

Contents lists available at [ScienceDirect](http://ScienceDirect.com)

# South African Journal of Botany

journal homepage: [www.elsevier.com/locate/sajb](http://www.elsevier.com/locate/sajb)

## An ethnobotanical study of medicinal plants used to treat livestock diseases in Onayena and Katima Mulilo, Namibia

K.C. Chinsembu <sup>\*</sup>, J. Negumbo, M. Likando, A. Mbangi

University of Namibia, Faculty of Science, Department of Biological Sciences, Private Bag 13301, Windhoek, Namibia

### ARTICLE INFO

#### Article history:

Received 7 February 2014

Received in revised form 4 June 2014

Accepted 10 June 2014

Available online 5 July 2014

Edited by JN Eloff

#### Keywords:

Ethnobotany

Medicinal plants

Indigenous knowledge

Livestock diseases

Namibia

### ABSTRACT

Since many small scale and resource-poor livestock farmers cannot afford synthetic pharmaceutical drugs, they turn to indigenous knowledge as an alternative key to unlock the power of ethnoveterinary medicinal plants to treat animal diseases. However, there is no ethnoveterinary pharmacopeia and data on ethnoveterinary usage of plants are still sparse. In this study, an ethnobotanical survey was conducted to document the indigenous knowledge of medicinal plants used to treat livestock diseases in Onayena and Katima Mulilo, Namibia. Using semi-structured interviews and questionnaires, ethnobotanical data were collected from 22 farmers in Onayena, Oshikoto region, and 20 farmers in Katima Mulilo, Zambezi region. The results showed that 16 plant species were used to manage various livestock diseases. Plant leaves were commonly used, being crushed in water, and administered orally or topically. Skin rashes were managed using the plants *Aloe esculenta*, *Salvadora persica*, *Friesodielsia obovata*, and *Acanthosicyos naudinianus*. Diarrhoea was treated using *Ziziphus mucronata*, *Acacia karroo*, and *Solanum delagoense*. The plants *Ximenia americana*, *Combretum imberbe* and *Geigeria pectidea* were used to relieve eye infections in cattle, goats and sheep. Wounds were treated with *Orthanthera jasminiflora*, *Aloe zebrina* and *Baphia massaiensis*. Livestock owners in Katima Mulilo used water extracts from the roots of *Capparis tomentosa* to treat the lack of appetite in cattle and goats. In Onayena, *Fockea angustifolia* roots were used to treat cattle suffering from anthrax. Further studies are needed to determine the minimum inhibitory concentrations, biological activities and toxicities, and to characterize the plants' chemical compounds.

© 2014 SAAB. Published by Elsevier B.V. All rights reserved.

### 1. Introduction

Namibia is the most arid African country south of the Sahara desert (Ministry of Environment and Tourism, 2010). According to the Namibian National Farmers Union (2008), only 2% of Namibia's land receives enough rainfall for growing crops. At par with this precipitation quandary, most of the farming activities in the country's harsh environment characterized by low and erratic rainfall revolve around livestock farming (Siegmond-Schultze et al., 2012). Livestock farming is dominated by cattle and goats, poultry and smaller numbers of sheep, pigs, and donkeys (Mendelsohn, 2006).

Up to 40% of Namibians are small-scale farmers that eke out a living through herding on rural marginal and fragile lands (Namibia National Farmers Union, 2008). Extensive goat and sheep farming is the main agricultural activity in areas that receive 100–200 mm of rainfall per annum, while cattle farming is prominent in areas where average annual rainfall is 350–500 mm (Mendelsohn, 2006). About 10% of the sheep, 60% of the cattle, and 65% of the goats in Namibia are owned by small-scale farmers living in communal areas (Namibia National Farmers Union, 2008).

Beef production is the main activity in Namibia's agricultural sector, constituting approximately 85% of agricultural incomes and on average 10% of Gross National Product (Namibia National Farmers Union, 2008). About 92% of the beef exports are mainly to South Africa and Europe, while the remaining 8% is for the local market (Mendelsohn, 2006). Livestock sales from commercial farms contributed 63% to the total agricultural output, and those from communal farmers contributed only 0.3% (Ministry of Agriculture, Water and Forestry, 2005).

Diseases hamper the marketing of cattle from the communal areas (Mendelsohn, 2006). These diseases include infectious bacterial black-quarter, diarrhoea, anthrax, botulism, brucellosis, tuberculosis, foot-and-mouth disease (FMD), and pleuropneumonia. Other livestock diseases are caused by parasitic worms and protozoa. Thus, although a total of 298,807 cattle were reportedly formally marketed for beef production in 2004, only 9,787 originated from the northern communal areas (Mendelsohn, 2006).

Export-led livestock and meat marketing chains are required to meet stringent standards set by the importing countries. Consequently, Namibia has implemented a quality assurance scheme known as the Farm Assured Namibian Meat Scheme (FAN Meat), the first of its kind in Africa. FAN Meat covers aspects of animal health and welfare, good farming practices and the traceability of livestock (Namibia National Farmers Union, 2008). These stringent measures have coerced farmers

<sup>\*</sup> Corresponding author. Tel.: +264 61 206 3426; fax: +264 61 2063791.  
E-mail address: [kchinsembu@unam.na](mailto:kchinsembu@unam.na) (K.C. Chinsembu).

to rely on the heavy use of chemicals for dipping against disease-transmitting vectors such as ticks and also using higher dosages of drugs for the treatment of diseases and parasites.

The use of chemicals for vector control and pharmaceutical drugs for treatment is mostly practiced by commercial farmers because small-scale communal farmers cannot afford the high prices of these products (Siegmond-Schultze et al. (2012)). The use of chemical pesticides and pharmaceutical drugs to manage livestock pests and diseases is also anathema to the environment and leads to the development of resistance. As an alternative to expensive synthetic pesticides and drugs, the use of plants to treat livestock diseases in Namibia has been reported by a few authors: Rodin (1985), Van den Eynden et al. (1992), Van Damme and Van den Eynden (2000), Van Koenen (2001), and Siegmond-Schultze et al. (2012).

The use of botanical products to treat animal diseases is an important part of ethnoveterinary medicine (EVM), which deals with people's knowledge, skills, methods, practices and beliefs about the care of domestic animals (McCorkle, 1986). According to Mathias (2001), EVM is developed by farmers rather than by scientists in laboratories and clinics. Therefore, it is less systematic and less formalized, and is usually transferred by word of mouth rather than in writing. EVM is now recognised as a distinct field of study especially after the publication of three important reviews by McCorkle (1986), Wanzala et al. (2005), and McGaw and Eloff (2008).

Recent research has addressed a broad range of topics within this field, including plant-based and non-plant-based preparations, folk categories of illness, efficacy of treatments and zoopharmacognosy. Also, EVM research is often undertaken as part of a community-based approach that serves to improve animal health and provide basic veterinary services in underserved areas (Mathias-Mundy and McCorkle, 1989). Ethnoveterinary practices are more appealing to organic livestock farmers whose goal is to improve meat quality by producing meat without chemical residues (Lans and Turner, 2011). Plant products used for animal health are also less likely to become environmental pollutants (Lans and Turner, 2011); hence EVM practices present a more environmentally-friendly approach to animal health care.

In Namibia, utilization of plant extracts as ethnoveterinary medicine is one of the alternative and perhaps most sustainable methods readily adaptable to rural communal livestock farming. Despite the fact that many communal farmers use plants to treat livestock diseases, there is no ethnoveterinary pharmacopeia and the current status of information on ethnoveterinary usage of plants is still scanty. Therefore, the aim of this inaugural study was to conduct an ethnobotanical survey of indigenous knowledge of medicinal plants used to treat livestock diseases in Onayena and Katima Mulilo, Namibia.

## 2. Materials and methods

### 2.1. Study areas

Ethnobotanical studies were done in two sites: Onayena constituency located south-east of Ondangwa town, Oshikoto region, and Katima Mulilo in the Zambezi region (Fig. 1A and B). Onayena has a subtropical climate, with very hot summers and mild winters. The average maximum temperature is around 29.7 °C, while the average minimum temperature is 14.4 °C. Average rainfall is 555 mm per annum (Ministry of Agriculture, Water and Forestry, 2010). The vegetation in Onayena changes from shrub-forest savanna and woodlands to mopane savanna dominated by *Colophospermum mopane* (Giess, 1971). Vegetation degradation to *Hyphaene petersiana* plains is common (Strohbach, 2000). Most of the people depend on agricultural practices such as rearing cattle and goats, and growing pearl millet (locally known as mahangu). The majority of the people belong to one dialect of the Oshiwambo tribe known as the Ndonga.

Katima Mulilo is the administrative centre of the Zambezi region, formerly called Caprivi region. The district forms a crossing point served by the Trans-Caprivi highway from Walvis Bay and Windhoek. Katima Mulilo experiences high temperatures (average of 32 °C in summer) and is one of the wettest areas of Namibia with annual rainfall of 650 mm. Its terrain is well vegetated, mostly made up of swamps, floodplains, wetlands, and deciduous woodlands dominated by trees such as the Zambezi teak (*Baikaea plurijuga*). Most of Katima Mulilo is inhabited by the Lozi ethnic group whose socio-economic conditions are generally poor. The Lozi people of Katima Mulilo (also known as Caprivians) have very strong beliefs in the use and efficacy of ethnomedicines (Chinsembu and Hedimbi, 2010).

Mendelsohn (2006) illustrated that the farming systems of Onayena and Katima Mulilo were similar, characterised by small-scale livestock (goats, cattle) and cereal (mahangu, sorghum, maize) farming. The animals graze on open communal land.

### 2.2. Ethnobotanical data collection

A method similar to that by Chinsembu and Hedimbi (2010) was used in this study. Briefly, snow-ball sampling was applied during ethnobotanical surveys with livestock farmers, the main informants in the survey, being identified by community leaders, whose permission was sought before proceeding into the study area. A total of 42 farmers were interviewed between December 2012 and April 2013. All interviews were conducted in local languages. Research assistants acted as the Oshiwambo-English (in Onayena) and Lozi-English (in Katima Mulilo) translators during the conversations between the farmers and the research team.

After explaining the objectives of the research and seeking their consent, the farmers were individually engaged in semi-structured interviews supplemented with questionnaires. During the conversations, data on respondent characteristics, livestock illnesses, and ethnoveterinary plant remedies used to treat diseases were obtained. Vernacular names of the plant species, plant parts, and methods of preparation of the plant remedies were also recorded.

To compare the relative importance of each plant species, frequency index was calculated. According to Mahwasane et al. (2013), frequency index is a numerical expression of the percentage frequency of citation for a single plant species by informants. The following formula was used to calculate frequency index (Madikizela et al., 2012):

$$FI = FC/N \times 100$$

where FC is the number of informants who mentioned the use of the plant species, and N is the total number of informants in each area; 22 in Onayena and 20 in Katima. The frequency index was high when there were many informants that mentioned a particular plant and low when there were few reports.

### 2.3. Plant collection and identification

Informants were used as guides during field trips to identify frequently cited plant species. According to Konè and Atindehou (2008), an alleged pharmacological value of a particular plant was recorded as valid only if it was mentioned by at least 3 independent sources. Photographs of putative ethnoveterinary plants were also taken in the field. Upon collection, the plant specimens were given voucher numbers and transported in plant presses to the University of Namibia (UNAM) and the Namibian Botanical Research Institute (NBRI) for taxonomic identification. Once specimens were identified, mounted, labelled, and accessioned, they were frozen at –20 °C for

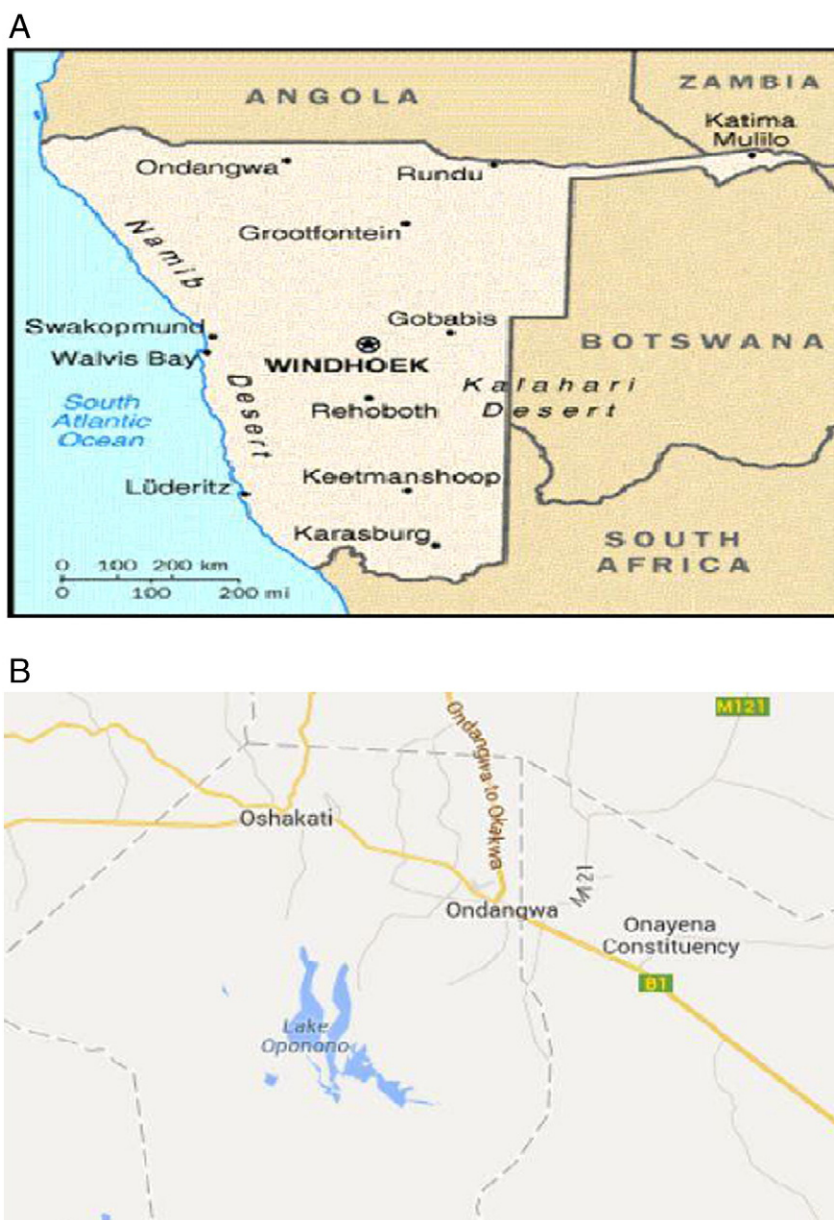


Fig. 1. A: Map of Namibia showing locations for Ondangwa and Katima Mulilo. B: Onayena constituency, located south-east of Ondangwa.

48 hours to kill insects, and then stored in the herbarium (British Columbia Ministry of Forests, 1996).

### 3. Results and discussion

#### 3.1. Use of ethnoveterinary medicinal plants

Overall, most of the respondents were in the 50–59 years age group (Fig. 2). This could mean that livestock ownership and knowledge of ethnoveterinary medicinal plants peaks during this age cohort. Female respondents were fewer than males: 6 out of 22 (27.3%) in Onayena, and 5 out of 20 (25%) in Katima Mulilo. This is because livestock production is usually a cultural preserve for males.

The plants' families, scientific names, vernacular names, voucher numbers, frequency indices, parts, and ethnoveterinary uses are presented in Table 1. Overall, sixteen plant species were used as ethnoveterinary medicines in Onayena and Katima Mulilo. The

frequency index (Table 1) also revealed that the most commonly used ethnoveterinary plants were *Aloe esculenta* in Onayena and *Aloe zebrina* in Katima Mulilo. The 16 plant species were distributed across 13 families (Fig. 3). With two plant species, the families Aloaceae, Capparaceae, and Fabaceae were slightly more predominant than the other families represented by a single species.

Generally, leaves were the most commonly used plant part (Fig. 4). This is not surprising because harvesting of leaves, unlike roots, is not labour-intensive and may not permanently damage the plants. In the whole study, most of the plant species were used to treat skin rashes, followed by diarrhoea, eye infections, and wounds (Fig. 5).

#### 3.2. Skin rashes

Skin rashes were managed using *Aloe esculenta*, *Salvadora persica*, *Friesodielsia obovata*, and *Acanthosicyos naudinianus*. Reports from



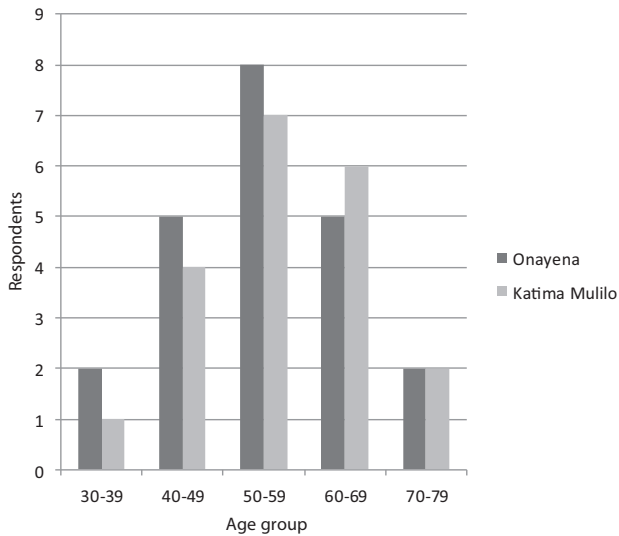


Fig. 2. Overall number of respondents by age group.

other studies demonstrate the potential of these plants to manage several infections of the skin. In Namibia, *A. esculenta* was used to treat cuts and burns (Rodin, 1985; Van Koenen, 2001) while *Aloe hereroensis* and *A. zebrina* were used to treat urinary and kidney ailments (Van Koenen, 2001).

The use of *S. persica* to manage skin rashes is consistent with reports that the aqueous extracts of *S. persica* had an inhibitory effect on the growth of *Candida albicans*, *Enterococcus faecalis*, *Streptococcus* sp. and *Staphylococcus aureus* (Halawany, 2012). In Mozambique, roots of *F. obovata* were also crushed in water and the filtered extract taken orally to treat stomach ache (Bruschi et al., 2011). In other studies, phytochemical analysis of *F. obovata* indicated significant antiplasmodial, cytotoxicity, and larvicidal activities (Joseph et al., 2007). Kaposhi et al. (1994) reported that *A. naudinianus* was used to manage ticks and other ectoparasites of cattle in western Zambia.

### 3.3. Diarrhoea

Diarrhoea was treated using the plants *Ziziphus mucronata*, *Acacia karroo*, and *Solanum delangoense*. *Z. mucronata* has antibacterial properties, and the fact that *Z. mucronata* was an ethnoveterinary plant for treating diarrhoea in Namibia was at par with accounts from Ethiopia where farmers use the same plant to treat other bacterial infections such as mastitis, wounds, and gastrointestinal complications in cattle (Kalayou et al., 2012). Semenya et al. (2013) explained that Bapedi healers use *Z. mucronata* (known as Mokgalo in Pedi language) to treat gonorrhoea and Chlamydial infections in humans. In Uganda, a related species, *Ziziphus mauritiana* Lam. was used to treat livestock constipation (Gradé et al., 2009).

In their review of *A. karroo* in smallholder beef production in southern Africa, Mapiye et al. (2009) found that *A. karroo* had fibres with moderate detergent activity. This may explain why *A. karroo* was used as a treatment for diarrhoea in Katima Mulilo. *S. delangoense* was used in this study to treat diarrhoea and coughs. Ndhlala et al. (2013) documented one *Solanum* species which contained steroid alkaloids that conferred antifungal and antibacterial properties. In Ethiopia, Teklehaymanot (2009) found that fresh leaf juice of *Solanum incanum* was topically applied to heal wounds and external injuries while crushed root juice was taken orally to alleviate stomach ache.

### 3.4. Eye infections

In this study, the plants *Ximenia americana*, *Combretum imberbe* and *Geigeria pectidea* were used to relieve eye infections in cattle, goats and sheep. The use of these plants to treat eye infections may be attributable to their antimicrobial properties. Use of *X. americana* and *C. imberbe* was also supported by ethnoveterinary reports from elsewhere. For example, *X. americana* was frequently used to treat ailments such as throat infections, malaria and dysmenorrhoea (Grønhaug et al., 2008). The use of *X. americana* for wound healing was also described in Mali (Diallo et al., 2002).

In Nigeria, *X. americana* was used against malaria, leprotic ulcers and skin diseases (Ogunleye and Ibitoye, 2003). Other reports declared activity of *X. americana* against schistosomiasis, fever, diarrhoea, ringworm, crawl-crawl and toothache (Burkill, 1997). Decoctions of *C. imberbe* leaves and roots were drunk to alleviate stomach ache in Mozambique (Bruschi et al., 2011). Els (2000) reported that *G. pectidea* was eaten by small stock in Namibia. This is interesting because *G. pectidea* can be used for both medicinal and nutritional purposes.

### 3.5. Wounds

Wounds were treated with *Orphanthera jasminiflora*, *Aloe zebrina* and *Baphia massaiensis*. In Botswana and Namibia, young fruits of *O. jasminiflora* were eaten fresh or cooked as a vegetable (Strohbach, 2000). Although farmers in Onayena, Oshikoto region, used *O. jasminiflora* to treat parasitic wounds, Rodin (1985) documented that leaves of *O. jasminiflora* were also used to treat diarrhoea.

Many members of the genus *Aloe* are used for different medicinal purposes in Namibia. Van Damme and Van den Eynden (2000) found that *A. hereroensis* was a treatment for chest, heart and stomach pains. The same authors documented that *Aloe asperifolia* was used to treat donkeys after grazing on poisonous plants. Among the Topnaar people of Namibia, Van den Eynden et al. (1992) claimed that *A. asperifolia* was a treatment for arteriosclerosis.

### 3.6. Other ailments

Livestock owners in Katima Mulilo used water extracts from the roots of *Capparis tomentosa* to treat the lack of appetite in cattle and goats. Ndhlala et al. (2013) reported that *C. tomentosa* had antimicrobial properties. This may support claims that the plant can restore appetite because the loss of appetite could be due to difficulties in swallowing following bacterial infection of the throat. This postulation is in agreement with Teklehaymanot (2009) who found that *C. tomentosa* powder mixed with water was orally taken as a treatment for tonsillitis and sore throat.

In Onayena, *Fockea angustifolia* roots were used to treat cattle suffering from anthrax. Alternatively, the beef of animals that died of anthrax was also treated using water extracts from the roots of *F. angustifolia*. It has been reported that fresh roots of some *Fockea* species, because of their diuretic properties, were applied to snakebites and stings to “draw out the poison” (Van Wyk, 2008). We hypothesize that extracts from *F. angustifolia* roots help to remove anthrax toxins from infected animals and contaminated meat.

In this study, *Boscia albitrunca* was used to treat liver and lung infections. Elsewhere, *B. albitrunca* leaves were traditionally used as a cold fusion for healing inflamed eyes of cattle (Coates, 1983). Many plants used in the treatment of livestock diseases were also used to treat human diseases. For example, Hedimbi and Chinsebu (2012) found that *B. albitrunca* relieved symptoms of syphilis while *S. delangoense* was used to treat coughs in humans. These authors also found that

**Table 1**  
Plant species used as ethnoveterinary medicines in Oshikoto and Zambezi regions, Namibia.

Scientific name (Family)	Voucher number	Local name of plant	Frequency index	Collection site, region	Plant parts	Mode of preparation and ethnoveterinary medicinal uses
<i>Aloe esculenta</i> Leach (Aloaceae)	M009	Endombo	81.8	Onayena, Oshikoto	Leaves	Crush fresh leaves are soaked in water; topically applied to treat skin infections (rashes) and falling hair; drenching to treat coughs
<i>Ziziphus mucronata</i> Willd. (Rhamnaceae)	M014	Omusheshete/ Mukekete	50.0	Onayena, Oshikoto	Leaves	Ground fresh leaves are soaked in water overnight, administer orally to treat diarrhoea in cattle and goats
<i>Orthanthera jasminiflora</i> (Decne.) Schinz (Asclepiadaceae)	M021	Eshompwa	77.3	Onayena, Oshikoto	Leaves, stems	Stems and leaves are crushed and soaked in water, topically applied to treat parasitic wounds in cattle and goats
<i>Geigeria pectidea</i> (DC) Harv. (Compositae)	M018	Ehindhi	40.9	Onayena, Oshikoto	Leaves, stems, flowers	Fresh leaves, stems and flowers are crushed and soaked in water and filtered through cloth. Drips of extract are applied into eyes to treat conjunctivitis in cattle
<i>Ximenia americana</i> L. (Olacaceae)	M026	Oshipeke	68.2	Onayena, Oshikoto	Leaves	Fresh leaves are crushed, soaked in water overnight, and filtered through cloth. Drips of extract are applied to treat eye infections in cattle, goats and sheep
<i>Salvadora persica</i> L. (Salvadoraceae)	M028	Omunkwavu	54.5	Onayena, Oshikoto	Bark, stems	Bark and stems are crushed, soaked in water and filtered through cloth. Topically applied to treat skin infections in goats
<i>Boscia albitrunca</i> (Burch.) Gilg. & Ben. (Capparaceae)	M017	Omukuzi	63.6	Onayena, Oshikoto	Leaves, roots	Fresh leaves and roots are crushed, mixed with water and filtered through wire sieve. Extract is orally taken to treat lung and liver infections in cattle and goats
<i>Combretum imberbe</i> Wawra (Combretaceae)	M030	Omukuku	45.4	Onayena, Oshikoto	Leaves	Fresh leaves are crushed, soaked in water and rubbed into infected eyes of cattle and sheep
<i>Fockea angustifolia</i> K. Schum. (Apocynaceae)	M035	Enongo	36.4	Onayena, Oshikoto	Roots	Crushed roots are mixed with water and filtered. Extract is orally taken to treat cattle suffering from anthrax or to wash beef of animal that died from anthrax
<i>Aloe zebrina</i> Baker (Aloaceae)	M001	Icenka/ Licenka	85.0	Katima Mulilo, Zambezi	Leaves	Crushed leaves are rubbed into wounds of cattle and goats
<i>Capparis tomentosa</i> Lam. (Capparaceae)	M033	Mukanangwe	40.0	Katima Mulilo, Zambezi	Roots	Roots are crushed and soaked in water overnight. Filtrate is drunk by sick animal to restore appetite
<i>Friesodielsia obovata</i> (Benth.) Verdc. (Annonaceae)	M040	Muchinga	60.0	Katima Mulilo, Zambezi	Roots	Roots are crushed, soaked in water, and rubbed into sores or skin rashes of cattle and goats
<i>Acacia karroo</i> Hayne (Fabaceae)	M012	Muhoto	75.0	Katima Mulilo, Zambezi	Leaves, roots	Roots and leaves are mixed together, crushed and soaked in water overnight. Water solution is drunk to treat diarrhoea in cattle and goats
<i>Baphia massaiensis</i> Taub. subsp. obovata (Schinz) Brummitt (Fabaceae)	M046	Isunde	70.0	Katima Mulilo, Zambezi	Leaves	Leaves are ground and directly rubbed into sores of cattle and goats
<i>Solanum delangoense</i> Dunal (Solanaceae)	M024	Tulukiza/Tulwa-tulwa	35.0	Katima Mulilo, Zambezi	Fruits, roots	Crushed roots and fruits are mixed with water. Solution is drunk to treat diarrhoea and coughs in cattle
<i>Acanthosicyos naudinianus</i> (Sond.) C. Jeffrey (Cucurbitaceae)	M038	Umbwiti	60.0	Katima Mulilo, Zambezi	Roots	Roots are crushed and directly rubbed into skin rashes of cattle and goats

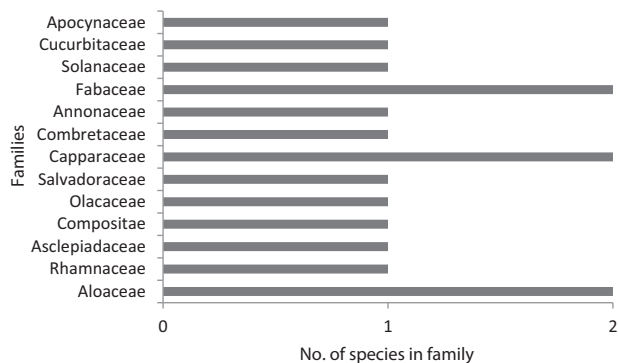


Fig. 3. Overall distribution of plant species across different families.

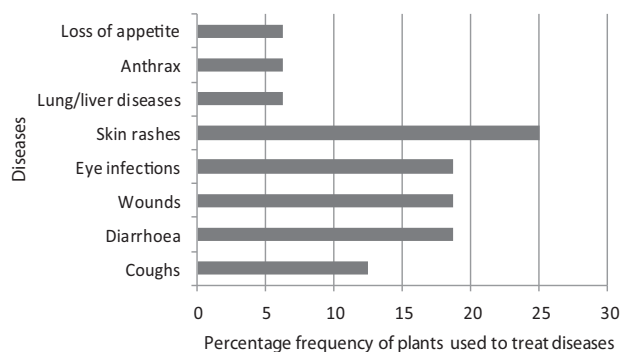


Fig. 5. Overall percentage frequency of the plants used to treat different disease conditions.

gonorrhoea was treated by formulations from several plants including *C. imberbe*, *Z. mucronata*, and *X. americana*.

#### 4. Conclusion

The study documented the indigenous knowledge of ethnoveterinary medicinal plants used in Onayena (Oshikoto region) and Katima Mulilo (Zambezi region). Overall, 16 plant species found in 13 plant families were used as ethnoveterinary medicines for treating mainly skin rashes, diarrhoea, eye infections, and wounds. Further studies are needed to determine the minimum inhibitory concentrations, biological activities and toxicities, and to characterize the plant chemical compounds.

#### Acknowledgements

We thank staff at the Namibian Botanical Research Institute especially Mr. David Aiyambo, and Ms. Fransiska Kangombe and Dr. Ezekiel Kwembeya at UNAM for helping with the scientific identification of the plants. We also thank all the respondents for providing valuable data. UNAM Department of Biological Sciences is thanked for funding the study.

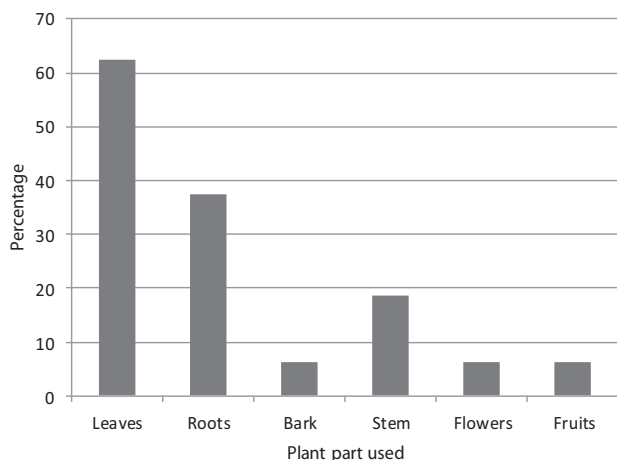


Fig. 4. Overall percentage use of plant parts.

#### References

- British Columbia Ministry of Forests, 1996. Techniques and procedures for collecting, preserving, processing, and storing botanical specimens. Res. Br., B.C. Min. For., Victoria, B.C. Work. Pap. 18/1996.
- Bruschi, P., Morganti, M., Mancini, M., Signorini, M.A., 2011. Traditional healers and lay-people: a qualitative and quantitative approach to local knowledge on medicinal plants in Muda (Mozambique). *Journal of Ethnopharmacology* 138 (2), 543–563.
- Burkill, H.M., 1997. The useful plants of west tropical Africa, families M–R, 2nd ed. Royal Botanic Gardens, Kew, Britain.
- Chinsebu, K.C., Hedimbi, M., 2010. An ethnobotanical survey of plants used to manage HIV/AIDS opportunistic infections in Katima Mulilo, Caprivi region, Namibia. *Journal of Ethnobiology and Ethnomedicine* 6, 25.
- Coates, P.K., 1983. *Trees of Southern Africa*, second ed. Struik Publishers (Pty) Ltd., Cape Town, South Africa.
- Diallo, D., Sogn, C., Samaké, F.B., Paulsen, B.S., Michaelsen, T.E., Keita, A., 2002. Wound healing plants in Mali, the Bamako region. An ethnobotanical survey and complement fixation of water extracts from selected plants. *Pharmaceutical Biology* 40, 117–128.
- Els, J.F., 2000. Diet selection of four free-ranging breeds of small stock. II. Species composition. *Agricola* 2000, 36–38.
- Giess, W., 1971. A preliminary vegetation map of South West Africa. *Dinteria* 4, 1–114.
- Gradé, J.T., Tabuti, J.R., Van Damme, P., 2009. Ethnoveterinary knowledge in pastoral Karamoja, Uganda. *Journal of Ethnopharmacology* 122 (2), 273–293.
- Grønhaug, T.E., Glæserud, S., Skogsrud, M., Ballo, N., Bah, S., Diallo, D., Paulsen, B.S., 2008. Ethnopharmacological survey of six medicinal plants from Mali, West-Africa. *Journal of Ethnobiology and Ethnomedicine* 4, 26.
- Halawany, H.S., 2012. A review of miswak (*Salvadora persica*) and its effect on various aspects of oral health. *The Saudi Dental Journal* 24, 63–69.
- Hedimbi, M., Chinsebu, K.C., 2012. Ethnomedicinal study of plants used to manage HIV/AIDS-related disease conditions in the Ohangwena region, Namibia. *International Journal of Medicinal Plant Research* 1 (1), 004–011.
- Joseph, C.C., Magadula, J.J., Nkunya, M.H., 2007. A novel antiplasmodial 3', 5'-diformylchalcone and other constituents of *Friesodielsia obovata*. *Natural Product Research* 21 (11), 1009–1015.
- Kalayou, S., Haileselassie, M., Gebre-egziabher, G., Tiku'e, T., Sahle, S., Taddele, M., Ghezu, M., 2012. In-vitro antimicrobial activity of some ethnoveterinary medicinal plants traditionally used against mastitis, wound and gastrointestinal tract complication in Tigay region, Ethiopia. *Asian Pacific Journal of Tropical Biomedicine* 7, 516–522.
- Kapshii, C.K.M., Mundia, M.P., Mwangala, F.S., Banda, R., Mugoya, C., 1994. Extraction and evaluation of active ingredients from selected Zambian plants with acaricidal and insecticidal properties. *Proceedings of the first national symposium, Lusaka, Zambia, 2–5 August, 1994*.
- Koné, W.M., Atindehou, K.K., 2008. Ethnobotanical inventory of medicinal plants used in traditional veterinary medicine in Northern Cote d'Ivoire (West Africa). *South African Journal of Botany* 74, 76–84.
- Lans, C., Turner, N., 2011. Organic parasite control for poultry and rabbits in British Columbia, Canada. *Journal of Ethnobiology and Ethnomedicine* 7, 21.
- Madikizela, B., Ndhkala, A.R., Finnie, J.F., Van Staden, J., 2012. Ethnopharmacological study of plants from Pondoland used against diarrhoea. *Journal of Ethnopharmacology* 141, 61–71.
- Mahwasane, S.T., Middleton, L., Boaduo, N., 2013. An ethnobotanical survey of indigenous knowledge on medicinal plants used by the traditional healers of Lwamondo area, Limpopo province, South Africa. *South African Journal of Botany* 88, 69–75.
- Mapiye, C., Chimonyo, M., Marufu, M.C., Dzama, K., 2009. Utility of *Acacia karroo* for beef production in Southern African smallholder farming systems: A review. *Animal Feed Science and Technology* 164, 135–146.
- Mathias, E., 2001. Introducing ethnoveterinary medicine. [www.ethnovetweb.com](http://www.ethnovetweb.com) (<http://www.ethnovetweb.com/docs/whatisvsm.pdf> (Accessed, 10/11/2013)).
- Mathias-Mundy, E., McCorkle, C.M., 1989. *Ethnoveterinary Medicine: An annotated bibliography. Bibliographies in Technology and Social Change*, no. 6. Ames, Iowa State University, USA.
- McCorkle, C.M., 1986. An introduction to ethnoveterinary research and development. *Journal of Ethnobiology* 6, 129–149.

- McGaw, L.J., Eloff, J.N., 2008. Ethnoveterinary use of southern African plants and scientific evaluation of their medicinal properties. *Journal of Ethnopharmacology* 119 (3), 559–574.
- Mendelsohn, J., 2006. Farming systems in Namibia. RAISON/ Namibian National Farmers' Union, Windhoek, Namibia.
- Ministry of Agriculture, Water and Forestry, 2005. Agricultural Statistics Bulletin. Ministry of Agriculture, Water and Forestry, Windhoek, Namibia.
- Ministry of Agriculture, Water and Forestry, 2010. Ministry of agriculture, water and forestry. Profile of investment projects in agriculture, Windhoek, Namibia.
- Ministry of Environment and Tourism, 2010. Fourth National Report to the United Nations Convention on Biological Diversity. Ministry of Environment and Tourism, Windhoek, Namibia.
- Namibian National Farmers' Union [NNFU], 2008. Livestock marketing in Namibia. NNFU report, Windhoek, Namibia.
- Ndhlala, A.R., Ncube, B., Okem, A., Mulaudzi, R.B., Staden, J.V., 2013. Toxicology of some important medicinal plants in southern Africa. *Food and Chemical Toxicology* 62, 609–621.
- Ogunleye, D.S., Ibitoye, S.F., 2003. Studies of antimicrobial activity and chemical constituents of *Ximenia americana*. *Tropical Journal of Pharmaceutical Research* 2, 239–241.
- Rodin, R.J., 1985. The Ethnobotany of the Kwanyama Ovambos. Missouri Botanic Garden, St. Louis, USA.
- Semenya, S.S., Potgieter, M.J., Erasmus, L.J.C., 2013. Exotic and indigenous problem plants species used by the Bapedi to treat sexually transmitted infections in Limpopo Province, South Africa. *African Health Sciences* 13 (2), 320–326.
- Siegmund-Schultze, M., Lange, F., Schneiderat, U., Steinbach, J., 2012. Performance, management and objectives of cattle farming on communal ranges in Namibia. *Journal of Arid Environments* 80, 65–73.
- Strohbach, B.J., 2000. Vegetation degradation trends in the northern Oshikoto Region: II. The *Colophospermum mopane* shrublands. *Dinteria* 26, 63–75.
- Teklehaymanot, T., 2009. Ethnobotanical study of knowledge and medicinal plants use by the people in Dek Island in Ethiopia. *Journal of Ethnopharmacology* 124, 69–78.
- Van Damme, P., Van den Eynden, V., 2000. Succulent and xerophytic plants used by the Topnaar of Namibia. *Haseltonia* 7, 53–62.
- Van den Eynden, V., Vernemmen, P., Van Damme, P., 1992. The Ethnobotany of the Topnaar. Universiteit Gent, Gent, Belgium.
- Van Koenen, E., 2001. Medicinal, poisonous and edible plants in Namibia. Klaus Hess Verlag, Windhoek, Namibia.
- Van Wyk, B.-E., 2008. A review of Khoi-San and Cape Dutch medical ethnobotany. *Journal of Ethnopharmacology* 119, 331–341.
- Wanzala, W., Zessin, K.H., Kyule, N.M., Baumann, M.P.O., Mathias, E., Hasanali, A., 2005. Ethnoveterinary medicine: A critical review of its evolution, perception, understanding and the way forward. *Livestock Research for Rural Development* 17 (11), 1–31.