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Studies on phytochemical estimation of selected ethanomedicinal and ethnoveterinary plants in Karauli District, Rajasthan

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Abstract
The rising demand for safe, affordable and sustainable therapeutic agents has rekindled scientific interest in ethnomedicinal and ethnoveterinary plants as valuable sources of bioactive compounds. Modern medical and veterinary facilities are not available in rural and tribal areas so the primary health care system for these populations has been traditional knowledge on medicinal plants. Rajasthan is a significant storehouse of ethnobotanical and ethnoveterinary resources with its extensive floral diversity and vast indigenous knowledge. This review summarizes the traditional uses of ethnomedicinal and ethnoveterinary plants with special emphasis on Karauli district of Rajasthan and emphasizes the need for phytochemical investigations for validation of their therapeutic potential. The review summarizes the published literature on the diversity of medicinal plants, traditional formulations, ethnoveterinary uses and phytochemical constituents such as alkaloids, flavonoids, phenolics, tannins, saponins, glycosides, terpenoids and other secondary metabolites responsible for diverse biological activities. Recent phytochemical screening and ethnopharmacological evaluations of plants have revealed that many plants used traditionally possess significant antioxidant, antimicrobial, anti-inflammatory, insecticidal and other pharmacological properties. Such findings endorse the continued use of such plants in health care and livestock management. The review additionally emphasizes the immediate need of documentation of indigenous knowledge, conservation of medicinal plants biodiversity and promotion of scientific validation through phytochemical, pharmacological and toxicological studies. The integration of traditional knowledge with modern scientific approaches can aid in the identification of new therapeutic agents, while ensuring sustainable use and conservation of valuable medicinal plant resources.

Keywords: Ethnomedicinal plants, ethnoveterinary medicine, phytochemical estimation, traditional knowledge etc

Introduction

India is an agro-based country with the main vocation being agriculture and animal husbandry and management. Agriculture is one of the major sources of Indian economy. Similarly, animal rearing and preservation of quality and quantity of animal products are also important features of our economy. The major edible products of animals are milk and milk products. The responsible animals are cattle. In this age of industrialization, pollution and environmental deterioration even livestock are affected. They suffer from numerous diseases that influence their health and productivity. Available yet very expensive medical services with adverse effects. Mostly the dairy individuals, farmers and livestock rearers do not utilize the drugs of allopathy and prefer their own traditional procedures of ethnoveterinary. animals to farmers are source of financial revenue as agriculture is seasonal whilst animals can give a regular source of income. They therefore need to be safeguarded from illnesses. Special attention must be given to the health and working conditions of the cattle. Costly current and novel methods of disease management are not affordable of average farmers. So, most of the villagers are used herbal formulations for treatment of different ailments of their cattle (Shrivastava *et al.*, 2017).

India has an extensive tradition of medicinal herbs. The knowledge of therapeutic plants has been handed down through many centuries. The Rigveda, one of the oldest scriptures, gives interesting information about therapeutic herbs. The Indian subcontinents is inhabited by around 53.8m tribal people in 5000 forest dominated villages of tribal population and compromising 15% of the total geographical area of Indian landmasses, marking one of the greatest emporia of ethno-botanical wealth. Medicinal plants have been playing an important part in the survival of ethnic populations living in distant villages and woodlands (Negi *et al.*, 2012) [24].

Medico-ethnobotany is the connection between botany and traditional knowledge about the therapeutic properties of plants. Rigveda and Atharvaveda dated from 2000-1000 Bc. And other after vedic Treatise viz. Sushruta Samhita, Charak Samhita, Dhanvuantri Nighantu. Important source of information and medicinal plants of old are Raj Nighautu to name a few. The tribals and rural inhabitants of India have been largely dependent upon the therapy from medicinal plants (Meena and Kumar, 2015) [23].

The history and current state of human kind are recorded in ethanobotany, even as it foresees the future. As a discipline, ethanobotany provides us in-depth insight and enjoyment of the richness and intimacy of relationships between human and nature. In recent years traditional ethno-botanical studies have been widely considered for its wide local acceptability and pointers for new or poorly known medicinal plant. The traditional knowledge of medicinal plants of different ethnic tribes of indigenous are orally transferred to next generation and others for generations, however it is fast fading owing to the advent of modern technology and modification of traditional culture. Tribals are a separate ethnic group usually confined to specific

geographical areas and speak a shared dialect and are culturally homogeneous and uniting social organization. India is undoubtedly the richest source of traditional knowledge applications of plants. The country has a long tradition of health treatment. Medicinal plants of various types, from higher plants to micro-organisms, provide more than 80 per cent of therapeutic products. The importance of traditional and folk medicines is well established and plays a key part in treating many human disorders. For many generations the aborigines maintained a traditional self-managed system of folk medicine mostly based on herbal medicines. Remote and far flung locations could not access modern medical facilities as yet. Ethnic people strongly believe in the traditional system of native folklore-medicine for remedies and depend primarily on herbal medicines. The plant cures of prehistoric societies, orally passed down from generation to generation, gradually became part of the wisdom of ancient civilizations (Chandel, 2020) [4].

Ethanomedicinal Plants

India is renowned for its extensive past and has been a significant source of medicinal herbs since antiquity. The conventional medical systems like Ayurveda, Siddha, and Unani have been employed for the treatment of diverse health ailments for an extensive duration. Historically utilized flora and their derivatives have undergone extensive assessment for their medicinal attributes, which have proliferated globally in contemporary times. Phytoconstituents originating from plants have a pivotal role in enhancing health and addressing numerous disorders through preventative and cytotoxic effects. According to a W.H.O. report, over 80% of individuals in underdeveloped nations depend on herbal remedies for improved health, leading to a global increase in the cultivation of medicinal plants (Malik and Upadhyay, 2020) [18]. India is among the most affluent floristic regions globally and is renowned for its historical legacy of medicinal flora and phytopharmaceuticals. The Indian medical framework has recognized 1,500 therapeutic plants, with 500 species predominantly utilized in drug formulation (Kapoor and Kumar, 2013) [15].

Flora are autonomous, multicellular eukaryotic organisms that constitute their own kingdom, Plantae. Owing to their autonomous capacity for food production through photosynthesis, they maintain their status as the primary producers in the food chain. The applications of medicinal flora stem from various anecdotes and hearsay; Ayurveda encompasses all these ethnomedicinal species, their applications, and advantages. More than 20,000 medicinal plant therapies are recorded together with their purposes in the Ayurvedic pharmacopoeia. Rajasthan, the most expansive state in the northwestern part of the country and rich in diverse folk medicinal flora, is prominently acknowledged in India for its ethnomedicinal plant research (Singh *et al.*, 2023) [32].

Medicinal flora held a significant role in the socio-cultural, spiritual, and therapeutic domains of Rajasthan's rural populace. The residents of the dry regions of Rajasthan rely entirely on traditional medicinal practices for their healthcare, as accessing contemporary medical services for everyday health issues is challenging for them. The conventional healers and residents of dry regions possess extensive knowledge about herbal remedies. The therapeutic applications of ethnomedicinal plants in Rajasthan have been examined in herbal and traditional treatments by numerous researchers (Kapoor and Kumar, 2013) [15].

Ethanoveterinry Practices

From antiquity, nature has bestowed countless advantages onto humanity through provisions of sustenance, habitation, medicinal resources, and both animal and botanical assets for our various necessities. Conventional wisdom for treating many illnesses has been an essential component of contemporary medicine within the global healthcare framework. This conventional medicine continues to hold considerable importance, not just in rural regions but globally. This furthermore suggests a significant rise in the demand for conventional medicines, which will be important in the future (Sen *et al.*, 2016) [29]. The conventional medicinal framework relies significantly on botanical resources, and it is now recognized that phytochemicals may offer safer or more efficacious alternatives to synthetically manufactured chemotherapeutic drugs (Tripathi and Singh, 2020) [40].

Ethnoveterinary refers to the conventional wisdom around individuals' beliefs and practices concerning the utilization of flora and botanical derivatives for animal therapy. This ancestral wisdom is invaluable and limited to a select few individuals, necessitating documentation and societal application. The Rigveda, the Atharveda, and Ayurveda are foundational texts that provide insights on the therapeutic qualities of plants as veterinary remedies. Consequently, during the Vedic era (3500 B.C. to 200 B.C.), notable Indian medical practitioners (Vaidya) and herbalists such as Dhanvantari, Atreya, Nagarjuna, Patanjali, Baghabhatta, Shushruta, and the Hindu Hippocrates Charak emerged as legendary figures who engaged in traditional Indian medicine for societal benefit (Shrivastava *et al.*, 2017).

Ethno-veterinary research and development refers to the comprehensive interdisciplinary examination of indigenous knowledge together with its related skills, practices, beliefs, practitioners, and social frameworks concerning the health treatment and management of economically valuable animals. Conventional ethnoveterinary methods rely on the intrinsic expertise of traditional healers, are easily accessible, simple to use, and offer economical alternatives to allopathic medications. Nevertheless, the conventional wisdom possessed by traditional healers lacks enough documentation and necessitates validation through research studies. Furthermore, the accessibility of contemporary veterinary services has led to a reduction in the application of old ethnoveterinary methods (Devi, 2021) [8].

Ethno-veterinary techniques encompass the conventional treatment of animal ailments, their cures, and the spiritual components linked to the healing rituals employed by a society. Agriculturalists cultivate ethno-veterinary practices in rural settings and stables instead of in research facilities. Ethno-veterinary practices are transmitted orally from one generation to the subsequent generation. It is more spontaneous, less structured, and is generally transmitted orally instead of through written means. Due to the benefits of contemporary veterinary techniques, ethno-veterinary medicine faces the threat of obsolescence. The relationship between humans and animals dates back to the inception of civilization, characterized by mutual benefit from ancient times. The existence and economic stability of rural inhabitants depend on cattle. Individuals generate income by marketing their livestock and goods to those need them.

Humans depend on their animals to fulfill various need, such as sustenance, dairy, apparel, farming, fertilizers, labor, and currency. Numerous clans in India, including the Raika and Gujjar, have migrated from one area to another in pursuit of grazing land for their livestock. Due to the absence of veterinary access throughout their move, they relied on their own expertise to care for their livestock (Meena *et al.,* 2021). These traditions and wisdom were transmitted verbally from one generation to the next. Ethno-veterinary medicine encompasses a diverse array of patterns and classifications. It relies on the accessibility of indigenous herbs and flora that are easily obtainable in the region, cost-effective, exhibit few adverse effects, and are ecologically sustainable relative to contemporary medicine. The Atharva Veda is acknowledged as a repository of conventional medicine, encompassing remedies for animal care, in numerous ancient Indian texts. Additional historical manuscripts encompass the Agni Purana, Devi Purana, Garuda Purana, Skand Purana, Matsya Purana, and Linga Purana, alongside the Charaka Samhita, Susruta Samhita, and Shalihotra, which provide insights into the application of medicinal flora for addressing animal health issues (Meena *et al.,* 2024) [21].

Livestock is integral to the Indian economy, providing substantial support to agriculture and the livelihoods of many. In rural regions, the raising of cattle offers job prospects for countless individuals, bolsters local economies, and enhances food security (Thornton, 2010). Numerous health complications, including illnesses and disorders, can severely impact animal well-being and productivity, presenting obstacles for farmers and the entire livestock industry. A significant challenge encountered by rural areas is the accessibility of veterinary pharmaceuticals. Isolated areas and insufficient infrastructure frequently lead to insufficient availability of veterinary pharmaceuticals (Jaime *et al.,* 2022). Ethno-veterinary pertains to the aggregate of beliefs, customary knowledge, competencies, and methodologies about animal well-being. These essential resources function as a principal method for tackling diverse animal health concerns, providing native remedies and treatments for various ailments (Stucki *et al.,* 2019). These customs have been transmitted across generations, utilizing indigenous resources and conventional therapeutic techniques. Ethno-veterinary medicine functions as a significant alternative or supplementary method, particularly in regions with restricted access to traditional veterinary services and pharmaceuticals (Tebug *et al.,* 2022; Krishna *et al.,* 2023) [16, 36].

Conventional animal healthcare methods, known as ethnoveterinary medicine, offer economical options in circumstances where Western pharmaceuticals and veterinary services are inaccessible or prohibitively priced. Conventional wisdom can encompass cultural, social, and technical insights, or it may have been acquired via significant endeavors of persistence and progress (Khadda *et al.,* 2018). India is an agrarian nation, with about 65% of its populace reliant on agriculture and animals. India holds the distinction of being the foremost milk-producing nation globally, attributed to its significant reliance on agriculture and cattle (NDDB 2017). Farmers in India with few resources heavily depend on traditional medicine because of their restricted access to contemporary health prevention methods and a notable absence of modern healthcare facilities in their regions (Khandelwal *et al.,* 2017). Although traditional knowledge is crucial for cattle health and productivity, its documentation is largely overlooked in most remote regions of India (Meena *et al.,* 2019) [22].

Ethnoveterinary Plants

Natural ecosystem services have fundamentally influenced the emergence of human civilization, providing essentials such as food, fodder, clothing, and shelter. The varied assortment of plant species has been employed by humans for survival and nourishment throughout history. From the dawn of human civilization, cattle have played a pivotal role in agricultural advancement, socio-economic equilibrium, and cultural identity, acting as a fundamental element of human existence. In a like manner, flora have historically served not just as essential providers of human medical care but also as crucial assets for sustaining animal well-being. The collective traditional wisdom on botanical treatments for animals has transformed into what is nowadays known as ethnoveterinary medicine (EVM). Comprehending the significance of these flora in livestock health management will greatly aid in formulating integrative veterinary methodologies that are regionally suitable, sustainable, and advantageous for both animal and human communities. At now, enthusiasm for EVM as an efficient and economical method for animal care has markedly risen (Praveen *et al.,* 2026) [26].

The word ethnoveterinary encompasses not just herbal and traditional remedies but also includes knowledge, practices, beliefs, skills, techniques, technologies, breed selection, and human resources. It was noted that nearly every component of the plant is utilized in the formulation of ethno-veterinary remedies. These consist of bark, foliage, stems, blossoms, roots, seeds, and fruits (Kumar *et al.,* 2018) [17]. The present evaluation observed that the majority of plants may be applicable to many animal ailments. Given the veterinary application of the cited medicinal flora, additional pharmacological investigations are necessary to validate the efficacy of these herbal treatments (Eiki *et al.,* 2021) [9].

Local populations have utilized plants for therapeutic purposes since ancient times. It is an acknowledged truth that plants provide a powerful remedy for treating numerous ailments. Ethnoveterinary medicine refers to the ideas, knowledge, skills, methods, and practices of individuals concerning animal health, which serve as a crucial source of treatment for cattle in rural regions. The application of ethnoveterinary medicine offers a more economical and sustainable option compared to manufactured pharmaceuticals. Ethnoveterinary remedies date back to the inception of animal domestication. These botanical remedies, rooted in centuries of conventional wisdom and application, are utilized by pastoralists and agriculturists over time for the management of various livestock ailments (Hassan *et al.,* 2014) [12]. Ethnoveterinary medicine prioritizes conventional animal health management and encompasses individuals' insights, techniques, competencies, practices, and convictions related to animal health care. Investigations in this domain are often executed within a community-oriented framework aimed at enhancing animal welfare and delivering fundamental veterinary services in rural areas. Ethnoveterinary practices are shaped by the cultural traditions and the community or ethnic group. Due to its safety, effectiveness, and cost-effectiveness, rural populations are embracing plant-based traditional therapeutic methods (Singh *et al.,* 2022) [34]. The

awareness of these methods, frequently transmitted throughout generations, demonstrates a profound comprehension of indigenous vegetation, animal health interactions, and the socio-cultural significance of cattle in these societies (Chavula *et al.,* 2024) [5].

Phytochemical Estimation of Plants

The use of plants for prevention and treatment of various health ailments has been in practice since time immemorial and it is estimated that about 25% of drugs prescribed are derived from plants, moreover, who's essential medicine list contains 252 drugs out of which 11% is exclusively of plant origin (Jana and Shekhawat, 2010) [13]. Phytochemical screening of plants has revealed the presence of numerous chemicals including alkaloids, tannins, flavonoids, steroids, glycosides and saponins etc. Secondary metabolites of plants serve as defense mechanisms against predation by many microorganisms, insects and herbivores. Plant products have been part of phytomedicines since time immemorial. These can be derived from any part of the plant like bark, leaves, flowers, roots, fruits, seeds, *etc* i.e., any part of the plant may contain active components. Knowledge of the chemical constituents of plants is desirable because such information will be of value for the synthesis of complex chemical substances (Tomar, 2012) [38].

Phytochemical progress has been aided enormously by the development of rapid and accurate methods of screening plants for particular chemicals. So many secondary metabolites contained in medicinal plants have been identified as active drugs. These active metabolites are broadly divided into a number of chemical groups among which are alkaloids, volatile essential oils, phenols and phenolic glycosides, resins, oleosins, steroids, tannins and terpenes etc. Natural products are mainly derived from medicinal plants, which are tested in *vitro* and in *vivo* models and used to investigate the mechanism of action of drugs with potential biological properties (Tripathi and Singh, 2020) [40].

Rajasthan is placed at sixth place in India from the point of view of tribal population. Bhil, Meena, Garasia, Damor, Sahariya, Gujar, Kathodia, Dindor, Ahari, Raot, Parmar, etc. are the important tribal sub-groups inhabiting the region. Rajasthan has a total livestock population of 3, 82, 840, 00 major part of which consists of cows, buffaloes, sheep and goats1. Tribals of this region have a predominantly livestock-based economy. Some of the best breeds of cattle, goat, sheep camel, wild ass and even wild ungulates are found here. Though there is no authentic evidence of when and how plants and animals came into usage for curing the domestic animals, the tribals seem to be aware of it through generations (Galav *et al.,* 2013) [10, 11].

Table 1: Various studies related to ethnomedicinal and ethnoveterinary survey of plants.

Author (Year)	Study Focus	Major Findings
Oublid *et al.,* (2026) [25]	Phytochemical analysis and bioactivity of *Withania adpressa*	Methanolic extract showed highest phenolics and flavonoids with strong antioxidant, antifungal and insecticidal activities.
Ullah *et al.,* (2024)	Ethnoveterinary medicinal plants	Documented 52 plant species (28 families) used for treating 32 livestock diseases; Asteraceae was the dominant family.
Bairwa (2023) [2]	Ethnomedicinal plants of Alwar, Rajasthan	Reported 26 medicinal plant species from 19 families used against cough, cold and asthma.
Krishna *et al.,* (2023) [16]	Ethnoveterinary practices	Identified 183 plant species belonging to 70 families; Euphorbiaceae was the dominant family.
Rehman *et al*. (2022)	Ethnoveterinary knowledge in Pakistan	Recorded 56 medicinal plant species used for treatment of 45 livestock ailments.
Singh *et al.,* (2022) [34]	Documentation of ethnoveterinary knowledge	Reported 43 plant species for treating 11 livestock diseases; leaves were the most frequently used plant part.
Mandal & Rahaman (2022) [19]	Ethnoveterinary medicinal knowledge	Documented 232 plant species used to prepare 306 remedies for 79 livestock disorders.
Purohit (2020) [27]	Ethnomedicinal plants of Rajasthan	Identified 106 medicinal plant species used by tribal communities for various ailments.
Aziz *et al.,* (2020) [1]	Review of ethnoveterinary plants in Pakistan	Reported 474 medicinal plant species used in 2,386 remedies; digestive disorders were the most commonly treated.
Kumar (2020)	Phytochemical screening of *Nyctanthes arbor-tristis*	Detected carbohydrates, proteins, flavonoids, alkaloids, tannins and phenolics.
Meena *et al.,* (2019)	Ethnoveterinary plants and formulations	Reported 50 medicinal plants from 35 families; whole plants and leaves were predominantly used.
Tilahun *et al.,* (2019) [37]	Ethnoveterinary medicinal plants of Ethiopia	Documented 645 medicinal plant species; leaves and oral administration were predominant.
Kasera *et al.,* (2018)	Phytochemical evaluation of medicinal plants	Evaluated primary and secondary metabolites; significant seasonal variation in alkaloids and phenols was observed.
Sharma & Bhardwaj (2018) [30]	Phytochemical study of *Marsilea* spp.	Determined variations in sugars, proteins, phenols, starch, proline and ascorbic acid among plant organs.
Dev *et al.,* (2018) [7]	Antioxidant and phytochemical characterization	Polyherbal extract rich in tannins, alkaloids, flavonoids and phenols exhibited superior antioxidant activity.
Suroowan *et al.,* (2017) [35]	Review of ethnoveterinary plants in South Asia	Reported 276 plant species from 95 families; herbs and plants for gastric disorders predominated.
Joshi *et al.,* (2016) [14]	Himalayan aromatic medicinal plants	Reviewed ethnopharmacology and phytochemistry of 116 aromatic medicinal plant species.
Bajpai *et al.,* (2015) [3]	Medicinal tree diversity	Documented 204 medicinal tree species belonging to 143 genera and 50 families.
Meena & Kumar (2015) [23]	Ethnoveterinary plants of Karauli	Documented traditional ethnoveterinary knowledge and medicinal plant utilization by local communities.

Hassan *et al.*, (2014) [12]	Ethnoveterinary medicinal plants	Reported 28 plant species used for livestock ailments; leaves were the most commonly utilized plant part.
Mayer *et al.*, (2014) [20]	European ethnoveterinary review	Reviewed 590 medicinal plant species from 102 families used in animal healthcare.
Das *et al.*, (2014) [6]	Phytochemical analysis of *Costus speciosus*	Identified proteins, carbohydrates, saponins, tannins, steroids, flavonoids and phenols in different plant parts.
Singha *et al.*, (2013)	Phytochemistry of *Ocimum sanctum*	Reported alkaloids, steroids and tannins with significant antimicrobial activity.
Sanghai *et al.*, (2013) [28]	Phytochemical investigation of *Malvastrum coromandelianum*	Identified alkaloids, tannins, proteins, carbohydrates, flavonoids and β-sitosterol.
Sharma *et al.*, (2012) [31]	Ethnoveterinary remedies	Documented 72 plant species used to treat 33 livestock ailments; Fabaceae was the dominant family.

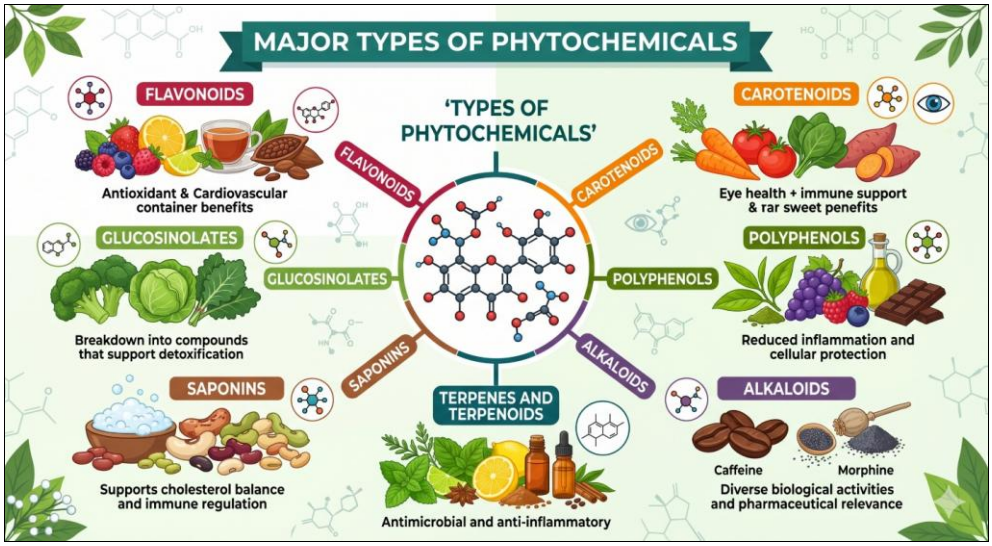

Fig 1: Different types of phytochemicals and their medicinal uses.

Conclusion

The present review emphasizes the great importance of ethnomedicinal and ethnoveterinary plants as valuable natural resources for human health care and livestock health care. The traditional knowledge of the indigenous and rural people especially of Rajasthan is a rich storehouse of plant-based remedies, which have been used effectively for generations. Medicinal plants have different bioactive phytochemicals like alkaloids, flavonoids, phenolics, tannins, saponins, glycosides, and terpenoids as reported in several studies reviewed in this chapter. These bioactive phytochemicals are responsible for antioxidant, antimicrobial, anti-inflammatory, insecticidal, and pharmacological properties. Many traditional claims have been scientifically validated by phytochemical and pharmacological research and have proved to be strong evidence that links the indigenous knowledge with modern medicine. However, rapid erosion of traditional knowledge, degradation of habitats and overexploitation of medicinal plant resources pose serious challenges to their conservation and sustainable use. Therefore, systematic documentation, phytochemical characterization, biological evaluation, and conservation of ethnomedicinal and ethnoveterinary plants are essential to conserve this invaluable heritage and promote the development of safe, effective and eco-friendly herbal therapeutics for human and veterinary healthcare.

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