

Ethnoveterinary medicine on preserving traditional knowledge for animal health in the Chumoukedima District of Nagaland in India

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Abstract. Kichu T, Jamir T, Imlinungla. 2025. *Ethnoveterinary medicine on preserving traditional knowledge for animal health in the Chumoukedima District of Nagaland in India. Asian J Ethnobiol 8: 40-48.* Animals have always been integral to human life, serving various purposes from companions to agriculture and livelihood. Indigenous knowledge and traditional plant-based healing practices remain vital for maintaining animal health offering natural and old-age remedies passed down through generations. The present study aims to document ethnoveterinary medicinal plants and practices in the Chumoukedima District of Nagaland, India using semi-structured interviews. A total of 50 plants belonging to 48 genera and 35 families were recorded, with Asteraceae being the most frequently reported family (5 species, 10%). Leaves (50%) were the most utilized plant part, favored for their abundance, ease of collection and sustainability. Herbs with 42% were the most favored growth form, while paste with 30.36% was the preferred preparation method. Medicinal remedies were used to treat a variety of animals, with pigs (39.7%) being the most frequently treated. Among the health issues addressed, injuries (21.7%) were the most commonly reported, followed by skin problems and dysentery (17.4%). The primary route of medicine administration was internal, with remedies either given in raw form or combined with other plants and fodder. This study will safeguard indigenous knowledge and could contribute to the development of effective plant-based remedies to address various livestock diseases and health issues.

Keywords: Asteraceae, diseases and health issues, indigenous knowledge, livestock, plants

INTRODUCTION

Livestock production provides food security and reduces poverty along with support for many cultural rituals (Wendimu et al. 2024). It also serves as a source of employment, manure and draft power for farming and goods transportation in most developing countries (Eiki et al. 2022). Animals may be at risk of exposure to various diseases, with the potential for economic disruption, which may be severe, and for more widespread consequences if disease cannot be well managed, the impact can extend further, potentially affecting other animals and the surrounding environment. Since ancient times, animal keepers have closely observed their animals, gaining valuable knowledge about various illnesses, their causes and management. The utilization of such indigenous knowledge and traditional beliefs in protecting animal health and treating various animal ailments or diseases is known as Ethnoveterinary Medicine (EVM). The use of diagnostic procedures, animal husbandry practices and surgical methods are also included in EVM (Oda et al. 2024).

EVM is extensively used as a primary source of medicine to treat livestock diseases in rural regions of developing countries (Asfaw et al. 2022). Developed by farmers in fields and barns rather than by scientists in laboratories and clinics, EVM offers more affordable, locally sourced, and easily accessible alternatives to western drugs (Verma 2014). Plants being rich in diverse phytochemicals are promising candidates for developing medicines and other active products essential for managing

health issues in livestock. Medicinal plants are being widely used by farmers and pastoralists belonging to different ethnic communities of different states in India in the management of livestock health (Kalita et al. 2024). EVM has been practiced in India since ancient times, with texts like the Atharvaveda and other scriptures, documenting the use of medicinal plants for treating animal diseases (Sikarwar and Tiwari 2020). Despite their role in the primary healthcare of animals, ethnoveterinary practices are declining because of habitat loss of plants from environmental degradation and overexploitation of medicinal plants, coupled with the reliance on oral transmission of knowledge instead of in recorded forms, which accelerates their decline in the absence of proper documentation and analysis (Asfaw et al. 2022).

North East India is often regarded as the geographic gateway for the majority of India's flora and fauna owing to its highly dynamic ecosystems and a relatively complex biogeography (Jain and Das 2022). It comprises Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim falling under the category of Himalayan and Indo-Myanmar biodiversity hotspots. Nagaland is a small state with varied climatic conditions that greatly influence its flora and fauna diversity. It is also home to various tribes, each with its unique cuisines, traditional attires and rich folklore. There are variations in plant usage among the tribes which highlight the depth and richness of their traditional knowledge. These communities have been relying on traditional medicines not only for their health but also for treating their livestock. Despite the fact that many households in the region raise animals, whether as

pets or for economic purposes such as livestock farming or poultry, the survey and documentation of EVM remain a largely neglected area of research in Nagaland.

Furthermore, the traditional knowledge of EVM in the state is rapidly fading, mainly due to modernization and the growing dominance of synthetic drugs. This calls for an urgent need to document the EVM practices of the Naga people before they are lost forever. Recognizing the importance of traditional knowledge in the healthcare of animals, the potential benefits of documenting these practices and the rapid decline in EVM practices in the state, this study was conducted to document the ethnoveterinary knowledge on plants and information on the preparation of remedies in the Chumoukedima District of Nagaland for treating livestock diseases and ailments.

MATERIALS AND METHODS

Study area

The Chumoukedima is a new district of Nagaland in India that was created on 18th December, 2021. It is situated at 23°3'N latitude and 93°30'30''E longitude, with an elevation of approximately 2000 meters above sea level. The district covers an area of approximately 6,110 square kilometers, including 81 villages and a population of 166,911 (<https://chumoukedima.nic.in/demography/>).

Fieldwork and data collection

The study on ethnoveterinary medicinal plants was conducted in the Chumoukedima District of Nagaland between September 2023 and April 2024. The study involved interviews with 11 participants (six males and five females) aged between 20 and 75 using a semi-structured questionnaire. The interviews were conducted at the informants homes or farms and were complemented by open discussions. Before data collection, each participant was provided with a consent form and verbal informed consent was obtained to ensure ethical compliance. Information such as the local name of plants, parts used, mode of preparation and dosage given, disease treated and duration of the treatment were recorded. The collected medicinal plants were identified using available literature and online sources (Hajra et al. 1995; Deorani and Sharma 2007; Changkija 2014; Changkija and Gurung 2017; WFO 2025). Herbarium was prepared and voucher specimens of the collected plants were deposited in the Department of Botany at St. Joseph University, Nagaland, India.

Data analysis

Microsoft Office Excel 2016 was used to calculate the percentage and other data of the collected information. Ethnobotanical data calculated were Use Value (UV) of the plant species and Factor Informant Consensus (FIC).

Use value

UV of plant species was calculated using the following formula:

$$UV = \sum U_i / N$$

Where: U_i represents the number of uses recorded for a given species by each informant and N indicates the number of total informants (Siddique et al. 2021).

Factor informant consensus

FIC was calculated to study the uniformity of knowledge about the medicinal plants used by the informants. It was calculated using the formula:

$$FIC = (Nur - Nt) / (Nur - 1)$$

Nur indicates number of use-report in each category and Nt is the number of species used for particular category by all informants (Bhatia et al. 2014).

RESULTS AND DISCUSSION

Plants used in ethnoveterinary medicine

Informants in the study area rely heavily on plants, as a source of food for their animals and as medicine for treating various animal diseases. All participants had experience in animal husbandry and veterinary practices and had acquired their knowledge of traditional medicine through generations of experience passed down by parents, grandparents, or earlier practitioners. Plants produce a diverse range of phytoconstituents, which help them defend against harsh environmental conditions and herbivores. These natural compounds also play crucial role in managing disorders and diseases in animals. In recent years, the use of herbal and plant-based medicine in livestock production has increased due to concerns over the side effects of modern drugs, high input costs, toxic residues in food, resistant against microbes, and the growing adoption of organic livestock production systems (Kuralkar and Kuralkar 2021). In the present study, 50 plant species belonging to 48 genera and 35 families are used as EVM by informants. Details regarding the reported ethnoveterinary medicinal plants including their botanical and vernacular names, families, uses, parts used, preparation methods, dosages used and modes of administration to treat various disorders of livestock in Chumoukedima were recorded (Table 1).

These plants were used to treat various livestock ailments, including parasite infections, poisoning, fractures, bleeding, cuts and wounds, flu, stomach disorders and inflammation among others. Verma (2014) documented the presence of several plants in another region of India including *Azadirachta indica* A.Juss., *Ficus racemosa* L., *Hibiscus rosa-sinensis* L., *Musa ×paradisiaca* L., *Tagetes erecta* L., *Trigonella foenum-graecum* L. and *Zingiber officinale* Roscoe among other plants. *Artocarpus heterophyllus* Lam., *Allium sativum* L., *A. indica*, *Centella asiatica* (L.) Urb., *Citrus ×limon* (L.) Osbeck, *Curcuma longa* L., *Cymbopogon nardus* (L.) Rendle, *Christella parasitica* (L.) H.Lév., *Euphorbia hirta* L., *M. ×paradisiaca*, *Ocimum tenuiflorum* L., *T. erecta*, *Zea mays* L., *Z. officinale* were among the plants used by another study by other ethnic community in northeast India for treating livestock ailments (Bhat et al. 2023). This signifies

the rich traditional and medicinal importance of these plants and suggests their potential for novel drug discoveries. It was interesting to note that people of the study area not only use plants as EVM but also as fodder for livestock, including the fruits of *Carica papaya* L., stem and leaves of *M. ×paradisiaca*, fruits of *A. heterophyllus*, tubers and leaves of *Manihot esculenta* Crantz and leaves of *Spilanthes acmella* A.Chev., 1920. along with several other locally available plants that serve as beneficial nutrition for animals.

Asteraceae and Moraceae were the highest reported families concerning species numbers where the Asteraceae family had five plant species, followed by Moraceae with four plant species accounting for 10 and 8% respectively (Figure 1). Euphorbiaceae, Fabaceae, Liliaceae, Malvaceae, Piperaceae, Poaceae, Rutaceae, and Zingiberaceae were represented by two species each (4%). The other 25 families were represented by only one species each (2%). The Asteraceae family encompasses a wide range of well-known species such as coreopsis, sunflower, chicory, lettuce, daisy and dahlias, along with medicinally significant plants like dandelion, chamomile and wormwood, with most of the members of this family recognized for their therapeutic applications while also serving as vital protective agents against infectious diseases in animals (Abd-Alla 2022). The family Asteraceae also dominated among EVM in another study (Wendimu et al. 2023). With 32,913 accepted species allocated in 1,911 genera in 13 subfamilies, the Asteraceae family is one of the largest and most economically significant plant families that comprises a diverse range of aromatic, annual or perennial herbs, subshrubs and shrubs and is highly rich in bioactive compounds, making it popularly used in medicine than many other plant families (Rustaiyan and Faridchehr 2021). The Moraceae family, commonly known as the mulberry or fig family, comprises 50 genera and 1,400 species, which are rich in diverse chemical compounds such as polyphenols, including flavonoids, anthocyanins and carotenoids, which contribute to a wide range of pharmacological activities (Basnett et al. 2023). The higher number of plant species within the Asteraceae and Moraceae in this study could be attributed to the suitability of climatic and soil conditions as well as the adaptability of this family in the study area, which support their widespread distribution and growth. Additionally, their medicinal properties might also be well-recognized by local people.

Habit and plant parts utilized

Herbs with 42% were the most frequently exploited among habit, followed by trees at 30% and shrubs and climbers at 18 and 10%, respectively (Figure 2). Other studies also reported the highest usage of herbs in preparation of herbal remedies (Feyisa et al. 2021; Rehman et al. 2022). Herbs are noted for their applications in gynaecological, surgical and bovine mastitis treatments, as well as in addressing various infections through their acaricidal and anthelmintic properties, and their use is particularly advantageous due to their typically higher concentrations of bioactive compounds compared to shrub or tree species (Umair et al. 2024).

Informants rely on various plant parts to prepare remedies but leaves with 50% were the most commonly utilized parts (Figure 3). This observation agrees with findings from another study, which highlight leaves as the most frequently used plant part in formulating treatments for animal ailments (Pratama et al. 2021; Wendimu et al. 2024).

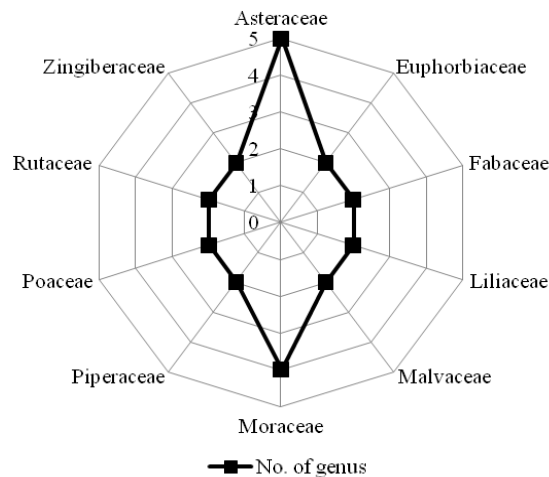


Figure 1. Dominant families of ethnoveterinary medicinal plants

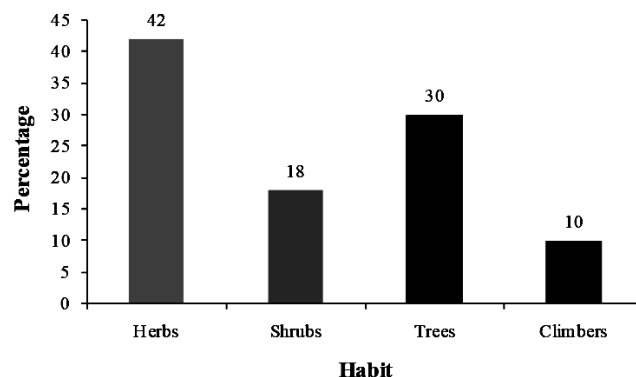


Figure 2. Habit of recorded ethnoveterinary plants

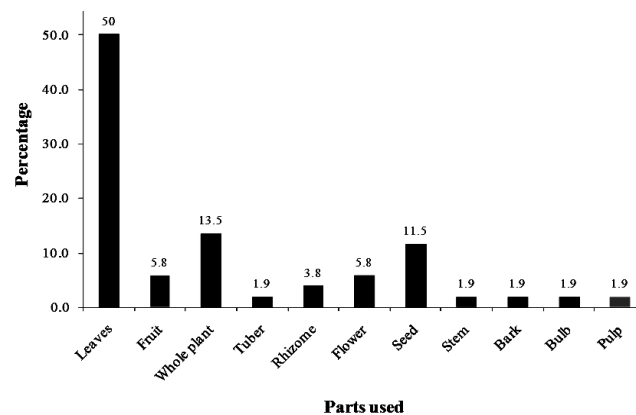


Figure 3. Percentage contribution of plant parts in ethnoveterinary medicine

Table 1. Plants used in various ethnoveterinary medicinal purposes by the Naga people of Chumoukedima District in Nagaland, Indonesia

Scientific name	Family	Local name	GH	AA	Purpose	PU	DT	Preparation	Application	UV
<i>Amaranthus spinosus</i> L.	Amaranthaceae	Aru	H	Cow	Lactagogue	Wp	60 days	Co	Cooked with fodder and given for consumption (In).	0.27
<i>Rhus semialata</i>	Anacardiaceae	Tangmoh	T	Pig	Food poisoning	Se	Two to three days	Co	Mixed with the fodder for consumption (In).	1.43
<i>Calotropis gigantean</i> (L.) W.T.Aiton .	Apocynaceae	Kutjak	S	Cow	Joint pain	Le	Four to five times a day for ten days	Ra	Cover the damaged area (Ex).	0.27
<i>Ageratum conyzoides</i> L.	Asteraceae	Imchenriza	H	Cow	Bleeding, cuts and wounds	Le	Until effect	Pa	Applied over cuts and wounds (Ex).	0.55
<i>Chromolaena odorata</i> (L.) R.M.King & H.Rob.	Asteraceae	Pongalai	S	Cow, pig	Cuts and wounds	Le	Until effect	Pa	Applied over cuts and wounds (Ex).	0.64
<i>Mikania cordata</i> (Burm.fil.) B.L.Rob.	Asteraceae	Ekobazu	C	Pig	Internal parasite	Wp	Four to five months	Ra, Co	Given orally (or) chopped and mixed along with the fodder (In).	0.18
<i>Spilanthes acmella</i> A.Chev.	Asteraceae	Tefumozitong	H	Cow	Tongue infection	FI	Two weeks	Pa	Applied over the infected part (Ex).	0.45
<i>Tagetes erecta</i> L.	Asteraceae	Kitsungnaro	H	Hen	Bird flu	FI	Until effect	Pa	Mixed with food and then given to consume (In).	0.45
<i>Centella asiatica</i> (L.) Urb.	Apiaceae	Longsokorok	H	Cow, pig	Skin infection	Wp	Until effect	Pa	Applied over the infected part (Ex).	0.36
<i>Basella alba</i> L.	Basillaceae	Zua aobaonu	C	Cow	Cuts and wounds	Le	One week	Pa	Applied on the cuts and wounds (Ex).	0.09
<i>Begonia picta</i> Sm.	Begoniaceae	Onsurup	H	Cat, dog	Cuts and wounds	Le	Two to three days	Pa	Applied over injured areas (Ex).	0.45
<i>Tamarindus indica</i> L.	Caesalpinaceae	Emlitenga	T	Cow, goat	Diarrhoea	Fr	Three days	Ju	Mixed with water and then given to consume (In).	0.45
<i>Cannabis sativa</i> L.	Cannabaceae	Ganja	H	Cow	Dysentery	Le	Five days	In, Co	Infusion for drinking or powder mixed along with fodder (In).	0.45
<i>Carica papaya</i> L.	Caricaceae	Mamazu	T	Pig	Lactagogue	Fr	Two months	Co	Cooked with fodder and then given to consume to lactating pig (In).	0.45
<i>Terminalia chebula</i> Retz.	Combretaceae	Nangkah	T	Pig	Dysentery	Ba	Twice a day for one week	Po	Given orally in small quantities (In).	0.18
<i>Commelina benghalensis</i> L.	Commelinaceae	Asurmechi	H	Pig	Internal parasite	Wp	Two weeks	Ra, Co	Given raw or chopped and mixed with fodder for consumption (In).	0.09
<i>Ipomoea batatas</i> (L.) Lam.	Convolvulaceae	Tazushe	C	Pig	Constipation	Le	Until effect	Ra, Co	Given raw or cooked along with fodder and given for consumption (In).	0.18
<i>Brassica campestris</i> var. mana Makino	Cruciferae	Chipi	H	Hen	Mouth and eye infection	Se	Until effect	Ra	Spread in the poultry rearing areas (Ex).	0.27
<i>Euphorbia hirta</i> L.	Euphorbiaceae	Asthma tong	H	Pig	Dysentery	Wp	Until effect	Ra, Co	Given orally or mixed with fodder and given to consume (In).	0.36
<i>Manihot esculenta</i> Crantz	Euphorbiaceae	Alishi	S	Pig	Loss of appetite	Tu	Until effect	Co	Mixed along with warm fodder (In).	0.09
<i>Trigonella foenum-graecum</i> L.	Fabaceae	Methi	H	Cow	Lactagogue	Se	20 days	Po	Cooked with fodder and given for consumption (In).	0.18
<i>Senna alata</i> (L.) Roxb.	Fabaceae	Napong chami	S	Cow, pig	Skin disease	Le	Until effect	Pa	Applied on the infected area (Ex).	0.36
<i>Psidium guajava</i> Linn.	Myrtaceae	Moterem	T	Goat, cow	Diarrhoea	Le	Three days	Pa	Diluted with water and given for drinking (In).	0.45
<i>Ocimum tenuiflorum</i> L.	Lamiaceae	Nangpera	H	Dog	Food poisoning	Le, FI	Two to three days	Co	Dried sample is mixed with <i>Rhus semilata</i> is in lukewarm water and given to consume (In).	0.64

<i>Allium sativum</i> L.	Liliaceae	Lahsung	H	Hen	Cough	Bu	Two to three days	Co	Paste made with raw mustard oil, mixed with rice and given to consume (In).	0.18
<i>Aloe vera</i> (L.) Burm. f.	Liliaceae	Tanulah o	H	Cow	Udder infection	Pu	One week	Co	Prepared with the mustard oil for massaging (Ex).	0.18
<i>Hibiscus rosa-sinensis</i> L.	Malvaceae	Yimpangnaro	S	Pig	Constipation	Le	Until effect	Ra	For consumption (In).	0.55
<i>Hibiscus sabdariffa</i> L.	Malvaceae	Tzrimartasentsu/Ensturep	S	Cow	Dysentery	Fr	Twice a day for one week	In	Soaked in water for 3 hours and given for drinking (In).	0.73
<i>Azadirachta indica</i> A.Juss.	Meliceae	Neem	T	Pig	Skin rashes and infection	Le	Two weeks	De	For bathing (Ex).	0.18
<i>Artocarpus heterophyllus</i> Lam.	Moraceae	Polong	T	Pig	Dysentery	Le	Until effect	Ra	For consumption (In).	0.09
<i>Broussonetia papyrifera</i> (L.) L'Hér. ex Vent.	Moraceae	Kagritong	T	Pig	Lactagogue	Le	Two months	Ra	For consumption (In).	0.45
<i>Ficus racemosa</i> L.	Moraceae	Munguzuno	T	Pig	Lactagogue	Le	Two months	Ra	For consumption (In).	0.09
<i>Morus alba</i> L.	Moraceae	Menaklashi	T	Pig	Constipation	Le	Until effect	Ra	For consumption (In).	0.45
<i>Moringa oleifera</i> Lam.	Moringaceae	Sajina	T	Cow	Mumps	Le	Until effect	Pa	Warmed for few minutes, transferred to cloth and gently pressed around the swollen area (Ex).	0.18
<i>Muntingia calabura</i>	Muntingiaceae	Thosu	T	Pig	Dysentery	Le	Until effect	Ra	Given in pure form or mixed with fodder (In).	0.18
<i>Musa ×paradisica</i> L.	Musaceae	Somomo	H	Pig	Dysentery	St, Le	Until effect	Co	Cooked with fodder then, given to consume (In).	0.09
<i>Piper betle</i> L.	Piperaceae	Patio	C	Dog	Cuts and wounds	Le	Until effect	Pa	Applied over cuts and wounds (Ex).	0.45
<i>Piper nigrum</i> L.	Piperaceae	Gol morich	C	Cow	Dysentery	Se	Three to four days	Co	Grinded with rhizome of <i>Zingiber officinale</i> and mixed in the drinking water to consume (In).	0.45
<i>Cymbopogon nardus</i> (L.) Rendle	Poaceae	Citronella	H	Pig	Skin rashes	Le	Twice a day for one week	De	As a disinfectant for bathing (Ex).	0.18
<i>Zea mays</i> L.	Poaceae	Menti	H	Pig	Lactagogue	Se	Two months	Co	Dried powder is mixed with warm fodder and given for consumption (In).	0.27
<i>Ziziphus mauritiana</i> Lam.	Rhamnaceae	Peenok	T	Cow, dog	Burns on skin	Le	Until effect	Pa	Applied over damaged area (Ex).	0.36
<i>Citrus ×limon</i> (L.) Osbeck	Rutaceae	Ongshe	T	Cow	External mouth Infection	Le	Until effect	Pa	Rubbed around the infected parts of the mouth (Ex).	0.64
<i>Murraya koenigii</i> Linn.	Rutaceae	Curry tu	S	Cow, dog	Cuts and wounds	Le	Until effect	Ra	Few leaves are crushed thoroughly and then applied (Ex).	0.73
<i>Houttuynia cordata</i> Thunb.	Saururaceae	Azuponhsmidu/Nokna	H	Pig	Internal parasites	Wp	Two weeks	Ra	For consumption (In).	0.18
<i>Solanum trilobatum</i> L.	Solanaceae	Koyalilok	S	Hen	Eye infection	Se	Until effect	Pa	Applied around the infected eye (Ex).	0.09
<i>Camellia sinensis</i> (L.) Kuntze	Theaceae	Sungoh	S	Dog	Cuts and wounds	Le	Until effect	Pa	Applied on the infected part (Ex.)	0.27
<i>Christella parasitica</i> (L.) H.Lév.	Thelypteridaceae	Jakemtsu	H	Hen	Lice repellent	Wp	Until effect	Ra	Spread in the poultry rearing areas (Ex).	0.45
<i>Aquilaria malaccensis</i> Lam.	Thymelaeaceae	Sungya	T	Dog	Allergy and wounds	Le	Thrice a week	De, Pa	Water from leaves boiled is used in bathing. Paste is applied on the body after bathing (Ex).	0.27
<i>Curcuma longa</i> L.	Zingiberaceae	Wakong	H	Cow	Cuts and wounds	Rh	Until effect	Co	Crushed with raw mustard oil and applied on the infected part (Ex).	1.57
<i>Zingiber officinale</i> Roscoe	Zingiberaceae	Sungmok	H	Pig	Cough and cold	Rh	One week	Pa	Paste made with <i>Allium sativum</i> are warm food and then given to consume (In).	1.43

Note: AA: Affected animal; DT: Duration of the treatment; PU: Parts used; WP: Whole plant; Fl: Flowers; Le: Leaves; Rh: Rhizome; Bu: Bulb; Fr: Fruit; Tu: Tubers; Se: Seeds; Pu: Pulp; GH: Growth habitat; H: Herb; T: Tree; S: Shrub; C: Climber; Pa: Paste; In: infusion; Po: Powdered; Co: Concoction; De: Decoction; Ju: Juice; Ra: Raw; (In): Internal; (Ex): External; (UV): Use value

Contrary to this, other studies reported that leaves are among the less frequently utilized parts of medicinal plants instead roots were more widely recognized and commonly used within communities (Xiong and Long 2020; Rafique Khan et al. 2021). The preference for leaves in this study could be attributed to several factors, including their abundance, ease of harvest, and high concentration of bioactive compounds. Besides being easier to collect compared to fruits, flowers and underground parts, leaves play a crucial role from a scientific perspective as they are actively involved in photosynthesis and the production of secondary metabolites (Kumar and Nagayya 2017). Moreover, harvesting leaves rather than other plant parts is a more sustainable approach to resources, as it is typically less destructive when compared with other plant parts such as roots and barks. The use of stems and roots may lead to the complete destruction of the medicinal plant due to the dysfunction of the xylem and phloem in its vascular system (Mthi et al. 2023).

Preparation method

The methods of preparation differed depending on the basis of ailments treated. Although herbal remedies were prepared through various methods, paste, accounting for 30% was the most common method. This was followed by concoction, direct/raw and decoction with 28.6, 25, and 5.4% respectively (Figure 4). Informants attributed the popularity of paste to their ease of preparation, which was prepared by crushing the plant sample alone or combined with oil or water and was either applied directly over the wounds or administered orally. Several methods of medicinal preparations for treating various ailments were recorded in other studies as well where, the paste was reported as the major mode of preparation for the treatment of livestock (Sundharakumar et al. 2020; Bhat et al. 2023; Shinde et al. 2024). In ethnoveterinary practices, paste is commonly used one of the major forms of drug preparation due to its ease of preparation using a pestle and mortar, either with or without water (Jayakumar et al. 2018). Infusion, juice and powder were the least utilized methods, each making up 3.57% of the recorded formulations. This

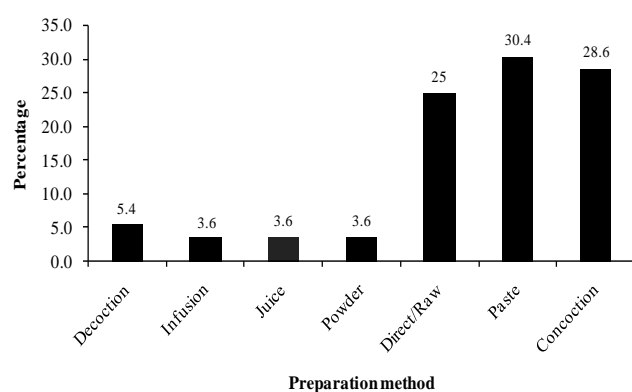


Figure 4. Percentage contribution of various preparation methods in ethnoveterinary medicines

finding contradicts another study where infusion was the most commonly prepared method for treating animals (Chaachouay et al. 2024). Medicinal preparations were often made by combing two plants to enhance their effectiveness (Table 1). For instance, a paste of *Z. officinale* rhizome mixed with *A. sativum* is considered a warm remedy and is given to treat cough and cold. To heal cuts and wounds, rhizome of *C. longa* is mixed and with crushed with raw mustard oil before application. For dysentery, seeds of *Piper nigrum* L. is grounded with the rhizome of *Z. officinale* and added to drinking water. Likewise, leaves and flowers of *O. tenuiflorum* are mixed with *Rhus semilata* in lukewarm water and administered during food poisoning. These practices highlight the rich traditional knowledge of herbal medicinal preparation in the study area.

Animals treated

Individuals involved in animal rearing and livestock management have knowledge of the causes of various diseases and ailments, as well as effective methods for their prevention, control and treatment. Informants in this study cited the use of ethnoveterinary remedies for 11 animals, with pigs (39.7%) being the most frequently treated, followed by cows (34.5%) and dogs (12.1%) (Figure 5). This result aligns with another conducted in a different country where pigs and cattle were among the animals that accounted for more than 70% of domestic animals treated with herbal medicines (Romero et al. 2022). In Nagaland, pork and beef are widely consumed and pork, in particular, holds cultural importance, being an essential part of tribal festivals, marriages and other celebrations. This led to a significant number of pig and cow farmers who rely on these livestock as a source of income. Additionally, dogs are popular pets among the Naga people, further contributing to the higher prevalence of traditional medicines used for treating these animals. Remedies for treating other animals such as hens (8.6%), goats (3.4%) and cats (1.7%) were also cited showcasing the adaptability and extensive application of indigenous veterinary knowledge in the study area.

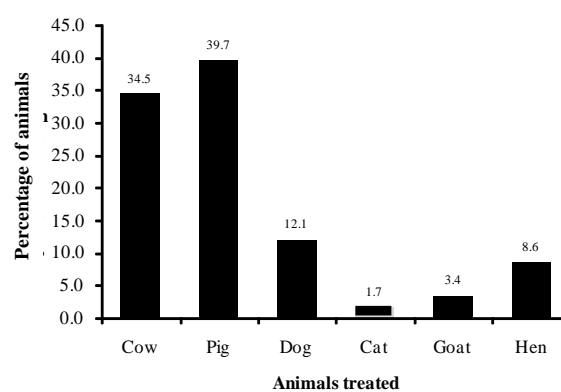


Figure 5. Animals treated using ethnoveterinary medicinal plants

Ailments treated

Livestock diseases negatively impact the production system, triggering a cascading effect that leads to reduced production, low income and subsistent livelihood and could also extend beyond immediate effects on producers (Jayakumar et al. 2018). Injuries including bleeding, burns, cuts and wounds (21.7%) were the most common problem issues in the study area, which was followed by skin problems and dysentery (17.4%) (Figure 6). According to informants, the high prevalence of injuries is largely due rearing of most animals in open areas, where they are more exposed to environmental hazards. Plants, rough terrain and other natural obstacles frequently lead to cuts and wounds. Additionally, insect bites are a common source of injuries, as animals tend to scratch or rub against rough surfaces to relieve itching, which can further aggravate wounds and increase the risk of infection. Informants attributed the main reason for skin issues to insect bites and poor sanitation, both of which create a favorable environment for infections and other dermatological issues. Plants were also used for other issues such as lactagogue, food poisoning, joint pain, internal parasites, flu, diarrhea, lice attack, mumps, constipation and cough and cold. A similar trend was recorded in another study where the plants were used for the treatment of various veterinary ailments including gastrointestinal disorders, infections and infestations, lactation and muscular-skeletal system disorders among others (Uprety et al. 2022). Informants in the present study revealed the use of one or more plants to address specific ailments, indicating the rich diversity of traditional knowledge and the therapeutic potential of medicinal plants.

Routes of medicine administration and dosage

Medicines were administrated through two means namely, external and internal. Internal methods included the consumption of medicines in the form of powders, raw or cooked or mixed with other things while, external methods involved bathing, rubbing or covering the

damaged area, applying treatments to infected part, injured area, cuts and wounds, or pressing on swollen areas. The most common route of administration was internal (56%) as compared to external (44%) (Figure 7). Another study also found that the oral mode of delivery was the most common route for treating cattle ailments, compared to topical routes and the combined use of both methods (Bhat et al. 2023). The oral route of administration is cosy-effective, convenient and generally safe and in some cases, animals can be trained to cooperate voluntarily, based on the compound being given (Turner et al. 2011). Internal administration was given either in their raw form or mixed with other plants and fodder. Similarly, medicines were applied to animals externally either in their raw form or after mixing with other plants.

Proper dosage is crucial in administrating medicines, as it ensures that the appropriate quantity is used for effectively treating ailments and diseases. However, it was noted that there was a lack of standardized measurement units for administrating medicines in the study area, as dosages were determined based on the personal judgment and satisfaction of the individual preparing the remedies. This issue has been observed in other studies as well, as it has been noted that ethnomedicine requires standardization, with veterinarians frequently complaining about non-standardized dosages in traditional medicines (Aziz et al. 2018). Standardizing herbal medicine dosage presents a formidable challenge due to the vast diversity of plant species and the inherent variation in their bioactive compounds (Busia 2024). Medicinal plants contain pharmacologically active compounds, but their effects can vary depending on dosage, as limited intake may have no impact, while excessive consumption can lead to harmful consequences. Addressing this gap by establishing standardized measurement systems and dosage guidelines could significantly improve the accuracy, safety and efficacy of ethnoveterinary practices and better animal health outcomes in the future.

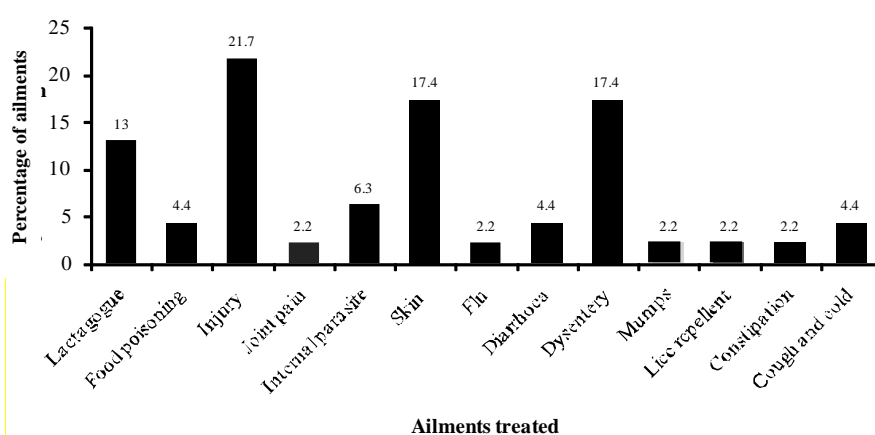


Figure 6. Ailments treated using ethnoveterinary practices

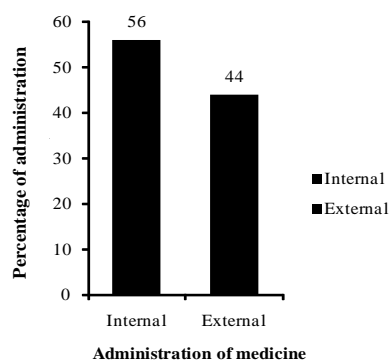


Figure 7. Mode of medicine administration

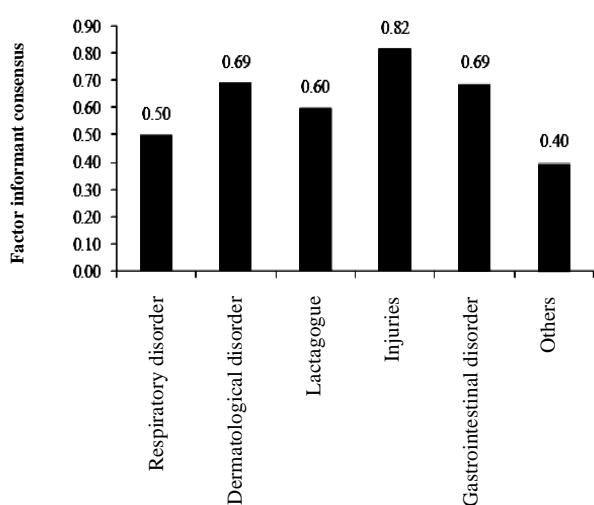


Figure 8. Factor informant consensus for ailment categories

Factor informant consensus

The FIC was evaluated after traditional remedies and corresponding diseases were grouped into six categories. FIC values are considered low if they are close to 0 and it indicates that there is no exchange of information about plant use among informants but the value approach 1 if information is shared among informants (Sharma et al. 2022). The FIC values ranged from 0.40 to 0.82, with the highest level of consensus observed for injuries, followed by gastrointestinal and dermatological disorders, both of which had FIC of 0.69 each (Figure 8). This indicates the frequent occurrence of injuries in livestock, as well as gastrointestinal and dermatological issues. It also reflects the local knowledge of the therapeutic applications of plants for these conditions. A high FIC value suggests an effective sharing of ethnoveterinary medicinal knowledge among informants and the availability of plant species for treating these health issues.

Use value

The UV shows the relative importance of ethnoveterinary medicinal plant species based on the frequency of mentions by local informants. In this study, the UV ranged from 0.09 to 1.57 (Table 1). Among the species, *C. longa* had a UV

of 1.57, reflecting its high cultural and medicinal relevance. This was closely followed by *Rhus semialata* and *Z. officinale*, both with a UV of 1.43, indicating their significant role in the local ethnoveterinary practices. *C. longa* is a perennial herb under the Zingiberaceae family. It has been widely recognized for its medicinal properties for many years, largely due to the presence of various beneficial compounds. For instance, curcumin, a key polyphenolic compound found in the plant has been reported to offer numerous benefits in promoting the health and enhancing the performance of livestock and poultry (Sureshbabu et al. 2023). *Zingiber officinale*, another herb under the Zingiberaceae family also hold diverse medicinal values. The informants in the present study used rhizome of the plant to treat cough and cold in pigs highlighting its role in respiratory ailments. In another study, the crude extract of its powder has been shown to enhance renal and hepatic function and is recommended as an effective and safe treatment option for managing gastrointestinal nematode infections in pigs (Kiambom et al. 2022). *Rhus semialata*, a deciduous tree belonging to the Anacardiaceae family, has long been valued in traditional medicines for its therapeutic properties in treating ailments in humans, such as dysentery and diarrhoea (Bose et al. 2007). The high UV of the plant in this study reflects its effectiveness and indicates its potential as a valuable remedy not only in human healthcare but also in ethnoveterinary medicinal practices.

In conclusion, a total of 50 plant species from 35 families were recorded as being used for the treatment of various livestock ailments in the Chumoukedima District of Nagaland. Herbs and leaves were the most utilized habit and plant parts. Pigs, cows and dogs were the primary animals treated, with injuries, skin problems and dysentery being the most prevalent issues. Remedies were prepared using various methods, with paste being the most common and administered both internally and externally. Despite the effectiveness of these practices, the lack of standardized dosage measurement poses challenges to safety and efficacy. Plants were documented from only one district of Nagaland but, the substantial number of medicinal plants in treating animals, emphasizes the importance of exploring and documenting EVM in other unexplored areas of the state. Preserving and scientifically validating this traditional knowledge can enhance veterinary practices and promote better animal health outcomes in the state.

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REFERENCES

- Abd-Alla HI. 2022. The potential use of some members belong to Apiaceae and Asteraceae plant family as immune boosters in livestock production. *Egypt J Anim Prod* 59 (4): 45-55. DOI: 10.21608/ejap.2022.244951.

- Asfaw A, Lulekal E, Bekele T, Debella A, Debebe E, Sisay B. 2022. Medicinal plants used to treat livestock ailments in Ensaro District, North Shewa Zone, Amhara Regional State, Ethiopia. *BMC Vet Res* 18 (1): 235. DOI: 10.1186/s12917-022-03320-6.
- Aziz MA, Khan AH, Adnan M, Ullah H. 2018. Traditional uses of medicinal plants used by indigenous communities for veterinary practices at Bajaur Agency, Pakistan. *J Ethnobiol Ethnomed* 14 (1): 11. DOI: 10.1186/s13002-018-0212-0.
- Basnett D, Banerjee M, Chowdhury SK. 2023. A review on medicinal values and pharmacological importance of Moraceae. *Plant Sci Today* 14719: 1-9. DOI: 10.14719/pst.2385.
- Bhat NA, Jeri L, Karmakar D, Mipun P, Bharali P, Sheikh N, Nongkynrih CJ, Kumar Y. 2023. Ethnoveterinary practices of medicinal plants used for the treatment of different cattle diseases: A case study in East Khasi Hill District of Meghalaya, North East India. *Heliyon* 9 (7): e18214. DOI: 10.1016/j.heliyon.2023.e18214.
- Bhatia H, Sharma YP, Manhas RK, Kumar K. 2014. Ethnomedicinal plants used by the villagers of district Udhampur, J&K, India. *J Ethnopharmacol* 151 (2): 1005-1018. DOI: 10.1016/j.jep.2013.12.017.
- Bose SK, Dewanjee S, Sen Gupta A, Samanta KC, Kundu M, Mandal SC. 2007. In vivo evaluation of anti-diarrhoeal activity of *Rhus semialata* fruit extract in rats. *Afr J Tradit Complement Altern Med* 5 (1): 97-102.
- Busia K. 2024. Herbal medicine dosage standardisation. *J Herb Med* 46: 100889. DOI: 10.1016/j.hermed.2024.100889.
- Chaachouay N, Azeroual A, Bencherki B, Benkhniq O, Zidane L. 2024. Use of ethnoveterinary medicinal plants to treat cattle diseases by the Oulad Heriz farmers in the Chaouia region, Northwest of Morocco. *Acta Bot Hung* 66 (1-2): 1-24. DOI: 10.1556/034.66.2024.1-2.1.
- Changkija S, Gurung PB. 2017. Flora of Nagaland (Vol-I and Vol-II). Department of forest, environment and climate change, Government of Nagaland, Nagaland.
- Changkija S. 2014. Biodiversity of Nagaland. Department of forest, ecology, environment and wildlife, Government of Nagaland, Nagaland.
- Deorani C, Sharma GD. 2007. Medicinal plants of Nagaland. Bishen Singh Mahendra Pal Singh, Dehra Dun.
- Eiki N, Maake M, Lebelo S, Sakong B, Sebola N, Mabelebele M. 2022. Survey of ethnoveterinary medicines used to treat livestock diseases in Omusati and Kunene regions of Namibia. *Front Vet Sci* 9: 762771. DOI: 10.3389/fvets.2022.762771.
- Feyisa M, Kassahun A, Giday M. 2021. Medicinal plants used in ethnoveterinary practices in Adea Berga District, Oromia Region of Ethiopia. *Evid Based Complement Alternat Med* 2021: 5641479. DOI: 10.1155/2021/5641479.
- Hajra PK, Rao RR, Sing DK, Uniyal BP. 1995. Flora of India. Vols. 12 & 13, Asteraceae. Botanical Survey of India, Calcutta.
- Jain A, Das A. 2022. North-East India: A unique biodiversity paradise unexplored or lost? *Intl J Sci Res Pub* 12 (4): 112-119. DOI: 10.29322/IJSRP.12.04.2022.p12417.
- Jayakumar S, Baskaran N, Arumugam R, Sathiskumar S, Pugazhenth M. 2018. Herbal medicine as a live practice for treating livestock ailments by indigenous people: A case study from the Konar community of Tamil Nadu. *S Afr J Bot* 118: 23-32. DOI: 10.1016/j.sajb.2018.06.002.
- Kalita CK, Mili C, Deka MJ, Das P, Das SN. 2024. Study on ethnoveterinary medicinal plants used by local people inhabiting char area, Kamrup District, Assam, North-East India. *Ecol Questions* 35 (4): 1-18. DOI: 10.12775/EQ.2024.048.
- Kiambom T, Kouam MC, Tegua A. 2022. The anthelmintic effect of ginger (*Zingiber officinale*) powder on the biochemical and haematological parameters of pigs experimentally infected with some gastrointestinal nematodes. *AJVS* 72 (1): 35-44. DOI: 10.5455/ajvs.132499.
- Kumar GMP, Nagayya S. 2017. Utilization of ethno-veterinary medicinal plants in Hassan District of Karnataka, India. *Intl J Pharm Pharm Sci* 9 (4): 107-114. DOI: 10.22159/ijpps.2017v9i4.16975.
- Kuralkar P, Kuralkar SV. 2021. Role of herbal products in animal production – An updated review. *J Ethnopharmacol* 278: 114246. DOI: 10.1016/j.jep.2021.114246.
- Mthi S, Rust J, Tokozwayo S, Dubeni Z. 2023. Ethnopharmacological assessment of medicinal plants used in the management of livestock ailments by resource-limited farmers in the Eastern Cape Province. *Open J Vet Med* 13 (6): 96-109. DOI: 10.4236/ojvm.2023.136009.
- Oda BK, Lulekal E, Warkineh B, Asfaw Z, Debella A. 2024. Ethnoveterinary medicinal plants and their utilization by indigenous and local communities of Dugda District, Central Rift Valley, Ethiopia. *J Ethnobiol Ethnomed* 20 (1): 32. DOI: 10.1186/s13002-024-00665-0.
- Pratama AM, Herawati O, Nabila AN, Belinda TA, Wijayanti AD. 2021. Ethnoveterinary study of medicinal plants used for cattle treatment in Bojonegoro district, East Java, Indonesia. *Biodiversitas* 22 (10): 4236-4245. DOI: 10.13057/biodiv/d221014.
- Rafique Khan SM, Akhter T, Hussain M. 2021. Ethno-veterinary practice for the treatment of animal diseases in Neelum Valley, Kashmir Himalaya, Pakistan. *PLoS ONE* 16 (4): e0250114. DOI: 10.1371/journal.pone.0250114.
- Rehman S, Iqbal Z, Qureshi R, Rahman IU, Sakhi S, Khan I, Hashem A, Al-Arjani AF, Almutairi KF, Abd Allah EF, Ali N, Khan MA, Ijaz F. 2022. Ethnoveterinary practices of medicinal plants among tribes of tribal district of North Waziristan, Khyber Pakhtunkhwa, Pakistan. *Front Vet Sci* 9: 815294. DOI: 10.3389/fvets.2022.815294.
- Romero B, Susperregui J, Sahagún AM, Díez MJ, Fernández N, García JJ, López C, Sierra M, Díez R. 2022. Use of medicinal plants by veterinary practitioners in Spain: A cross-sectional survey. *Front Vet Sci* 9: 1060738. DOI: 10.3389/fvets.2022.1060738.
- Rustaiyan A, Faridchehr A. 2021. Constituents and biological activities of selected genera of the Iranian Asteraceae family. *J Herb Med* 25: 100405. DOI: 10.1016/j.hermed.2020.100405.
- Sharma R, Sharma YP, Hashmi SAJ, Kumar S, Manhas RK. 2022. Ethnomycological study of wild edible and medicinal mushrooms in district Jammu, J&K (UT), India. *J Ethnobiol Ethnomed* 18 (1): 23. DOI: 10.1186/s13002-022-00521-z.
- Shinde SS, Narwade KB, Kharat VV, Swami SG, Raut SD. 2024. Ethnoveterinary medicinal plants for treatment of animal ailments by traditional healers in Nanded District (MS), India. *Afr J Bio Sci* 6 (9): 5542-5557. DOI: 10.48047/AFJBS.6.9.2024.5542-5557.
- Siddique Z, Shad N, Shah GM, Naeem A, Yali L, Hasnain M, Mahmood A, Sajid M, Idrees M, Khan I. 2021. Exploration of ethnomedicinal plants and their practices in human and livestock healthcare in Haripur District, Khyber Pakhtunkhwa, Pakistan. *J Ethnobiol Ethnomed* 17 (1): 55. DOI: 10.1186/s13002-021-00480-x.
- Sikarwar RLS, Tiwari AP. 2020. A review of plants used in ethnoveterinary medicine in Central India. *Indian J Tradit Knowledge* 19 (3): 617-634. DOI: 10.56042/ijtk.v19i3.40808.
- Sundharakumar S, Aruna R, Shrinitha TM. 2023. An ethnoveterinary study on plants used for livestock diseases in Theni and Madurai Districts, Tamil Nadu, India. *J Tradit Folk Practices* 8 (2): 21-28. DOI: 10.25173/jtftp.2020.8.2.113.
- Sureshbabu A, Smirnova E, Karthikeyan A, Moniruzzaman M, Kalaiselvi S, Nam K, Goff GL, Min T. 2023. The impact of curcumin on livestock and poultry animal's performance and management of insect pests. *Front Vet Sci* 10: 1048067. DOI: 10.3389/fvets.2023.1048067.
- Turner PV, Brabb T, Pekow C, Vasbinder MA. 2011. Administration of substances to laboratory animals: Routes of administration and factors to consider. *J Am Assoc Lab Anim Sci* 50 (5): 600-13.
- Umair M, Altaf M, Ahsan T, Bussmann RW, Abbasi AM, Gatasheh MK, Elroh M. 2024. Study of medicinal plants used in ethnoveterinary medical system in riverine areas of Punjab, Pakistan. *J Ethnobiol Ethnomed* 20 (1): 48. DOI: 10.1186/s13002-024-00686-9.
- Uprey Y, Karki S, Poudel RC, Kunwar RM. 2022. Ethnoveterinary use of plants and its implications for sustainable livestock management in Nepal. *Front Vet Sci* 9: 930533. DOI: 10.3389/fvets.2022.930533.
- Verma RK. 2014. An ethnobotanical study of plants used for the treatment of livestock diseases in Tikamgarh District of Bundelkhand, Central India. *Asian Pac J Trop Biomed* 4 (Suppl 1): S460-S467. DOI: 10.12980/APJTB.4.2014C1067.
- Wendimu A, Bojago E, Abrham Y, Tekalign W. 2023. Practices of ethnoveterinary medicine and ethnobotanical knowledge of plants used to treat livestock diseases, Wolaita zone, Southern Ethiopia. *Cogent Food Agri* 9 (1). DOI: 10.1080/23311932.2023.2248691.
- Wendimu A, Bojago E, Abrham Y. 2024. Medicinal ethnoveterinary plants used for treating livestock ailments in the omo-gibe and Rift valley basins of Ethiopia. *BMC Vet Res* 20 (1): 166. DOI: 10.1186/s12917-024-04019-6.
- WFO. 2025. World flora online. <http://www.worldfloraonline.org>.
- Xiong Y, Long C. 2020. An ethnoveterinary study on medicinal plants used by the Buyi people in Southwest Guizhou, China. *J Ethnobiol Ethnomed* 16 (1): 46. DOI: 10.1186/s13002-020-00396-y.