



# Ethnomedicinal uses of fauna in the Lesser Himalayan Region of Pakistan

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## Research

### Abstract

**Background:** Many wild animal species have been used in medicine worldwide since the origin of human beings, and these folklore medicinal uses are still present. Current survey research was planned to examine wildlife-based folklore medication used by the communities of the Lesser Himalayan region of Pakistan.

**Methods:** Field surveys were conducted from 2017 to 2020 at various sites in the Lesser Himalayan region of Pakistan. Data were collected through conversations with individual respondents and groups of native individuals.

**Results:** The ethnopharmacological applications of 48 species of wild animals were documented. Fat, meat, bones, brain, hair, musk gland, and whole body were utilized as body parts. Out of the total, 18 species were documented for the first time. The house sparrow (*Passer domesticus*) and russet sparrow (*P. cinnamomeus*) were reported as the most frequently utilized species for paralysis, with a frequency count (FC) of 21 from the study area. Among the documented wildlife taxa, the highest use values (UVs) of 1.0 were calculated for *Laudakia agorensis*, *Coturnix coturnix*, *Columba livia*, *C. hodgsonii*, *Upupa epops*, *Passer domesticus*, and *P. cinnamomeus* from the Lesser Himalayan Region of Pakistan.

**Conclusions:** This study is the first to explore the medicinal benefits of wild animals in the study area. Furthermore, the use of 44 animal species has a zero similarity index; these species have no previous similar disease treatment. Our findings offer important baseline data that can be used to conserve and preserve animal biodiversity in the study area.

**Keywords:** Insects, Wildlife, Communities, Lesser Himalayan Region, Folklores

## Background

Fauna and its products have retained significant value for human societies since the origin of humanity (Acharya *et al.*, 2025; Khan *et al.*, 2024a). Humans have been using fauna for different purposes, e.g., food, religion (Bashir and Babar, 2023), magic (Lemhadri *et al.*, 2024), tools, art, entertainment (Delfino, 2024), literature, and especially for medicine (Rasheed and Faiz, 2024). Animal-based folklore medicine is used in every society (Faiz, 2023), and each society has its own mode of preparation and use (Hussain and Altaf, 2023). Therefore, to identify the mandatory affiliation, ethnozoology and ethnopharmacology should be considered important fields (Muvengwi and Maroyi, 2025), and traditional links between fauna and native peoples should be documented (Muhammad *et al.*, 2023a). The use of animals for medicinal purposes is an element of traditional knowledge (Kausar *et al.*, 2025). Wild fauna and its products are not only utilized in ethnopharmacology but are also used as raw resources in the formation of nano-medicines. It is documented that about 9 percent of vital chemicals are derived from wild and domestic fauna (Assefa *et al.*, 2025). Many species of animals have been reported in Traditional Chinese Medicine, and these fauna are utilized to cure different ailments (Song *et al.*, 2024). Approximately 20% of Ayurvedic medicines rely on animal species, and more than 500 invertebrate species are utilized to cure ailments in India (Acharya *et al.*, 2025). It is noted that a large amount of data has been published on ethnobotany; on the other hand, comparatively very little data has been reported on ethnozoology.

Pharmaceutical industries are analyzing many animal-based nano-medicines (Launet, 1993; Liu *et al.*, 2024). A familiar example is the venom of snakes that stops angiotensin-converting enzyme, which causes contraction of blood vessels and enhances blood pressure (BP) (Bisset, 1991; Osipov and Utkin, 2025). Likewise, many chemicals with defensive roles, e.g., alkaloids, biogenic amines, peptides, and steroids, have been noted in the skin of amphibians (Daly, 2003). These chemicals have different pharmacological special effects, such as cardiotoxic, myotoxic, and neurotoxic activities (Clarke, 1997). It is also noted that many insects have chemicals that are important for different modern pharmacological uses, e.g., analgesic, antibacterial (Habib, 2022; Sohail *et al.*, 2025), anti-cancer (Hassan and Bhat, 2022; Umair *et al.*, 2022a), anesthetic, diuretic, anti-rheumatic, and immunological (Yamakawa, 1998). Chitosan, a part of the exoskeleton of insects, is utilized as an anticoagulant, to repair tissues, and to control blood cholesterol levels (Goodman, 1989; Mei *et al.*, 2024).

Because many civilizations are quickly losing ethnomedicinal knowledge (Altaf *et al.*, 2023; Rahman *et al.*, 2022b), it is necessary to collect data regarding animal-based folk medicine (Majeed *et al.*, 2024). Fauna are known as the most essential species utilized in traditional medicine. In several human societies, fauna form the main source of protein and are used in medicine. Pakistan has a rich diversity of fauna (Batool *et al.*, 2025; Batool *et al.*, 2024; Laraib *et al.*, 2024; Mirza and Wasiq, 2007), including more than 665 avian species (Bashir *et al.*, 2025; Grimmett *et al.*, 2008; Mirza, 2012; Mirza and Wasiq, 2007), more than 220 species of herptiles (Khan, 2006; Khan, 2010), and 195 mammalian species (Ahmad *et al.*, 2025; Roberts, 1997). The traditional knowledge of animal-based ethnomedicines in the Lesser Himalaya region of Pakistan is rapidly fading due to modernization, environmental degradation, and inadequate documentation. Local communities utilize various animal species for health-related purposes, yet this valuable indigenous knowledge remains under-researched and poorly represented in scientific literature. To protect this traditional knowledge and ensure the sustainable management of biodiversity resources, it is essential to systematically document and analyze the ethnomedicinal uses of animals in the region. However, the ethnopharmacological utilization of fauna in the lesser Himalayan region of Pakistan has not been previously noted; therefore, this study was planned to investigate the ethnomedicinal uses of fauna by the people of the Lesser Himalayan region of AJK.

## Materials and Methods

### Field sites

An ethnozoological survey was conducted in 2017 and 2020 in rural and urban areas (i.e., Hattian Bala, Sudhan Gali, Birpani, and Bagh city) of the Lesser Himalayan region of AJK (Figure 1).

The Lesser Himalayas are situated north of the Sivalik Hills and south of the Great Himalayas (Figure 2). This range extends from the Indus River in Pakistan to the Brahmaputra Valley in Northeast India, traversing North India, Nepal, and Bhutan (Gani *et al.*, 2023). The average elevation of the sub-range is between 3,700 and 4,500 meters. Drainage systems in the region have evolved with numerous tributaries. In the plains of India, temperatures fluctuate based on elevation. The highest areas experience snowfall in winter, while other regions endure cold temperatures. Some areas do not experience summer at all (Abbasi *et al.*, 2013; Majid *et al.*, 2020).

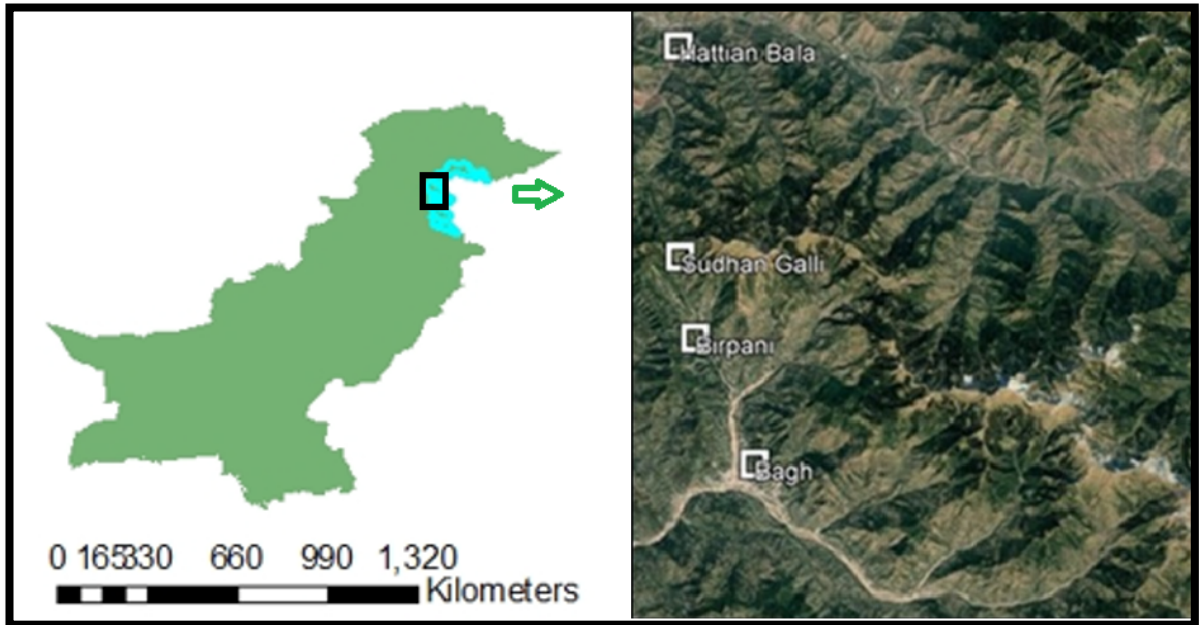


Figure 1. Map of the study area (i.e. Hattian Bala, Sudhan Gali, Birpani and Bagh city).



Figure 2. Landscapes of study area.

#### Data collection and analysis

Before the field survey, consent was obtained from the Department of Zoology, Women University of Azad Jammu and Kashmir, Bagh, Pakistan. Questionnaires and semi-structured interviews were conducted to note the ethnomedicinal uses of fauna. Data were collected from respondents ( $n=100$ ) including farmers, government employees, students, teachers, traditional healers, and shopkeepers (Figure 3). Informants were selected based on their familiarity with traditional therapy involving animals. Fauna species were identified utilizing books and field guides about mammals (Roberts, 2005a; Roberts,

2005b), birds (Roberts, 1991; Roberts, 1992), and herptiles (Khan, 2006). Various indices were used to examine data on ethnopharmacological applications, i.e. frequency of citation, use value, relative importance, similarity index, principal component analysis, and cluster analysis.

**Frequency of citation (FC)**

The number of responders who mentioned ethnopharmacological applications of fauna species is denoted by FC.

**Relative importance (RI)**

RI was calculated by the following formula:

$$RI = PP + AC$$

Where

PP= quantity of pharmacological properties.

AC= number of ailment categories treated by a given species divided by the maximum number of ailment categories treated by the most resourceful species (Oliveira *et al.*, 2010).

**Use-value (UV)**

UV can be calculated by given formula:

$$UV = \sum U / n$$

Where,

n= "the number of citations per species"

U= "the number of informants" (Phillips and Gentry, 1993; Trotter and Logan, 1986).

**Similarity index (SI)**

Similarity index is analyzed utilizing formula:

$$SI = M_s / M_t \quad (0 \leq SI \leq 1)$$

Where  $M_s$  = Similar figure of illness in recent and prior records of a fauna and  $M_t$  = Total figure of illness in present.

**Statistical analysis**

Animal-based ethnopharmacological data were analyzed by using "principal component analysis" and "Cluster Analysis" methods with the assist of "Past statistical software" (version 3) (Hammer *et al.*, 2001).

**Results and Discussion**

**Ethnography**

The survey revealed that all participants were Muslims, with the majority being educated and from rural areas. We gathered most of the data from these rural areas (79%), while the remainder came from urban locations. The informants represented various occupations, including students, shopkeepers, teachers, government employees, and farmers from the study area. A significant portion of the informants (93%) were educated, while the rest were illiterate. Most respondents (n=36) were aged between 51 and 56 years, whereas the youngest participants (n=18) were between 18 and 40 years old (Figure 3).

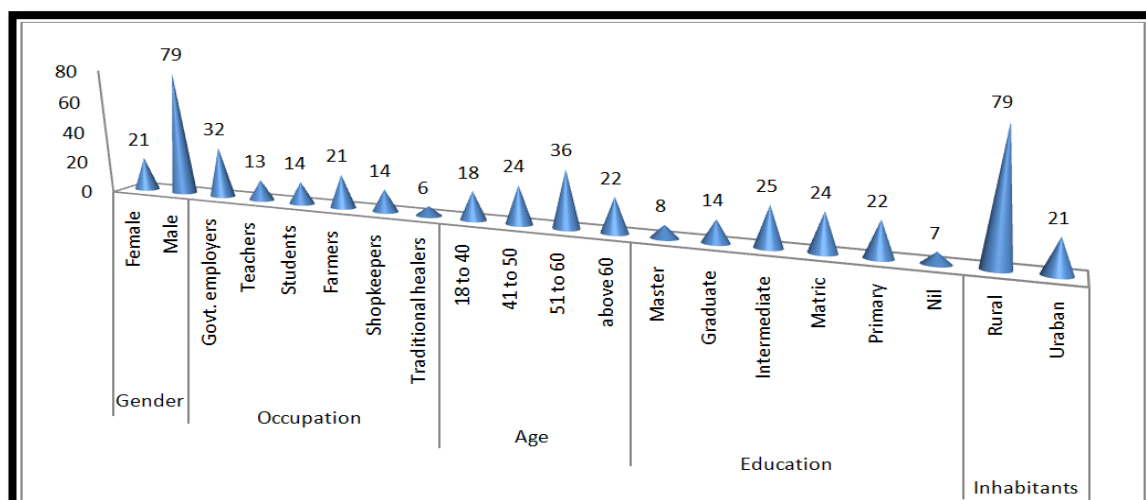


Figure 3: Respondents of study area.

### Ethnomedicinal application of animals

The inhabitants of the study area possess significant knowledge of traditional medicine and utilize fauna to treat different ailments. A total of 48 animal species were used to treat 29 various illnesses, including backbone pain, male impotency, antibacterial, antifungal, antivirus, weakness, fever, kidney stones, snake bites, wound healing, cancer, enhanced memory, protein, heart and liver diseases, Parkinson's disease, joint pain, skin diseases, tongue problems in children, bladder disease, biliousness, boils, chickenpox, heartbeat control, cough, paralysis, diabetes, diarrhea, eye diseases, and reduced inflammation (Figure 4). Nutritional deficiency and inbreeding may contribute to the high prevalence of these illnesses in the Lesser Himalayan region of Pakistan.

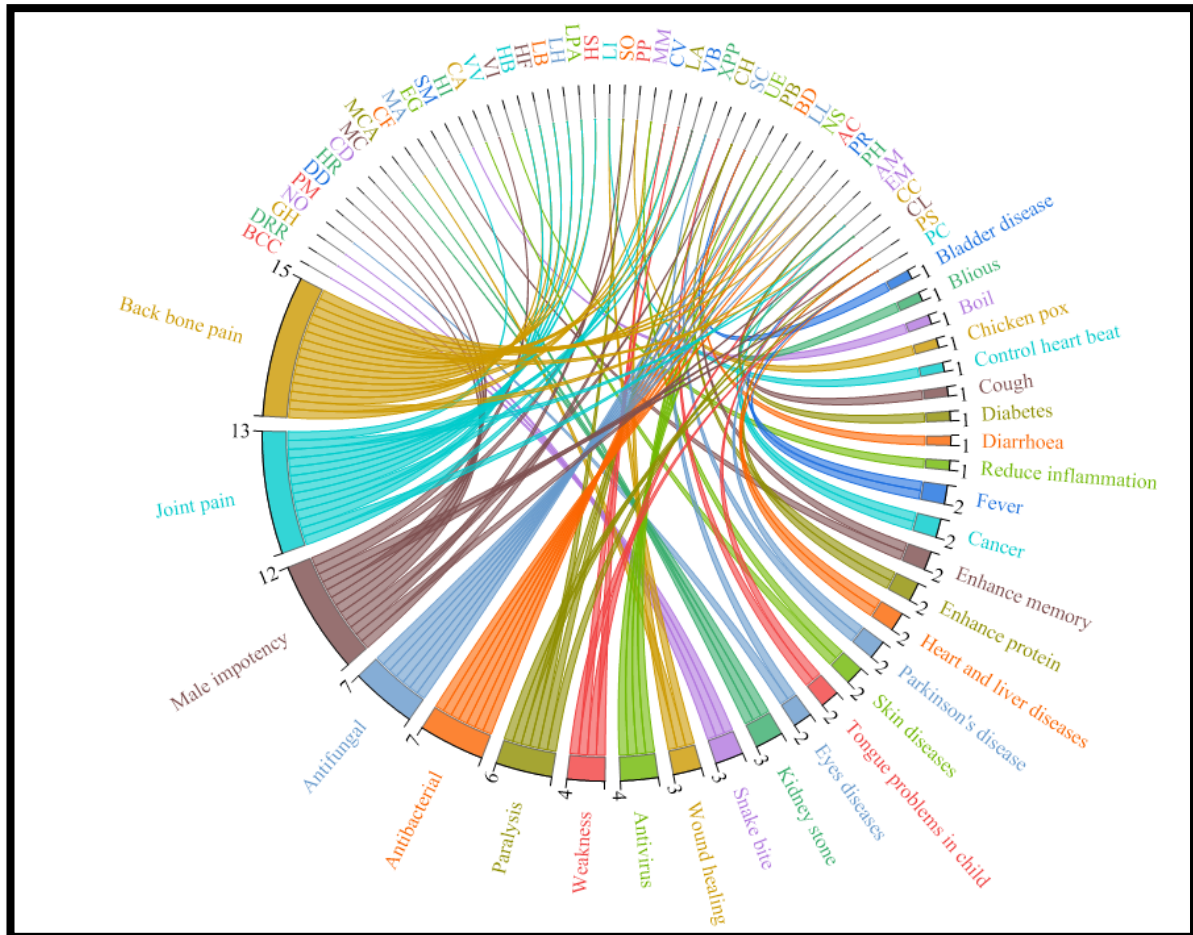


Figure 4. Species of animals used (in Table 1, codes are present) to cure disease in study area for: Skin diseases (SD), Tongue problems in child (TP), Bladder disease (BD), Blious (BS), Boil (BL), Chicken pox (CP), Control heart beat (CHB), Cough (CH), Diabetes (DS), Diarrhoea (DA), Eyes diseases (ED), Back bone pain (BBP), Joint pain (JP), Male impotency (MI), Paralysis (PA), Antibacterial (AB), Antifungal (AF), Antivirus (AV), Weakness (WK), Fever (FE), Kidney stone (KS), Snake bite (SB), Wound healing (WH), Cancer (CN), Enhance memory (EM), Enhance protein (EP), Heart and liver diseases (HLD), Parkinson's disease (PD).

House sparrow, *Russet sparrow*, common pigeon, speckled wood pigeon, common quail, and brown cobra were normally used species in the study area. On the other hand, the people of this region utilize these species (i.e., Indian bullfrog, black cobra, Indian flying fox bat, and foji Khaga) to treat various diseases.

Himalayan pit viper (*Gloydius himalayanus*), Brooke's house gecko (*Hemidactylus brookii*), Himalayan monal (*Lophophorus impejanus*), great tit (*Parus major*), Asian house martin (*Delichon dasypus*), barn swallow (*Hirundo rustica*), red-rumped swallow (*Cecropis daurica*), grey wagtail (*Motacilla cinerea*), citrine wagtail (*Motacilla citreola*), griffon vulture (*Gyps fulvus*), white wagtail (*Motacilla alba*), common peacock (*Papilio bianor*), great windmill (*Byasa dasarada*), common beak (*Libythea lepita*), Pallas sailer (*Neptis sappho*), grey worm (*Aporrectodea caliginosa*), rosy-tipped worm (*Aporrectodea rosea*), and earthworm (*Pheretima hawayana*) were documented in the study area for the first time. These species are used to treat

cancer, male impotence, kidney stones, joint pain, backbone pain, weakness, and as antibacterial, antifungal, and antiviral agents.

**Body part (s) used**

All 48 diseases were treated with 8 different body parts of animal species, namely fat, meat, whole body, skin, bone, brain, hair, and musk gland (Figure 5). Fat was the most utilized body part (n=18), followed by meat, whole body, skin, bone, brain, hair, and musk gland (14, 8, 5, 1, 1, 1, and 1, respectively).

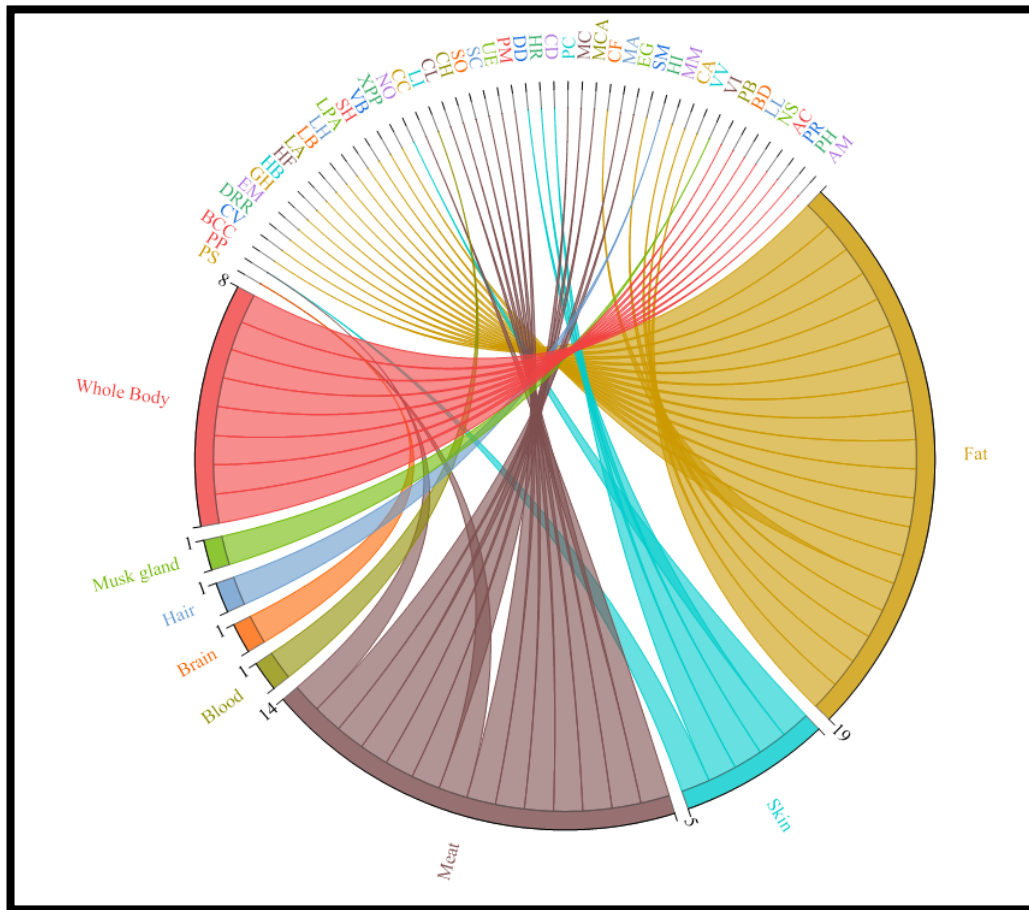


Figure 5. Parts of animal (in Table 1, codes are present) used in the study area.

Local inhabitants of this region use the fat of various taxa such as the common krait (*Spalerosophis diadema*), the Oriental garden lizard (*Calotes versicolor*), Russell's chain viper (*Daboia russelii russelii*), the leopard gecko (*Eublepharis macularius*), the Himalayan pit viper (*Gloydius himalayanus*), Brooke's house gecko (*Hemidactylus brooki*), the yellow-bellied common house gecko (*Hemidactylus flaviviridis*), the agror agama (*Laudakia agorensis*), the Badkhashan rock agama (*Laudakia badakhshana*), the Himalayan agama (*Laudakia himalayana*), the North Pakistan agama (*Laudakia pakistanica auffenbergi*), the Himalayan skink (*Scincella himalayana*), the Bengal monitor (*Varanus bengalensis*), the checkered keelback (*Xenochrophis piscator piscator*), the griffon vulture (*Gyps fulvus*), the house shrew (*Suncus murinus*), the rhesus macaque (*Macaca mulatta*), the Asiatic jackal (*Canis aureus*), and the red fox (*Vulpes vulpes*) to treat snake bites, weakness, backbone pain, joint pain, cancer, male impotency, skin diseases, and wound healing. It is noted that fatty acids (i.e. omega 3 fatty acid, omega 6 fatty acid, and omega 9 fatty acid) in animal fats decrease swelling and cure pain (Ammatussalm, 2022; Wilson, 2015). These uses are also noted in previous documents that fauna fats are valuable to treat atherosclerosis, thrombotic, neurological problems, aging impacts and cancer (Altaf, 2023; Ammatussalm, 2022; Breteler, 2000; Haag, 2003; Umair et al., 2022b).

Likewise, the meat of *Coturnix coturnix*, *Columba livia*, *Columba hodgsonii*, *Streptopelia orientalis*, *Spilopelia chinensis*, *Upupa epops*, *Parus major*, *Passer domesticus*, *Passer cinnamomeus*, *Motacilla citreola*, *Motacilla cinerea*, *Motacilla alba*, and *Egretta garzetta* was used to treat biliousness, paralysis, control heartbeat, back pain, Parkinson's disease, fever, tongue problems in children, enhance protein, diarrhea, bladder disease, enhance memory, male impotency, heart and liver

diseases, kidney stones, and enhance memory. Meat is composed of nitrogenous compounds and different elements (Hui, 2012; Keeton and Eddy, 2004; Muhammad *et al.*, 2023b). Meat composition is diverse because of the effects of ecological and physiological factors (Cheung and Mehta, 2015). Fish, poultry, beef, pork, and lamb are the major sources of meat worldwide. However, in a few countries, especially in arid and semi-arid regions, camel meat is known as the main source of animal protein that equals and, in some cases, surpasses other meats in commercial importance (Abbasi, 2021; Ahrhaley and Leta, 2018; Altaf *et al.*, 2021; Bashir *et al.*, 2023; Faiz *et al.*, 2022; Haidar and Bashir, 2021; Iqbal *et al.*, 2023; Muhammad *et al.*, 2023b; Rahman *et al.*, 2022a; Schönfeldt and Gibson, 2008; Williams, 2007). During the interview, it was noted that the bones of *Lophophorus impejanus* were used to treat wound healing. Bone is composed of water, lipids (Goldberg and Boskey, 1996; Mroue *et al.*, 2016), collagen (Garnero, 2008), minerals (Boskey and Robey, 2013; Robey and Boskey, 2008), and non-collagenous proteins (Boskey and Villarreal-Ramirez, 2016; Ijaz and Iftikhar, 2021b; Mughal *et al.*, 2020; Schäfer *et al.*, 2003). Different ethnobiologists noted that various taxa of animals, i.e., cinereous vulture (*Aegypius monachus*), goat (*Capra aegagrus*), alpine musk deer (*Moschus chrysogaster*), crow (*Corvus* spp.), crab-eating macaque (*Macaca fascicularis*), common carp (*Cyprinus carpio*), pigs (*Sus* spp.), fruit bat (*Pteropus* spp.), deer (*Cervus* spp.), horse (*Equus ferus caballus*), and Indian gagata (*Gagata cenia*) were used for different ailments, such as improving heart strength (Yeshi *et al.*, 2017a), wound healing (Altaf *et al.*, 2018), digestion (Yeshi *et al.*, 2017a), earache (Altaf *et al.*, 2017b; Vijayakumar *et al.*, 2015b), cough (Vijayakumar *et al.*, 2015b), lumbago (Vallejo and González, 2014), skin issues (Bullitta *et al.*, 2018), eye problems (Ghosh *et al.*, 2013), chest pain (Ghosh *et al.*, 2013), neuralgia (Vijayakumar *et al.*, 2015a), and urinary problems (Altaf *et al.*, 2020; Ijaz and Iftikhar, 2021a).

Similarly, the whole body of *Aporrectodea caliginosa*, *Aporactodea rosea*, *Pheretima hawayana*, *Apis mellifera*, *Papilio bianor*, *Byasa dasarada*, *Libythea lepita*, *Neptis sappho* were used to treat bacterial, fungal, viral infections, diabetes, backbone pain, cough, and cancer. Same as *Delichon dasypus*, *Hirundo rustica*, *Cecropis daurica* and *Panthera pardus* were used to cure male impotency, measles and chicken pox. While the brain of *Passer domesticus* was used to treat fever, musk gland of *Viverricula indica* was used to treat reduce inflammation and hair of *Hystrix indica* was utilized to cure boils. This confirms that bones have upto “95%” elastic protein, inorganic minerals and collagen fibers which heal fracture resistance (Hall, 2011).

#### Frequency of citation (FC)

Species of animals reported most frequently for curing various ailments were cited between 1 and 21 times. The house sparrow (*Passer domesticus*) and russet sparrow (*Passer cinnamomeus*) emerged as the most commonly used species for treating paralysis, with a frequency of citation (FC) of 21 from the study area. The brown cobra (*Naja oxiana*) was utilized for eye diseases, while the common quail (*Coturnix coturnix*), common pigeon (*Columba livia*), and speckled wood pigeon (*Columba hodgsonii*) were all employed to treat paralysis, each with an FC of 7. The common leopard (*Panthera pardus*) was also recorded for treating chickenpox, maintaining an FC of 7. Conversely, the lowest FC of 1 was noted for *Scincella himalayana*, *Parus major*, and *Egretta garzetta* (see Table 1 and Figure 6).

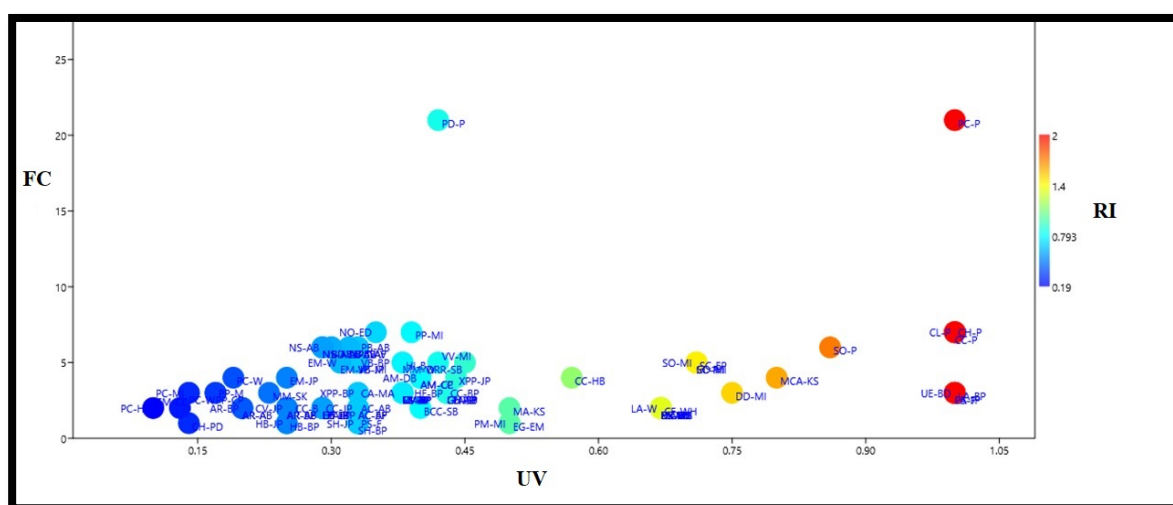


Figure 6. Comparative analysis among FC, UV and RI of animal taxa (in Table 1, codes are present) used in ethnomedicine in study area.

### Relative importance (RI)

The “relative importance” of fauna utilized by the people of the study area is noted. Most of the animal species were found to be highly versatile in their uses, such as LA-BP, LA-JP, CC-P, CL-P, PC-P, UE-BD, and PS-P, with RI = 2 in the Lesser Himalayan Region, followed by SO-P, having RI = 1.71; MCA-KS, having RI = 1.60; DD-MI, having RI = 1.50; and SO-MI, SC-P, SC-EP, and SC-MI (codes are present in Table 1), having RI = 1.43. The maximum relative importance values might indicate high affordability and accessibility of animal taxa in the study area.

### Use value (UV)

The use value results highlight the significance of various fauna species within the population. This index was developed to establish a connection between animal species and their assigned uses by analyzing the index in relation to different use categories. Among the documented animal taxa, the highest Use Values (UVs) of 1.0 were recorded for LA-BP, LA-JP, CC-P, CL-P, CH-P, UE-BD, PS-P, and PC-P (refer to Table 1). Conversely, the lowest UV of 0.10 was observed for PC-HL in the study area (Table 1). The high Use Values of these animal taxa indicate their frequent use in treating various ailments. Additionally, the significant number of respondents utilizing these species, along with the Use Values, suggests that these animal species are well recognized and commonly employed for ethnopharmacological purposes in the region.

### Similarity index (SI)

During the study, it was noted that the highest SI=1 was observed for the yellow-bellied common house gecko (*Hemidactylus flaviviridis*) and the brown cobra (*Naja oxiana*), followed by the agror agama (*Laudakia agrorensis*), which had an SI of 0.67. The Oriental garden Lizard (*Calotes versicolor*) had an SI of 0.5. It was also noted that 44 species, i.e., *Spalerosophis diadema*, *Daboia russelii russelii*, *Eublepharis macularius*, *Gloydus himalayanus*, *Hemidactylus brookii*, *Hemidactylus flaviviridis*, *Laudakia badakhshana*, *Laudakia himalayana*, *Laudakia pakistanica auffenbergi*, *Parus major*, *Scincella himalayana*, *Varanus bengalensis*, *Xenochrophis piscator piscator*, *Coturnix coturnix*, *Lophophorus impejanus*, *Streptopelia orientalis*, *Spilopelia chinensis*, *Upupa epops*, *Hirundo rustica*, *Delichon dasypus*, *Cecropis daurica*, *Motacilla cinerea*, *M. citreola*, *M. alba*, *Gyps fulvus*, *Egretta garzetta*, *Panthera pardus*, *Suncus murinus*, *Vulpes vulpes*, *Hystrix indica*, *Canis aureus*, *Macaca mulatta*, *Viverricula indica*, *Papilio bianor*, *Byasa dasarada*, *Libythea lepita*, *Neptis sappho*, *Aporrectodea caliginosa*, *Aporactodea rosea* and *Pheretima hawayana* have zero SI.

### Principal component analysis (PCA) and Cluster Analysis (CA)

Statistical analysis with the help of PCA revealed that the first two axes account for 99.9994% of the variation, with PC 1 and PC 2 having variability of 97.216% and 2.7834%, respectively. Data loaded onto Principal component 1 include: FC ( $r = 0.99904$ ), UV ( $r = 0.019453$ ), and RI ( $r = 0.039163$ ); while data loaded onto Principal component 2 include: FC ( $r = -0.04373$ ), UV ( $r = 0.44708$ ), and RI ( $r = 0.89342$ ) (Figures 7 and 8). All components are not correlated with each other, as documented in the Lesser Himalayan region of AJK. The findings are consistent with previously documented research (Altaf, 2016).

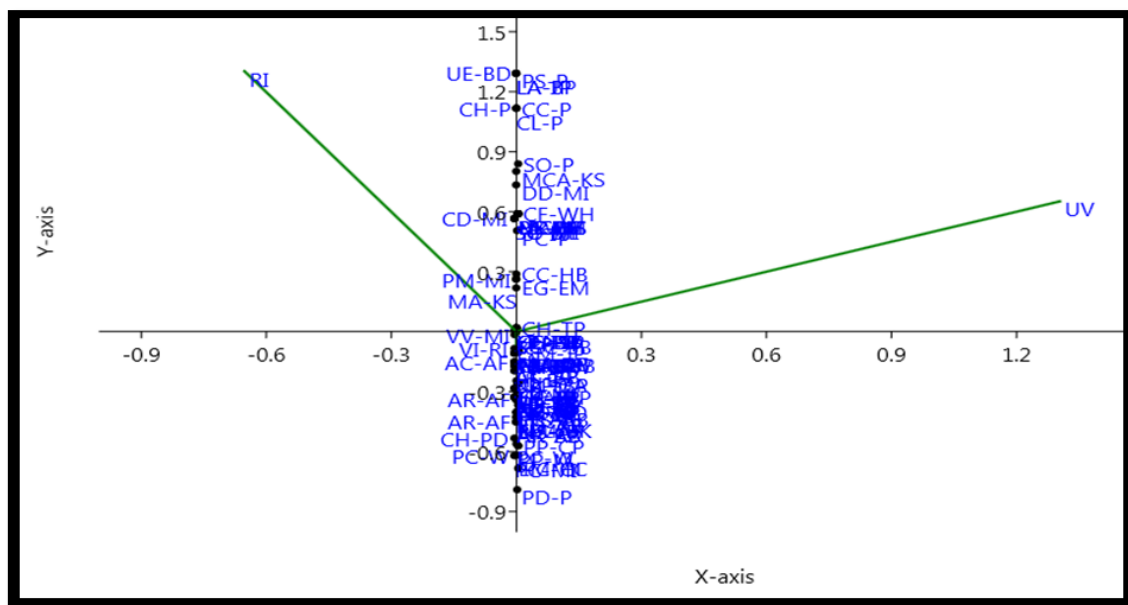


Figure 7. Principal Component Analysis (PCA) showing the correlation among FC, UV and RI of animal species (in Table 1, codes are present) used in ethnomedicine in study area.

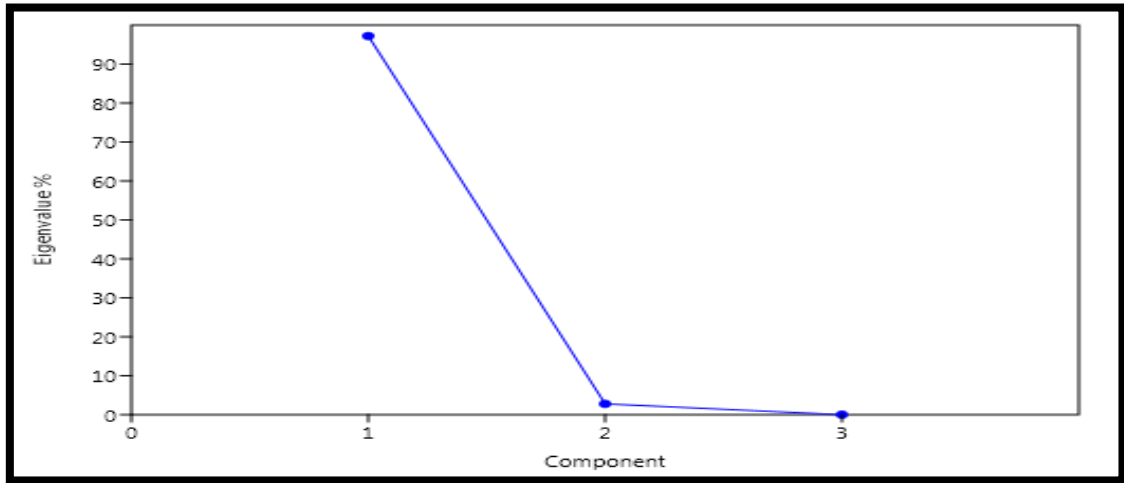


Figure 8. Component of PCA.

The statistical analysis shows that in the cluster analysis of the study area; two groups are documented: G1 (Group One) and G2 (Group Two). G1 and G2 have a distance of 17 points. G2 has species with diseases such as PC-P and PD-P (codes are present in Table 1); this group has the highest number of informants compared to the other group. G1 has two subgroups, namely Subgroup One (G1a) and Subgroup Two (G1b), which have a distance of one point. G1a is further divided into two groups: G1a-I and G1a-II; G1b is also divided into two groups: G1b-I and G1b-II (distance = 0.5 points). G1b-I has species with diseases HB-BP, HB-JP, SH-BP, SH-JP, CH-DP, PM-MI, PS-F, EG-EM, LA-W, LH-BP, LH-JP, LPA-BP, CC-B, CC-JP, LI-WH, BCC-SB, CV-JP, EM-CC, HF-JP, AR-AB, AR-AF, UE-D, UD-EM, HR-MI, PS-HI, PS-MI, PC-HL, MC-KS, CF-HW, MA-KS, AC-BP, AC-AB, AC-AF, AR-BP, AR-AB, AR-AF, and AR-BP, and this group has the lowest number of informants (Figure 9). The findings resemble those of the reported study (Altaf, 2016).

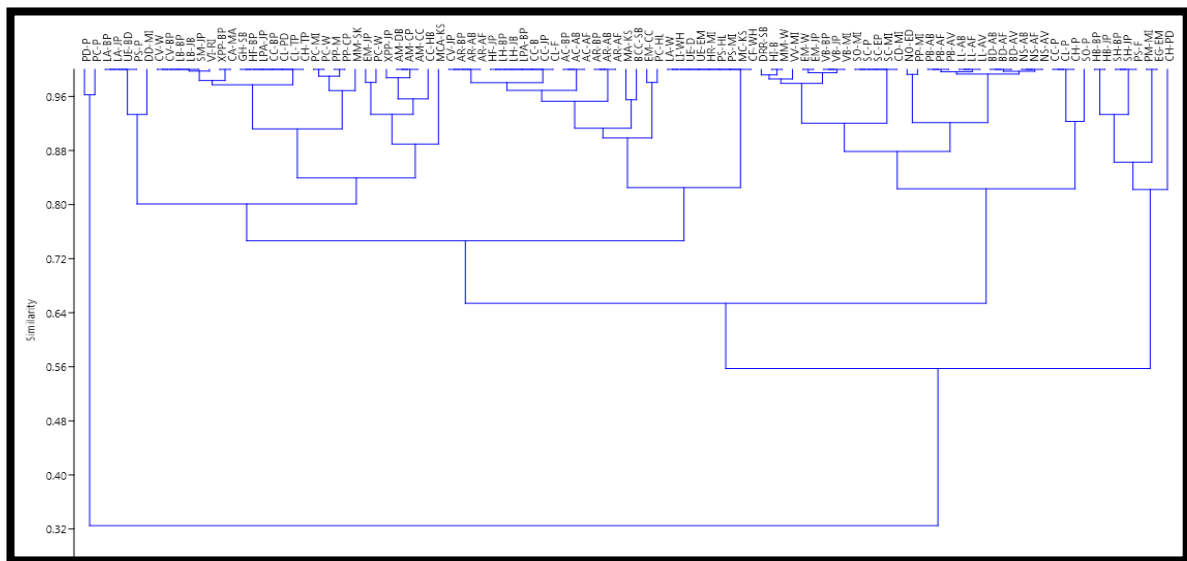


Figure 9. Cluster Analysis of species of animals (in Table 1, codes are present) used in the study area.

Zoonotic illnesses are illnesses caused by infected organisms (such as viruses, bacteria, prions, or parasites) that have mutated from animals to humans. Contagious illnesses are becoming a serious public health problem, affecting the entire globe (Ali *et al.*, 2020). Diverse pathogens have different sources of transformation (Kruse *et al.*, 2004; Van Vliet *et al.*, 2017). The likelihood of transmission of infection from fish fauna to humans is quite low. Humans are sensitive to the skin of amphibians (Altaf *et al.*, 2020). *Macaca mulatta* poses possible zoonotic risks to humans, including the potential transmission of viral diseases such as the herpes B virus, as well as other simian-type viruses. Additionally, handling and close contact with this species may increase the risk of tuberculosis transmission, which is a significant public health concern (Viridana *et al.*, 2024).

Humans are negatively impacting nature and natural resources in different ways, such as deforestation (Agravat *et al.*, 2025; Komla *et al.*, 2025), urbanization (Kaior *et al.*, 2025; Nisar *et al.*, 2025), agricultural intensification (Khan *et al.*, 2024b; Khan *et al.*, 2022), and the direct use of animals (Albuquerque and de Sousa, 2016; Kaior *et al.*, 2025; Nisar *et al.*, 2025; Safi *et al.*, 2025; Sayyad *et al.*, 2026). Therefore, ethnozoological study is important (Rasheed and Faiz, 2024), and it is reported that the utilization of fauna in folklore medicine by societies is not the only risk to fauna in any part of the Earth; factors like climate and habitat also play an important role in the conservation of animal diversity (Alves, 2012; Alves *et al.*, 2018; Rasheed *et al.*, 2024). There is a need to work on a solution to address the current crisis of fauna and flora loss (Boivin *et al.*, 2016), and ethnozoology is important for conveying knowledge about conservation (Dickman, 2010; Saunders, 2003).

### Conservation of fauna

The leopard (*Panthera pardus*) was most recently assessed for The IUCN Red List of Threatened Species in 2023 and is listed as Vulnerable under criteria A2cd. In 2015, the *Macaca mulatta* was last evaluated for inclusion on the IUCN Red List of Threatened Species. The classification for *Macaca mulatta* is "Least Concern." CITES Appendix II contains a list of this species. Additionally, it is protected, along with all other primates, under the Nepalese National Parks and Wildlife Conservation Act of 1973, Schedule III of the Bangladesh Wildlife (Preservation) (Amendment) Act of 1974, Schedule I, Part I of the Indian Wildlife (Protection) Act (as amended until 2002), and Category II of the Chinese Wildlife Protection Act of 1989. The distribution of the species differs greatly in terms of protection status. In Azad Jammu and Kashmir (AJK), the conservation of these species have become a significant concern due to factors such as habitat loss, forest clearance, poaching, and rising human-wildlife conflict.

### Conclusion

The folklore animal-based medicinal notions of communities in the Lesser Himalayan area indicate that people have a strong link with ecology. For the first time, the medicinal benefits of animals in AJK's Lesser Himalayan area have been investigated. Furthermore, the use of 44 animal species has a zero similarity index; these species have no previous similar disease treatment. Our findings provide baseline data that may be useful in the conservation and protection of animal species in the Lesser Himalayan area of AJK. Screening of medicinal active compounds, as well as in vivo or in vitro examinations of the biological activities of fauna with the highest FC, UV, RI, and SI, may be significant for novel medications based on animals.

### Limitations of the study

The following limitations exist in this study: first, the geographically small area should be expanded to a larger scale to collect maximum ethnomedicinal knowledge; second, the number of respondents is limited (n=100); more participants would provide more accurate knowledge; and third, this study mainly focuses on ethnomedicinal uses, so further studies should also include cultural uses of fauna, which would be useful for the conservation of fauna.

### Recommendations

- The following suggestions are provided for the conservation of fauna:
- Awareness of wildlife conservation and zoonotic concerns in the study area.
- Enforcing wildlife conservation rules and policies in the study area.
- Promotion of sustainable use and conservation of wildlife in the study area.
- Documenting ethnomedicinal knowledge in the study.

### Declarations

**Ethics statement:** All participants provided oral prior informed consent.

**Conflicts of interest:** All authors declared that they have no competing interests in the manuscript

**Consent for publication:** Not applicable

**Competing Interest:** The authors declare no conflicts of interest between them.

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**Author's contributions :** MA designed and supervised the study; RH and MF assisted with the field survey and data collecting; MA assisted with statistical analysis; and AMA assisted with data analysis, interpolation, and the final write-up.

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Table 1. Ethnomedicinal uses of Wild animals in lesser Himalayan.

Common name	PU=MA	Medicinal uses	Code	FC	UV	RI	Reported data	References	SI
<i>Bungarus caeruleus caeruleus</i> Schneider, 1801 Common krait Kala sup	F=T	Snake bite	BCC-SB	2	0.40	0.80	Anti-venom	(Arshad <i>et al.</i> , 2014)	0
<i>Calotes versicolor</i> Daudin, 1802 Oriental Garden Lizard Girgit	F=T	Weakness	CV-W	3	0.38	0.75	Visual, joint pain, blood	(Aloufi and Eid, 2016; Dixit <i>et al.</i> , 2010; Vijayakumar <i>et al.</i> , 2015)	0.5
		Backbone pain	CV-BP	3	0.38	0.75			
		Joint pain	CV-JP	2	0.25	0.50			
<i>Daboia russelii russelii</i> Shaw and Nodder, 1797 Russell's chain viper Sap	F=T	Snake bite	DRR-SB	5	0.42	0.83	Eyesight, urination, stool, flatus, anti-venom	(Aloufi and Eid, 2016; Arshad <i>et al.</i> , 2014; Benarjee <i>et al.</i> , 2010)	0
<i>Eublepharis macularius</i> Börner, 1981 Leopard gecko Panj gira Sandaila	F=T	Weakness	EM-W	5	0.31	0.63			0
		Backbone pain	EM-BP	5	0.31	0.63			
		Joint pain	EM-JP	4	0.25	0.50			
		Cancer	EM-CC	2	0.13	0.25			
<i>Gloydus himalayanus</i> Giinther, 1864 Himalayan pit viper Himalayan sup	F=T	Snake bite	GH-SB	3	0.43	0.86			0
<i>Hemidactylus Brookii</i> Gray, 1845 Brooke's house gecko Barani sandaila	F=T	Backbone pain	HB-BP	1	0.25	0.50			0
		Joint pain	HB-JP	1	0.25	0.50			
<i>Hemidactylus flaviviridis</i> Ruppell, 1835 Yellow belly common house gecko Gharailo sandaila	F=T	Backbone pain	HF-BP	3	0.43	0.86	Pain, vitiligo	(Aloufi and Eid, 2016)	1
		Joint pain	HF-JP	2	0.29	0.57			
<i>Laudakia agrorensis</i> Stoliczka, 1872 Agror agama Sandaila	F=T	Weakness	LA-W	2	0.67	1.33	Cough, fever, jaundice, burn, joint pain, skin disease, arthritis, malaria, sexual stimulant	(Altaf <i>et al.</i> , 2018; Bagde and Jain, 2015; Benarjee <i>et al.</i> , 2010; Borah and Prasad, 2017; Chakravorty <i>et</i>	0.67
		Backbone pain	LA-BP	3	1.00	2.00			
		Joint pain	LA-JP	3	1.00	2.00			

								<i>al.</i> , 2011; Lalmuanpuii <i>et al.</i> , 2013; Padmanabhan and Sujana, 2008)	
<i>Laudakia badakhshana</i> Anderson and Leviton, 1969 Badkhashan rock agma Sandaila	F=T	Backbone pain	LB-BP	3	0.38	0.75			0
		Joint pain	LB-JB	3	0.38	0.75			
<i>Laudakia himalayana</i> Steindachner, 1869 Himalayan agma Rat Sandaila	F=T	Backbone pain	LH-BP	2	0.29	0.57			0
		Joint pain	LH-JB	2	0.29	0.57			
<i>Laudakia pakistanica auffenbergi</i> Baig and Bohme, 1996 North-Pakistan Agma Karbara	F=T	Backbone pain	LPA-BP	2	0.29	0.57	Healing, wounds	(Yeshi <i>et al.</i> , 2017)	0
		Joint pain	LPA-JP	3	0.43	0.86			
<i>Scincella himalayana</i> Gunther, 1864 Himalayan skink Kirkila	F=T	Backbone pain	SH-BP	1	0.33	0.67			0
		Joint pain	SH-JP	1	0.33	0.67			
<i>Varanus bengalensis</i> Daudin, 1802 Bengal monitor Kehs karow	F=T	Backbone pain	VB-BP	5	0.33	0.67	Malaria, jaundice, piles, arthritis, erectile dysfunction, muscular pain, fungal infection, virility	((Benarjee <i>et al.</i> , 2010; Chinlapianga <i>et al.</i> , 2013; Dixit <i>et al.</i> , 2010; Padmanabhan and Sujana, 2008)	0
		Joint pain	VB-JP	5	0.33	0.67			
		Male impotency	VB-MI	5	0.33	0.67			
<i>Xenochrophis piscator piscator</i> Schneider, 1802 Chekered keelback Chitra sup	F=T	Backbone pain	XPP-BP	3	0.33	0.67			0
		Joint pain	XPP-JP	4	0.44	0.89			
<i>Naja Oxiana</i> Eichwald, 1837 Brown cobra Chajla sup	S=T	Eyes diseases	NO-ED	7	0.35	0.70	Visual illnesses	(Ajagun <i>et al.</i> , 2017; Aloufi and Eid, 2016)	1
<i>Coturnix Coturnix</i> (Linnaeus, 1758	M/O	Blious	CC-B	2	0.29	0.57	Skin diseases, anemia, body weakness, enhance	(Altaf <i>et al.</i> , 2017; Lohani, 2011;	0
		Control heart beat	CC-HB	4	0.57	1.14			

Common quail Batair		Paralysis	CC-P	7	1.00	2.00	memory, sexual power, fever	Vijayakumar et al., 2015)	
		Joint pain	CC-JP	2	0.29	0.57			
		Back bone pain	CC-BP	3	0.43	0.86			
<i>Lophophorus impejanus</i> (Latham, 1790) Himalayan Monal Murgh	B/T	Wound healing	LI-WH	2	0.67	1.33			0
<i>Columba livia</i> (Gmelin, 1789) Common Pigeon Jungli Kabotar	M/O	Parkinson's disease	CL-PD	3	0.43	0.86	Menorrhagia, Bronchitis, puberty in young girls, epilepsy, anemia, infertility, Menorrhagia, abscess, wound healing	(Alonso-Castro <i>et al.</i> , 2011; Altaf et al., 2017; Arshad et al., 2014; Bagde and Jain, 2013; Benarjee et al., 2010; Chakravorty et al., 2011; Jacobo-Salcedo <i>et al.</i> , 2011; Jaroli <i>et al.</i> , 2010; Mootosamy and Mahomoodally, 2014; Mughal et al., 2020; Paudyal and Singh, 2014; Vijayakumar et al., 2015)	0
		Fever	CL-F	2	0.29	0.57			
		Paralysis	CL-P	7	1.00	2.00			
		Tongue problems in child	CL-TP	3	0.43	0.86			
<i>Columba hodgsonii</i> (Vigors, 1832) Speckled Wood Pigeon Kabootar	M/O	Parkinson's disease	CH-PD	1	0.14	0.29	Menorrhagia, Bronchitis, puberty in young girls, epilepsy, anemia, infertility	(Chakravorty et al., 2011; Vijayakumar et al., 2015)	0
		Paralysis	CH-P	7	1.00	2.00			
		Tongue problems in child	CH-TP	3	0.43	0.86			
<i>Streptopelia orientalis</i> (Latham, 1790) Oriental Turtle Dove Fakhta	M/O	Paralysis	SO-P	6	0.86	1.71	Maturity in girls, sexual tonic	(Aloufi and Eid, 2016; Altaf et al., 2017)	0
		Male impotency	SO-MI	5	0.71	1.43			
<i>Spilopelia chinensis</i> (Scopoli, 1786) Spotted Dove Fakhta	M/O	Paralysis	SC-P	5	0.71	1.43	Maturity in girls, sexual tonic	(Aloufi and Eid, 2016; Altaf et al., 2017)	0
		Enhance protein	SC-EP	5	0.71	1.43			
		Male impotency	SC-MI	5	0.71	1.43			
<i>Upupa epops</i> (Linnaeus, 1758)	M/O	Diarrhoea	UE-D	2	0.67	1.33	Gall bladder stone, kidney problems	(Altaf et al., 2017; Betlu, 2013)	0
		Bladder disease	UE-BD	3	1.00	2.00			

Common Hoopoe		Enhance memory	UE-EM	2	0.67	1.33			
<i>Parus major</i> (Linnaeus, 1758) Great Tit Tit	M/O	Male impotency	PM-MI	1	0.50	1.00			0
<i>Delichon dasypus</i> (Bonaparte, 1850) Asian House Martin Mandoli	S/T	Male impotency	DD-MI	3	0.75	1.50			0
<i>Hirundo rustica</i> (Linnaeus, 1758) Barn Swallow Mandoli	S/T	Male impotency	HR-MI	2	0.67	1.33			0
<i>Cecropis daurica</i> (Linnaeus, 1771) Red-Rumped Swallow Mandoli	S/T	Male impotency	CD-MI	5	0.71	1.43			0
<i>Passer domesticus</i> (Linnaeus, 1758) House Sparrow Chiri	M/O	Paralysis	PD-P	21	0.42	0.84	Increase sexual desire, aphrodisiac, allergy, paralysis, impotency, gas trouble, constipation, Chickenpox, weakness, fever, delay dentition (child)	(Aloufi and Eid, 2016; Altaf et al., 2017; Arshad et al., 2014; Bagde and Jain, 2015; Betlu, 2013; Lohani, 2011; Vijayakumar et al., 2015)	0
		Heart and liver diseases	PS-HL	2	0.67	1.33			
		Enhance protein	PS-P	3	1.00	2.00			
		Male impotency	PS-MI	2	0.67	1.33			
	BR/ O	Fever	PS-F	1	0.33	0.67			
<i>Passer cinnamomeus</i> (Tesmmnck, 1836) Russet Sparrow Jungli Chiri	M/O	Paralysis	PC-P	21	1.00	2.00	Power	(Kiran Rauf and Iftikhar, 2017)	0
		Heart and liver diseases	PC-HL	2	0.10	0.19			
		Weakness	PC-W	4	0.19	0.38			
		Male impotency	PC-MI	3	0.14	0.29			
		Fever	PC-W	3	0.14	0.29			
<i>Motacilla citreola</i> (Pallas, 1776) Citrine wagtail Wagtail Chiri	M/O	Kidney stone	MC-KS	2	0.67	1.33			0
<i>Motacilla cinerea</i>	M/O	Kidney stone	MCA-KS	4	0.80	1.60			0

(Tunstall, 1771) Grey wagtail Wagtail Chiri									
<i>Gyps fulvus</i> (Hablizl, 1783) Griffon Vulture Gidh	F/T	Wound healing	CF-WH	2	0.67	1.33			0
<i>Motacilla alba</i> (Linnaeus, 1758) White wagtail	M/O	Kidney stone	MA-KS	2	0.50	1.00			0
<i>Egretta garzetta</i> (Linnaeus, 1766) Little egret Safaid wagtail Chiri	M/O	Enhance memory	EG-EM	1	0.50	1.00	Immune enhancer, body strength, breathing trouble Asthma	(Vijayakumar <i>et al.</i> , 2015a)	0
<i>Panthera pardus</i> Linnaeus, 1758 Common Leopard Cheetah/tanduwa	S, M/T	Measles	PP-M	3	0.17	0.33	Rheumatism	(Nijman and Shepherd, 2017)	0
		Chicken pox	PP-CP	3	0.17	0.33			
		Male impotency	PP-MI	7	0.39	0.78			
<i>Suncus murinus</i> Linnaeus, 1758 House Shrew Choa	F/T	Joint pain	SM-JP	3	0.38	0.75			0
<i>Hystrix indica</i> Kerr, 179 Indian Crested Porcupine, Say	H/T	Boil	HI-B	5	0.38	0.77	Skin infection, rheumatic pain, colic, boiled, stomach-ache, foot mouth disease, easy delivery of a child, pre menstrual pain, weakness and muscle fatigue, asthma	(Aloufi and Eid, 2016; Altaf <i>et al.</i> , 2017; Altaf <i>et al.</i> , 2018; Bagde and Jain, 2013; Betlu, 2013; Borah and Prasad, 2017; Galave <i>et al.</i> , 2013; Lohani, 2010; Lohani, 2011; Mishra <i>et al.</i> , 2011)	0
<i>Macaca mulatta</i> Zimmermann, 1780 Rhesus Macaque Bndar/Bojo	F/T	Wound healing	MM-W	5	0.38	0.77	Weakness and asthma	(Padmanabhan and Sujana, 2008)	0
		Skin diseases	MM-SK	3	0.23	0.46			

<i>Canis aureus</i> Linnaeus, 1758 Asiatic jackal Gedar	F/T	Skin diseases	CA-MA	3	0.33	0.67	Rheumatic pain, body ache	(Altaf et al., 2017; Altaf et al., 2018; Benarjee et al., 2010; Betlu, 2013; Chakravorty et al., 2011; Chinlapianga et al., 2013; Lohani, 2011; Lohani, 2011; Paudyal and Singh, 2014; Vijayakumar et al., 2015)	0
<i>Vulpes vulpes</i> Linnaeus, 1758 Red fox Phand	F/T	Male impotency	VV-MI	5	0.45	0.91	Heals pus in lungs and ear diseases	(Lev, 2003; Yeshi et al., 2017)	0
<i>Viverricula indica</i> Geoffroy Saint-Hilaire, 1803 Small Indian civet Mushk billa	MG/T	Reduce inflammation	VI-RI	3	0.38	0.77	Antidotal, anti-inflame, pain reduction, epilepsy, Acne	(Altaf, 2017; Alves and Rosa, 2013; Chellappandian et al., 2014; Nijman and Shepherd, 2017; VPE, 2020)	0
<i>Papilio bianor</i> Cramer, 1777 Common peacock Titli	WB/T	Antibacterial	PB-AB	6	0.33	0.67			0
		Antifungal	PB-AF	6	0.33	0.67			
		Antivirus	PB-AV	6	0.33	0.67			
<i>Byasa dasarada</i> Moore, 1857 Great windmill Titli	WB/T	Antibacterial	BD-AB	6	0.30	0.60			0
		Antifungal	BD-AF	6	0.30	0.60			
		Antivirus	BD-AV	6	0.30	0.60			
<i>Libythea lepita</i> Moore, 1857 Common beak Titli	WB/T	Antibacterial	LL-AB	6	0.32	0.63			0
		Antifungal	LL-AF	6	0.32	0.63			
		Antivirus	LL-AV	6	0.32	0.63			
<i>Neptis sappho</i> Pallas, 1771 Pallas sailer	WB/T	Antibacterial	NS-AB	6	0.29	0.57			0
		Antifungal	NS-AF	6	0.29	0.57			
		Antivirus	NS-AV	6	0.29	0.57			

Titli									
<i>Aporrectodea caliginosa</i> Savigny, 1826 Grey worm	WB/T	Backbone Pain	AC-BP	2	0.33	0.67			0
		Antibacterial	AC-AB	2	0.33	0.67			
		Antifungal	AC-AF	2	0.33	0.67			
<i>Aporactodea rosea</i> Savigny, 1826 Rosy-tipped worm	WB/T	Backbone Pain	AR-BP	2	0.20	0.40			0
		Antibacterial	AR-AB	2	0.20	0.40			
		Antifungal	AR-AF	2	0.20	0.40			
<i>Pheretima hawayana</i> Rosa, 1891 Earthworm	WB/T	Backbone Pain	AR-BP	2	0.25	0.50			0
		Antibacterial	AR-AB	2	0.25	0.50			
		Antifungal	AR-AF	2	0.25	0.50			
<i>Apis mellifera</i> Linnaeus, 1758 European honey bee Shahd Makhi	WB/T	Diabetes	AM-DB	4	0.40	0.80	Eye disease, expectorant, cold, body ache, gastritis, snakebite, erupting of teeth in child, Migrain, stomach, spleen, dark spots, skin, diarrhea, allergy, burn, wounds in mouth, influenza, toothache, diabetes mellitus, hypertension, athero-sclerosis, and Alzheimer's disease.	(Altaf <i>et al.</i> , 2018; Barros <i>et al.</i> , 2012; Benítez, 2011; Betlloch Mas <i>et al.</i> , 2014; Erejuwa <i>et al.</i> , 2012; Haileselesie, 2012; Jaroli <i>et al.</i> , 2010; Lev, 2003; Lohani, 2011b; Mahawar and Jaroli, 2006; Mootoosamy and Mahomoodally, 2014; Oliveira <i>et al.</i> , 2010; Padmanabhan and Sujana, 2008; Vijayakumar <i>et al.</i> , 2015b; Waykar and Alqadhi, 2016; Yeshe <i>et al.</i> , 2017; Yirga <i>et al.</i> , 2011)	0
		Cough	AM-CP	4	0.40	0.80			
		Cancer	AM-CC	4	0.40	0.80			

**Note:** PU (parts use), MA (mode of application), F (fat), M (meat), S (skin), B (blood), BR (brain), WB (whole body), O (oral), T (topical), MG (musk gland), H (hair), SI (Similarity Index)