

# Exploring the medicinal heritage: traditional applications of vertebrates and their by-products in human and veterinary remedies in India

Manuhar Sharma<sup>1</sup>, Kushal Thakur<sup>1</sup>, Sunil Kumar<sup>1</sup>, Rakesh Kumar<sup>1</sup>, Danish Mahajan<sup>1</sup>, Bhavna Brar<sup>1</sup>, Dixit Sharma<sup>1</sup>, Amit Kumar Sharma<sup>1\*</sup> 

<sup>1</sup>Department of Animal Sciences, Central University of Himachal Pradesh, Kangra 176206, India.

\*Corresponding to: Dr. Amit Kumar Sharma, Department of Animal Sciences, Faculty of Life Sciences, Central University of Himachal Pradesh, Shahpur, Kangra, 176206, India. E-mail: dr.amitcuhp@gmail.com.

## Author contributions

The author Manuhar Sharma, Kushal Thakur, Danish Mahajan, and Bhavna Brar contributed to the study design, data collection, and manuscript preparation. Amit Kumar Sharma and Dixit Sharma contributed to writing-review, editing of the manuscript, and supervising the whole experimental study. Rakesh Kumar and Sunil Kumar helped with manuscript writing, investigation, and reviewing. Amit Kumar Sharma designed the whole research study, data collection, data, and interpretation.

## Competing interests

The authors declare no conflicts of interest.

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## Abstract

Indigenous peoples are the custodians of traditional knowledge, encompassing their ideas, innovations, and methods. Throughout history, both plants and animals have served as valuable sources for medicinal remedies, capable of treating or preventing illnesses. This article aims to offer a concise overview of the traditional medical uses of vertebrates and the derived products in both human and veterinary medicine. Animal species are utilized as raw materials, and the resulting products are employed to cure a wide array of ailments. In different regions of India, indigenous peoples have diverse traditional applications for vertebrates and their by-products, which are utilized to treat human and animal illnesses. In various parts of India, medical practices involve the use of forty percent mammals, seven percent birds, eleven percent reptiles, eight percent fish, and two percent amphibians. Kerala employs around 69 different animal species and their by-products for the treatment of human and veterinary ailments. Similarly, the Theni district of Tamil Nadu utilizes 69 animals, the state of Madhya Pradesh employs 18 animals, the state of Tripura utilizes 25 animals, and the state of Assam employs 44 animals for the treatment of human and veterinary illnesses. Consequently, the main objective of this review is to provide a summary of the traditional therapeutic applications of animals and the resulting products.

**Keywords:** Traditional knowledge; zootherapy; natural remedies; fishes; birds and mammals

## Introduction

Traditional knowledge refers to the information acquired by local residents or communities through their life experiences, which they use to address daily challenges. India's traditional healing practices are renowned worldwide and have long been recognized as essential to the global healthcare system state that the population is knowledgeable about utilizing natural ecosystems for their immediate needs, such as food, medicine, and other essentials [1, 2]. Throughout history, various societies have utilized biodiversity as a healing tool. India's rich flora, fauna, and civilization offer immense diversity, and many immigrant populations worldwide rely on the folk medical system for their essential healthcare [3]. With its vast geographical and climatic variations, India is blessed with abundant faunal and floral biodiversity, with approximately 81,000 animal species [4].

Ethnobiology takes into account the active interaction between humans and the life forms in their environment. Ethnozoology, a branch of anthropology, studies the historical interactions between humans and animals. India has made significant progress in preserving its historical traditions, as well as the overall environment and natural resources. As a result, indigenous peoples have been utilizing various resources from wild animals or their components in therapeutic practices [5]. According to the World Health Organization, up to 80% of the world's more than 6 billion inhabitants primarily rely on animal- and plant-based treatments for medical conditions [6]. There is evidence of humans utilizing plants and animals for various purposes such as food, clothing, and medicine for a long time. Zootherapy, which involves treating human illnesses with pharmaceuticals derived directly from animals or borrowed from them, is a significant aspect of ethnozoology.

Zootherapeutic resources play a crucial role in several traditional systems. Animals, their byproducts, and their parts have been used as therapeutic remedies in various cultures. India has made significant advancements in the fields of zootherapy and traditional medicine throughout its history, as documented in works like Ayurveda and the Charaka Samhita. The Ayurvedic system provides detailed information about numerous animals, including 24 insects, 16 reptiles, 21 fish, 41 birds, and 41 mammals. Presently, many different ethnic groups and tribes in India utilize animals and animal products to treat both human and animal ailments. The inhabitants of these villages possess extensive knowledge about the medicinal properties of animals and their byproducts. India is home to a large number of tribal and ethnic communities, and most rural, tribal, and ethnic groups heavily rely on their local traditional medical systems for treatment due to limited access to modern institutions and hospitals. As stated by, this knowledge is passed down orally from one generation to the next [4].

Zootherapy serves as a significant alternative to other well-known therapies practiced worldwide. Over the past decade, there has been a notable increase in research interest and activities in the fields of ethnobiology and ethnomedicine. Scientific research in these fields has greatly contributed to the understanding of traditional subsistence practices and medical knowledge. In rural areas, it is evident that people continue to utilize various animal byproducts and products to treat a range of ailments. There are several goods made from animals, such as honey from honey bees that is used as medicine and restorative cow, goat, and other animal urine [7]. Many other animal-derived products and animal parts, including blood, skin, spines, bones, feathers, ash of shells, flesh, excreta, dung, brain, and fat, are used by locals and various communities throughout India as traditional remedies for treating human and animal illnesses.

Cattle milk has numerous health benefits. There has been a type of dissatisfaction with the current allopathic treatment as a result of its negative side effects and the lack of a cure for many conditions, which has brought all this knowledge back to the fore. As a result, people are searching for traditional treatments for illnesses. However, as India becomes more modernized, this ancient knowledge is quickly disappearing. All ethnobiological knowledge from the diverse cultural

people must be carefully examined and protected in order to prevent the extinction of traditional cultures [8]. Research on the biomedical benefits of living things and their biological components has lagged behind that of plants [9]. According to, between 15 and 20 percent of the traditional Indian medicines used in India come from animals [10].

Herbal medicines have been used in India to treat illnesses by our traditional healers since ancient times. In many parts of India where traditional knowledge is still being preserved by a new generation of traditional healers and is being verbally passed down from parents to their children, etc., many people are still using these cures to treat illnesses. Consequently, people rely on this local knowledge for healing and to meet their needs from generation to generation. This information is cost-effective, highly efficient, and advantageous for the future growth of India's healthcare system. We are all aware of the numerous adverse effects that medications and other chemically made substances have on our bodies. These age-old treatments, on the other hand, have no impact on our bodies.

Traditional medical practices derive their basic components from various sources, including healing minerals, plants, animals, and marine life [11]. The use of animals or their products for therapeutic purposes has been documented throughout history in written sources such as papyri, archives, and different classical medical compendiums, dating back to ancient civilizations like Mesopotamian, Assyrian, and Babylonian [12]. Some well-known authors of medical treatises with animal examples include Hippocrates (Greece, V-IV century BC), Dioscorides (Greek physician born in Anatolia, 1st century AD), Avicenna (Persia, X-XI century AD), and Ibn al Baitar (Andalusia, XII-XIII century AD).

Approximately 10% of the medicinal samples found in classical literature are derived from animals [13]. In the past, zootherapeutic activities received less attention from researchers compared to ethnobotanical research and surveys focused on medicinal plants [14]. While the registration, use, diagnosis, and authenticity of traditional plant-based medicines have received significant attention, many animal-based medications are traditionally used worldwide [15, 16]. Zootherapy provides a competitive advantage over other well-known treatments currently employed in modern civilization worldwide. Remedial, preventive, and redemptive drugs are largely derived from the hooves, skin, bones, feathers, and tusks of both wild and domesticated animals [16].

Of the 252 active chemicals selected by the World Health Organization, 8.7% and 11.1% come from animals and plants, respectively [17]. In America, 27 out of 150 medicines are derived from animals [6]. According to Traditional Chinese Medicine, over 1500 different life forms have medicinal value states that between 15 and 20 percent of ayurvedic medicine used in India comes from animals [6, 10]. The Unani medical system utilizes 200 different drugs found that 584 species in 13 systematic groups in Latin America have traditional healing and therapeutic purposes [18, 19]. Brazil alone uses 283 different animal species to treat various diseases [20].

Argentina utilizes 72 different animal species [21]. In Israel, twenty animal species are actively used as folk medicines [22]. The Tamang people of Nepal have discovered that 11 different animal species and their byproducts are useful as traditional medicines and are effective in treating diseases [23]. The Kingdom of Jordan is home to 30 different animal species, and it has been found that some of their products are used in complementary treatments [24]. This review combines information on the use of traditional and folk remedies for treating human and animal ailments across all vertebrate species, including fish, amphibians, reptiles, and mammals.

## Use of animals and their by-products for treating human diseases

Many years of observation and experimentation have provided medical knowledge in the use of natural products [25]. Approximately 60% of commercially available drugs are based on bioactive compounds extracted from natural resources traditionally used by various indigenous cultures around the globe [26]. Since ancient

times, numerous diverse societies have used animals and their various organs' products as medications. Ongoing examination into the phenomenon of zootherapy in the Levant from early medieval to modern mainstream medicine has unearthed 99 compounds of animal origin that were utilized medicinally during that lengthy period. Animal experts and products recognized as being used numbered 52 during the late Ottoman era (19th century) and 77 in the 20th century [27, 28]. The topic of zootherapy is characterized by both a vast global range and exceedingly significant historical antecedents. Animal-based remedies have been used since the classical era, as several authors have proven [28, 29]. Many historical sources dealing with medicine show that animals and their parts, as well as their products, were used for medicinal purposes. Evidence of such practices has been revealed in ancient civilizations including Egypt and Mesopotamia, which had an influence on the several tribes that later evolved in the Levant [30, 31]. Ancient Egyptian writings emphasize the need for a variety of biological commodities for healing, notably cow's milk, bee honey, lizard blood, swallow's liver, bat limbs, oakmoss made from whale sperm, and musk deer glands [31–34]. Mesoamerican artifacts, mostly Assyrian and Babylonian, depict the use of fish oil, beeswax, honey, turtle shells, goat skin, gazelle, deer, and sheep sinew, as well as bird droppings and animal fat [35–38]. The glands of the musk deer were administered in ancient China, alongside a range of other compounds derived from animals [39, 40]. The Hindu faith in India has long recognized the advantages of cow by-products and has employed them as traditional treatments for illness [41].

#### Use of animals and their by-product for treating veterinary diseases

Respondents also highlighted the practice of using animals and animal-based products to detect various veterinary ailments, in addition to treating human diseases. Approximately 11 different animal species are utilized to cure different veterinary maladies, including 8 wild animal species and fish. In the majority of these cases, blood was the most commonly used product for treating body pain, arthritis, and healing fractured bones in animals [42].

#### Fish species used for treatment of human and veterinary diseases

Only one fish species, *labeo rohita*, was found among the 18 animals reported in Chhindwara district, Madhya Pradesh [43]. An ethnozoological study conducted by traditional healers and indigenous inhabitants of Gibbon Wildlife Sanctuary, Assam, reported fishes accounting for 16.7% [3]. In Theni district, Tamil Nadu, traditional healers reported fishes comprising 10.29% [2]. Tripura reported fishes making up 8% of all vertebrates [44]. Among the Shoka tribes of Pithoragarh district, Uttaranchal, two fish species were reported out of 38 animals [45]. The Silent Valley of Kerala reported Actinopterygii, a class of fish, accounting for 4% [46].

#### For human diseases

One fish species, *Amphipnous cuchia*, reported by the Ao Tribe of Nagaland, is used for treating Asthma [47]. Tribes and rural communities in the Chhindwara District of Madhya Pradesh have found medicinal use of one fish species, *Labeo rohita*, for treating rheumatism. Fish species such as *Zygaena blochii*, *Hippocampus kuda*, etc. have been reported in District Kachchh, Gujarat [42]. *Channa punctatus* has been reported in Tripura [44]. Species of fish like *Anguilla bengalensis*, *Harpadon nehereus*, and *Labeo rohita* have been reported in Silent Valley, Kerala, for treating cough, lactation, and urinary obstruction, respectively [46]. In Tamil Nadu, fish species such as *Stolephorus spp.*, *Lepidocephalichthys thermalis*, and *Channidae* are used [46]. The Sahara tribe of Rajasthan uses *Labeo rohita* for urinary problems [7]. In Uttaranchal, *Tor putitora* and *Schizothorax richardsoni* are used [45]. In Arunachal Pradesh, *Mystus seenghala*, *Channa punctatus*, *Anabas testidunus*, etc. have been reported [2]. In Mizoram, *Cyprinus carpio* and *Bagarius bagarius* are used [2]. Various types of fish and their by-products are used for treating various diseases in humans. Traditionally, at least 30–31 fish species are used (Table 1).

#### For veterinary diseases

For treating animals, only 2 fish species have been reported, namely *Hippocampus kuda* and *Hippocampus spp.*, in Kachchh, Gujarat. The whole body and brain of these animals are used for treating stomach pain and urinary problems. The fish species used to treat veterinary diseases are shown in (Table 2).

#### Amphibia species used for treatment of human and veterinary diseases

3% of the species are found in Kerala [46]. In Tamil Nadu, the percentage is 4.34% [46]. In Tripura, it is 4% [44]. Only one species has been reported in Uttaranchal [45]. Similarly, one species of amphibian has been reported in Madhya Pradesh and one in Nagaland [43, 47]. In Assam, 7.1% of amphibian species have been reported [3]. No species of amphibians have been found in Gujarat for treating human and veterinary ailments [42].

#### For human diseases

One species of *Rana sp.* has been reported in Nagaland [47]. In Assam, *Polypedates leucomystax*, *Bufo sp.*, and *Rana sp.* have been reported [3]. In Kerala, the species *Euphyctis hexadactylus* and *Rana clamitans* have been reported [46]. The species *Rana tigrina* is used in Uttaranchal [45]. *Rana sp.* and *Bufo sp.* have been reported in the Theni district of Tamil Nadu [2]. Only *Rana sp.* has been found in Madhya Pradesh [46]. *Rana tigrina* species is used in Tripura [44]. In Andhra Pradesh, the species *Rana tigrina*, *Nanorana liebigii*, and *Amolops himalayans* are used [19–21, 48]. *Bufo melanostictus* has been reported in Mizoram [2]. *Rana tigrina* species has also been reported in West Bengal [49]. Various types of amphibians and their by-products are used for treating various diseases in humans. Traditionally, at least 10–15 amphibian species are used (Table 3).

Table 1 Fish species used to treat human diseases

Scientific name of fish species	Method of making traditional remedies	Human diseases to be cure\use for human treatment	Places	References
<i>Labeo rohita</i>	Fish curry is made	Rheumatism	Chhindwara district of Madhya Pradesh, India	[43]
<i>Labeo rohita</i>	Cervical vertebra of fish rubbed with water and this essence water is taken in urine blockage problem	Urine problem	Sahara Tribe of Rajasthan, India	[7]
<i>Tor putitora</i>	Blood of fish is used in foot and mouth disease; it is also applied on sore wounds in legs too	Treatment of foot and mouth disease, wounds	Shoka Tribes of District Pithoragarh, Uttaranchal, India	[45]
<i>Schizothorax richardsoni</i>	Blood is used and applied on wounds	Foot and mouth disease, heal wounds of legs		

Table 1 Fish species used to treat human diseases (continued)

Scientific name of fish species	Method of making traditional remedies	Human diseases to be cure\use for human treatment	Places	References
<i>Stolephorus spp.</i>	Dried fish cooked and consumed	Diarrhoea, body strength	Pachamalai hills of Tamil Nadu, India	[46]
<i>Lepidocephalichthys thermalis</i>	Fish is cooked and consumed	Arthritis		
<i>Channidae</i>	Cooked and consumed	Small pox		
<i>Kerria lacca</i>	Cooked and consumed, powdered and consumed	Aphrodisiac, Diarrhoea	Traditional healers of Theni district, Tamil Nadu, India	[2]
<i>Anguilla bengalensis</i>	Flesh is cooked	Cough	Silent Valley of Kerala, India	[46]
<i>Harpadon nehereus</i>	Raw dried fish is eaten	Lactation		
<i>Labeo rohita</i>	Cervical vertebra of fish rubbed with water and this essence water is taken in urine blockage problem	Urinary obstruction		
<i>Labeo rohita</i>	Gall bladder (bile) ground with water, whole gall bladder	Gastric ulcer, intestinal cancer	-	[2]
<i>Clarias batrachus</i>	Whole body cooked with spices like black pepper	Body pain and healing of wounds		
<i>Heteropneustes fossilis</i>	Whole body cooked with spices like black pepper and eaten	Pain and wound healing		
<i>Amphipnous cuchia</i>	Raw blood is consumed and cooked meat is eaten	Anaemia		
<i>Channa stewartii</i>	Body boiled with water and then consumed	Diabetes, pain, hypertension		
<i>Amblypharyngodon mola</i>	Cooked fish is eaten	Asthma, pox and pain		
<i>Chaca chaca</i>	Dry fish is grind and consumed with water	Asthma		
<i>Channa punctatus</i>	Head of fish used to make soup and consumed	Sex stimulant	Khowai district of Tripura, NE, India	[44]
<i>Amphipnous cuchia</i>	Blood of fish is prescribed to drink	Asthma, general weakness	Ao tribe of Nagaland, India	[45]
<i>Zygaena blochii</i>	Fat is directly applied externally	Joint pain	Kachchh, Gujarat, India	[43]
<i>Stolephorus spp.</i>	Dried fish cooked with Lagenaria siceraria and consumed	Diarrhoea	Traditional healers of Theni district, Tamil Nadu, India	[2]
<i>Lepidocephalichthys thermalis</i>	Meat soaked in dilute milk, then cooked and consumed	Gain weight		
<i>Anguilla bengalensis</i>	Meat cooked and consumed	Cough, Diarrhoea, Wheezing and Dysphonia		
<i>Lepturacanthus savala</i>	Meat cooked and consumed, Dried fish soaked in juice of Pergularia darmia, dried and stored, cooked and used as food supplement			
<i>Mystus seenghala</i>	Given to new mother	Good for health	Arunachal Pradesh, India	[50]
<i>Channa punctatus</i>	Animal cooked and eaten	By new mother for good health, and malaria		
<i>Anabas testidumus</i>	Eaten after cooked	Energy source, malaria		
<i>Clarius batracus</i>	Cooked and eaten	Energy source, diabetes, skin disease		
<i>Puntius spp.</i>	Cooked and eaten	For old age and diabetes		
<i>Heteropneustes fossilis</i>	Cooked and eaten	Energy source		
<i>Mystus cavasius</i>	Cooked and eaten	Energy improvement		
<i>Cyprinus carpio</i>	Bile engulfs and fat orally consume.	Fever, headache	Mizoram	[50]
<i>Bagarius bagarius</i>	Combination of fatty oil of fish along with Rhyticeros undulatus, Hylobates hpplock and Panthera tigris fat oil rubbed on affected region	Gout, rheumatism and joints		

**Table 2 Fish species used to treat veterinary diseases**

Scientific name of species	Method of making traditional remedies	Animal diseases to be cure	Places	References
<i>Hippocampus kuda</i>	Whole animal body after drying mix with animal fodder and given to animal	Cure stomach pain of horse	District Kachchh, Gujarat, India	[42]
<i>Hippocampus sp.</i>	Brain mixes with water and this water orally taken	Urinary problems in livestock	–	–

**Table 3 Amphibian species used to treat human diseases**

Scientific name of Amphibian species	Method of making traditional remedies	Human diseases to be cure\use for human treatment	Places	References
<i>Polypedates leucomystax</i>	Meat is boiled with spices like clove, cinnamon, black pepper, paste is prescribed to eat	Asthma	Gibbon Wildlife Sanctuary, Assam, India	[3]
<i>Bufo spp.</i>	Fresh blood and heart mixed with clove, cardamom, pepper, paste is prescribed to eat	Bronch pneumonia		
<i>Ranna spp.</i>	Cooked meat is eaten	Asthma		
<i>Euphlyctis hexadactylus</i>	Decoction is made	Sexual stimulant for male sex organ	Silent Valley of Kerala, India	[46]
<i>Rana clamitans</i>	Whole animal skin is dried and taken orally	Rabies		
<i>Rana tigrina</i>	Frog boiled in oil is used for healing wounds due to burn	Wound healing	Shoka Tribe of district Pithoragarh, Uttaranchal, India	[45]
<i>Rana sp.</i>	Meat cooked with pepper	Bronchitis,	Traditional healers of	[2]
	Telson fried in oil and applied over affected part, Tied in neck	Joint pain, Hemiplegia, To prevent diseases of children	Theni district, Tamil Naidu, India	
<i>Bufo sp.</i>	Whole animal is wrapped in cloth and tied over the neck	For malnourished people		
<i>Rana clamitans</i>	Meat is cooked	Rheumatism, arthritis, fever,	Pachamalai hills of	[46]
	Whole body soup is made and orally consumed	Cough, Angina pain, Cough, Cold	Theni district, Tamil Naidu, India	
	Fat is rubbed on infected area	Erysipelas		
	Foot is cooked and eaten	Sexual dysfunction		
	Blood is rubbed on infected area	Allergy		
	Skin is boiled and rubbed on externally	Skin infections		
<i>Rana sp.(mendak)</i>	Flesh is crushed into paste and applied over wound	Healing wounds	Chhindwara District of Madhya Pradesh, India	[43]
<i>Rana sp.</i>	Skin washed in water and applied on wounds	Healing wounds	Ao Tribe of Nagaland, India	[47]
<i>Rana tigrina</i>	Crushed flesh applied on wound	Healing wounds	Khowai district of Tripura, NE, India	[44]
<i>Rana tigrina</i>	Whole body of frog put in oil to boil and then oil used	Heal wounds due to burns	Warangal district, Andhra Pradesh, India	[48]
<i>Nanorana liebigii</i>	After removing skin small pieces of meat boiled by addition of salt and orally taken	Cough and cold, Dysentery, diarrhoea, piles		
<i>Amolops himalayans</i>	After removing skin small pieces of meat softened by boiling and consumed, Application of raw eggs	Cold, cough, bodyache, Cuts or wounds		
<i>Bufo melanostictus</i>	Bile consumed	Diabetes	Mizoram	[50]
<i>Rana tigrina</i>	Head used	Psychological problems	Bankura district, West Bengal	[49]

**Reptile species used for treatment of human and veterinary diseases**

6.53 % reptiles reported in Tamil nadu [14]. 4% reptile species found to be used as medicinal purposes in Tripura [44]. 5 reptiles species used in Uttaranchal [45]. 11.9% reptiles reported in Assam [3]. 3 reptiles fauna used in Madhya Prasadsh [43]. 10% reptiles used in Kerala [46]. 6.53% reported in Tamil Nadu [14]. 2 species found in Nagaland [47]. 1 reptile (4%) species reported in Tripura [44]. 3 species found in Kachchh Gujarat [42].

**For human diseases**

In Madhya Pradesh, *Varanus bengalensis*, *Naja naja*, and *testudo spp.*

were used [43]. *Kachuga tentoria* was found in Rajastham [7]. In Tamil Nadu, species such as *Calotes versicolor*, *Serpentes*, and *Ptyas mucosa* were found [2]. In Assam, *Ptyas mucosa* and *Varanus bengalensis* were reported [3]. Various types of reptiles and their by-products are used for treating various diseases in humans. Traditionally, at least 30–35 reptile species are used (Table 4).

**For veterinary diseases**

*Calotes versicolor* is used in Andhra Pradesh [48] and *Lissemys punctatus* is used in Gujarat [42] for treating both animals and humans. The reptile species used for treating veterinary diseases are listed below in Table 5.

Table 4 Reptile species used to treat human diseases

Scientific name of Reptiles species	Method of making traditional remedies	Human diseases to be cure\use for human treatment	Places	References
<i>Varanus bengalensis</i>	Skin oil is used for massaging, Penis and testis are consumed raw	Arthritis, Produce sexual stimulant of male sex organs	Chhindwara District of Madhya Pradesh, India	[43]
<i>Naja naja</i>	Ash of slough is used orally, ash mixed with coconut oil and applied on leprosy wound	Cancer, Rapid healing of leprosy wound		
<i>Testudo spp.</i>	Powder of shell is mixed with water and paste is made	Piles		
<i>Kachuga tentoria</i>	Ash of carapace is mixed with coconut oil, Ash of carapace is used	Skin burns, Lung diseases (cough, asthma, T.B. etc.)	Sahara Tribe of Rajasthan, India	[7]
<i>Calotes versicolor</i>	1–2 drops of blood given with milk	Skin problems of children	Traditional healers of Theni District, Tamil Nadu, India	[2]
<i>miChamaeleo zeylanicus</i>	Meat is cleaned and boil in neem oil and applied externally	Paralysis, Rheumatagia		
<i>Serpentes</i>	Moulted skin tied around waist, Powdered and applied externally	For easy birth, Rashes		
<i>Ptyas mucosa</i>	Meat boiled in oil and applied externally, Fat melted and oil is applied externally	Snake bite, Paralysis and warts		
<i>Varanus bengalensis</i>	Meat cooked and consumed	Snake bite, Aphrodisiac, immune enhancer, to cure tooth loosening, haemorrhoids, warts, bone fracture		
<i>Ptyas mucosa</i>	Meat is cooked and eaten	Pain	Gibbon Wildlife Sanctuary, Assam, India	[3]
<i>Eutropis carinata</i>	Meat is boiled in water and left out water after boiling is prescribed to drink	Snake bite and pain		
<i>Varanus bengalensis</i>	Meat is boiled and eaten	Skin disease (ring worm)		
<i>Hemidactylus flaviviridis</i>	Meat is inserted in banana for easy swallowing	Pain		
<i>Ophiophagus hannah</i>	Raw bile and gallbladder is orally consumed	Tonsil		
<i>Uromastix hardwickii</i>	Oil is extracted from whole body of lizard	Back pain	Tal Chhaper area Churu, Rajasthan, India	[5]
<i>Naja naja</i>	Skin moulting crushed with curd and applied on skin	Microbial infections of skin		
<i>Naja naja</i>	Cast of slough used and ash is mixed with mustard oil on wounds	Leprosy	Khowai district of Tripura, NE, India	[44]
<i>Varanus bengalensis</i>	Skin fat cooked and eaten	Piles, Rheumatism, body pain, piles burn	Ao Tribe of Nagaland, India	[47]
<i>Testudo sp.</i>	Flesh cooked and prescribed to eat	Skin disease and piles		
<i>Lissemys punctatus</i>	Carapace is burnt and ash is used for healing	Internal injuries, pruntis and cough	Kachchh, Gujarat, India	[42]
<i>Uromastix hardwickii</i>	Whole animal boiled in oil and oil applied externally	Joint paint and rheumatism		
<i>Hemidactylus sp.</i>	Whole animal boiled in sesamum oil and oil is applied	Heal eczema	Shoka Tribes of District Pithoragarh, Uttaranchal, India	[45]
<i>Vipera russelli, Ptyas mucosus, Ancistrodon himalayans</i>	Meat is used	Promote eyesight, facilitates elimination of urine, stool, flatus.	Shoka Tribes of District Pithoragarh, Uttaranchal, India	[45]
<i>Calotes versicolor</i>	Raw blood consumed orally	Skin disease	Silent valley Kerala, India	[46]
<i>Chamaeleo zeylanicus</i>	Meat oil is used	Rheumatism		

**Table 4 Reptile species used to treat human diseases (continued)**

Scientific name of reptiles species	Method of making traditional remedies	Human diseases to be cure\use for human treatment	Places	References
<i>Crocodylus palviustris</i>	Raw eggs consumed	Asthma	Silent valley Kerala, India	[46]
<i>Hemidactylus frenatus</i>	Whole animal decoction is taken orally	Erectile dysfunction		
<i>Lissemys punctata</i>	Shell powder is used, Shell soup is consumed orally, Meat soup taken orally, Raw blood consumed orally	Diarrhoea, indigestion, dermatitis, acne, Malaria, Arthritis, bronchitis, cough, asthma, cold, menorrhagia, Sexual dysfunction		
<i>Serpentes spp.</i>	Skin (dried) powder is used	Sore throat		
<i>Varanus bengalensis</i>	Raw meat is orally consumed	Teeth strength,warts, bone fracture		
<i>Vipera russeli</i>	Meat eaten	Improve eyesight, facilitates urination, stool and flatus	Warrangal district, Andhra Pradesh, india	[48]
<i>Varanus bengalensis</i>	Meat eaten, Fat used	Promote strength and virility, Joint pains	-	-
<i>Ophiophagus hannah</i>	Direct application of moulted skin on affected part	Cuts or wounds	Indigenous community of Sikkim Himalaya, India	[51]
<i>Cyclemys gemeli</i>	Bones used	Skin disease	Arunachal Pradesh, India	[50]
<i>Monitor lizard</i>	Species used	Joint pains and skin diseases		
<i>Viper ruselli</i>	Fatty oil warmed and rubbed on affected region	Warts and verrucose	Mizoram	[50]
<i>Varanus bengalensis</i>	Tongue cooked and eaten, Burnt skin smoke is inhaled at night, Bile cooked and consume, Meat cooked and eaten, Combination of meat and skeleton with 3 L coconut milk boiled till meat dissolve and consume	Stop stammering in children, Asthma, Malarial fever	-	-
<i>Tehanochelys trijuga</i>	Meat cooked and consume, Dipped bile in water and consume after a while	Malarial fever, diabetes	-	-
<i>Geochelone elongata</i>	Fluid obtained from neck is used	Piles	-	-
<i>Calotes versicolor</i>	Meat fry and consume,	Pneumonia, asthma, cough, cold	-	-
<i>Python molurus</i>	Bile consumed, Fat rubbed on affected part, Warm fat oil massaged pm affected region	Colic, stomach ache, Dysentery, cholera, hotness inside, stomach and localized headache, fever, burn, cut and wounds, easy labor	-	-
<i>Crocodylus palustris</i>	Mixture of excreta and coconut oil massaged in small amount	Skin disease	Similipal Biosphere Reserve, Orissa, India	[52]
<i>Lissemys punctata punctata</i>	Combination of fresh blood and sugar and orally consumed	Asthma	-	-
<i>Varanus</i>	Meat eaten	Asthma	Bankura district, West Bengal	[49]
<i>Testudines</i>	Shell dust used	Skin problems	-	-
<i>Ptyas</i>	Fat used or massaged on affected part	Joint pain	-	-

**Table 5 Reptile species used to treat veterinary disease**

Scientific name of species	Method of making traditional remedies	Animal diseases to be cure	Places	References
<i>Calotis versicolor</i>	Whole body put in oil and boil then oil massaged on affected area	Wounds healing	Warangal district, Andhra Pradesh, India	[48]
<i>Lissemys punctatus</i>	Ash of burnt carapace is used for healing internal injuries, pruritis and cough, also for healing blunt injuries of cattle	Healing injuries	District Kachchh, Gujarat, India	[42]

### Aves species used for treatment of human and animal diseases

Tripura reported 3 birds (12%) [44]. 23.92% of aves are found in Kerala [14]. 8 species are used in Gujarat [42]. Tripura also reported 3 birds (12%) [44]. Tamil Nadu has 33.827 bird species [2]. Nagaland has 7 bird species [47]. Madhya Pradesh has 3 bird species [43]. No bird species have been reported in Assam [3]. Uttaranchal has 6 species used [45].

#### For human diseases

In Uttaranchal, some of the species reported are *Columba Livia*, *Anas platyrhynchos*, etc. [45]. In Kerala, species such as *Columba livia*, *Corvus macrorhynchos*, etc. are used [46]. In Churu, *Passer domesticus*, *Pavo cristatus*, etc. are used [5]. In Gujarat, *Passer domesticus*, *Pavo cristatus*, etc. are used [42]. In Rajasthan, *Columba livia*, *Passer domestica* are used [7]. In Sikkim, *Pavo cristatus*, *Corvus macrorhynchos*, etc. are used [51]. In Orissa, *Buceros bicornis* and *Pavo cristatus* are used [52]. Various types of aves and their by-products are used for treating various diseases in humans. Traditionally, at least 39–40 aves species are used [Supplementary Table 1](#).

#### For veterinary diseases

Only one bird species *Gallus domesticus* reported in Gujarat [42]. Birds' species used to treat veterinary diseases are given below in the [Table 6](#).

### Mammal species used for treatment of human and veterinary diseases

Kerala reported 30.43% of mammals [14]. Tripura reported 11 mammals (44%) [44]. Assam reported 23.8% [3]. Madhya Pradesh reported 5 mammals [43]. Nagaland reported 12 mammals [47]. Tamil Nadu reported 33.8% of mammals used [2]. Tripura also reported 11 mammals (44%) [44, 52]. Gujarat reported 16 mammal species [42]. Kerala reported 29% of mammals [46]. Uttaranchal reported 20 mammals [45].

#### For human diseases

In Assam, species such as *Herpestes edwardsii*, *Bos indicus*, *Bubalus bubalus*, etc. have been reported [3]. In Tamil Nadu, species such as *Pteropus giganteus*, *Elephas maximus*, *Bos primigenius taurus*, etc. have been reported [14, 15]. In Gujarat, *Camelus dromedarius*, *bubalus spp.*, *Bos indicus*, *Canis familiaris*, etc. are used [42]. In Kerala, some of the species used are *Bubalus bubalus*, *canis aureus*, *Capra indicus*, *Rusa unicolor*, etc. [46]. In Uttaranchal, species reported include *Equus caballus*, *Panthera Pardus*, *Rattus rattus*, *Maccaca mulatta*, etc. [45]. In Andhra Pradesh, reported species are *Equus equus*, *Panthera pardus*, *Bos bubalus*, etc. [48]. In Ladakh, species used are *Ursus arctos*, *Vulpes vulpes*, *Lutra lutra*, *Lynx lynx*, etc. [50, 53]. In Sikkim, recorded species are *Panthera tigris*, *Canis aureus*, *Vulpes vulpes*, etc. [51]. Various types of mammals and their by-products are used for treating various diseases in humans. Traditionally, at least 40–50 species of mammals are used [Supplementary Table 2](#).

#### For veterinary diseases

In Gujarat 7 mammals species reported which are *Hystrix indica*, *Bubalus spp.*, *Camelus dromedarius*, *Capra indicus*, *Equus hemionus*, *Paraechinus microlapus*, *Cervus unicolor*. Mammals used to treat veterinary diseases are shown below in the [Table 7](#).

### Conclusion

This article provides a summary of the various types of vertebrates that have been used as traditional medicines in different states of India. These species are used either as raw materials or in the production of derived products. In this analysis, we learn about different techniques for preparing these traditional medicines using either the animal itself or its components. The data compilation process involved the use of 15 research articles on zootherapeutic investigations conducted in India between 2000 and 2007. Traditional medicine in India's diverse regions reportedly utilizes approximately 109 different animals in 270 different ways. The treatment of respiratory system problems has been recorded for the largest number of animal species (42, 38.5%) and the highest number of uses (50, 18.5%). To alleviate rheumatic and other types of pain, 32 species,

**Table 6 Birds species used to treat veterinary diseases**

Scientific name	Method of making traditional remedies	Animal diseases to be cure	Places	References
<i>Gallus domesticus</i>	Blood is massaged on affected parts of cattles, goats	Arthritis and fractured bones	District Kachchh, Gujarat, India	[42]

**Table 7 Mammals used to treat veterinary diseases**

Scientific name of species	Method of making traditional remedies	Animal diseases to be cure	Places	References
<i>Hystrix indica</i>	Intestine and rectum mixed with water as prevention to birds	Prevention against common poultry birdflu	Mizoram	[50]
<i>Bubalus spp.</i>	Application of blood on neck of cow	Reduce body heat	District Kachchh, Gujarat, India	[42]
<i>Camelus dromedarius</i>	Blood massaged, Bones of dead camel put on fire and left out ash combine with water and given to animals	Arthritis Healing		
<i>Capra indicus</i>	Application of turmeric powder and then used skin as cloth over it, Blood rubbed on affected part	Pneumonia, injury, fracture		

or 29.4%, are used for 34 different purposes, or 12.9%. For the treatment of digestive disorders, there have been reports of 26 (9.9%) different species being used for 22 (20.2%) different purposes. The majority of medicinal animal species belong to mammalian genera. There have been sightings of 44 mammals, accounting for forty percent of the total, 18 birds, seventeen percent, twelve reptiles, eight percent, nine fish, and two amphibians, accounting for two percent. Data were taken from various previously published study papers on ethnozoological practices in the states of Gujarat, Assam, Madhya Pradesh, Nagaland, Tripura, Tamil Nadu, Rajasthan, Uttaranchal, Kerala, Ladakh, Sikkim, Mizoram, Arunachal Pradesh, Orissa, Andhra Pradesh, and West Bengal. Reports have been made of people using products derived from fish, amphibians, reptiles, birds, and mammals, as well as the animals themselves, as traditional medicines in various parts of these states. Only the states of Gujarat and Mizoram have provided information regarding the use of these species or their derived parts in the treatment of animal ailments. No evidence was found of any amphibian species being effective in the treatment of veterinary illnesses. Information on human diseases can be found for almost every state mentioned earlier. In most cases, these practices involve the use of mammals, while amphibian species are the least frequently used. There is still a significant amount of unexplored data in these states. Several states, including Himachal Pradesh, have not yet been fully investigated. Despite its vast diversity of flora, fauna, and traditional knowledge, no relevant data or research work on ethnozoological practices has been found in Himachal Pradesh. This suggests that in the future, extensive research can be conducted in these locations to uncover unknown or hidden information.

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