somali, Afar, and Oromo tribes, where livestock like camels, cattle, and goats are central to livelihoods, animal-based remedies are particularly prominent. These communities often use animal products such as milk, meat, blood, and bones for medicinal purposes, particularly to treat digestive issues, joint pain, and fatigue [24]. In contrast, highland farming communities like the Amhara and Tigray tend to use more cattle and sheep products, such as milk, butter, and bones, to treat ailments like skin infections, respiratory conditions, and general physical weakness [15, 23]. The Southern Nations, with their rich biodiversity, may incorporate local wildlife or specific animal parts, reflecting their unique cultural beliefs and healing practices [10, 26].

The predominance of mammals in Ethiopian traditional medicine can be attributed to several factors. Mammals such as cows, goats, and sheep are not only abundant but also integral to Ethiopian agricultural systems, making them easily accessible for medicinal use. These animals provide a variety of products, including milk, bones, fats, and blood, which are believed to have healing properties for treating conditions such as digestive issues, joint pain, and skin diseases. Additionally, the cultural significance of mammals often associated with strength, vitality, and fertility, further reinforces their use in healing practices. The long-standing domestication of these animals has cultivated a deep understanding of their therapeutic potential, and their use is both a practical and spiritual practice within many Ethiopian communities. Ethiopia's diverse mammalian fauna also contributes to its rich medicinal wildlife heritage, with many species continuing to play a vital role in traditional healing.

Source of medicinal animals

According to this review, 95 (88%) of the medicinal animals and their body parts used in Ethiopia are sourced from wild animals, while only 13 (12%) come from domesticated species (Table 1). Ethiopian communities rely on a variety of species found in their local surroundings and remote areas to address health concerns and treat ailments [14, 23]. For instance, the Kunama people of Tigray obtain 56% of their medicinal animals from the wild and 44% from domestic sources, highlighting a similar trend across different regions [19]. Studies have shown that the majority of traditional healers source medicinal animals from wild animals, with proportions ranging from 60 to 80% depending on the area [15, 18, 21, 22, 24]. This reliance on wild animals is particularly

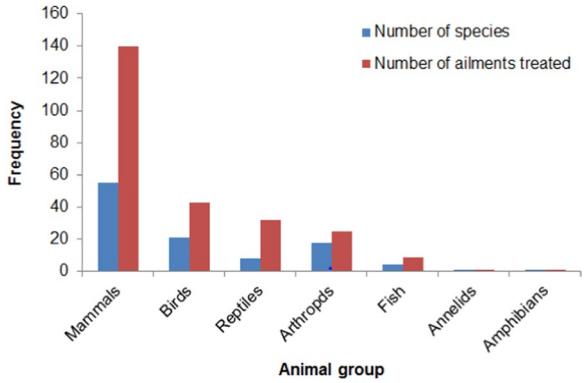

Fig. 1 Number of animal species used as remedies and number of ailments treated per animal group in Ethiopia

prominent among the Kore people in southern Ethiopia, where nearly all medicinal species are sourced through hunting [10]. This heavy dependence on wild species, however, poses significant conservation challenges, as over-hunting and the depletion of wildlife can limit the availability of these animals for future use. Traditional healers tend to favor wild animals over domesticated ones, possibly due to cultural preferences and the perception that wild species offer more potent healing properties. Domesticated animals, primarily used for food, are less frequently considered for medicinal purposes. This growing demand for wild animal parts, combined with unsustainable harvesting practices, has led to a decline in the populations of many species, contributing to the threat of extinction for certain animals [10, 19, 26]. As traditional medicine plays a crucial role in the healthcare systems of rural Ethiopia, where access to modern health care is limited, the overuse of wild animals for medicinal purposes creates a conflict between preserving cultural practices and conserving biodiversity. The situation calls for urgent action to balance the preservation of Ethiopian cultural heritage with the need for wildlife conservation. Promoting the sustainable use of domesticated animals, such as cattle, goats, and sheep, as well as farmed alternatives, could alleviate pressure on wild populations. Furthermore, increased awareness and education about the environmental impact of these practices, coupled with appropriate regulations, could help mitigate the negative effects on wildlife. By integrating sustainable alternatives into traditional medicine, it is possible to support both cultural practices and wildlife conservation, ensuring the survival of medicinal traditions and the protection of animal species for future generations [19].

Animal body parts or products used for medicine

In Ethiopia, various animal parts and products, including meat, fat, blood, skin, bones, teeth, hair, nails, visceral organs (such as liver, bile, and pancreas), and products like milk, butter, honey, eggs, and even excreta (urine and feces), are widely used in traditional remedies to treat a range of ailments [15, 18, 26] (Fig. 2). Among these, meat is the most commonly utilized, accounting for 33.8% of medicinal preparations, followed by fat (11.5%), bones (8.6%), and blood (8.5%) in Kore People in Amaro Woreda, Southern Ethiopia [10]. Studies in various regions, such as Metema district in the Amhara region and Wolaita in southern Ethiopia, also report that meat and fat are frequently used to treat conditions like stomach pain, intestinal diseases, heart failure, rheumatism, pleurisy, HIV/AIDS, and fever [13, 18]. Additionally, visceral organs, honey, venom, milk, butter, and other body parts such as bones, teeth, and skin are often incorporated into remedies. The use of animal parts like meat, liver, and blood is prevalent in various communities, including the Awi, Gamo, Konta, and Gumuz peoples [7, 25, 26], as well as in the Gojam and Bahir Dar Zuria districts, where these parts are commonly used to treat a wide array of illnesses [20, 23]. However, certain regions like Tigray place more emphasis on visceral organs, particularly liver and bile, for treating diseases such as asthma, tuberculosis, and night blindness [15]. Excreta, such as feces and urine, are also used in some areas, although they are less common than other animal products [22]. Meat plays a central role in Ethiopian traditional medicine due to its perceived strength and vitality-promoting qualities. It is believed to restore energy, treat physical weakness, and aid in recovery from illness [19]. The meat of domesticated animals such as cattle, goats, and sheep is commonly used, as these animals are readily available and integral to Ethiopian agricultural systems. Moreover, the cultural significance of meat in Ethiopian society, where it symbolizes health, power, and well-being, further strengthens its use in medicinal preparations. Nutritionally, meat is rich in proteins, fats, and essential nutrients, contributing to its role in traditional remedies aimed at strengthening the body [15]. In rural areas with limited access to modern healthcare, the use of meat in remedies remains a deeply ingrained practice, blending both nutritional needs and cultural healing traditions.

The risk of depleting medicinal animal resources is particularly high when using meat, fat, bile, and visceral organs, as these items are integral to a wide range of traditional remedies and often require the killing of an animal [26]. The collection of such animal parts, including meat, bile, internal organs, and teeth, poses a direct threat to animal survival. In contrast, using non-lethal animal products like feces, feathers, eggs, and honey has a significantly lower impact on the individual animal, making them more sustainable options in the preparation

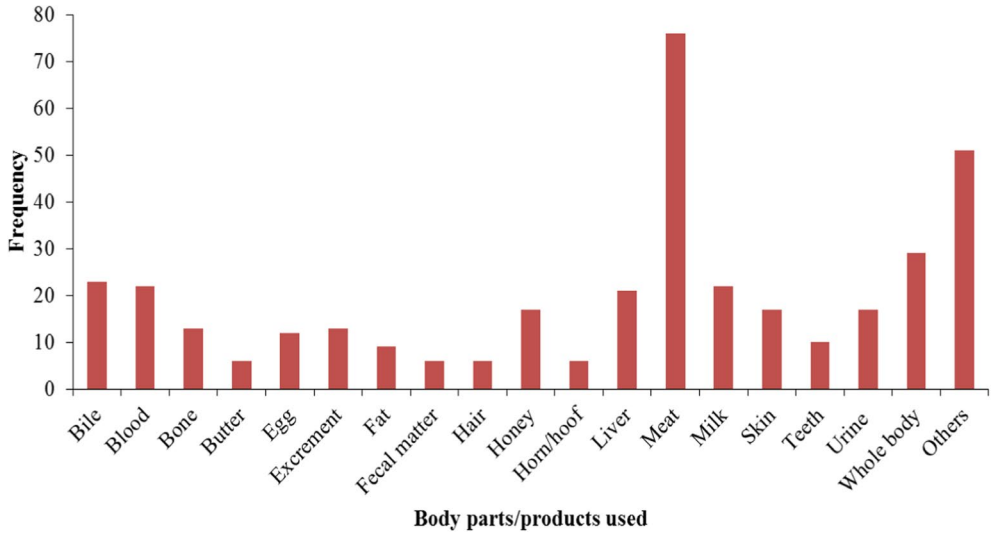

Fig. 2 Animal body parts or products used for medicine

of animal-based remedies. To ensure the long-term sustainability of animal-derived remedies, alternative practices must be prioritized. These include using farmed animal products instead of wild-caught animals, particularly from reptiles and insects, which could be more readily available and regulated. Additionally, focusing on animal products such as milk, honey, butter, eggs, and even excreta like urine and feces, rather than their meat, bile, or internal organs, would reduce the need for killing animals and lessen the strain on wild populations. Furthermore, investing in research to develop plant-based or synthetic alternatives that can replicate the therapeutic benefits of animal-derived remedies is an important avenue for sustainable healthcare practices. Bridging the gap between traditional knowledge and modern science through collaborative efforts could result in solutions that both respect cultural practices and promote conservation. By embracing these sustainable alternatives, Ethiopia can continue to benefit from its rich traditional medicine heritage while ensuring the protection of its animal populations and ecosystems. Such practices would allow traditional healing to evolve in a way that balances the preservation of biodiversity with the therapeutic needs of local communities, securing a healthier future for both people and animals.

Method of preparation, administration and application of medicinal animals

In Ethiopia, traditional medicine practitioners employ various methods to prepare animal-based remedies, with the most common being cooking (27.3%), mixing animal body parts or products such as honey, blood, and stomach contents (15%), and heating (15.8%) [10]. Fasil et al. [18] reported that traditional preparation methods include using fresh animal parts directly as raw materials (36.4%), cooking (23.6%), burning (13.6%), crushing or grinding (7.3%), wrapping (7.3%), powdering (6.4%), and drying (5.4%). Similarly, Abenezer and Wondimagegnehu [13] found that raw usage was the most frequent method (65.9%), followed by cooking (10.23%), soup drinking (4.55%), and other methods such as fumigating, roasting, warming, drying (3.4% each), oiling, decocting (2.3% each), and churning (1.1%) in the Wolaita area. Additional methods like drying, smashing, chopping, squeezing, anointing, and tying were also employed, though with varying frequency [19, 24]. Mulugeta et al. [26] noted that direct use of animal parts accounted for 68.9% of the remedies, with soup either with or without ingredients comprising 6.9%. Some remedies were used individually or combined with other animal products like honey, milk, sugar, salt, or plants such as seeds, flowers, and roots [15, 26]. However, some studies have indicated that most remedies are prepared without any additive substances [18, 19, 22]. Water is the most widely used solvent in the preparation of animal-based medicines, though milk, cheese, and butter are sometimes used as solvents or additives in specific cases [19, 22].

The most common route of administration for animal-derived remedies in Ethiopia is oral, primarily through eating and drinking, followed by dermal application through massaging, tying, anointing, and heating [10, 22]. The nasal route is also used, though less frequently, with the ear canal being the least utilized [25]. Misganaw et al. [23] noted that oral administration accounts

for 63.3% of applications, followed by dermal (46.7%) and fumigation (6.7%). Eating (33.8%) is the most common form of oral administration, followed by drinking and anointing (13.8%), massaging and tying (12.3%), and less common methods like dropping, fumigating (6.2%), and sitting (1.5%) [25]. Mulugeta et al. [26] reported that the primary routes for administering animal remedies are oral, dermal, and nasal, with dermal application in the form of lotions or creams being the dominant method (50%), followed by oral (46.4%), while nasal remains the least common. Other studies have also confirmed that oral administration is the most prevalent method in various regions across Ethiopia [13, 18, 19].

In Ethiopian traditional medicine, dry solid and liquid remedies are primarily administered orally, while treatments involving banding, heating, anointing, and massaging are applied dermally [13]. Medicinal fumes, like those from burning animal parts, are inhaled through the nasal opening. Some animal parts, such as bones, skin, and teeth, are believed to have healing properties when tied around the neck or other parts of the body as protective amulets [18]. However, a significant challenge in traditional medicine practices is the lack of standardized measurement for doses of animal-based remedies. Traditional healers typically determine dosages through trial and error, without consistent or accurate measurements [15, 23]. This lack of standardization and precision in dosing is one of the key issues preventing broader recognition and integration of traditional healthcare practices into modern medical systems. There is also no consensus among healers on appropriate dosages, which can lead to inconsistencies in treatment outcomes [20, 24].

Tying, as a practice, can be considered a form of folk medicine against nightmares, even without a direct physical application such as eating, drinking, massaging, or anointing. In many traditional healing practices, symbolic actions like tying are believed to have therapeutic effects by addressing psychological or spiritual factors. The act of tying something, such as a string or cloth, can be seen as a way to bind or restrict negative forces, such as evil spirits or malevolent energies, which are often thought to cause nightmares. This practice may provide psychological comfort, as the person believes they are protecting themselves from these harmful influences. Additionally, the ritual of tying may offer a sense of security and control, helping to alleviate anxiety, which is often linked to sleep disturbances. The belief in the efficacy of this practice can also trigger a placebo effect, where the individual's expectation of relief leads to a reduction in symptoms. In this way, the act of tying becomes a form of medicine, rooted in cultural beliefs and psychological processes, even in the absence of direct physical intervention. Therefore, while tying may not involve a physical application like eating or massaging, it can still function as a form of medicine within certain cultural and psychological frameworks, offering symbolic, emotional, or psychological benefits that contribute to the treatment of nightmares.

Ailments treated by medicinal animals

In Ethiopia, animals have long played a crucial role as sources of traditional medicine for treating various human and livestock ailments. This review compiled the use of medicinal animals across different regions of the country. Fasil et al. [18] identified 36 human and livestock ailments treated using animal-based remedies, which aligns with findings by Mezgebu [21] and Manaye et al. [20] who reported 31 and 33 ailments, respectively. Similarly, Dereje and Meseret [10] and Tsegazeabe [15] recorded 46 and 45 ailments, respectively, that were treated through traditional animal-based medicinal practices. Debela et al. [17] identified 12 ailments, including typhoid, heart failure, python molurus bite, diarrhea, and bat disease that were treated with animal-derived medicines in the Sayo and Hawa Galan districts. Among the Kore people, stomach pain was the most frequently treated ailment (11.29%), followed by wounds (9.23%) and rheumatism (5.81%) [10]. Gidey et al. [19] documented 18 ailments treated by medicinal animals among the Kunama people, with common conditions such as abdominal cramps, burns, common colds, migraines, goiter, tinea vesicular, night blindness, malaria, and diarrhea. In the Awil, Gamo, and Konta communities of the Amhara and Southern regions of Ethiopia, asthma, the evil eye, and broken bones were among the most commonly treated ailments using animal-based therapies [7].

Tsegazeabe [15] recorded ailments treated using medicinal animals, including cough, asthma, headache, earache, tuberculosis (TB), anemia, weakness, muscular pain, eye spirit, night blindness, fever, heart diseases, respiratory conditions, and snake bites. Remarkably, some studies have revealed that certain animals and their body parts are used to treat life-threatening diseases like HIV/AIDS and cancer. For instance, dried owl meat, along with the tail and bones of python species, has been reported for cancer treatment [18, 21]. Additionally, the meat and bile of the Olive baboon, as well as the bile of the common warthog and porcupine, have been used to treat HIV/AIDS [13, 18]. Various respiratory and reproductive system-related issues are also addressed through the use of different medicinal animals [22, 24, 27]. These findings highlight the need for stronger connections

between traditional medicinal practices and modern medicine to explore and potentially validate the therapeutic properties of these animal-based remedies.

Problems associated with using of medicinal animals

While animal-based traditional medicines play a significant role in treating various human and livestock ailments, they may also have side effects on patients. Unfortunately, there have not been many comprehensive studies examining the health risks associated with these medicines in Ethiopia, and thus limited records are available on the adverse effects. However, some research highlights health problems linked to the use of animal-derived medicines. Mekides and Mosissa [24] reported side effects such as diarrhea (22.7%), vomiting (31.8%), abdominal pain (9.1%), and the transmission of zoonotic diseases from using both plant- and animal-based traditional medicines. These issues may be related to the lack of precision in dosage measurement, preparation methods, and the consumption of raw animal products like meat and visceral organs. Zoonotic diseases, which are transmitted from animals to humans, are a significant concern, especially since many emerging human infectious diseases are zoonotic in nature. For instance, harmful pathogens such as bacteria, fungi, viruses, and parasites can be transmitted through medicinal animals, causing illness. Ingesting raw animal parts like bile and liver can lead to chronic diarrhea or toxicity [26]. Although users often believe that animal medicines are risk-free, some traditional healers, particularly those with more education, are aware of the potential risks, including zoonotic diseases like tuberculosis (TB) and rabies. Samuel et al. [28] also noted that patients have experienced adverse effects such as bleeding, abortion, visual loss, tetanus, jaundice, fistulas, gastritis, psychosis, exacerbation of illness, paralysis, and even death following traditional medicine therapy. Conversely, some users, as reported by Manaye et al. [20], believe that animal-based medicines are natural, harmless, and effective at treating ailments. Despite this belief, standardizing dosages is crucial to prevent complex health issues that may arise in addition to the original disease being treated.

Factors threatening medicinal animals

In Ethiopia, the use of animals and their body parts for treating various human and livestock ailments is widespread due to factors such as limited access to modern medical treatments and cultural practices. However, the species diversity and populations of these medicinal animals are declining due to anthropogenic pressures, such as illegal hunting, habitat destruction, overexploitation, and the introduction of exotic species. Studies indicate that hunting is the primary method for collecting medicinal animals from the wild, which adversely impacts their distribution and abundance [10]. Research by Mulugeta et al. [26] has identified key threats to medicinal animals in the Arba Minch Zuriya area, including habitat degradation, climate change, and pollution. Additionally, the sustainable use of medicinal animals faces challenges related to the secrecy of indigenous zootherapy knowledge and inadequate documentation of how medicinal animal body parts are prepared, prescribed, and used. Deforestation and habitat loss have led to the disappearance of certain medicinal animals, such as ostriches and warthogs, from specific regions like Gendewuha and Kumeraaftit villages in northwestern Ethiopia [21]. This highlights the need for ecological balance and biodiversity conservation in the use and trade of medicinal animals and their by-products [18]. To mitigate these threats, it is crucial for local communities to adopt sustainable practices by using medicinal animals wisely and exploring alternative treatments, such as utilizing animal by-products like milk and honey rather than killing the animals. Raising awareness about the conservation of medicinal animals and promoting alternative treatment methods are essential steps in protecting these important biological resources. Sustainable use of medicinal animals can also create employment opportunities and generate income, further supporting the conservation efforts.

Transferring of indigenous knowledge on medicinal animals

Traditional medicinal animals are crucial to the primary health care systems of Ethiopia's indigenous ethnic communities. Their significance stems from the limited availability of modern medical facilities, the lower cost of traditional medicines, and deep-seated belief in their efficacy. However, this invaluable traditional knowledge is rapidly deteriorating, necessitating urgent documentation to prevent its complete loss. Several factors contribute to this decline: Most traditional healers are over 45 years old and often view their knowledge as a professional secret or a source of income, limiting access to this information. Furthermore, the knowledge is typically passed down orally, primarily to their eldest sons, which complicates its transfer to younger generations [19, 22, 23]. The introduction of modern education, religious influences, and cultural shifts has also disrupted the transmission of this knowledge. To preserve this cultural heritage, it is essential to document and safeguard this wealth of information. Applying modern science and technology can help meet the growing health needs of humanity and ensure that traditional knowledge

contributes to the development of modern medicines. Moreover, as younger generations are less committed to preserving traditional practices, it becomes even more crucial to capture and conserve this knowledge for future generations [19, 21].

Conclusion

Ethnozoological studies reveal that the people of Ethiopia possess a rich body of indigenous knowledge, passed down through generations, regarding the use of animals and their body parts for treating various ailments. Researches indicate that 112 medicinal animal species are utilized to address 167 human and livestock health issues across the country. Among these, mammals are the most frequently used group, followed by birds, arthropods, and reptiles. The majority of these medicinal animal resources are sourced from the wild, with some also derived from domestic animals. The most commonly used body parts include meat and fat, followed by visceral organs, whole bodies, and by-products such as honey and milk. Animal remedies are typically prepared through cooking and are primarily administered orally, with some applied dermally. Traditional knowledge of these practices is largely transmitted orally from traditional healers to their sons. However, this knowledge faces significant threats from illegal hunting and deforestation, which endanger the availability of medicinal animals and their habitats. Therefore, comprehensive ethnozoological investigations are urgently needed across Ethiopia to document the diverse range of traditional medicinal animals and their associated practices. These studies would provide invaluable insights into the current use of animal-derived remedies and help identify sustainable practices that balance cultural heritage with conservation efforts. It is also crucial to encourage traditional healers to share their knowledge with interested individuals and to collaborate with higher institutions, such as universities and research centers, for sustainable documentation, development of modern medicine, and the creation of guidelines for ethical resource management. Additionally, training local communities on the value, management, and conservation of animal resources would be essential in promoting the sustainable use of these resources, ensuring that they can continue to support the health systems of rural areas without depleting local animal populations. Moreover, further studies on the conservation and management of medicinal animals are needed to evaluate the long-term impact of traditional medicine on wildlife and ecosystems. These studies can help develop strategies for sustainable use, including exploring alternatives to high-risk animal products like meat, bile, and internal organs. By focusing on these critical areas, Ethiopia can promote the continued practice of traditional medicine while protecting its rich biodiversity for future generations.

Acknowledgements
Authors thank to Aksum University for the facilities.

Author contributions
AA and KM wrote the manuscript; AA, KM and TG collected and organized the data; and AA, KM and TG revised and reviewed the article. All authors reviewed the manuscript.

Funding
There is no external funding for this review.

Availability of data and materials
No datasets were generated or analyzed during the current study.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Received: 21 November 2024 Accepted: 11 February 2025
Published online: 11 April 2025

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