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## CHAPTER 7 : GENERAL DISCUSSION, CONCLUSION, AND RECOMMENDATIONS

### 7.1 Introduction

Livestock is crucial for several developing countries' economies. The livestock sub-sector significantly contributes to the national economy of most African countries including in Lesotho and South Africa; however, its growth is constrained by various factors (Perry & Grace, 2009). These factors consist of widespread infectious diseases that reduce market opportunities, harm human welfare, and cause livestock and agricultural productivity loss. Poor communities that primarily rely on livestock yet have little access to resources such as modern veterinary care are severely affected by animal diseases (Eiki *et al.*, 2021). These diseases have a significant economic impact on people. The most important causes of these diseases, which annually result in considerable livestock losses that impact the economy, animal variety, and ecological balance, are poor nutrition, breeding, hygiene, and management systems (Fatima & Amina, 2022).

Ethnoveterinary knowledge is the use of local people's habits, traditions, and beliefs to preserve the health and welfare of their domestic animals and treat livestock ailments. Ethnoveterinary research aims to investigate and apply traditional veterinary knowledge, theory, and practice (Erarslan & Kültür, 2019; Yigezu *et al.*, 2014). Most of this traditional knowledge of medicinal plants is either no longer used or completely lost, owing to the quick socio-economic, ecological, and technical changes in people's lifestyles over the years (Abraha, 2016). The issue, according to some authors, is worsened by beliefs that traditional activities are wicked, evil, and hence ungodly (Odongo *et al.*, 2018). When some religious groups hold such beliefs, the loss of this knowledge is guaranteed since religion plays a huge role in decision-making processes in most cultures.

Furthermore, some young people find it difficult to uphold their traditions and culture. At the same time, governments refuse to acknowledge the role played by ethnoveterinary practitioners in the prevention, management, and treatment of livestock diseases in various nations (Eika *et al.*, 2021). Madisha and McGaw (2023) also confirmed that many rural areas in Africa, especially in places with limited access

to western veterinary medicine, use ethnoveterinary medicine to treat livestock ailments, although this is poorly documented.

Indigenous herbal remedies are the only option for treating many livestock illnesses in rural areas because there is a shortage of veterinarians per capita, including essential services. The availability of current veterinary medications is restricted in many impoverished nations due to pricing, supply uncertainty, and shortages (McGaw & Eloff, 2008; Tolossa *et al.*, 2013). The vast variety of plant species and cultural groupings found in South Africa and Lesotho make it an ideal place to research traditional uses of plants for human and animal health (Eika *et al.*, 2021). The adoption of EVM by western-trained veterinary professionals and the relevant government agencies charged with promoting primary animal healthcare will only be able to advance once conventional methods for caring for animals and plant-based remedies have been adequately documented and evaluated for efficacy and toxicity (McGaw *et al.*, 2020).

## 7.2 General discussion

The ethnoveterinary survey findings were published in '[The Journal of Medicinal Plants and By-products](#)' as shown in Table 7.1. Some findings were further analysed for phytochemical constituents, antimicrobial activity, *in vitro* cytotoxicity and anthelmintic properties.

**Table 7.1: An overview of the results obtained from the current study**

<b>Ethnoveterinary survey</b>	<b>Most mentioned plants</b>	<b>RFC index</b>	<b>Phytochemical screening</b>	<b>Antimicrobial assay</b>	<b>In vitro cytotoxicity</b>	<b>Anthelmintic activity</b>
51 ethnove	<i>R. prinoides</i>	0.45	Standard method: Alkaloids, steroids, phenols, cardiac glycosides, tannins, flavonoids and saponins	+	Not done	Not done
rinary medicinal	<i>A. striatula</i>	0.38	Standard method: Alkaloids, steroids, phenols, cardiac glycosides, tannins, flavonoids and saponins	+	Not done	Not done
plant species	<i>M. burkeana</i>	0.29	Standard method: Alkaloids, steroids, phenols, cardiac glycosides, tannins, flavonoids and saponins	++	Highly toxic	Least active +
	<i>L. sericea</i>	0.25	Standard method: Alkaloids, steroids, phenols, cardiac glycosides, tannins, flavonoids and saponins	++	Mildly toxic	Highly active ++

The use of medicinal plants to cure animal-related conditions and diseases is well known, especially in poor rural and marginalised South African and Lesotho communities. However, the elderly, especially men, are the repositories of this knowledge. There are fears that this knowledge may be lost in time if it is not passed on to younger generations or not properly documented using modern methods. Documenting this knowledge for future reference and posterity is critical since most subsistence farmers and traditional healers rely on it. A study was conducted to document ethnoveterinary medicinal plant uses in the Free State province of South Africa and Lesotho. The results revealed 51 medicinal plant species belonging to 35 different families from 69 respondents. These medicinal plants are used to treat other diseases in the study areas, and the most mentioned or predominantly used plants were calculated using the relative frequency citation index. Four medicinal plants, including *Rhamnus prinoides*, *Aloe striatula*, *Leucosidea sericea* and *Monsonia burkeana*, were then selected to test their phytochemical properties qualitatively and quantitatively. Although alkaloids were absent, these ethnoveterinary medicinal plants possessed some important secondary metabolites. Plants that showed the presence of tannins and phenols were further subjected to quantitative analysis for total phenolic and tannin contents. *A. striatula* aqueous extract showed the highest presence of total tannins (2.242 mg/ml), and *R. prinoides* methanol extract showed the maximum phenolic contents (5.102 mg/ml). Chen *et al.* (2020), Amabye (2015), and Abebe (2023) showed that phenols as part of *R. prinoides* had noteworthy antioxidant, anti-inflammatory activities, and antimicrobial activities, justifying their use in its folkloric use to treat ringworm infections. Tannins in *A. striatula* potentially enable the plant to act against antimicrobial infections, gastrointestinal and inflammatory conditions (Cock, 2015).

The four medicinal plants were further investigated for antimicrobial activity. These plants were tested against eight bacterial strains and three fungal strains. *R. prinoides* showed some antibacterial activity, although *L. sericea* and *M. burkeana* showed more noteworthy results. *L. sericea* acetone extracts showed an MIC of  $\leq 0.098$  mg/ml against four bacterial strains with an MBC of 0.098 mg/ml, and its aqueous extract showed an MIC of 0.78 mg/ml and an MBC of 12.5 mg/ml against half of the bacterial strains tested. *M. burkeana* methanol extract displayed  $\leq 0.098$  mg/ml MIC against two bacterial strains, with an MBC of 1.56 mg/ml, while the aqueous extract showed an

MIC of 6.25 mg/ml and MBC of >12.5 mg/ml for all bacterial strains. The assay carried out against the fungal strains showed *A. striatula acetone* and *R. prinoides acetone* extracts to have obtained 0.049 mg/ml and 0.195 mg/ml against *Candida albicans* and *Trichophyton mucoides*, respectively. *M. burkeana* did not show much activity against the tested fungal strains, and *L. sericea* extracts showed no activity against all tested strains. These results confirmed other researchers' findings who reported that some extractants such as water are not effective and this is not in the best interest of subsistence farmers and traditional healers as they mostly or entirely use aqueous extracts (Dhawan & Gupta, 2017; Elfalleh *et al.*, 2019; Anyanwe & Okoye, 2017).

Following the antimicrobial activities of the selected medicinal plants, the noteworthy plant extracts, i.e., *L. sericea* (water and acetone) and *M. burkeana* (methanol and water extracts), were further screened for both cytotoxic and anthelmintic properties. Cytotoxicity tests were conducted to investigate the effects of the extract on cell viability in livestock. The assay was determined using four extracts against monkey Vero cells. The assay results displayed mild toxicity of *L. sericea* acetone extract; *L. sericea* has Phyto-constituents such as phenols, tannins, and alkaloids, which in their nature have cytotoxic effects. This medicinal plant showed that its aqueous extract is not toxic to the Vero cells. This may be due to the solubility of the extractant used.

*M. burkeana* results showed that its aqueous extract has low cytotoxicity, while the methanol extract has mild cytotoxicity. After being tested for cytotoxicity, these medicinal plant extracts were further screened for anthelmintic activity. Two tests were conducted: the egg hatch and the larval development assays. The L<sub>1</sub>, L<sub>2</sub> and L<sub>3</sub> stages of *Haemonchus* were exposed to different extracts of the tested medicinal plants. Both aqueous and acetone extracts of *L. sericea* showed the highest inhibition of larvae at 50 µg/ml with 98 % and 97 % respectively. All extracts showed less inhibition at 12 µg/ml, especially *M. burkeana* methanol extract, with 22.95 % inhibition of larvae. *L. sericea* further showed activity against the egg hatch assay as it inhibited 100 % at 25 µg/ml and 12.5 µg/ml for both acetone and water extract, respectively. However, *M. burkeana* methanol extract was the least recorded with 9.57 % at the highest 50 µg/ml concentration. These assays confirm that the two medicinal plants both possess ovicidal and larvicidal properties.

To extrapolate the cytotoxicity data to a recommended safe dose for animals, the LC<sub>50</sub> values based on Vero cells were scaled using standard interspecies scaling factors.

As a rule of thumb, a safety factor between 100-1000 is used to estimate a tolerable in vivo dose (mg/kg body weight) from the in vitro LC<sub>50</sub> according to OECD or WHO recommendation (OECD, 2009; WHO, 2005). The aqueous extract of *Monsonia burkeana* which had low cytotoxicity was assigned a conservative extrapolation factor of 1000 and an estimated safe dose of about 10 mg/kg if the LC<sub>50</sub> was 10,000 µg/ml. However, an additional cytotoxicity test showed cytotoxic effects with a dose of 100 µg/mL, and the methanol extract was scaled down 500 times to a tentative safe dose of 2 – 5 mg/kg based on which the actual LC<sub>50</sub> concentration values. The estimates offer a translational platform for future in vivo studies of therapeutics, to ensure prescribed doses are kept under cytotoxic levels, whilst also maintaining anthelmintic effectiveness. More crucially, these figures should be checked with acute and sub-chronic toxicity studies in the target animal species, prior to the extension of these findings into the field (OECD, 2010; WHO, 2005).

### 7.3 Conclusion

Animal ailments are frequently treated using conventional herbal remedies. The present study observed that most plants can be used to treat multiple animal diseases and are used in both highlands and grasslands of the Free State province of South Africa and Lesotho. The study further showed that four selected medicinal plants with the highest RFC indices from the ethnoveterinary survey were rich in secondary metabolites and active against bacteria and fungi. The two medicinal plants (*M. burkeana* and *L. sericea*) that displayed the highest antimicrobial activity were further tested for anthelmintic properties against livestock parasitic infections. They displayed impressive results, especially *L. sericea* and *M. burkeana*. The water extract indicated no cytotoxicity, and this justifies the farmers' use of water for extraction. Extract toxicity is very negligible. The present study thus validated the use of medicinal plants in traditional medicine. However, more work must be done to document these species for posterity. Suppose these species are not properly documented using modern methods. In that case, they may be lost in time and driven to extinction in the face of globalisation, urbanisation, monoculture, and climate change. The younger generations' interest in these plants also needs to be encouraged to keep local traditions of oral transfer of knowledge and information alive and to preserve their culture. However, further comprehensive studies are required to investigate their

phytochemistry and validate these species. Not much has been done in this regard. The solutions to drug resistance problems potentially lie in some compounds that have yet to be discovered in these plants. Although the road ahead is long, it looks promising.

#### **7.4 Recommendations**

The indigenous population continues to employ plants in ethnoveterinary medicine despite modern advancements and the creation of synthetic medications. Animal ailments are frequently treated using conventional herbal remedies. Some plants have poisonous elements that are harmful to animal health. These plants' adverse effects or overdose might be detrimental; to avoid overdose, harmful side effects, or even death, special care should be taken when using them, and dose adjustments ought to be done carefully. Further comprehensive studies are needed to investigate the phytochemistry of these medicinal plants and validate these species. These may include extensive in vitro, in vivo, and clinical trials.

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## **ANNEXURES**

### **INFORMED CONSENT FORM FOR LIVESTOCK FARMERS AND HERD BOYS**

**PROJECT TITLE: Medicinal properties of plants used for ethnoveterinary purposes in the Highland Grasslands the Free State and Lesotho**

#### **INTRODUCTION:**

You are invited to participate in a research study on **Medicinal properties of plants used for ethnoveterinary purposes in the Highland Grasslands of the Free State and Lesotho**. Please take your time to discuss the study with your family and friends, or anyone else you wish to. The decision to join or not to join is based on you. I am investigating on the treatment of animal diseases used by different ethnic groups using medicinal plants in the Highland Grasslands of Free State and Lesotho. Findings will be documented through catalogues and publishing in accredited journals which will be written in Sesotho for community members and the public at large. Aspects such as determining the phytochemical contents, evaluating medicinal properties of plants most commonly used in the study area and finally attempt to isolate, purify and identify the bioactive compounds of medicinal plants will be carried out.

#### **What is involved in the study?**

If you decide to participate you will be asked to share your knowledge of plants, their uses and methods of preparation. This project will take at least 3 years. You can stop participating at any time. If you stop, you will not lose any benefits.

#### **Risks**

There may be risks that we cannot predict.

#### **Benefits to taking part in the study**

It is reasonable to expect cultural, economic and environmental benefits from the research. However, we cannot guarantee that you will personally experience them from participating in this study. Others may benefit in future from the information we find in the study.

### **Your rights as a participant**

Participation in the study is voluntary. You have the right not to participate at all or to leave the study at any time. Deciding not to participate or choosing to leave the study will not result in any penalty or loss of benefits to which you are entitled, and it will not harm your relationship with the Central University of Technology.

### **Confidentiality**

Confidentiality will be provided to the fullest extent possible by law. We will write down the information you give us on interview sheets. We will keep information about you confidential and protect it from unauthorized disclosure, tampering, or damage. We will not identify you by name in any reports using information obtained from this interview. Subsequent uses of records and data will be subject to standard data use policies which protect the anonymity of individuals and institutions.

### **Contacts for questions or problems**

If you have questions about the study, any problems, or think that something unusual or unexpected is happening you can contact:

#### **Mr. Tankiso Mots'oari**

Faculty of Health and Environment Sciences

Central University of Technology

**Tel: (+266) 57555338/ (+27) 787913256**

**Email: [tk\\_motsoari@yahoo.com](mailto:tk_motsoari@yahoo.com)**

If you have any questions or concerns about your rights as a research participant, contact:

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**Email: [cvdwesth@cut.ac.za](mailto:cvdwesth@cut.ac.za)**

Consent of participant

---

Name	Signature	Date
Person taking consent		

---

Name	Signature	Date
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## INTERVIEW GUIDE FOR LIVESTOCK FARMERS AND HERD BOYS

### Demographic details

Name (Lebitso):

---

Gender(Boleng):

---

Age(Lilemo):

---

Race(Mohlobo):

---

Religion(Tumelo):

---

Marital status (Moemo ba lenyalo):

---

Level of education (Boemo ba thuto):

---

When did you start practicing as a livestock farmer/ herd boy? (U qalile neng ho rua/ho lisa liphoofole?)

---

---

What kind of livestock do you keep? (U ruile liphoofole lifeng)

---

---

How did you become a livestock farmer/ herd boy? (Ho tlile joang hore u be morui/molisana oa liphoofole)

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What other type of occupation are you involved in? (Ke ofeng mosebetsi o mong ntle le ho sebetsana le liphoofole?)

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Where did you work before you became a farmer/ herd boy? (U ne u sebetsa kae pele u sebetsana le liphoofole)

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## PUBLISHED ARTICLE FORM THE STUDY

Motsoari, T., Manduna, I., Buwa-Komoreng, L., Ngobeni, B. and Nwafor, I., 2023. Predominantly Used Medicinal Plants for Ethnoveterinary Purposes in the Highland Grasslands of South Africa and Lesotho: An Ethnobotanical Survey. *Journal of Medicinal plants and By-product*, 12(3), pp.293-303.

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### Original Article

## Predominantly Used Medicinal Plants for Ethnoveterinary Purposes in the Highland Grasslands of South Africa and Lesotho: An Ethnobotanical Survey

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#### ABSTRACT

Medicinal plants have been used for the maintenance of animal health in most parts of the world. However, ethnoveterinary knowledge is verbally passed on from generation to generation and can easily be lost or distorted if not documented for future reference. This study therefore seeks to ascertain the mostly used medicinal plants for ethnoveterinary practices in the research area. An ethnobotanical survey was carried out with 69 respondents consisting of subsistence livestock farmers, traditional healers and other traditional knowledge holders from four (4) towns in the study region. Interviews were conducted using semi-structured questionnaires designed to collect data on the plants used, their common names, methods of preparation and administration and livestock ailments treated. The relative frequency of citation (RFC) index was calculated in order to determine the most predominantly used plant species. Fifty-one (51) plant species were mentioned by respondents. *Rhamnus prinoides* L'Hér., *Aloe striatula* var. *striatula*, *Monsonia burkeana* Planch. ex Harv. and *Leucosidea sericea* Eckl. & Zeyh. were the frequently mentioned plants mostly from the Asteraceae family. Roots (45%) and leaves (43%) were the most frequently used plant parts. Approximately 84% of Medicines were prepared in the form of decoctions and administered orally. Thirteen (13) health conditions of livestock were treated with medicinal plants and bile acid malabsorption was the most predominant (39%). The study region is endowed with a rich biodiversity of medicinal plant species which are used for the treatment of various animal diseases. Therefore, it is imperative to establish the salient medicinal plant species used in this area for possible drug development.

#### INTRODUCTION

Livestock such as cattle, poultry, pigs, sheep and goats are of paramount importance in Africa. They provide food and transport, improve livelihoods and are of cultural value especially in rural settings. However, the high prevalence of diseases experienced in communal livestock production systems present a serious setback to profitability, food security and sustainability due to increased morbidity and mortality [1]. Additionally, the high cost of modern drugs, lack of access to veterinary facilities and increasing resistance of pathogens to

pharmaceutical medicines present numerous challenges to productivity [2]. In mostly rural and peri-urban areas, the options available to mitigate these problems are limited. Therefore, resource-poor smallholder farmers often turn to traditional methods such as the use of medicinal plants for disease management. In fact, the World Health Organization [3] estimates that 80% of people in developing countries use ethno-methods to monitor livestock-related diseases. It has also been reported that people utilize medicinal plants to treat various livestock diseases because they possess the