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Ethnopharmacological Assessment of Medicinal Plants Used in the Management of Livestock Ailments by Resource-Limited Farmers in the Eastern Cape Province

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Abstract

Medicinal plants play a major role in meeting people's medical and health needs, especially in developing countries. However, due to a lack of access to modern veterinary facilities, poor visibility of animal health personnel, and high prices of orthodox medicines, most farmers rely on traditional healers and the administration of medicinal plants to treat livestock ailments. The present study was conducted to document Ethnopharmacological knowledge of medicinal plants used to manage livestock ailments in three rural communities of the Eastern Cape. This study was carried out in three rural communities between July 2009 and February 2010. Data were collected by administering pre-tested semi-structured questionnaires and participative field observations. For the interviews, a sample of 48 knowledgeable respondents was purposively selected. Data were analyzed using descriptive and inferential statistics, determination of information consensus factor, and fidelity level. A total of 12 medicinal plants belonging to 9 families were used by local people to cure different ailments. A high number of medicinal plants were claimed by males compared to females. Roots and barks were the major plant parts used, and the least were leaves (27.3%). Six plants were used to treat diarrhea and fertility, five plants to treat wounds, and two plants to treat scabs. This study has shown that Eastern Cape flora is rich with various plants which could be used to replace orthodox drugs. Further studies are needed to determine the minimum inhibitory concentrations, biological activities, and toxicities and characterize the plant's chemical compounds.

Keywords

Ethnopharmacology, Medicinal Plants, Livestock Ailments, Farmers, Eastern Cape

1. Introduction

Medicinal plants have been used worldwide and are regarded as essential natural resources because of their efficacy, availability, and cultural beliefs [1] [2]. They have been used as shelter, clothing, food, flavors, and fragrances, not the least medicines [3] [4] [5] [6]. The use of medicinal plants with therapeutic properties is as ancient as human civilization and, for a long time, mineral, plant, and animal products were the primary sources of drugs [7]. Plant-based ethnoveterinary medicine is widely practiced by various ethnic groups in many undeveloped nations, such as South Africa, because livestock husbandry is an essential source of income [8] [9].

According to [10], the Eastern Cape Province (ECP) owns 29 percent of the country's livestock herds/flocks, with smallholder farmers owning the majority. The strong linkage between agriculture and the economy remains crucial for economic growth and poverty alleviation in South Africa. Livestock production plays an essential role in guaranteeing food security income for households and contributing to the economy [10].

Nutrition and diseases are the key factors that hinder sustainable production and the maintenance of animal health [11] [12] [13] [14]. Infectious and non-infectious diseases generate considerable economic losses in South Africa's livestock farming, resulting in extensive mortality and morbidity and negative repercussions for animal welfare, health, production, and high treatment costs [15] [16]. In addition to their usefulness in the animal health care system, challenges such as the development of drug resistance in livestock and consumer-unfriendly effects such as excessive antibiotic residues in milk and other animal by-products have increased the importance of ethnoveterinary medicines [17].

Antibiotics are often used to manage livestock ailments to decrease mortality from clinical diseases [18] [19]. The use of these antibiotics in animal husbandry has been restricted globally due to the transmission of traces of antibiotics in meat [20]. There is, therefore, a necessity to look for new alternatives that can replace the function of antibiotics used in the livestock production process.

According to [21], traditional livestock management using medicinal plants is of great socioeconomic importance for farmers and pastoral populations. Naturally available medicinal plants have been tested to combat some pathogens affecting humans and animals, as they contain a wide range of active substances that can induce biological functions [22] [23]. Medicinal plants are cheaper than Western drugs [24] [25]. Their extracts have been utilized as alternatives to the antibiotics used in ruminant nutrition [26].

This study aimed to document Ethnopharmacological knowledge on ethnoveterinary practices in three previously undiscovered settlements in the Eastern Cape Province. Various ethnobotanical studies have been conducted in the surrounding areas and some of the investigated locations due to livestock producers' increased reliance on therapeutic herbs [27]. Despite the Eastern Cape's strong agricultural past, these potential locations have received little attention from an ethnoveterinary standpoint. The current research is part of a larger effort to investigate in detail the ethnoveterinary practices used in seven Eastern Cape regions. People in these regions have sound Ethnopharmacological knowledge and are actively using ethnoveterinary practices to improve the health of their livestock and supplement their income. The current study's findings would contribute significantly to the preservation of valuable traditional ethnoveterinary knowledge. The results will further provide baseline data for future *in vitro* and *in vivo* studies that could identify novel active compounds and develop low-cost, low-side-effect veterinary drugs.

2. Materials and Methods

2.1. Ethical Consideration

Before the commencement of data collection, ethical clearance was obtained from the Research Ethics Committee at Dohne Agricultural Development Institute (Registration number: 01/2012). To protect the rights and welfare of the interviewees, guidelines based on the protection of indigenous knowledge bill (2013) were followed. Consent was sought from the farmers prior to the commencement of the trial using a language of their choice. The farmers were assured of the confidentiality of the information provided during the study period.

2.2. Study Areas

The current investigation was carried out in three villages in the Eastern Cape's Amathole and O.R. Tambo districts (**Figure 1** and **Table 1**). The study's villages were chosen based on preliminary surveys conducted by the first author, which revealed that the communities' residents have a wealth of undocumented traditional knowledge regarding the use of traditional medicines. The villages were chosen based on the apparent willingness of healers in the communities to collaborate with the study's goals. The medical plant specimens were collected with informants in places where they typically collected plant materials for use, pressed, dried, and mounted on standard herbarium sheets, and afterward identified using Flora of South Africa as illustrated in the published book 'Trees of South Africa [28]. The specimens that were accurately identified were deposited in the ECP's herbarium, DADI, Stutterheim. In **Table 1**, the voucher numbers are shown.

2.3. Data Collection and Analysis

Peer recommendations from extension personnel and community leaders were

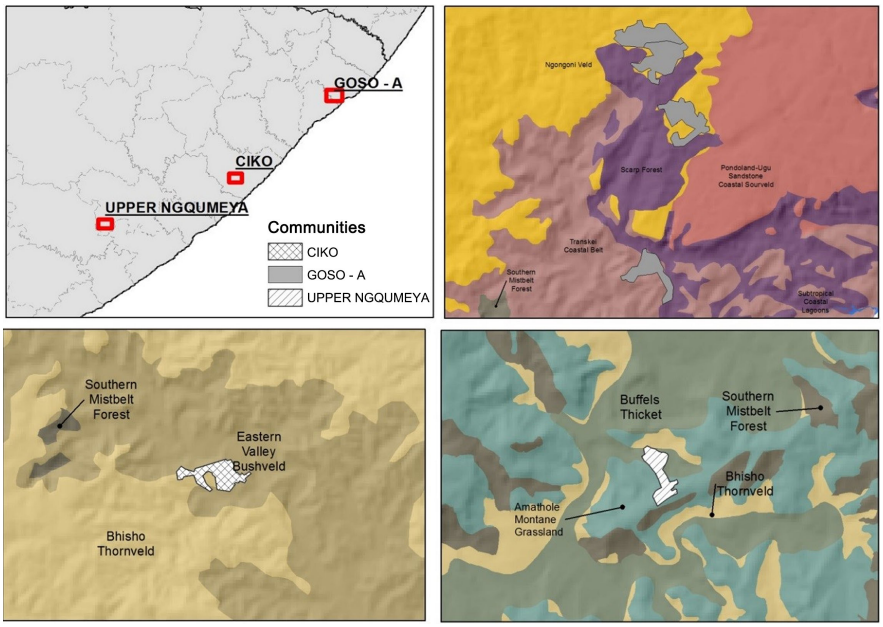

Figure 1. Map study areas showing the communities where the study was conducted.

Table 1. Shows description of study site (villages) in the district municipalities.

District municipality	Local municipality	Description of the study sites
Amathole	Amahlathi	**Upper Ngqumeya** found 10 km South of Keiskammahoek town, 32˚43'08.87"S longitude and 27˚07'42.14"E latitude. Vegetation is a mixture of thicket, forests, savanna and grassland.
	Mbhashe	**Ciko** found 7 km East of Willowvale town, 32˚16'11.18"S longitude and 28˚32'03.22"E latitude. Vegetation is thicket of the Eastern Valley Bushveld
O.R. Tambo	Ngquza Hill	**Goso** found 15 km South of Lusikisiki town, 31˚22'49.38"S longitude and 29˚35'48.57"E latitude. Vegetation is Indian Coastal Belt.

used to contact a total of 100 informants from the research locations. Each respondent who was approached was given a full explanation of the study's aim, including research objectives, data-gathering techniques, and the desire to publish data. Following that, only participants who accepted to participate in the study and signed an individual written prior informed permission were interviewed in detail for data collecting reasons. Interviews with 48 informants utilizing a semi-structured questionnaire with predetermined open-ended and direct questions were used. Each participant was interviewed using their vernacular language (IsiXhosa) and later translated to English at Dohne Agricultural Development Institute (DADI). The plants used, diseases and ailments treated, processes of preparation and administration of herbal remedies, and elements of time and place that they deem crucial when harvesting medicinal plants were all discussed during the interviews. Individual healers were questioned, and most of the inter-

views took place in their homes or at locations where they collected plants for treatments.

Microsoft Excel was used for data management and entry. All the collected data were coded and entered into the computer with excel. The Statistical Package for Social Sciences (SPSS) software version 20 computer program was used for data analysis. Descriptive statistics such as frequencies, distributions, and percentages were used to summarize the data.

3. Results

The current study found that in the three villages, respondents use a variety of flora to treat a variety of ailments, and the locals have a wealth of traditional medicinal plant knowledge. The age of the informants ranged from 21 to 82 years old. An interesting finding was that, while both males and female participants used medicinal plants, males were the most common, accounting for more than 60% of the informants (Table 2). A total of 12 plant species from nine different families were identified as being used, Fabaceae was the most abundant family (three species) followed by Rhamnaceae (two species). Each of the other families had only one species (Table 3). The majority of the informants mostly used trees (75%) for herbal preparation followed by shrubs (25%) (Table 3). Leaves were the most frequently used plant part accounting for 58.3%, followed by barks (25.0%) and roots (16.7%) were used for herbal preparation. The medicinal plants for the treatment of different ailments were prepared and administered using various methods. Infusions and decoctions were the most common procedures of medicinal preparation/extraction. For distinct plant preparations, two different administrative routes were used in this study namely: oral (89%) and cutaneous (56%). A total of four ailments were discovered to be treated with the identified medicinal plants, with poor fertility being the most common, followed by diarrhea, wounds, and scabs, according to the informant's knowledge (Table 3). Of the recorded medicinal plants, 91.7% are from the wild and 8.3% from the homestead. Information consensus results have shown a high degree of consensus for fertility (0.88), diarrhea (0.84), scab (0.80), and wounds (0.78) (Table 4). The present study revealed seven medicinal plants having high Fidelity Level (FL) values (Table 5). *Vachellia karroo* ranked first scoring the highest FL value (90.0%) followed by *Grewia occidentalis* ranked second (83.9%), *Olea europaea* subsp. Africana ranked third (76.2%), *Rhamnus p*rinoides ranked fourth (72.7%), *Lippia javanica* ranked fifth (71.4%), *Elephantorrhiza elephantine* ranked sixth (71.0%), and *Asparagus africanus* that ranked the seventh (60.0%).

Table 2. Information consensus factor rates of the medicinal plants used.

Variables	Character	Response	Percentage
Gender	Male	31	64.4
	Female	14	35.4
Age	Young (<35)	10	20.8
	Adult (>35)	38	79.2

Table 3. List of plants used in treating animal diseases in the study areas.

Family local n	*Local name*	*Habitat*	*Part used*	*Herbal formulation*	***Growth forms***	*Mode of application*	*Medicinal uses*
Asphodelaceae *Aloe ferox* P.	Ikhala	Wild	Leaves	Infusion & decoction	Tree	Dermal & oral	Wounds, diarrhea, scab
Asparagaceae *Asparagus africanus*	Umathunga	Wild	Leaves	Infusion & decoction	Shrub	Oral & dermal	Fertility, wounds
Fabaceae *Acacia karroo*	Umnga	Wild	Bark	Infusion & decoction	Tree	Oral & dermal	Diarrhea, wounds
Elephantorrhiza elephantine	Intolwane	Wild	Roots	Decoction	Tree	Oral	Fertility
Schotia latifolia	Umngxam	Wild	Bark	Decoction	Tree	Oral	Diarrhea
Malvaceae *Grewia occidentalis*	Umnqabaza	Wild	Leaves	Infusion & decoction	Shrub	Dermal and oral	Wounds, fertility
Oleaceae *Olea europaea* subsp. Africana	Umnquma	Wild	Bark	Decoction	Tree	Oral	Diarrhea
Rhamnaceae *Rhamnus prinoides*	Umlindi	Wild	Leaves	Decoction	Tree	Oral	Fertility
Ziziphus micronata	Umphafa	Wild	Roots	Decoction	Tree	Oral	Enhance fertility, diarrhea
Rosaceae *Prunus persica*	Ipesika	Homestead	Leaves	Infusion & decoction	Tree	Oral & dermal	Diarrhea, wounds
Vitaceae *Rhoicissus tomentosa*	Isaqondi	Wild	Leaves	Decoction	Tree	Oral	Fertility
Verbenaceae *Lippia javanica*	Inzinziniba	Wild	Leaves	Infusion	Shrub	Dermal	Scab

Table 4. Information consensus factor rates of the medicinal plants used.

Diseases category	Number of species (N_t)	All species (%)	Number of use reports (N_{ur})	Information consensus factor (F_{ic})
Scab mites	2	10.5	6	0.80
Fertility	6	31.6	41	0.88
Wounds	5	26.3	19	0.78
Diarrhea	6	31.6	32	0.84

Table 5. Most used medicinal plants and their major uses with their fidelity level (0 = least, 100 = the highest efficiency).

Family & scientific name	Uses	Ip	Iu	FL %
Asphodelaceae *Aloe ferox*	Wounds, Diarrhea, Scab	13	30	43.3
Asparagaceae *Asparagus africanus*	Enhance fertility, wounds	9	15	60.0
Fabaceae *Acacia karroo*	Diarrhea, wounds	18	20	90.0
Elephantorrhiza elephantine	Enhance fertility	10	14	71.0
Schotia latifolia	Diarrhea	2	5	40.0
Malvaceae *Grewia occidentalis*	Wounds, enhance fertility	26	31	83.9
Oleaceae *Olea europaea* subsp. Africana	Diarrhea	32	42	76.2
Rhamnaceae *Rhamnus prinoides*	Enhance fertility	8	11	72.7
Ziziphus micronata	Enhance fertility, Diarrhea	4	27	14.8
Rosaceae *Prunus persica*	Diarrhea, Wounds	14	38	36.8
Vitaceae *Rhoicissus tomentosa*	Enhance fertility	19	41	46.3
Verbenaceae *Lippia javanica*	Scab	15	21	71.4

4. Discussion

Ethnoveterinary applications of the local plant species play a vital role in the local microeconomics and livelihood of communal farmers in the Sub-Saharan region of the African continent. It is believed that Ethnomedicine is cheaper than allopathic remedies as result, they are most preferred by the semi-nomadic population [24] [25]. The current study revealed that in some parts of the Eastern Cape indigenous plant species are still used as a cheaper remedy for animal health care by the local communities (**Table 3**). However, exploitation of these natural resources or medicinal plants may occur due to uncontrolled access [29].

Taxonomic analysis indicated that Fabaceae and Rhamnaceae were the dominant families as shown in **Table 1**. Fabaceae is known as the largest plant family after Orchidacea and Asteracea which are rich in essential oils and other secondary metabolites [30] [31]. According to previous studies in South Africa [8] [32], and other countries the Fabaceae plant family was the most extensively used by traditional healers for cattle sickness therapy. Moreover, the abundance of Fabaceae and Rhamnaceae families could be caused by wider distribution in selected study areas and their diverse traditional uses for the pastorals. The high usage of Fabaceae and Rhamnaceae could be triggered by high concentrations of bioactive compounds [33] [34].

Some of the plant species documented in this study were also found to be used in other regions in the Sub-Saharan. [35] used *Aloe ferox* to control internal and external parasites in goats, [36] used *Asparagus africanus* for childbirth, [37] used *Schotia latifolia* for skin problems, [38] used Prunus persica and *Lippia javanica* to treat wounds, and [37]. *Rhamnus prinoides* was used to control anaplasmosis, ticks, and foot rot [39], *Rhoicissus tomentosa* was used to manage helminths [40], and *Olea europaea* subsp. Africana was used to manage constipation [41], and *Ziziphus mucronata* was used to treat wounds in cattle [42]. *Elephantorrhiza elephantine* was utilized to control diarrhea in studies conducted by [37] and [43]. [44] used *Acacia karroo* to treat diarrhea in livestock diseases. *Grewia occidentalis* was used to manage gall sickness [32].

The fact that the same plant species are used for the same condition in different places implies that they have a wide distribution and are useful in treating certain ailments. Trees were the most regularly used growth forms for the treatment of livestock ailments across all growth forms and habitats and they were widely grown (**Table 3**). More trees were recorded during the survey due to perennially, defense mechanisms against herbivores, deeper root system (taproot), ability to produce more seeds, and capability to withstand cold and dry conditions, resulting in their abundance and year-round availability. These results are contrary to most medicinal plant inventories, which show that herbs are the most common plant growth forms [45] [46]. The high frequency of occurrence of therapeutic plant species is explained by the fact that wild plants are rich in bioactive compounds [47]. Harvesting therapeutic plant species from farmlands

and home gardens was spurred by the necessity to have medicinal plant species close to homesteads to prevent having to travel long distances in search of them in the wild.

Leaves were the most widely used plant part in livestock treatment formulation (**Table 3**), generally created by infusion and decoction, which involves pouring water (hot, cold, or warm) onto the plant material and allowing the mixture solution to settle. Decoction, on the other hand, entails boiling plant components in a precise amount of water and allowing the concoction to cool before use. Similar findings were reported by [48], however, this author used different techniques for extraction namely crushing, pounding, and squeezing [1].

The variation in terms of extraction techniques may be influenced by culture and knowledge among different socio-cultural groups. Additionally, most medicinal plants used to treat livestock disease were orally taken, followed by topical application. [49] discovered a similar mode of delivery of medicinal plant treatments. Oral and cutaneous administrations were the predominant methods of administration for cattle illnesses therapies, according to [48] and [50].

In this study, leaves were used as plant parts for medicinal preparation for livestock, and similar outcomes were reported by numerous Researchers [49] [51] [52]. Farmers perceived that the use of leaves was most conservative and sustainable compared to the use of roots or stems. The use of stems and roots may result in a complete kill of the medicinal plant due to the dysfunction of the xylem and phloem in the plant's vascular system. However, the harvesting of leaves may negatively impact the process by which plants convert light energy into chemical energy (i.e. photosynthesis).

The Informant Consensus Factor (ICF) of four ailments is shown in **Table 4**. The highest level of ICF was obtained for fertility (ICF = 0.88) (**Table 4**). In agreement with our findings study conducted in Tanzania by [53] obtained 0.88 (ICF) for Jaundice. This shows the persistent use of traditional medicinal plants by local people in one part of South Africa. This point to the fact that although the local people have access to government animal health care support, still medicinal plants have not lost their value among the people living. Also, high ICF values can be used to pinpoint interesting species in search of bioactive compounds [54].

Fidelity Level (FL) was used to classify the recorded plant species based on their claimed relative effectiveness. As illustrated in **Table 5**, six plant species have FL range from 60% - 90%, which includes *Vachellia karroo*, *Grewia occidentalis*, and *Olea europaea* subsp. Africana, *Rhamnus prinoides*, *Lippia javanica*, *Elephantorrhiza elephantine,* and *Asparagus africanus*. Low FL indicated less-preferred species for treating specific ailments. Plant species with especially high-fidelity level values are regarded as viable candidates for additional pharmacological investigations, according to [55], this plant species warrants urgent attention. As a result, high FLs for specific species suggested that the plants may contain beneficial phytochemical substances.

5. Conclusion and Recommendations

The study area includes a huge reservoir of ethnoveterinary medicinal plants, according to the findings, and informants in the area have considerable traditional knowledge of how to employ these plants to heal their animals. In summary, we discovered flora species used by informants in the research areas to treat four cattle illnesses. *Vachellia karroo*, *Grewia occidentalis*, *Olea europaea* subsp. Africana, *Rhamnus prinoides*, *Lippia javanica*, *Elephantorrhiza elephantine*, and *Asparagus africanus* were among the most used species in the study area, with pharmacological importance in preventing or controlling various ailments on livestock. The phytochemical and pharmacological features of plants with high F_{ic} and FL values should be explored further. It is necessary to implement conservation strategies for multifunctional and other medical plant species. Before the demise of ethnoveterinary practices, young people should be mobilized to learn about them. The phytochemical and pharmacological investigations to isolate the active compound and test the *in vitro* or *in vivo* efficiency of the above-mentioned plants against the targeted veterinary diseases are important. In addition to this, critical toxicological investigations are required for the safe and secure use of documented ethnomedicine.

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Authors' Contribution

SM identified the research area and title, collected field data, and drafted the manuscript. JR participated in refining the title and the formation of the research problem. ZBD and ST provided useful scientific and technical inputs on the drafting of the manuscript and data analysis. All authors read and approved the final manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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