

Traditional Knowledge on Zootherapeutic Uses and Sociocultural Practices by the Boro Tribe Living in the Ripu and Kachugaon Reserve Forest, Assam, India

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ABSTRACT

The present preliminary study documents the use of animal by-products in zootherapeutic practices among the Boro tribe residing in the forest fringe villages of Ripu Reserve Forest and Kachugaon Reserve Forest in Kokrajhar District, Assam, India. A total of 40 animal-derived materials were recorded as being used in traditional medicine preparation, of which 12 originated from invertebrates and 28 from vertebrates. Species used directly in zotherapy included 1 fish, 1 amphibian, 4 reptiles, 2 birds, 12 mammals, 5 molluscs, and 5 arthropods. Among these, the cocoon of Eri silkworm (*Samia ricini*) served as a natural wrapping material for storing medicines or preserving the umbilical cord intended for future medicinal use. Detailed accounts of the traditional preparation methods and modes of administration were documented for the first time. No written records or manuscripts on zootherapeutic practices were found in the study area, indicating that this knowledge system is transmitted orally across generations. Traditional healers, locally known as *Ojha*, were identified as the primary custodians of this knowledge. In addition to medicinal applications, several animal body parts were also used in the socio-cultural practices of the Boro community. This study provides baseline information crucial for understanding and conserving the ethnomedicinal knowledge associated with animal-based remedies in this region.

Keywords: Assam, Boro tribe, Diseases, Traditional, Zotherapy, *Ojha*.

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INTRODUCTION

Throughout human evolution, people have faced numerous environmental challenges, including disease, injury, and predation (Rogers, 1972). Tribal communities, which often live in close association with nature, have developed the ability to use natural resources for survival and well-being, a skill regarded as one of their most valuable forms of knowledge (Pushpangadan, 1984; Binu *et al.*, 1992; Pushpangadan and Pradeep, 2008). Over generations, they have acquired and transmitted traditional knowledge that enables them to harvest and use natural resources to meet human needs (Anonymous, 1992). Zotherapy refers to the treatment of human ailments using medicines obtained from animals or animal-derived products (Costa-Neto, 2005; Mahawar and Jaroli, 2006). According to the World Health Organization (WHO), 80% of the world's population relies primarily on plant- and animal-based medicines (WHO, 1993).

Animal by-products, including hooves, skins, bones, feathers, and tusks, are used in the preparation of zootherapeutic medicines (Adeola, 1992; Angeletti *et al.*, 1992). Zotherapy remains widely practiced in traditional medicine systems, particularly in China, where more than 1,500 animal species are reportedly used by the China National Corporation

of Traditional and Herbal Medicine (CNCTHM, 1995); in India, where animal-derived substances constitute 15 - 20% of Ayurvedic medicines (Unnikrishnan, 1998); and in northern Brazil, where 180 animal species are used (Costa-Neto, 2004). Historical records show that people from diverse cultures have long used animal body parts and products in traditional remedies, indicating that such practices have broad geographical distribution and deep historical roots (Lev, 2006).

Since ancient times, Hindus have used five cow-derived products - milk, urine, dung, curd, and ghee in various purification rituals (Simoons, 1974). Tribal communities in India practice Ayurveda and Homeopathy as traditional healthcare systems (Pushpangadan *et al.*, 2014). AYUSH is an acronym for Ayurveda, Yoga and Naturopathy, Unani, Siddha, Sowa Rigpa, and Homeopathy. In India, Ayurveda is one of the oldest and most comprehensive healthcare systems, with a documented history of more than 5,000 years, while Homeopathy has been practiced for about 100 years. The therapeutic properties of plants, animal products, and minerals are extensively described in the compendia Caraka Samhita and Susruta Samhita (AYUSH, 2023). Homeopathic medicines are prepared mainly from plant materials, minerals, animal sources, nosodes, and sarcodes (Sankar *et al.*,

2016). Homeopathy was founded in the nineteenth century by Christian Friedrich Samuel Hahnemann, a German physician (Cook, 1981). In Nagaland, India, the Chakhesang tribe uses traditional medicines derived from vertebrate and invertebrate animal products to treat various ailments, including products from one fish, two amphibians, one bird, one reptile, twelve mammals, one mollusc, one annelid, and four arthropods (Kakati and Doulo, 2002). Several Naga tribes use 26 animal species and their products in ethnozoological practices to treat different ailments (Jamir and Lal, 2005). The Ao tribe of Nagaland uses 25 vertebrate species, including some rare species, for traditional therapeutic purposes (Kakati *et al.*, 2006). Similarly, different ethnic groups in Rajasthan, India, use 13 animal species and their products to cure various ailments (Jain *et al.*, 2008).

Advances in scientific research and modern methods have increased interest in ethnobiology and ethnomedicine, contributing significantly to the understanding of traditional knowledge and healing practices (Pieroni *et al.*, 2005). The present study documents the use of animal products in medicine and socio-cultural activities among the Boro tribe living in forest villages of Ripu Reserve Forest (RF) and Kachugaon RF in Assam, India.

Materials and Methods:

The study was conducted through direct field surveys from May 2021 to July 2023 in forest villages of Ripu RF and Kachugaon RF. In-person interviews were carried out with selected respondents identified based on their local reputation and community recognition for knowledge of specific traditional practices. The respondents included local healers, known as Ojha; village priests, known as Dwory; women aged 30–70 years; makers and performers of traditional musical instruments; and village heads, known as Gaonburas. Structured questionnaires were prepared to guide the interviews. Respondents were asked in detail about the use of animal parts and animal-derived products in disease treatment, including methods of medicine preparation and preservation, dosage, and modes of administration, and the information was recorded following Kim and Song (2011). Scientific names of animals used in zootherapy were recorded with reference to standard literature (Prater, 1996; Puri, 2007).

Study Area:

The study area Ripu Reserve Forest and Kachugaon Reserve Forest in Assam are located between 24°N–28°N latitude and 90°E–96°E longitude. Assam is among the world's richest biodiversity zones and is well known for its abundant forest resources. The Kachugaon Forest Division lies adjacent to Raimona National Park, which extends across the Gossaigaon and Kokrajhar subdivisions of Kokrajhar district in the Bodoland Territorial Region of Assam, India. The park supports rich faunal diversity, including

tiger, clouded leopard, golden langur, Indian gaur, Asian elephant, spotted deer, wild buffalo, and hornbill. The area surrounding Raimona National Park comprises approximately 2,864 households, with an estimated population of 13,165.

The Boro Tribe:

The Boro are the largest ethnolinguistic community among the notified Scheduled Tribes of Assam, India. They are recognized as an ethnic plains tribe under the Sixth Schedule of the Indian Constitution and speak Boro (Bodo), one of the 22 Scheduled languages of India (GoI, 2003). The Boro population is concentrated mainly in Assam, with smaller populations found in Meghalaya, Nagaland, West Bengal, Bangladesh, and Nepal. According to the 2011 Census of India, the Boro population in Assam was approximately 1.3 million, accounting for 5–6% of the state's population (GoI, 2011). Most Boro people live in villages, often near forest areas.

Data Analysis:

By following the method of Vitalini *et al.* (2012), Relative Frequency of Citation (RFC) index was calculated:

$$RFC = FC/N,$$

Where, FC is the number of respondents who mentioned about the use of the species, and N is the total number of participated respondents in the survey. When RFC index is 0, it means that no one refers to the animal as useful and RFC index is 1, it indicates that all informants in the survey refer to the animal as useful (Mootsamy and Mahomoodly, 2014).

Fidelity Level (FL) of the data obtained during survey was calculated to find the percentage of respondents claiming use of a particular animal species most frequently in the treatment of a particular disease:

$$FL (\%) = N_p \times 100/N,$$

Where, N_p is the number of respondents that claim the use of a particular animal species to heal a particular disease and N is the number of respondents that use animals as a medicine to treat any disease (Alves *et al.*, 2012). The FL is from 1 to 100%; value close to 100 means high use of a particular animal species by large number of people, while low value shows that the respondents deny that species to be used in the treatment of the disease.

Result:

The present investigation documented extensive zootherapeutic practices among the Boro tribe inhabiting the forest villages of Ripu Reserve Forest (RF) and Kachugaon RF in Assam, India. A total of 40 animal-based medicinal products were recorded, of which 12 originated from invertebrates and 28 from vertebrates. The study identified the use of 1 fish species, 1 amphibian, 4 Reptiles, 2 Birds, 12 Mammals, 5 Molluscs, and 5 Arthropods as part of the community's traditional healthcare system.

The Fidelity Level (FL) analysis showed that honey (*Apis indica*) had the highest value (100%),

indicating universal acceptance and use. Freshwater molluscs, including *Brotia* (*Antimelania*) *costula* (98%) and *Brotia costula* var. (98%), along with the freshwater crab *Sartoriana trilobata* (96%), also recorded high FL values. The lowest FL value (7%) was recorded for praying mantis eggs (*Mantis religiosa*) and the whole body of the bed bug (*Cimex lectularius*), suggesting limited therapeutic use and low cultural recognition.

A wide variety of ailments were treated using animal-derived products. For instance, anaemia and pregnancy-related weakness were treated through the consumption of blood and meat of the fish *Monopterusuchia*. Respiratory disorders such as dyspnea were managed using the liver of *Bufo bufo* and *Calotes versicolor*, often wrapped in Eri silkworm cocoon (*Samia ricini*) before application. Dermatological problems including skin rashes, wounds, scaling skin, cracked lips, and fungal infections were treated using ingredients such as lizard tails, spider webs, ashes of rhinoceros skin, and snail body fluids. Other conditions treated included bone fractures, bed-wetting, marasmus, stomachache, athlete's foot, and tuberculosis.

The study also revealed significant socio-cultural uses of animals (Table 2). One reptile and five mammalian species were used to craft traditional ornaments, tools, and musical instruments. Rhinoceros horn and elephant tusk were fashioned into rings; Porcupine spines were used as weaving tools; and animal skins from Goat (*Capra hircus*), Horse (*Equus caballus*), and *Varanus* species were essential materials for making traditional musical instruments such as khaam and serja.

A unique and culturally important finding was the use of Eri silkworm cocoon (*Samia ricini*) locally known as *pithwb* for wrapping, storing, and preserving medicinal materials, especially the umbilical cord of newborns. The preserved cord is later soaked and administered orally to infants to relieve abdominal pain, a practice that remains widespread among Boro household.

Table 1: Medicinal uses of animal and animal parts for traditional zootherapy by Boro tribe living in the Ripu and Kachugaon Reserve Forest, Assam, India.

Sl. No.	English Name	Boro (Local Name)	Scientific Name	Family	Parts Used	Medicinal Use (Term in Bodo)	Method of Use	RFC	FL (%)
1.	Cuchia	Kuchia	<i>Monopterusuchia</i> (Hamilton, 1822)	Synbranchidae	Whole fish	Anaemia (Twi gwiwi)	Blood and meat are cooked and eaten.	1	50
		Ambu sitro/			Liver	Dyspnea (Gwrwb saonai)	Whole fresh liver inserted inside Eri cocoon, tied around the neck hanging on the chest.	0.4	30

RESEARCH PAPER

2.	Common toad	Ambu dadura	Bufo bufo (Linnaeus, 1758)	Bufo	Skin	Peripheral cyanosis (Asi gwtang janai)	Skin of the toad is peeled off and put on the finger and toe tips.	0.2	70
3.	Garden lizard	Twi silora	Calotes versicolor (Daudin, 1802)	Agamidae	Liver	Dyspnea (Gwrbw saonai)	Whole fresh liver inserted inside Eri cocoon, tied around the neck hanging on the chest.	0.12	60
					Whole body	Frequent bed wetting (Undunayao hasugunai)	Roasted and eaten.	0.3	48
4.	Common house lizard	Tik Tika / Mainao	Hemidactylus frenatus (Schlegel, 1836)	Gekkonidae	Tail	Rashes/ Wounds (Bigur gwja sin janai /garai)	Lizard tail, women's fallen hair and roots of Cocculus hirsuta should be dry fried, then powdered and mixed with coconut oil. The solution is applied to the rashes and wounds.	0.3	55
5.	Indian monitor lizard	Mwpou	Varanus bengalensis (Daudin, 1802)	Varanidae	Skin	Skin rashes (Bigur gwja sin janai)	Skin is heated and applied on the skin rashes.	0.2	65
6.	Cobra	Jibou Pitigom	Naja naja (Linnaeus, 1758)	Elapidae	Head	Joint pain (Hara jorayao sanai)	After removing the venomous part of dead snake's head, is roasted with coconut oil and applied in the joints.	0.3	20

7.	Red-wattled Lapwing	Daosin	Vanellus indicus (Boddaert, 1783)	Charadriidae	Nest	Fractured bones (Hara bainai)	Nest is crushed into powder and applied to the fractured areas and tied with bandage.	0.82	48
8.	Chicken	Dao	Gallus gallus domesticus (Linnaeus, 1758)	Phasianidae	Egg	Burning sensation in stomach (Udwi alounai)	Whole egg is to be drunk.	0.6	39
						Burned skin (bigur kamnai)	Whole egg to be applied on the burned skin.	7.1	42
9.	Tiger	Mwsa	Panthera tigris (Linnaeus, 1758)	Felidae	Fur	Postpartum dyspnea (Bagnisor nangnai)	Furs soaked in water for a while and made to drink.	0.24	15
					Milk (dry preserved)	Postpartum dyspnea (Bagnisor nangnai)	Milk (dry preserved) kept in water for a while and made to drink.	0.44	64
10.	One Horn Indian Rhinoceros	Ganda	Rhinoceros unicornis (Linnaeus, 1758)	Rhinocerotidae	Skin	Scaling skin (Ganda rogo janai)	Rhinoceros skin burned into ashes and mixed with coconut oil and applied in the infected skin/areas.	0.6	59
					Urine	Deafness (Benga)	Urine is poured into the ear.	0.64	70

11.	Elephant	Mwider	<u>Elephas maximus</u> (Linnaeus, 1758)	Elephantidae	Dung	Dyshidrosis and Athlete's foot (Sitor rakeb and athing digun)	Dung is burned and covered with raw Imperata brevifolia to produce huge fumes. Infected parts are placed on the fumes and repeated for 3-4 times.	0.34	86
12.	Assam macaque	Mwkra	Macaca assamensis (McClelland, 1840)	Cercopithecidae	Eye brow	Marasmus (Mwkra kaya nangnai)	Eye brow of monkey inserted inside the Eri cocoon, tied around the neck hanging on the chest.	0.3	96
13.	Mole	Anjor Sika	Anourosorex assamensis (Anderson, 1875)	Soricidae	Whole body	Malnutrition in children (Supungsargra adarni khoha)	Cooked and eaten	0.1	34
14.	Hispid hare	Sesa	Caprolagus hispidus (Pearson, 1839)	Leporidae	Fur	Wound / Cuts (Garai/bwonai)	Furs are ground into paste and applied to the wounds/cuts.	0.3	20
15.	Human	Mansi	Homo sapiens (Linnaeus, 1758)	Hominidae	Milk	Sunken spot-on infant's anterior fontanelle (Talw gwdwnai)	Mother's milk is applied to anterior fontanelle.	0.4	15
					Umbilical cord	Stomachache of infant (Udwisanai gotopwrnao)	Dry umbilical cord of the newborn is dry preserved and soaked in water. It is given to drink to infants.	0.28	10
					Saliva	Stomachache and wound (Udwisanai/garai)	Saliva is applied on the naval during stomachache and on any wound.	0.78	80

					Hair	Rashes/ Wounds (Bigur gwja sin janai/ garai)	Lizard tail, women's fallen hair and roots of Cocculus hirsuta should be dry fried, then powdered and mixed with coconut oil. The paste is applied on rashes and wounds.	0.9	60
16.	Porcupine	Mwdwi	Hystrix indica (Kerr, 1792)	<u>Hystricidae</u>	Dung	Stomachache (Udwisanai)	Dry dung is soaked in a glass of water and drunk.	1	89
17.	Buffalo	Mwisw	Bubalus bubalis (Linneaus, 1758)	Bovidae	Skin	Dysentery (Amousa twi kinai)	Ash mixed with water and drunk.	0.5	90
18.	Otter	Motam	Lutra lutra (Linneaus, 1758)	Viverridae	Vomit	Noisy breathing in kids (Gontong gabnai)	Vomit is applied in the nasal cavity.	0.1	35
19.	Cow	Mwsou	Bos taurus (Linneaus, 1758)	Bovidae	Clarified butter (Ghee)	Paralyzed legs and hands (Badd janai)	Applied and massaged externally.	0.7	95
20.	Wild fox	Siyal	Vulpes bengalensis (Shaw, 1800)	Canidae	Blood	Tuberculosis	Raw blood is drunk.	0.1	12
					Meat	Tuberculosis	Meat is cooked and eaten.	0.1	23
21.	Apple snail	Samo ladai	Pila globosa (Swainson, 1822)	Ampullariidae	Body fluid	Ingrown toenail infection (Abwi khoru janai)	Body fluid is applied into the infected ingrown toenail.	0.44	72
22.	Freshwater snail	Samo khohe	Angulyagra microchaetophora (Annandale, 1921)	Viviparidae	Whole soft body	For better eyesight	Cooked and eaten.	0.92	48
23.	Freshwater snail	Samo dahwnai	Bellamya bengalensis (Lamarck, 1822)	Viviparidae	Whole soft body	For better eyesight	Cooked and eaten.	0.86	88
24.	Freshwater snail	Samo khingkri	Brotia (Anti melania) costula (Rafinesque 1833)	Pachychilidae	Whole soft body	For better eyesight	Cooked and eaten.	1	98

25.	Freshwater snail	Sam o gwla o	Brotia costula var (Rafinesque 1833)	Pachychilidae	Whole soft body	For better eyesight	Cooked and eaten.	1	98
26.	Common house spider	Bema	Parasteatoda tepidarium (C.L. Koch, 1841)	Theridiidae	Spider web	Chapped lips/ Cracked skin/ /Scaling skin (Gusti gaonai/bigur gaonai/ ganda Rogo Janai)	Spider web is ground and applied on affected areas.	0.72	33
					Exoskeleton (because of ecdysis)	Heat headache (Khorogwtang sanai)	Ground the exoskeleton and smoked with dry leaf of Shorea robusta.	0.8	23
27.	Fresh water crab	Kangkrai	Sartoriana trilobata Alcock, 1909)	Gecarcinucidae	Whole body	Jaundice (Gwmw janai)	Cooked with star fruit and eaten.	0.98	96
28.	Praying mantis	Gum a gang u	Mantis religiosa (Linnaeus, 1758)	Mantidae	Eggs	Wounds (Garai)	Eggs are crushed and applied.	0.56	30
						Bed wetting (Undunayo hasugunai)	Eggs are fried and eaten.	0.54	7
29.	Bed bug	Urao	Cimex lactularius (Linnaeus, 1758)	Cimicidae	Whole body	Common cold/ Runny nose (Goga mwnnai)	Species crushed and inhaled	0.2	7
30.	Honeybee	Bere konkromao	Apis indica (Fabricius, 1973)	Apidae	Honey	Cough (Gujunai)	Administered orally.	1	100
					Bee wax	Chest pain/Joint pain (Bikha sanai/hara jora sanai)	Bee wax is applied.	0.76	45

RFC - Relative Frequency of Citation; FL - Fidelity Level.

Table 1: Medicinal Uses of Animal and Animal Parts for Traditional Zotherapy by Boro Tribe Living In The Ripu And Kachuga
Table 2: Socio-cultural uses of animals among the Boro tribe in the Ripu and Kachugaon Reserve Forests, Assam, India

Uses	Boro Name	Animal	Part of Animal Used
Ornaments	Astam/Angthi	Rhinoceros	Horn
		Elephant	Tusk
Hook in weaving	Khaita	Porcupine	Spine
Musical Instruments	Khaam	Goat and Horse	Skin
	Serja	Indian Monitor Lizard	Skin

Discussion:

This study demonstrates the rich ethnozoological knowledge of the Boro tribe and their strong reliance on animal-based remedies for primary healthcare. The high Fidelity Level (FL) values recorded for honey, freshwater snails, and freshwater crab suggest that these products are culturally significant, readily available, and widely perceived as effective. Honey recorded the highest FL value (100%), highlighting its central role in treating common ailments such as cough, chest pain, and joint pain. Conversely, the low FL values for praying mantis eggs and bed bugs suggest that these remedies are either infrequently used or associated with ailments of lesser occurrence. Similar patterns have been observed in other ethnomedicinal systems, where accessibility, cultural familiarity, and perceived efficacy strongly influence the frequency of use.

The findings indicate that the Boro tribe has developed a well-established system of zootherapy for treating diverse conditions, ranging from common acute ailments such as wounds, stomachache, and skin infections to chronic and serious diseases including dyspnea, jaundice, and tuberculosis. The use of specific animal parts, such as lizard tails, porcupine dung, otter civet vomit, rhinoceros skin ash, and buffalo skin ash, reflects detailed knowledge of animal-based remedies derived from long-term empirical observation.

A noteworthy aspect of Boro ethnomedicine is the prominent use of Eri cocoons (*Samia ricini*) for wrapping and preserving medicinal materials. This practice, particularly in the preservation of umbilical cords, demonstrates remarkable indigenous knowledge regarding moisture control, protection from fungal infections, and long-term storage. Interestingly, modern biomedical research has highlighted the therapeutic potential of umbilical cord blood stem cells, drawing a parallel between traditional practices and contemporary advances (Verma et al., 2016; Sachdeva et al., 2018).

The documentation of animal-based socio-cultural items, such as rings, weaving tools, and musical instruments emphasizes the multifunctional role of fauna in Boro cultural heritage. These traditions reflect a holistic worldview in which animals are integrated not only into healthcare but also into art, craft, music, and ritual life.

The study further underscores that ethnomedicinal knowledge in the community is largely oral, transmitted across generations through observation and apprenticeship. While chronic illnesses are typically treated by specialized healers known as *Ojha*, common household ailments are addressed by family members, demonstrating a decentralized and community-based healthcare system. Collection of animal materials is predominantly performed by male members, whereas the preservation of culturally important items, such as the umbilical cord, lies with the women revealing gendered patterns of medicinal responsibility.

The findings resonate with global observations that indigenous societies are primary users and monitors of natural resources, possessing intimate ecological knowledge and awareness of biodiversity depletion (Johannes et al., 2000). In this context, the documentation

of Boro zootherapy serves as a crucial step toward the conservation of indigenous knowledge systems, which are threatened by modernization, habitat degradation, and loss of biodiversity.

Conclusion:

The findings of this study are derived from direct field surveys and represent the first systematic attempt to document the use of animal body parts and animal-derived products in the zootherapeutic traditions of the Boro tribe. The study area, located within and around the recently established Raimona National Park, is ecologically sensitive and rich in wildlife diversity. Since the declaration of the National Park, local communities have reported decreased access to forest resources, which has led to a noticeable decline in the use of animal-based remedies. This reduction may also be attributed to the growing reliance on modern medical facilities and the possible decline in wild animal populations. Despite these changes, the ethnomedicinal knowledge retained by the Boro community remains a valuable cultural and biological resource. The documented practices highlight a deep understanding of local fauna and their perceived therapeutic properties. Further molecular and pharmacological investigations of these animal-based materials may provide scientific insights into their bioactive compounds and mechanisms of action. Such research could contribute to modern drug discovery and, importantly, offer sustainable alternatives that reduce pressure on wildlife populations.

Overall, this preliminary study underscores the need for continued documentation, scientific validation, and conservation of traditional zootherapeutic knowledge. Integrating indigenous knowledge with modern biomedical research may help preserve cultural heritage while promoting wildlife protection and sustainable healthcare solutions.

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Conflict of Interest

The authors declare that they have no conflict of interest.

Ethics approval

This article does not contain any study trials with humans or higher animals performed by any of the authors.

Authors' contributions

The importance of this study of ethnozoological study of Boro tribe was conceptualized by NB. Questionnaires were prepared by DB. Field survey, communication, questioning, preparation of Tables and contents were done jointly by both the authors. Data analysis was done jointly by both the authors. Pictures were clicked and arranged by DB. Abstract was written by NB. Writing and final editions were done by both the authors.

Consent of participants

The purpose of the study and importance were explained to the participants in their mother tongue Boro language during the interview. Participants' consent was taken verbally before recording the information or taking pictures.

Consent for publication

Both the authors give their consent to publish this manuscript, if accepted for publication.

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