Exploration of Plant Species Used by Bapedi Ethnic Group for Ethnoveterinary Purposes: A Case Study of Ga-Mphahlele Region in the Limpopo Province, South Africa

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Abstract: The use of plant resources by the Bapedi people in the Limpopo province in South Africa is regarded as part of their tradition and culture. This study was aimed at documenting ethnoveterinary uses of plants in Ga-Mphahlele region in the Limpopo province, South Africa. Information was gathered through semi-structured questionnaires supplemented by field observations from 30 randomly selected Pedi speaking people in Ga-Mphahlele region of the Limpopo province. A total of 52 plant species from 32 plant families were used for 18 ethnoveterinary purposes. The majority of the species (21.2%) were used as fodder, followed by ethnoveterinary medicinal applications against wounds (19.2%), diarrhoea (17.3%), ticks (13.5%) and worms (11.5%) in domestic animals such as cattle, chickens, dogs, donkeys, doves, goats and sheep. The species with frequency of citation (RFC) higher than 0.70 included *Citrullus lanatus* (fodder), *Vachellia karroo* (ethnoveterinary medicine and fodder), *Sclerocarya birrea* subsp. *caffra* (fodder), *Aloe ferox* (ethnoveterinary medicine), *Drimia sanguinea* (ethnoveterinary medicine), *Sarcostemma viminale* subsp. *viminale* (ethnoveterinary medicine) and *Sorghum bicolor* (fodder). The traditional knowledge about forage and ethnoveterinary medicines demonstrated by the Bapedi people enable extension officers and policy makers to appreciate how local communities perceive and utilize plant resources around them.

Keywords: Bapedi, ethnoveterinary, Limpopo province, medicinal plants, traditional knowledge.

INTRODUCTION

The role of ethnoveterinary plants in livestock development and health is common in Africa where there is limited access to modern veterinary care, and this is emphasised by studies conducted in different countries such as Uganda [1], Tanzania [2,3], Ethiopia [4], Zimbabwe [5], Ethiopia [6] and Ivory Coast [7]. Livestock is an integral part of many households inhabiting rural areas and will continue to be intimately linked to their everyday lives. Cost, inaccessibility and other problems like side effects of modern animal health care system have encouraged the local people to developed their own system of keeping animals healthy through ethnoveterinary medicines [8]. Phondani *et al*. [8] argued that ethnoveterinary practices are often cheap, safe and based on locally available resources and therefore, can serve as an important alternative to modern animal health care systems. In many developing countries, local communities interface ethnoveterinary medicine and modern veterinary health care systems to treat their livestock, the later is often unavailable due to either staffing problems in agriculture extension services or because synthetic drugs are expensive and ethnoveterinary medicine therefore plays an important role in the animal health care system in developing countries and this approach is perceived as simple, cost-effective, environment friendly, contextually appropriate and culture-based [9]. Other researchers like Suroowan *et al*. [10], Aziz *et al*. [11] and Patil [12] argue that ethnoveterinary medicine is often the only available alternative to rural, peri-urban and marginalized populations of the developing world particularly in South Asian and African countries. Previous research showed that livestock play a diverse role in the livelihoods of people in the peri-urban, rural and marginalized areas, as an important source of fertiliser, income, employment, transport and clothing among other uses [1-7]. In South Africa, similar studies were conducted among diverse ethnic groups such as Batswana [13], Xhosa [14-16], Vhavenda [17-18] and Zulu [19]. Despite the availability of these studies, there is no survey that focused on documenting ethnoveterinary practices among the Bapedi people of the Limpopo province in South Africa. Bapedi people are one the prominent cultural group in the country, particularly in the Limpopo province, South Africa. According to Lodge [20], the Bapedi people is the

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ISSN: 2223-3806 / E-ISSN: 1927-5951/19

largest ethnic group in the Limpopo province, accounting 57% of the total population in the Limpopo province. For most parts of the Bapedi communities, the rich indigenous knowledge on plant species used for veterinary purposes is not adequately documented. Therefore, the present study was aimed at documenting plant species used by the Bapedi people for ethnoveterinary purposes in Ga-Mphahlele region in the Limpopo province of South Africa. Such documentation of ethnoveterinary practices and medicinal plant resources is important due to changing socio-economic and cultural values of the traditional communities as the indigenous practices of livestock rearing and ethnoveterinary practices are changing throughout the world [8,9,21].

MATERIALS AND METHODS

Study Site

This study was undertaken in Ga-Mphahlele region of the Lepelle-Nkumpi Municipality, located in Limpopo province, South Africa (Figure **1**). The majority (87.2%) of indigenous people in the studied area belong to the Bapedi ethnic group [22]. The regional climate is subtropical with very hot, humid summers and a cooler, dry and sunny winter season lasting from June to September [23]. Mean annual rainfall ranges from 300 to 500 mm [24]. Daily temperatures vary from mid-20°C to mid-30°C, with an average range of between 16°C and 28°C in summer and 5°C to 21°C in winter [24]. According to the vegetation classification of Mucina and Rutherford [25], the study areas have a semi-arid savanna, characterized by a mixture of trees, shrubs and grasses. Dominant plants species include *Boscia albitrunca* (Burch.) Gilg & Gilg-Ben., *Combretum hereroense* Schinz, *Croton gratissimus* Burch., *Dombeya autumnalis* I.Verd, *Hippobromus pauciflorus* (L.f.) Radlk., *Kirkia wilmsii* Engl., *Cheilanthes dolomiticola* (Schelpe) Schelpe & N.C. anthony, *Sansevieria hyacinthoides* (L.) Druce and *Plectranthus neochilus* Schltr. [25].

The local leaders were provided with the details of the study and its objectives. A total of 30 participants were randomly selected and were requested to sign a consent form. Research by Crouch and McKenzie [26], Guest *et al*. [27] and Latham [28] showed that saturation often occurs when 12 participants in homogeneous groups and for a heterogenous sample, the number of participants should be at least 12. Data was collected using semi-structured questionnaires during face-to-face interviews which were conducted in Sepedi, the local language. These participants included 20 males and 10 females, who were aged between 31 to 80 years. The questionnaires were designed to capture information on plant species used for veterinary purposes, used part/s and methods of preparation. Voucher specimens were collected during field walks with the participants. Preliminary

Figure 1: Map of southern Africa showing Ga-Mphahlele region, the study area in the Limpopo province, South Africa.

Table 1: Plants Used for Veterinary Purposes in Ga-Mphahlele Area of the Limpopo Province, South Africa. Species Marked with an Asterisk (*) are Exotic to South Africa

Species and family name	Parts used	Habit	Preparation methods	Utilisation	RFC
Citrullus lanatus (Thunb.) Matsum. & Nakai, Cucurbitaceae	Fruits	Herb	Chopped and given to donkeys	Food for donkeys	0.93
Vachellia karroo (Hayne) Banfi & Glasso, Fabaceae	Roots	Tree	Pounded and mixed with salt and mixture given to sheep	Diarrhoea in sheep	0.33
			Boiled and extract given to dogs	Increase aggression and speed in dogs	0.33
	Leaves		Dry or fresh leaves given to livestock	Fodder for cattle, doves, donkeys, sheep and goats	0.90
Sclerocarya birrea (A.Rich.) Hochst. subsp. *caffra* (Sond.) Kokwaro, Anacardiaceae	Fruits and leaves	Tree	Fruits and leaves	Fodder for cattle, donkeys, sheep, goats and pigs	0.77
Aloe ferox Mill., Asphodelaceae	Leaves	Shrub	Juice applied topically	Ticks in cattle	0.73
Drimia sanguinea (Schinz) Jessop, Hyacinthaceae	Bulb	Herb	Crushed and macerated in warm water and applied topically	Wounds in cattle, donkeys, sheep, goats and pigs	0.73
Sarcostemma viminale (L.) R.Br. subsp. viminale, Apocynaceae	Bark	Shrub	Boiled and extract given to livestock	Diarrhoea in pigs	0.73
Sorghum bicolor (L.) Moench, Poaceae	Whole plant	Shrub	Dry or fresh parts given to livestock	Fodder for cattle, doves, donkeys, sheep, goats and pigs	0.73
Ficus thonningii Blume, Moraceae	Leaves	Tree	Dry or fresh leaves given to pigs	Fodder for pigs	0.33
			Pounded and applied topically	Wound dresser in cattle, donkeys, sheep and goats	0.63
Dichrostachys cinerea (L.) Wight & Arn., Fabaceae	Fruits	Tree	Dry or fresh fruits	Fodder for sheep	0.60
Lippia javanica (Burm.f.) Spreng, Verbenaceae	Leaves	Shrub	Crushed and macerated in warm water and applied topically	Ticks in cattle, donkeys, sheep and goats	0.60
				Flies in chickens and doves	0.23
**Zea mays* L., Poaceae	Seeds	Shrub	Dry or fresh seeds given to livestock	Food for doves and chickens	0.37
	Whole plant		Dry or fresh parts given to livestock	Fodder for cattle, donkeys, sheep, goats and pigs	0.60
Adansonia digitata L., Bombacaceae	Bark	Tree	Pounded and given to livestock	Fodder for doves, chickens, sheep and goats	0.57
**Nicotiana tabacum* L., Solanaceae	Leaves	Shrub	Boiled and cold extract given to livestock	Constipation in cattle, donkeys, sheep and goats	0.57
			Boiled and cold extract applied topically	Eye infections in cattle, donkeys, sheep, goats and pigs	0.33
			Pounded and mixed with leaves of *Dodonaea viscosa* var. *angustifolia*	Wounds in cattle and pigs	0.33
Tribulus terrestris L., Zygophyllaceae	Leaves	Herb	Boiled and extract given to livestock	Facilitate birth in goats, sheep and cows	0.57
				Diarrhoea in goats, sheep and cattle	0.30
Aloe marlothii A.Berger, Asphodelaceae	Leaves	Tree	Juice squeezed and mixed with drinking water	Newcastle disease in chickens	0.50
**Lantana camara* L., Verbenaceae	Leaves	Shrub	Crushed and macerated in warm water and applied topically	Ticks in cattle, donkeys, sheep and goats	0.40

(Table 1). Continued.

Species and family name	Parts used	Habit	Preparation methods	Utilisation	RFC
Peltophorum africanum Sond., Fabaceae	Bark	Tree	Pounded and mixed with drinking water	Internal parasites in cattle	0.37
Withania somnifera (L.) Dunal, Solanaceae	Roots	Shrub	Pounded and mixed with drinking water	Cold and cough in chickens and doves	0.37
Myrothamnus flabellifolius Welw., Myrothamnaceae	Leaves	Herb	Pounded and mixed with drinking water	Enhance appetite in cattle and sheep	0.33
Senegalia senegal (L.) Britton, Fabaceae	Fruits and leaves	Tree	Fruits and leaves given to livestock	Fodder for sheep and goats	0.27
Cassia abbreviata Oliv. subsp. *beareana* (Holmes) Brenan, Fabaceae	Bark	Tree	Pounded and mixed with water and applied topically	Dermatophilosis in cattle, donkeys, sheep, goats and pigs	0.23
Olea europaea L. subsp. *africana* (Mill.) P.S.Green, Oleaceae	Leaves	Tree	Pounded and mixed with drinking water	Constipation in cattle, donkeys, sheep and goats	0.23
Capparis tomentosa Lam., Capparaceae	Roots	Tree	Boiled and extract given to livestock	Diarrhoea in cattle and sheep	0.13
**Citrus limon* (L.) Burm., Rutaceae	Fruits	Tree	Squeezed and mixed with drinking water	Worms in chickens	0.13
Ziziphus mucronata Wild., Rhamnaceae	Roots	Tree	Pounded and mixed with salt and applied topically	Wound dresser in cattle, donkeys, sheep and goats	0.13
**Allium cepa* L., Amaryllidaceae	Bulbs	Herb	Crushed, macerated in water and mixed with drinking water	Constipation in cattle, chickens, goats and sheep	0.10
**Aloe vera* (L.) Burm, Asphodelaceae	Leaves	Shrub	Juice squeezed and mixed with salt and applied topically	Wounds in cattle, sheep and goats	0.10
Dombeya rotundifolia Hochst., Malvaceae	Leaves	Tree	Boiled and extract given to livestock	Diarrhoea in cattle, sheep and goats	0.10
**Urtica urens* L., Urticaceae	Leaves	Herb	Crushed and macerated in warm water and applied topically	Wounds in donkeys	0.10
Ximenia caffra Sond., Olacaceae	Leaves	Tree	Pounded and mixed with water and applied topically	Dermatophilosis in cattle, donkeys, sheep, goats and pigs	0.10
Zanthoxylum capense (Thunb.) Harv., Rutaceae	Bark	Tree	Pounded and mixed with drinking water	Worms in goats and sheep	0.10
**Agave americana* L., Agavaceae	Leaves	Tree	Crushed and macerated in warm water	Wounds dresser in cows, goats and sheep	0.33
**Allium sativum* L., Amaryllidaceae	Bulbs	Herb	Chopped and added to drinking water	Worms in chickens and sheep	0.33
Asparagus falcatus L., Asparagaceae	Roots	Shrub	Boiled and extract given to livestock	Constipation in cattle, chickens and doves	0.33
Bulbine latifolia (L.f.) Roem. et Schult., Asphodelaceae	Leaves	Shrub	Pounded and mixed with water and applied topically	Ticks in cattle	0.33
			Pounded and mixed with water and given to livestock	Worms in cattle	0.33
**Carica papaya* L., Caricaceae	Leaves	Tree	Boiled and mixed with diesel® and mixture applied topically	Ticks in cattle	0.33
Carissa edulis Vahl, Apocynaceae	Leaves	Tree	Pounded and mixed with petrol® or diesel® and mixture sprayed on livestock	Heart-water in cattle	0.33
Elephantorrhiza elephantina (Burch.) Skeels, Fabaceae	Roots	Shrub	Pounded and mixed with petrol® or water and mixture sprayed	Ticks in donkeys and cattle	0.33
Combretum molle R.Br. ex G.Don, Combretaceae	Leaves	Tree	Pounded and mixed with drinking water	Fertility in sheep	0.33

(Table 1). Continued.

Species and family name	Parts used	Habit	Preparation methods	Utilisation	RFC
Colophospermum mopane (J.Kirk ex Benth.) J.Kirk ex J.Léonard, Fabaceae	Leaves	Tree	Boiled and mixed with salt and extract given to livestock	Diarrhoea in cattle and sheep	0.33
Dodonaea viscosa Jacq var. *angustifolia* (L.f) Benth., Sapindaceae	Leaves	Tree	Pounded and mixed with leaves of *Nicotiana tabacum* and applied topically	Wounds in cattle and pigs	0.33
Englerophytum magalismontanum (Sond.) T.D.Penn., Sapotaceae	Leaves	Tree	Pounded and mixed with drinking water	Prevent abortion in cattle	0.33
Grewia flavescens Juss., Malvaceae	Leaves	Tree	Dry or fresh leaves given to sheep	Fodder for sheep	0.33
**Jatropha curcas* L., Euphorbiaceae	Roots	Tree	Pounded and mixed with drinking water	Worms in cattle	0.33
**Melia azedarach* L., Meliaceae	Leaves	Tree	Boiled and applied topically	Eye infections in cattle	0.33
**Morus alba* L., Moraceae	Leaves	Tree	Dry or fresh leaves given to livestock	Fodder for sheep and goats	0.33
**Persea americana* Mill., Lauraceae	Roots	Tree	Pounded and applied topically	Wounds in cattle, donkeys, sheep, goats and pigs	0.33
**Piper nigrum* L., Piperaceae	Seeds	Shrub	Pounded and applied topically	Wounds in cattle, donkeys, sheep, goats and pigs	0.33
			Pounded and mixed with drinking water	Worms in cattle, donkeys, sheep, goats and pigs	0.33
**Psidium guajava* L., Myrtaceae	Leaves	Tree	Boiled and extract given to livestock	Diarrhoea in pigs	0.33
**Ricinus communis* L., Euphorbiaceae	Leaves	Shrub	Pounded and mixed with petrol® or water and mixture sprayed	Flies in chickens and doves	0.33
Vachellia nilotica (L.) P.J.H.Hurter & Mabb., Fabaceae	Leaves	Tree	Boiled and extract given to livestock	Diarrhoea in sheep	0.33
Waltheria indica L., Malvaceae	Leaves	Shrub	Boiled and extract given to livestock	Diarrhoea in cattle	0.33

identification was done in the field and authentication of collected specimens was done by Prof Maroyi, a professional taxonomist and plant names were confirmed using 'the plant list' (http://www.theplantlist.org/tpl1.1/record/kew-4776111).

We determined the Relative Frequency of Citation (RFC) of reported plant species using the following formula:

$$RFC = FC/N; (0<RFC<1)$$

This index shows the local importance of each species and is given by the frequency of citation (FC), that is the number of informants mentioning the use of species divided by the total number of informants participating in the study [29].

RESULTS AND DISCUSSION

Fifty two species from 32 plant families were used for 18 ethnoveterinary purposes (Table **1**). The majority of the species (21.2%) were used as fodder, followed by ethnoveterinary medicinal applications against wounds (19.2%), diarrhoea (17.3%), ticks (13.5%) and worms (11.5%). This diversity of plants in the current study is much higher than that recorded amongst other South African cultures such as Vhavenda [17,30], VaTsonga [13] and Xhosa [16], probably because these previous studies focused explicitly on plants used as ethnoveterinary medicines. Nevertheless, the relatively high variety of plant species recorded in the present study point out the broad extent of participants' knowledge of ethnoveterinary plants, and also demonstrates that plant species are a fundamental resource for enhancing livestock development in the Limpopo province. Trees (57.6%), shrubs (28.8%) and herbs (13.4%) were the most widely used growth forms (Table **1**). The plant parts used as fodder and ethnoveterinary medicines were the bark, bulbs, fruits, leaves, roots, seeds and whole plant. The leaves were the most frequently used (59.6%), followed by roots (28.8%) (Figure **2**). The variation in the preferences of

plant habits for the documented uses by the Bapedi households could be attributed to the wide agro-ecological diversity and specific indigenous knowledge associated with the documented species. However, the high use of trees and shrub in this study may be due to the fact that these growth forms are mainly available throughout the year and thus, can provide plant material needed as fodder as well as ethnoveterinary medicines whenever these resources are required.

Table 2: Ethnoveterinary Uses of Plants in Ga-Mphahlele Area, the Limpopo Province, South Africa

Use	No. of species	%
Fodder	11	21.2
Wounds	10	19.2
Diarrhoea	9	17.3
Ticks	7	13.5
Worms	6	11.5
Constipation	4	7.7
Dermatophilosis	2	3.8
Eye infections	2	3.8
Flies	2	3.8
Aggression	1	1.9
Cold and cough	1	1.9
Enhance appetite	1	1.9
Facilitation of birth	1	1.9
Fertility	1	1.9
Heart-water	1	1.9
Internal parasites	1	1.9
Newcastle	1	1.9
Prevent abortion	1	1.9

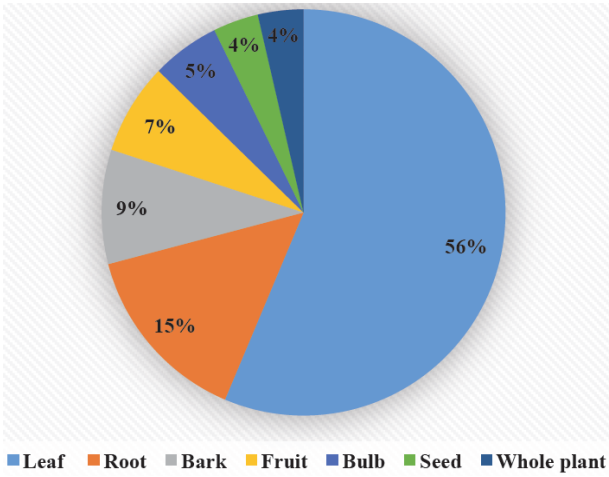

Figure 2: Plant parts used for ethnoveterinary purposes by Bapedi people.

About a third (32.7%) of the documented species are exotic to South Africa, among these were: *Agave americana* L., *Aloe vera* (L.) Burm, *Allium cepa* L., *Allium sativum* L., *Carica papaya* L., *Citrus limon* (L.) Burm., *Jatropha curcas* L., *Lantana camara* L., *Melia azedarach* L., *Morus alba* L., *Nicotiana tabacum* L., *Persea americana* Mill., *Piper nigrum* L., *Psidium guajava* L., *Ricinus communis* L., *Urtica urens* L. and *Zea mays* L. (Table **1**). These findings corroborate previous research which showed that exotic plants cultivated worldwide as ornamentals or food plants are often incorporated into traditional pharmacopoeias as herbal medicines mainly due to their use-versatility applications [31]. A large number of the documented species (59.6%) were from 11 families (Table **3**) as the other 19 families were represented by one species each (Table **1**). Plant families with the highest number of species were: Fabaceae (8 species), Asphodelaceae (4 species), Malvaceae (3 species), Amaryllidaceae, Apocynaceae, Euphorbiaceae, Moraceae, Poaceae, Rutaceae, Solanaceae and Verbenaceae with two species (Table **3**). The species with frequency of citation (RFC) higher than 0.5 included (in their order of importance): *Citrullus lanatus* (Thunb.) Matsum. & Nakai (fodder), *Vachellia karroo* (Hayne) Banfi & Glasso (ethnoveterinary medicine and fodder), *Sclerocarya birrea* (A.Rich.) Hochst. subsp. *caffra* (Sond.) Kokwaro (fodder), *Aloe ferox* Mill. (ethnoveterinary medicine), *Drimia sanguinea* (Schinz) Jessop (ethnoveterinary medicine), *Sarcostemma viminale* (L.) R.Br. subsp. *viminale* (ethnoveterinary medicine), *Sorghum bicolor* (L.) Moench (fodder), *Ficus thonningii* Blume (ethnoveterinary medicine and fodder), *Dichrostachys cinerea* (L.) Wight & Arn.

Table 3: Families with the Largest Number of Plants Used for Veterinary Purposes in Ga-Mphahlele Area, the Limpopo Province

Family	No. of species	%
Fabaceae	8	15.4
Asphodelaceae	4	7.7
Malvaceae	3	5.8
Amaryllidaceae	2	3.8
Apocynaceae	2	3.8
Euphorbiaceae	2	3.8
Moraceae	2	3.8
Poaceae	2	3.8
Rutaceae	2	3.8
Solanaceae	2	3.8
Verbenaceae	2	3.8

(ethnoveterinary medicine and fodder), *Lippia javanica* (Burm.f.) Spreng (ethnoveterinary medicine), *Zea mays* L. (fodder), *Adansonia digitata* L. (fodder), *Nicotiana tabacum* L. (ethnoveterinary medicine), *Tribulus terrestris* L. (ethnoveterinary medicine) and *Aloe marlothii* A.Berger (ethnoveterinary medicine) (Table **1**).

More than three quarters (76.9%) of the documented plant species were used on cattle, followed by goats (71.2%), sheep (69.2%), donkeys (38.5%), pigs (28.8%), chickens (21.2%) and dog (1.9%) (Table **4**). When we asked participants about the importance of plants in ethnoveterinary practices, the participants highlighted factors such as fodder quality, the ability of plant species to fatten livestock, increase milk production, treat livestock and poultry diseases. Our findings corroborate results obtained by Yirga *et al*. [4] which showed that ethnoveterinary medicine play an important role in animal production and livelihood development as they provide valuable alternatives to and complement Western veterinary medicines which are accessible, easy to prepare and administer at very little or no cost to the farmers.

Table 4: Dog, Livestock and Poultry Species Treated with Ethnoveterinary Medicines in Ga-Mphahlele Area, the Limpopo Province

Animal species	No. of plant species	%
Cattle	40	76.9
Goats	37	71.2
Sheep	36	69.2
Donkeys	20	38.5
Pigs	15	28.8
Chicken	11	21.2
Dog	1	1.9

CONCLUSION

This paper provided detailed information on plant species used for veterinary purposes in Ga-Mphahlele area in the Limpopo province, South Africa. Results of this research revealed that local people have extensive knowledge on fodder species and plant species used as ethnoveterinary medicines. Knowledge on which forage and ethnoveterinary medicinal plants are suitable for various livestock and poultry species enables local communities to better plan and manage their livestock and poultry species in a sustainable manner. The traditional knowledge about plant resources in relation to forage and ethnoveterinary medicinal plants in the Ga-Mphahlele region in the Limpopo province enable researchers, agricultural extension officers and policy makers to appreciate how the Bapedi people in the province perceive and utilize plant resources around them. The efficacy of ethnoveterinary medicines identified in this study need to be fully investigated in terms of their phytochemistry and pharmacological activities. Lack of scientific validation corroborating the ethnoveterinary medicinal applications of several plant species is the major reason for non-adoption of ethnoveterinary medicines throughout the world.

ACKNOWLEDGEMENTS

The authors are grateful to the traditional healers practising in the Lepelle-Nkumpi Municipality for participating in this study and sharing their valuable knowledge on medicinal plants used against oral diseases. This study was possible through a grant provided by National Research Foundation (NRF) and Govan Mbeki Research and Development Centre (GMRDC), University of Fort Hare with grant number T398 and C169, respectively.

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Received on 03-04-2019 Accepted on 25-04-2019 Published on 10-06-2019

DOI: https://doi.org/10.29169/1927-5951.2019.09.03.5