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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

knowledge of these plants' medicinal properties [4-6].

In South Africa and Lesotho, livestock farmers from different ethnic groups also utilize specific medicinal plants like *Aloe ferox*, *Aloe maculata* and *Lycium horridum*, for ethnoveterinary purposes. Health conditions such as diarrhea, fractures, eye inflammations, reproductive problems, ecto- and endo-parasitism, black quarter and digestive difficulties are but a few of the diseases which have reportedly been treated with these medicinal plants [5-8]. It is noteworthy to state that the traditional medicinal knowledge and practices within any culture may differ by environmental origin, ethnicity, religion, age and gender [2]. In most African backgrounds, ethno-knowledge is transmitted orally from generation to generation. Without adequate documentation, information from traditional knowledge holders can be easily lost or distorted, and insufficient knowledge may be passed on to younger generations [8-10]. Consequently, the documentation of traditional medicinal knowledge becomes important as it preserves vital information and creates a possibility for the discovery of new sources of drugs [11, 12]. Therefore, this research was carried out to document the various medicinal plants that are used to treat livestock diseases in selected areas of the highland grasslands of the Free State province of South Africa and Lesotho, and to highlight the salient plant species used for possible ethnoveterinary drug development.

MATERIALS AND METHODS

Description of the Study Area

This study was carried out in the highland grasslands of the Free State, South Africa (QwaQwa and Thaba 'Nchu) and Lesotho (Maseru and Mokhotlong) (Fig. 1). These areas were selected because of the high concentration of smallholder livestock farmers, their accessibility and the willingness of the informants to participate in the study.

The Free State is an inland province that is known to provide for most of the commercial farming of South Africa. QwaQwa is situated at 28°31'27"S, 28°48'57"E and 1646m elevation in the Free State. The area receives average annual rainfall of 687.8mm and the mean annual temperature is 15 °C. Thaba 'Nchu, located in the southeast of the Free State province, falls within coordinates 29°12'34"S, 26°50'20"E and an elevation of 1532m. The average annual temperature is 15.2 °C with about 629mm of annual precipitation [13,14]. The topography of both study areas can be described as a succession of flat plains, sprinkled with pasture lands. Frosty conditions which are prevalent in these areas inhibit tree development and aid in maintaining grass dominance [15]. The natural grassland vegetation boasts of wild grasses and flowers, and various species of wild animals and insects [16]. Generally, the Free State climate can be classified as arid in the west and semi-arid in the east [17].

The other two study locations are found in the mountain kingdom of Lesotho which is surrounded by South Africa. Maseru, the capital of Lesotho, is situated between 29.3151°S and 27.4869°E. The elevation is 1600m, the annual precipitation is 691mm and the mean temperature is 15.1 °C. Mokhotlong is located between 29.2573°S and 28.9529°E with an elevation of 2512m. Its annual precipitation is 601mm and the average annual temperature is 12.5 °C [18]. The two study areas in Lesotho are characterized by mountainous topography and situated in a basically grassland vegetation region [19,20] consisting of typical grass species like *Hyparrhenia hirta* and *Themeda triandra* [21]. In both the Free State and Lesotho, *Sesotho* which is the language of the *Basotho*, is widely spoken [13]. The majority of the *Basotho* gain their livelihood from subsistence farming and animal husbandry [21,22].

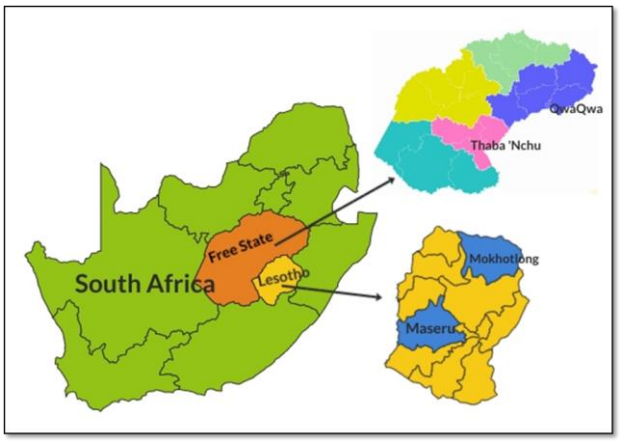

Fig. 1 Map of South Africa and Lesotho showing the study areas.

Ethnobotanical Survey

The study was approved by the Faculty Research and Innovation Committee (FRIC) at the Central University of Technology (CUT), Free State and all ethical protocol was observed. Interviews were held

with prior informed consent of participants. Semi-structured interviews were conducted with 69 respondents which were made up of subsistence livestock farmers who engage in ethnoveterinary practices, traditional healers or traditional knowledge holders in the study regions. The respondents were selected purposefully, with the assistance of community elders and local authorities, based on their traditional knowledge of medicinal plants and willingness to participate in the study. Two participants below the age of 18 assented to participate in the study and they were interviewed in the presence of their parents. Participants were interviewed in *Sesotho* or English language. Questions such as "what plants do you use?", "the local names of the plants" "health indications for plant use", "plant parts used", "method (s) of preparation and administration", "types of diseases cured", etc. were asked. The interviews were held either on the farm, homestead or communal locations in the selected study regions. The ethnobotanical survey was carried out from November 2018 to March 2019.

Collection of plant specimen and identification

The medicinal plants mentioned in the interviews were collected from their different habitats and identified with the assistance of the knowledge holders and a qualified Botanist. Environmental laws were taken into consideration during plant collection and the harvested plants were tagged with their local names. Thereafter, voucher specimens were prepared and deposited in the Centre for Applied Food Sustainability and Biotechnology (CAFSaB) of the Central University of Technology, Free State (CUT).

Data analysis

Data obtained from responses was cleaned and coded in Microsoft® Excel Worksheet ver.2019. Thereafter, descriptive statistics in the form of graphs and tables were drawn from the data. Results were validated using the relative frequency of citation (RFC) according to the procedures of Samaha et al. [23]. This procedure describes the importance of a plant based on its frequency of mention by respondents using the formula:

$$RFC_s = FC_s / N$$

Where:

FC_s is the frequency of citation; N is the number of respondents. The index varies from 0.0 to 1.0; the closer the values are to 1.0, the higher the consensus among the informants.

RESULTS

Demography of respondents

The demographic characteristics of the informants are presented in Table 1. As seen in the Table, the majority of respondents were from the Maseru region, followed by Mokhotlong and QwaQwa. Results of this study showed that the majority (28%) of respondents were between the ages of 66 – 75 years. Male respondents were higher (94%) than female respondents.

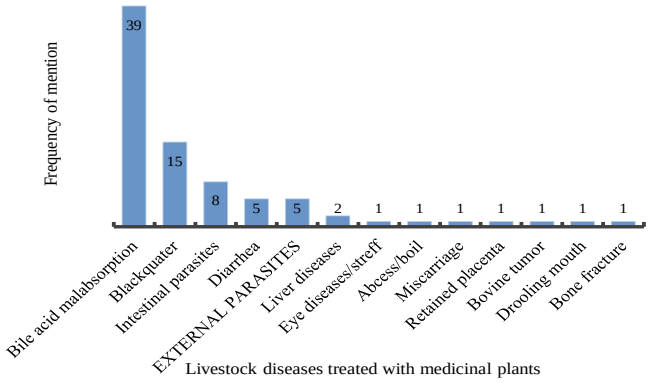

Fig. 2 Frequency of mention of livestock diseases treated with medicinal plants

Livestock Diseases and Conditions Treated with Herbal Remedies

The livestock diseases that are commonly treated with medicinal plants in the study areas are highlighted in Fig. 2. Digestive anomaly or liver malfunction which presents as excess bile acid circulation in the animal's body (bile acid malabsorption) was the most frequentlty (56.5%) mentioned disease. This condition in animals is locally known as *nyoko* in the study areas. Other significant diseases were black quarter and intestinal parasites.

Diversity of Medicinal Plant Species used in the Study Area

A total of 51 medicinal plants in the form of trees, shrubs, perennials, and grasses belonging to 35 families were documented in this study (Fig.3). The most predominant family was Asteraceae which had eight (8) species, followed by Asphodelaceae with

four (4) plant species. Anacardiaceae, Fabaceae, Hyacinthaceae, Lamiaceae, Rosaceae and Thymelaeaceae recorded two (2) species each, while the remaining families recorded one (1) species respectively (Table 2). These plants were collected from different locations such as mountains, valleys, homes (as weeds or cultivated in gardens) and in the veld. Plant roots (45%) and leaves (43%) were mostly used for herbal remedies while the oral route of administration ranked highest (84%).

Plant Species Listed per Study Area

The various plants that were listed per study area are shown in Fig. 3. Plants like *Senecio discodregeanus* (*Lehlomane le lenyanyene*), *Phytolacca heptandra* (*Monatja/ Monyela-ntja*), *Asparagus microraphis* (*Lerara-tau*) were commonly used in both the Free State, South Africa and Lesotho. Four plants were mentioned in all study areas depicting their common usage in these areas; these plants are *A. striatula* (*Mohalakane*), *Leucosidea sericea* (*Cheche*), *Monsonia burkeana* (*Khoara*) and *Dicoma anomala* (*Hloenya*). More plants (32) were mentioned in Thaba 'Nchu than in any other study locality.

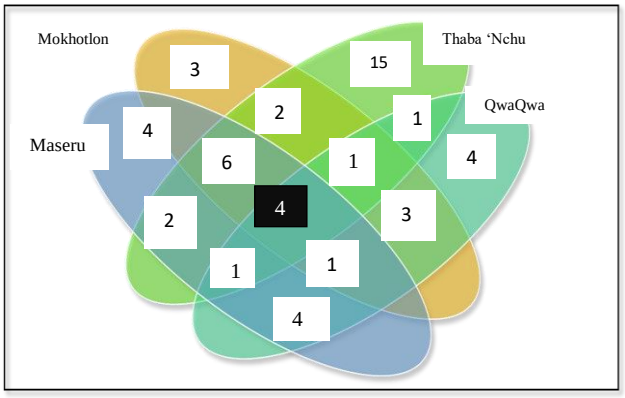

Fig. 3 Array of medicinal plants used for ethnoveterinary purposes in the study areas

DISCUSSION

The use of medicinal plants to treat livestock diseases has been a long-standing practice, especially among rural and resource-poor farmers. In this study, the majority (94%) of respondents were males. Similar results were obtained by researchers who also observed that most traditional healers and subsistence livestock farmers were men [1,19,24-27]. Women are traditionally believed or expected to perform home duties and to take care of their families. Also, there are existing taboos that exclude women from tending livestock or handling strong medicines [19,25].

Table 1 Demographic characteristics of respondents

Characteristics	Gender		Frequency	Percentage (%)
	Male	Female		
Age (years)				
16-25	3	0	3	4
26-35	6	0	6	9
36-45	13	0	13	19
46-55	11	3	14	20
56-65	13	1	14	20
66-75	19	0	19	28
Total	65	4	69	100
Level of education				
Primary education	40	4	44	64
Secondary education	4	0	4	6
High school education	1	0	1	1
No education	20	0	20	29
Total	65	4	69	100
Study areas				
Maseru	19	3	22	32
Mokhotlong	16	1	17	25
QwaQwa	16	0	16	23
Thaba 'Nchu	14	0	14	20
Total	65	4	69	100

Table 2 Plants used for ethnoveterinary purposes in the highland grasslands of the Free State, South Africa and Lesotho

S. no	Botanical name	Family name	Local name	RFC	Part used	Ethnoveterinary use	Preparation and administration	Voucher number	Study areas
1	**Agave americana* L.	Agavaceae	Lekhala le leputsoa	0.09	L	Tick repellant	Ground leaves are mixed with water and administered topically	013/2019	Maseru, Thaba 'Nchu, Mokhotlong
2	*Allium sativum* L.	Alliaceae	Konofolo	0.01	L	Acts against bile acid malabsorption	Decoctions are prepared and administered orally	036/2019	Thaba 'Nchu
3	*Aloe ferox* Mill.	Asphodelaceae	Lekhala la Quthing	0.10	L	Acts against bile acid malabsorption	Decoctions of the leaves are made and administered orally	012/2019	Maseru, QwaQwa
4	*Aloe maculata* All.	Asphodelaceae	Lekhala la thaba \ bafu	0.04	L	Acts against bile acid malabsorption	Ground fresh leaves are mixed with water and administered orally	019/2019	Maseru, QwaQwa
5	*Aloe striatula* Haw. (synonym *Aloe striatula* var. *striatula*)	Asphodelaceae	Mohalakane	0.38	L	Acts against bile acid malabsorption	Decoction of *Aloe striatula* Haw. var. striatula *and Rumex lanceolatus* is prepared and administered orally	02/2019	Maseru, Mokhotlong, Thaba 'Nchu, QwaQwa
6	*Artemisia afra* Jacq. ex Willd	Asteraceae	Lengana	0.03	L	Used to treat stomach ailments and intestinal worms	Decoctions are prepared and administered orally	051/2019	QwaQwa
7	*Asparagus microraphis* (Kunth) Baker	Asparagaceae	Lerara-tau/ lehonyeli	0.04	R	Black quarter/ blackleg disease and acts against bile acid malabsorption	Grind roots and mix with water, then administer orally	021/2019	Maseru, Mokhotlong, QwaQwa
8	*Buddleja salviifolia* (L.) Lam.	Buddlejaceae	Lelothoane	0.10	L	Acts against bile acid malabsorption	Decoctions of the leaves are made and administered orally	011/2019	Maseru, Thaba 'Nchu, Mokhotlong
9	*Bulbine narcissifolia* Salm.-Dyck	Asphodelaceae	Khomo ea balisa	0.09	R	Acts against bile acid malabsorption, diarrhea and abscess	Prepared as a decoction/ground roots are mixed with salt. It is orally administered	015/2019	Maseru, Thaba 'Nchu, Mokhotlong
10	*Calpurnia sericea* Harv.	Fabaceae	Tloele/ Mot'sohlo	0.01	L & S	Used as tick repellant	Shred and mix plant parts with water and administer topically	031/2019	Thaba 'Nchu
11	*Clematis brachiata* Thunb.	Ranunculaceae	Morara oa thaba	0.01	R	Acts against bile acid malabsorption	Infusions are made and administered orally	034/2019	Thaba 'Nchu
12	*Cussonia paniculata* EckL. & Zeyh. (*Cussonia paniculata* subsp. *sinuata* (Reyneke & Kok) De Winter)	Araliaceae	Mots'ets'e	0.04	L	Acts against bile acid malabsorption	Decoctions of leaves are prepared and administered orally	020/2019	Thaba 'Nchu
13	*Cyathula. uncinulata* (Schrad.) Schinz	Amaranthaceae	Bohome ba lipoli/ Bohome bo boholo	0.01	R	Acts against bile acid malabsorption	Decoctions are prepared and administered orally	035/2019	Thaba 'Nchu
14	*Dicoma anomala* (Sond.)	Asteraceae	Hloenya	0.16	R	Acts against bile acid malabsorption	Decoctions are prepared and administered orally	08/2019	Maseru, Mokhotlong, Thaba 'Nchu, QwaQwa
15	*Dierama robustum* N.E.Br.	Iridaceae	Lethepu	0.01	R	Used for constipation	Crush and mix roots with water. Administer as enema	044/2019	Mokhotlong
16	*Elephantorrhiza elephantina* (Burch.) Skeels	Fabaceae	Mositsane	0.09	R	Acts against bile acid malabsorption	Grind whole plant and mix with salt, then administer orally	016/2019	Maseru, Thaba 'Nchu

Continue Table 2

17	*Erica maesta* Bolus	Ericaceae	Chalebeke/ Sekikitlela	0.01	L	Acts against bile acid malabsorption	Decoctions are prepared and administered orally	042/2019	QwaQwa
18	*Eriocephalus tenuifolius* DC.	Asteraceae	Sehala-hala sa matlaka	0.16	L	Treats Kokoana (small parasites) and acts against bile acid malabsorption	Decoction are prepared/ leaves are ground and mixed with salt. It is administered orally	09/2019	Maseru, Thaba 'Nchu, Mokhotlong
19	**Eucalyptus* sp.	Myrtaceae	Boloukomo	0.01	L	Eliminates excessive drooling of mucus in sheep	Prepared as a decoction and administered orally	027/2019	Maseru
20	*Eucomis autumnalis* subsp. *clavata* (Baker) Reyneke	Hyacinthaceae	Khapumpu	0.01	R	Used to treat black quarter/ blackleg disease	Prepared as a decoction and administered orally	028/2019	Thaba 'Nchu
21	*Euphorbia clavarioides* Boiss.	Poaceae	Sehloko	0.01	L & R	Acts against colic	Decoctions are prepared and administered orally	026/2019	Thaba 'Nchu
22	*Euphorbia ericoides* Lam.	Euphorbiaceae	Malebesana	0.04	R	Acts against bile acid malabsorption	Decoctions of Malebesana and *Rumex lanceolatus* are made and administered orally	017/2019	Mokhotlong, QwaQwa
23	*Gazania krebsiana* subsp. *serrulata* (DC.) Roessler	Asteraceae	Tsikitlana	0.01	R	Acts against bile acid malabsorption	Decoctions are prepared and administered orally	032/2019	Thaba 'Nchu
24	*Gnidia kraussiana* Meisn.	Thymelaeaceae	Thobeha/ th'opa e nyenyane	0.03	L	Acts against bile acid malabsorption/ heart water, anthrax and as tick repellant	Prepare decoctions and administer orally	024/2019	Thaba 'Nchu
25	*Gomphocarpus fruticosus* (L.) W.T.Aiton	Apocynaceae	Moithimolo/ Lebejane/ Matalenyane	0.22	L	Acts against bile acid malabsorption	Prepared as a decoction or the leaves are ground and mixed with salt and administered orally	06/2019	Maseru, Thaba 'Nchu, Mokhotlong
26	*Gunnera perpensa* L.	Gunneraceae	Qobo	0.13	R	Treats diarrhea	Decoctions of the roots are made and administered orally	010/2019	Mokhotlong, QwaQwa
27	*Halleria lucida* L.	Stilbaceae	Lebetsa	0.01	L & S	Used in the treatment of Streff syndrome	Dry and burn the plant parts and administer the smoke through inhalation	030/2019	QwaQwa
28	*Hermannia depressa* N.E.Br.	Sterculiaceae	Seletjane	0.01	L & R	To treat or prevent miscarriage	Decoctions are prepared and administered orally	025/2019	Mokhotlong
29	*Leucosidea sericea* Eckl. & Zeyh.	Rosaceae	Cheche	0.25	L	Used to treat black quarter/ blackleg disease, Papisi (small parasites)	Decoction of the leaves are made and administered orally or used as enema for horses	04/2019	Maseru, Mokhotlong, Thaba 'Nchu, QwaQwa
30	**Malva parviflora* L. *(Malva parviflora* var. *parviflora)*	Malvaceae	Mosala suping/ Tika-motse	0.03	WP	Used as a lotion for bruised or broken limbs and acts against bile acid malabsorption	Grind whole plant and mix with water, then administer orally/topically	022/2019	Thaba 'Nchu, Mokhotlong
31	*Melolobium microphyllum* (L.f.) Eckl. & Zeyh.	Asteraceae	Mofahla-toeba	0.01	R	To treat inflammation/ swelling in the mouth	Decoctions are prepared and administered orally	047/2019	Maseru, Mokhotlong, Thaba 'Nchu
32	*Monsonia burkeana* Planch ex Harv.	Geraniacea	Khoara/ Makorotsoane	0.29	R	Diarrhea, intestinal parasites and acts against bile acid malabsorption	Decoctions are prepared or roots are ground and mixed with salt. It is administered orally	03/2019	Maseru, Mokhotlong, Thaba 'Nchu, QwaQwa
33	*Morella serrata* (Lam.) Killick	Myriaceae	Monna mots'o	0.01	R	Acts against bile acid malabsorption	Decoctions are prepared and administered orally	033/2019	Maseru
34	*Olea europaea* subsp. *africana* (Mill.) P.S.Green	Oleaceae	Mohloare	0.01	L	Acts against bile acid malabsorption	Infusions are prepared and administered orally	041/2019	Maseru
35	*Ornithogalum shawii*	Hyacinthaceae	Sesepa sa linoha	0.03	L	Intestinal parasites and	Macerate leaves and add water.	050/201	Mokhotlong

Continue Table 2

	(Baker) J.C.Manning & Goldblatt					gastrointestinal diseases in sheep	Administer orally	9	
36	*Othonna natalensis* Sch. Bip.	Asteraceae	Phela/ Naka	0.03	WP	Anthelmintic for calves	Decoctions are prepared and administered orally	049/2019	Thaba 'Nchu, QwaQwa
37	*Pentanisia prunelloides* (Klotzsch ex Eckl. & Zeyh.) Walp.	Rubiaceae	Setima-mollo	0.03	L	Used for external cuts and acts against bile acid malabsorption	Decoctions are prepared and administered orally/ as enema/topically	023/2019	Maseru, QwaQwa
38	*Phytolacca heptandra* Retz.	Phytolaccaceae	Monatja/ Monyela- ntja	0.19	R	To treat Kokoana (small parasites), stomach pains caused by parasites (Papisi) and Streff syndrome	Mix ground roots in hay or with salt and administer orally	07/2019	Mokhotlong, Thaba 'Nchu, QwaQwa
39	*Plectranthus ciliatus* E.Mey.	Lamiaceae	Lephele-phele	0.01	WP	Used for diarrhea	Decoctions are prepared and administered orally	045/2019	Thaba 'Nchu
40	*Podaxis pistillaris* (L. ex Pers.) Fr.	Agaricaceae	Ts'upane ea liholo	0.01	WP	Used to treat black quarter/ blackleg disease	Grind whole plant and mix with salt, then administer orally	029/2019	Thaba 'Nchu
41	**Populus* sp.	Salicaceae	Populeri ea Thaba	0.04	R	Acts against bile acid malabsorption	Decoctions of Populiri and peach tree are prepared and administered orally	018/2019	Maseru, Thaba 'Nchu
42	**Prunus persica* (L.) Batsch (*Prunus persica* var. *persica*)	Rosaceae	Sefate sa perekisi	0.01	L	Acts against bile acid malabsorption	Decoctions of Papoleri and peach tree are prepared and administered orally	046/2019	Thaba 'Nchu
43	*Rhamnus prinoides* L'Hérit	Rhamnaceae	Mofifi	0.45	L	Acts against bile acid malabsorption	Prepared as a decoction or the leaves are ground and mixed with salt. It is administered orally	01/2019	Maseru, Thaba 'Nchu, QwaQwa
44	*Rumex acetosella* subsp. *angiocarpus* (Murb.) Murb.	Polygonaceae	Khamane	0.22	R	Acts against bile acid malabsorption and intestinal parasites	Ground roots are mixed with water and administered orally	05/2019	Mokhotlong, QwaQwa
45	*Salvia repens* Burch. ex Benth.	Lamiaceae	Mosisili/ Mosisili oa loti	0.03	L	Acts against bile acid malabsorption	Decoctions are prepared and administered orally	049/2019	Maseru, QwaQwa
46	*Searsia divaricata* (Eckl. & Zeyh.) Moffett	Anacardiaceae	Kolits'ana	0.01	R	Used to treat blurry eyes; acts against bile acid malabsorption	Decoctions are prepared and administered orally	043/2019	QwaQwa
47	*Searsia erosa* (Thunb.) Moffett	Anacardiaceae	Ts'inabelo\ Ts'ilabele	0.01	R	Acts against bile acid malabsorption	Decoctions are prepared and administered orally	037/2019	Thaba 'Nchu
48	*Senecio asperulus* DC.	Solanaceae	Moferefere/ Letapisoana	0.01	L	Acts against bile acid malabsorption	Decoctions are prepared and administered orally	039/2019	Maseru
49	*Senecio discodregeanus* Hilliard & B.L. Burtt	Asteraceae	Lehlomane le lenyenyane	0.09	R	Acts against bile acid malabsorption and Papisi (small parasites)	Decoctions of the roots are made and administered orally	014/2019	Mokhotlong, Thaba 'Nchu
50	*Senecio serratuloides* DC.	Asteraceae	Khotolia ea noka	0.01	L	Acts against bile acid malabsorption and used for external cuts	Burn or grind leaves and apply topically. Or decoctions are prepared and administered orally	040/2019	Maseru
51	*Xysmalobium undulatum* (L.) W.T. Aiton	Apocynaceae	Poho-ts'ehla/ Leshokhoa	0.01	R	Diarrhea	Grind the roots, mix with salt and administer orally	038/2019	Thaba 'Nchu

RFC = Relative Frequecy Citation; Asterisk (*) indicates naturalized alien species; L= leaves, R= roots, WP= whole plant, S= stem.

This may explain the poor representation of women in this study since they are only allowed to rear small animals like pigs and poultry. However, the participation of women in this study demonstrates assertions by Morris and Msonthi [20] that women are interested and are knowledgeable in issues relating to the general use of medicinal plants and healing. Therefore, women should also be considered as knowledge holders in traditional healing activities which have historically been dominated by males. More respondents were between the ages of 66-75 years, and this concurred with the submissions of Luseba and Tshisikhawe [2] who specified that the younger age group are less keen on traditional matters due to modernization and its impact on the youths of nowadays. As a result, the younger generation possess limited knowledge pertaining to the use of traditional medicines.

Livestock, especially cattle, are considered very important in the African community as they play crucial roles in the socio-cultural and socio-economic wellbeing of people. They are used for traditional rituals and ceremonies, provision of milk, meat, manure, and raw materials, and they serve as social security/store of wealth in many cultural settings [28-31].

Fifty-one (51) medicinal plant species from thirty-five (35) families which are used for ethnoveterinary purposes were recorded in this study. Some authors had earlier documented a number of medicinal plant species in the southern region that are used for both human and livestock purposes. For instance, in 2006, Luseba and van der Merwe [33] documented 19 plant species from 12 families among the Tsonga speaking people of South Africa, Moteetee et al. [34] recorded 437 plant species in both Lesotho and the Free State province of South Africa, while McGaw et al. [35] recorded 139 plant species in South Africa. Similarly, Nyahangare et al. [31] recorded 51 plant species in Zimbabwe, and Bruschi et al. [36] documented 39 plant species in Angola which are used for ethnoveterinary purposes.

The majority (27%) of the medicinal plants recorded in this study belong to the Asteraceae family. This portrays their high frequency of use and availability in the study areas. *Rhamnus prinoides, Aloe striatula, Leucosidea sericea and Monsonia burkeana.* were among the frequently mentioned medicinal plants in this study. This may be due to the antimicrobial [33,37], anthelmintic [38], anti-inflammatory and high antioxidant biological activities of these plants [39,40]. Additionally, Burhanu [41] and Molla et al. [42] showed that *R. prinoides* has purgative and antimicrobial activity, and Chen et al. [43] also showed that *R. prinoides* is a good source of polyphenols and flavonoids. Likewise, Aremu et al. [38] reported that *A. striatula* and *L. sericea* possess antimicrobial and anthelmintic activities. With reference to *L. sericea, in vitro* observations by Mafole et al. [40] recorded anti-parasitic, antioxidant, antimicrobial, anti-inflammatory properties of the plant which also is a rich source of essential oils. Earlier, Bosman and co-authors [44] observed the anthelmintic and anti-protozoal potential of aspidinol, a compound in *L. sericea*. In spite of the potpourri of biologically active phytochemicals in *R. prinoides*, its high-use frequency may also be attributed to the ease of accessibility of the plant by users, due to intensified cultivation practices [41,42]. Plants such as *Withania somnifera* and *Momordica charantia* were not mentioned in this study but they have been reported by other authors for the treatment of similar livestock aliments observed in this study like blackleg (black quarter) disease [45], parasitic infections [46], dysentery and retained placenta [47,48].

The most frequently used plant parts to prepare herbal remedies in this study were roots (45%) and leaves (43%). This result agrees with other researchers who stated that most of the bioactive compounds in plants are produced in the roots [10, 49, 50]. Therefore, herdsmen and traditional healers continue to utilize these plant parts in formulating their traditional medicine regimen. The harvesting of some plant parts like bark and roots, coupled with the high local and international market demand for medicinal plants can result in the extinction of such plant species and damage the environment [51,52]. Hence, the practice of responsible harvesting of these natural resources within their limits to regenerate is encouraged to promote conservation and enhance the sustainability of medicinal plant use.

Local farmers and livestock herdsmen employ different methods to prepare remedies for their animals. Decoctions and infusions were the most predominant water-based preparations recorded in this study. This concurs with an earlier report by

Luseba and Tshisikhawe [2] who also documented the same preparatory methods. Earlier studies by Masika et al. [53] indicated that most livestock farmers diagnose their livestock based on the signs and symptoms the animals exhibit or even by postmortem findings. Based on their diagnosis, appropriate medicinal plants will be collected, prepared accordingly, and administered to the ailing animal. In this study, problems such as parasitism (*kokoana or papisi*), excessive salivation in sheep due to bacterial infection, bovine tumour, miscarriage, bone fracture, retained placenta, eye problems, gall bladder abnormalities and liver issues are combated with a number of plants, either individually or in combination with other plants or non-plant materials. Similar observations have been made by Yipel et al. [47] who reported that the diseases of livestock mostly treated with medicinal plants were gastrointestinal disorders. It has been noted that these diseases and parasites cause great economic losses to the farmer [54, 55].

CONCLUSION

The use of medicinal plants for ethnoveterinary purposes has remained a common and important practice amongst the rural resource-poor subsistence farmers in the selected study areas. This study revealed that the region is endowed with a rich biodiversity of medicinal plant species which are used for the treatment of various animal diseases. The importance of some plants such as *R. prinoides* for digestive problems and *M. burkeana* against internal parasites and diarrhea has been identified in this study through the relative frequency of citation index. These medicinal plants indicate efficacy and may be priority plants for further investigation with the potential for new ethnoveterinary drug development. It is therefore recommended that traditional knowledge should be preserved through documentation to safeguard the use of plants as medicines. Documentation of medicinal plants will complement the oral tradition of dissemination of knowledge and generate comprehensive baseline data which will be used for future references. The youth should also be encouraged to actively participate in the knowledge acquisition, propagation and use of these beneficial plants to ensure knowledge continuity. More investigations to validate medicinal claims, ascertain safety, establish mechanisms of action and effective dosage of administration of these medicinal plants are still required.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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