Livestock Research for Rural Development 23 (2) 2011

Ethnopharmacological practices in management of livestock helminthes by pastoral communities in the drylands of Uganda

A S Nalule, J M Mbaria*, D Olila and J W Kimenju*****

[1] Department of Land Resource Management and Agriculture Technology, University of Nairobi, P. O. Box 29053 00625 Nairobi, Kenya
snalule@vetmed.mak.ac.ug ; snalule@gmail.com
***Department of Public Health, Pharmacology and Toxicology, University of Nairobi, P. O. Box 29053 00625 Nairobi, Kenya**
****** Department of Physiological Sciences, Faculty of Veterinary Medicine, Makerere University, P.O. Box 7062 Kampala Uganda**
******* Department of Plant Science and Crop Protection, University of Nairobi, P. O. Box 29053 00625 Nairobi, Kenya**

Abstract

A two stage sampling ethno-pharmacological study was carried out with agro-pastoralists in Nakasongola district involving two sub-counties namely; Nabiswera and Nakitoma. Participatory methods were used to establish a livestock disease inventory, ethno-diagnosis, medicinal plants used and implication for livestock-based livelihoods. Fourteen focus groups discussion comprising of 198 persons and 32 key informant interviews were conducted.

Trypanosomosis (20.9%), East cost fever (15.5%) and helminthosis (12.8%) were found to be the most prevalent of the twenty five diseases affecting different livestock species in the area. Thirty seven plants species belonging to 28 genera and 24 families were reported as traditional treatments against helminthosis. The frequently used plant parts were leaves(54.1%) and roots (29.7%). Cold aqueous extraction (pounding and adding water) (81.1%) was the main method of preparation of ethno-veterinary remedies with oral drenching as the main route of administration. About 65% of population used combination of traditional and conventional veterinary medicine, 22% used only conventional veterinary medicines, while 13% of the farmers used traditional medicine. Accuracy of ethno-diagnosis compared well with conventional veterinary medicine diagnosis although the causes of the diseases were not well understood by the respondents. Medicinal plants were found to be an important input in livestock production although their efficacy, active molecules and safety is not known thus there was urgent need of scientific studies into these research gaps.

Key words: Agro-pastoralists, Cattle corridor, Ethno-diagnosis, Medicinal plants, Nakasongola

Introduction

The prevalence of helminthes constitutes a serious impediment to livestock production in Uganda. They have been reported to cause high morbidity and low production in stocks (Githiori et al 2006; Grade et al 2008) with a high nematode prevalence (Ssewannyana et al 2010). Helminthes reduces the level of meat, milk and manure output, and reduces asset value through increased mortality, especially of young stock (Cabaret et al 2002; Githiori 2004; Adebisi 2008). The incidence and severity of various helminthes parasitic diseases are more widespread in tropical regions (Ibrahim et al 1984). Despite this importance, helminthes are the most neglected area of veterinary care in the developing countries due to its chronic and insidious nature, with endemic pathogens, vectors and diseases particularly where extensive grazing is practiced (Magona et al 2008; Bizimenyera et al 2008).

In sub Saharan Africa and Uganda in particular modern methods of helminthes treatment have been by use of three classes of synthetic drugs of which helminthes have become resistant (Wolstenholme et al 2004; Coles et al 2006; Gilleard 2006). Commercial dewormers are rarely used by rural communities probably due to high costs, unavailability and inaccessibility especially to the low income communities. This has led has led to seeking for alternative methods of helminthes control. The communities instead rely on ethnoveterinary medicine (EVM) (McCorkle et al 1996) involving use of medicinal plants to control these diseases a situation that has also been acknowledged by World Health Organisation (WHO 2010) who estimated that 80% of people in the developing world or 60% of the human race depend on traditional medicine based largely on the use of plants. In communities dependent on verbal communication and natural herbal pharmacopoeias, it is paramount to tap and document ethnopharmacological practices on disease identification and management using medicinal plants

To-date, specific ethnopharmacological studies carried out in pastoral areas of Uganda have been limited, yet ethno veterinary medicine could be used to a great advantage in control of helminthosis in the face of drug resistance in the socio-cultural context of resource poor farmers for sustainable livestock production. However, measures to search for solutions to emerging diseases have often neglected the role of indigenous knowledge in the overall context of disease control.The current study was undertaken to identify and document ethnopharmacological practices by agro-pastoral communities, specifically how pastoralists in mid western Uganda cattle corridor recognize the diseases and subsequent management of the disease.

Materials and methods

Study area description

The study was conducted between December 2009 and February 2010 in Nakasongola district. This is one of the cattle corridor districts that stretches south-west to north-east of Uganda. The district is bordered by Apac district to the north, Masindi district to the west, Luwero district to the south and Kayunga district to the east. The district has a human population of 144,100 (UBOS 2009) and is characterized by inadequate provision of extension services, weak industrial sector, cultural diversity and high livestock population, declining soil fertility, environmental degradation and droughts.

The cattle corridor occupies an area of 44% of the country surface area and has a bi-modal rainfall and high evaporation rate. In 2010, a report by a consortium of institutions including Ministry of Agriculture, Animal Industry and Fisheries, Uganda; Uganda Bureau of Statistics; Food and Agriculture Organization of the United Nations; International Livestock Research Institute; and World Resources Institute, indicated 78% of households in the cattle corridor own livestock of one or another kind of which 29% own cattle, 44% own small ruminants (sheep and goats), 23% own pigs and 65% own chicken. The cattle population densities in the mid corridor was reported to be 50-150 heads of cattle per square kilometer (MAAIF and UBOS 2009). Livestock is the main source of livelihoods in the cattle corridor compared with outside districts where livestock is ranked second or third as source of livelihood nationally (MAAIF and UBOS 2009).

Study Design

Nakitoma and Nabiswera sub-counties of Nakasongola district were purposively selected based on livestock production systems, accessibility, ease of follow-up and response of the local authorities to collect ethnopharmacological practices. Fourteen focus groups were formed based on parish level from which thirty two key informants were also identified during focus group discussions by participants for in-depth interviews. Each group consisted on average twelve people purposively selected based on livestock health management knowledge and experience and herbal medicine knowledge. The elderly community members (aged above 60 years) and herbalists were targeted as respondents.

Ethnopharmacological data collection methods

Rapid rural appraisal (RRA) techniques explained in the different publications (Rudqvist and Tobisson 1991; Chambers 1992; Holland and Blackburn, 1998) were employed. The research methodology was designed to allow free sharing of information between the researcher, pastoralists and the key informants. Specifically, focus group discussion using an interview schedule, key informants interviews employing semi-structured questionnaire and transect walks was employed. Field excursions were conducted in accompaniment of key informants, local leader and extension worker for direct observations to assess conservation status of these medicinal plants mentioned and to collect the herbarium voucher specimens under the guidance of the herbalist. Information on livestock diseases including helminthes regarding perceived causes and diagnosis, treatment, herbal preparation, plant preference and source of the plants, dosage were collected. Other information collected included conservation efforts and challenges encountered while using herbal medicine. The medicinal plants collected were those mentioned during FGD and key informant interviews. The plants specimens were given collection numbers, pressed and later identified by a voucher code by which it was botanically identified in Makerere University Department of Botany Herbarium.

Generation of disease list and the medicinal plants used in disease treatment

Fourteen focus groups of pastoralists including men and women were each converged in their communities and asked to name all livestock diseases that occurred in their area and mention species affected in their local language. A list of diseases mentioned was generated and spread on the floor. Each member was then given a bean seed and asked to press it on the most common disease among the diseases on the list. Total number of beans on each disease was counted and recorded and thereafter removed and redistributed again. They were asked to indicate the second most common, the third and so on for the rest of the diseases. Similarly, a list of medicinal plants used to treat the disease was generated by a checklist of questions.

Qualitative Data analysis

The qualitative data was analyzed by themes and content approach according to Taylor-Powell and Renner, (2003). While all primary data obtained using semi-structured interview questionnaire from key informants were entered in excel spread sheet and analyzed for descriptive statistics using SPSS 12.0.1 for windows.

Results

Respondents' biographic details

A total of fourteen focus group discussions comprising of 198 agro-pastoralists aged 30-72 years of whom 47% were women and 53% men were held. About sixty five percent (65.6%) of key informants were women while 34.4 % were men. Majority (75.5%) women interviewed were more knowledgeable in disease diagnosis and herbal treatment than the equivalent proportion of men.

Common Livestock diseases in study area

A total of 25 livestock diseases were reported as existing in the area (Table 1).

Table 1. Common livestock diseases in Nakasongola district

Common Disease name	Local name Lululi or Luganda	Species affected	Suspected cause (s)
Trypanosomosis	Kipumpuri	Ruminants and pigs	Tsetse flies
East cost fever	Amakebe	Ruminants	Ticks/much milk?
Contagious	Kihaaha	Ruminants	Wind
pleuropneumonia	Enjoka	All species	Worms & swamp water
Helminthosis	Kalusu	Ruminants and pigs	Dry season with wind
Foot and mouth disease	Kakooto	Cattle	Dry season
Black quarter	Kamenya	Cattle	Not known
Three day sickness	Okuziiba amaaso	Cattle	worms, wounds &fever
Blindness/Thelezia	Ekifuruto	Cattle	drought and wind
Lumpy skin disease	Nabuguma	Ruminants & humans	Much heat
Brucellosis	Ebigoye/amakajjo	Cattle	not known
Hygroma	Ekikororo/ekifuba	All species	worms/unknown
Cough/TB?	Okusowola	All female mammals	Mounting pregnant animal
Abortions	Obunwanwa	Small ruminants	Grazing on burnt pastures
Orf	Omutwe	Cattle	Not known
Headache	Ebiguuna	Cattle and pigs	Not known
Ring worm	Ebaanyi	Mammals	Poor hygiene
Mastitis	Olukuku/oburoro	Pigs, dogs, cattle	Poor hygiene & dust
Mange	Okugonesa	Cattle, pigs, goats	Poor breed
Poor milk letdown	Amabwa/ebiwundu	All species	Injuries and calf bites
Open wounds	Kutumbira	Ruminants	Young pastures
Bloat	Mulalama	Poultry	Wind
Newcastle disease	Kijonjobaro	Poultry	Unknown
Coccidiosis	Rubyamira	Small ruminants	Unknown
Bronchopneumias (P*PR?)*	Ekidukaano	All species	Unknown
Diarrhea			

Ethno-diagnosis of common diseases by the Baruli agro-pastoral community

Efforts were made to identify peoples' knowledge of livestock diseases diagnosis (Table 2). The pastoralists were able to diagnose with correctness the peculiar characteristic clinical signs of a specific animal disease and used these signs to guide treatment. The area veterinary officer assisted in getting the equivalent scientific name of the described disease by the participants.

Table 2. Ethno-diagnosis of livestock diseases and conditions by the Baluli pastoral community

Disease name	Local name (Lululi or runyankore)	Animal species and age affected	Peculiar clinical signs as described by people in study area
Trypanosomosis	Kipumpuuri	Cattle	-Loss of weight and poor health, diarrhea and running eyes/tears, animal has poor appetite, tarry hair coat, blood spots in feaces
East coast fever (ECF)	Amakebe	Cattle, great impact in calves less than one year old	-Common in calves, swollen lymph nodes especially the parotids, nasal and eye discharges, high temperatures, clouded eyes, coughing, circling, Starry hair coat, dry muzzle. High respiratory rate, cough, diarrhea or constipation
Contagious bovine pleuropneumonia (CBPP)	Kihaaha	The disease affect cattle and goats, and all ages	-Animal stays in the shade and stands with the head lowered and neck stretched, back arched and elbows abducted, painful fast difficult breathing with bad smell of breath and mucus in the nose, Severe dry coughing on moving and loss of weight, failure to lie down/sleep, abortions, enlarged lungs
Stomach and intestinal worms	Enjoka or ebiwuka	All animal species, all age groups, but more significance in young animals	-Animal is thin and looks weak, rough hair coat, sometimes with diarrhea, anemic, sometimes loose appetite, reduced milk production, swollen neck in calves, distended stomach/pot belly of calves and piglets, retarded growth, worms sometimes seen in faeces, on slaughter, stomach worms are visible in animals stomach and intestine. Some leaf like worms seen in liver ducts
Foot and Mouth disease	Karuusu	All ruminants and pigs, all age groups	-Contagious and highly infectious, animal develops wounds on gums, udder, teats, hooves and drool saliva. Low milk production. Abortions & waterly milk. Morbidity high but low mortality. Said to result from contamination by cattle traders, migration, infected livestock products and dry season
Lumpy skin disease	Ekifuruto	Cattle of all age structure	-Severe lumps about 4 cm in diameter on the skin of the animal's whole body, and swollen lymph nodes legs swollen with water, high temperature.
Ring worm	Ebiguuna	Cattle, goat and pigs	-Loss of hair on body in a ring form, itchy rings, Animal scratches on objects or ground
Placenta relation		Cattle, goats, sheep	-Hanging tissue, from vulva and failure to find afterbirth at site,
Blackquarter	Kakooto	Cattle, all age structure but affect yearlings most	-Sudden lameness in hind limbs, depression, fever, heavy muscles especially the hind quarters swollen, skin on the swelling is dark, swellings are hot and painful and give crackling sound when touched. Diarrhea, Common with young pastures shortly after dry season, If animal dies, the meat is blue/black and soft

Ephemeral fever (Three day sickness)	Kamenya	Cattle of any age	-Animal is sick for 3-5 days. There is fever, shivers and sudden lameness and stiffness of limbs, animal lies down, saliva drool, watery eyes, some animals develop bloat, starry hair and animal breathes with difficult.
Mastitis	Ebaanyi	Milking cows	-Swollen udder and painful teats, sometimes milk clotted or with blot clots. Sometimes udder engorged with milk but fail to get out when teat is squeezed
Orf	Obumwamwa	Goats and sheep	-It occurs when goats graze on rush grass after bush burning. Small swellings appear around the muzzle that turn into wounds
Theleziasis	Eminyororo	cattle	-Animal blind, tears run down, threadlike worms seen on cornea
Brucellosis	Ebigoye or Nabuguma	Cattle and goats	-Swollen joints and lameness and failure to mount if bull, abortions towards last semester, sometimes retained placenta and weak calves, joint pains
Anaemia		All species	-Weak, pale/yellow mucous membranes, white eyes
Headache	Omutwe	Ruminants	-Lowering the head, running tears in eyes, reddening of the eye
Bloat	Kutumbira	Ruminants	-Extended para lumber region, difficult breathing, and failure to lie down.
Newcastle disease	Murarama	Poultry	-Diarrhea with green and red colour, turned neck on the back, failure to eat, drooping feathers, sometimes sudden death, all age affected
Coccidiosis	Kijonjobaro	Poultry	-Whitish-bloody diarrhea, poor health, drooping feathers
Bronchopneumonias (PPR?)	Rubyamira or Omubyamo	Goats and sheep	-Bronchopneumonia, respiratory distress, including dyspnea and sneezing in an attempt to clear nose, serous white nasal discharge that can crust over and occlude nostrils, diarrhea & anorexia. dehydration, abortion and mortality occur

Ethno-diagnosis and management of Livestock helminthes in Nakasongola

The community uses clinical signs and circumstantial evidence to diagnose helminthosis. Particularly the presence of round worms and/or segments of cestodes in feacal material and flat "leaf-like" worms in the liver ducts, poor body condition and diarrhea are highlighted as their guide to diagnosis. Also mentioned is the presence of threadlike material in the eyes of cattle and associated with high lacrimation.

The study established that 65% of the community use a combination of traditional and modern veterinary medicine to treat livestock diseases while 22% solely use modern veterinary medicine and 13% use traditional herbal medicine. The frequently used conventional anthelmintics were *Albendazole hydrochloride (*Wormicid©*)* and *Levamisole hydrochloride (*Levacide©).

Use of Medicinal plants in livestock helminthes control

Thirty seven (37) medicinal plants species belonging to 28 genera and 24 families mentioned as used to treat helminthosis of livestock and/or humans were documented (Table 3). Species from Euphorbiaceae being the most used (13.5%). The plant parts used were leaves (54.1%), roots 24.3%, stem bark 5.4%, fruits and seeds 8.1% and a combination of roots and leaves (8.1%).

Table 3: Medicinal plants used to treat livestock helminthosis by Nakasongola community

Family name	Species name	Plant local name	Growth form	Part(s) used	Preparation	Dosage/quantity administered
Rutaceae	*Zanthoxylum chalybeum Engl*	Entale yedungu	Tree	R	-Pound about 0.3kg of root bark and boil in 4L of water	Drench ½L to adult cattle, 300mls calves and 1table spoon to children
Eurphorbiaceae	*Euphorbia heterophylla Linn.*	Akasandasanda/Kimotooka	Herb	WAP	-½ kg of mature aerial plant parts steamed in 2L of water	Drench 750ml to adult and 300ml to calves and small ruminants.
Asclepiadaceae	*Secamone africana (Oliv) Bullock*	Obukoni or Akatakura	Lianar	WAP	-About ½ kg pounded and boiled in 1L of water and cooled	Drench ½ L to adult cattle &; 300ml to calves and small ruminants
Compositae	*Vernonia amygdalina Del.*	Omululuza	Tree	L, R	-About ½ kg of mature leaves pounded, add 3L of cold water, or boil 1kg of roots in 2L of water	Drench 1.5L to adult cattle or 750ml to young ones

Vitaceae	*Rhoicissus tridentata (L.f.) Wild & R.B. Drummond*	Omumara	Shrub	RT	-About 1kg of pounded root tubers boiled in 2L of water	Administer ½ L to 1liter to young and adult animals respectively
Compositae	*Vernonia grantii Oliv*	Omukuzanyaana	shrub	L, R	-Boil pounded 1kg in water	Drench ½ L to 1.5liters
Phytolaccaceae	*Phytolacca dodecandra L'Herit*	Oluwooko	shrub	L	-About ½ kg of mature leaves boiled in 3L of water to remain with 1.5L and cool	Drench 1.5L to adult cattle, 750ml to calves and small ruminants
Caparicacea	*Carica papaya L.*	Pawpaw	tree	F, S, SP	-Chop 1kg young fruits or about 100g of seeds	Mix with feed or put in mouth of animal
Vitaceae	*Cyphostemma adenocaule (A.rich.)willd Drummond*	*Ekimara*	Lianar	RT	-Add 4L water to pounded 1kg of fresh roots & let mixture stand for few minutes before straining	Drench 2L to adult cattle, 1L to calves & 100ml adult humans
Caesalpinioideae	*Cassia occidentalis L.*	Omutanjooka	shrub	R	-Pound a handful of roots (200g), add 1liter of water, boil to remain 1/2 liter	Drench 1/2L once to adult animal, 100ml to young ones
Caesalpinioideae	*Cassia obtusifolia L*	Omwitanjoka	shrub	R	-Pound a handful of roots (200g), add 1liter of water, boil to remain 1/2 liter	Drench 1/2L once to adult animal, 100ml to young ones
Verbenaceae	*Clerodendrum rotundifolium Oliv.*	ekisekaseke	Shrub	L	-Pound ½ kg of leaves add 1liter of water, stir and sieve	Drench 750ml to adult cattle about & 500mls pig and small ruminants
Solanacae	*Nicotiana tabacum L.*	Taaba	herb	L	-Boil 5 leaves in 1L of water and cool or pound a leaf to make paste	Drench about 300mls or squeeze drops of juice into the eye
Cucurbitaceae	*Lagenaria sphaerica*	Omutanga	lianar	L	-Pound ½ kg of mature leaves, add 1L of water stir and filter	Drench about 700ml to adult and 300mls to calves
Lamiaceae	*Tetradenia riparia Hochst) Codd*	*Kyewamala*	shrub	L	-Pound about ½ kg of fresh leaves add 3l of water and filter	Drench 1L to adult animal; ½ L to young animals

Solanaceae	*Physalis peruviana L*	*Entuntunu*	shrub	L	-Pound 2 handful (300g) add 1.5 L of water	Drench 1lter to adult animals and ½ L to young animals
Cucurbitaceae	*Momordica foetida* Schumach	*Ebbombo*	lianar	L	-Pound ½ kg of fresh leaves add 3L water and filter	Drench 1.5l to adult cattle
Labiatae	*Coleus latifolius Andr*	*obushohera*	herb	L	-Pound (200g) a handful of leaves and add 1liter of water	Drench all to adult animal
Caesalpinioideae	*Senna didymotrya Fresen*	Omucuura	shrub	R	-Pound a handful (0.3kg) of roots, boil in 1 liter of water to reduce to half liter extract	Drench a ¼L of extract to yearlings & 150ml small ruminants
asparagaceae	*Asparagus tuberosum*	Obushebasheshe /Kadaari	shrub	L, R	-Pound leaves add few drops of clean water or crush 1kg of roots add 2L of water	-Put drops in the eyes or drench ½ to 1L
Euphorbiaceae	*Flueggea virosa (wild) Voigt/ Securinega. Virosa*	Lukandwa	shrub	R	-Pound 1kg of roots add 2l water and boil	Drench 1liter to adult cattle
Eurphorbiaceae	*Sapium ellipticum (Hochst)*	Omusasa	tree	L	-About 3kg/half a "debe" tin, mix with fodder	Given as forage
Cannabaceae	*Cannabis sativa L*	Enzayi/enjaga	Herb	L	-*Mix C. sativa* (100g)+ *J. betonica* (100g) + *T. riparia*(150g) and boil in 2L of water	Drench ¼ to ½ L of extract to calves and small ruminants and adult cattle respectively
Acanthaceae	*Justicia betonica L*	Nnalongo	Herb	L		
Lamiaceae	*Tetradenia riparia Hochst) Codd*	Kyewamala	shrub	L		
Cucurbitaceae	*Curcubito maxima*	Ensujju	Lianar	S	-Pound 100g of dried seeds and mix with feeds	Administer together with feeds
Euphorbiaceae	*Jatropha curcas L.*	Kiroowa	shrub	L	-To ½ kg of leaves add 1 liter of water boil to remain with ½ liter	Drench ½ l once
Simaroubacea	*Harrisonia abyssinica Oliv.*	Ndalike or Kalarike	tree	R	-Boil pounded 1kg bark in 2L of water	Drench 250mls
Bignoniaceae	*Kigelia africana*	Omuusa	tree	SB	-Boil stem bark in 1L of water	Drench ½ liter to calves

Malvaceae	*Sida rhombifolia*	Akeyeeyo	shrub	R	-Pound & boil 200g of fresh roots in 1L of water	Drench ½-1 L to calves & adult cattle respectively
Moringaceae	*Moringa oleifera Lam.*	Moringa	shrub	L	-Leaves mixed with fodder	Administer as feeds
Poaceae	*Sporobolus pyramidalis*	Kasibante	grass	R	-Pound clean roots, add few drops of water and little salt	Squeeze 5 drops in the cattle eye
Euphorbiaceae	*Ricinus communis L.*	Ensogasoga	shrub	S	-pound seeds into paste	3 seeds to calve and 9 seeds to adult animal
Acanthaceae	*Brillantaisia owariensis P. Beauv.*	Ekirarankuuba	shrub	L	-collect five leaves boil them in 1 liter of water	administer ½ L early in the morning
Acanthaceae *Lamiaceae*	*Justicia exigua* *+Ocimum basilicum*	Kayayana and kakubansiri	herb shrub	L L	-A handful of *Justicia exigua*leaves + a handful of*Ocimum basilicum* leaves + 1L of boil slightly	Drench ¼ L to young animals and ½ liter to adult
Nc	NC	Olugero	lianar ?	SB; L	-Chop about 2.5kg of stem and leaves, add 2.5 liters of water and boil briefly	Drench 2liters a day to cattle, 300ml to pigs or chop the stem and give it as feed
Rutaceae	*Vepris nobilus (Del.) mziray (Teclea nobilis)*	Enzzo	tree	L	-Pound about 200g of leaves, add ½ water and strain	Drench ½ L to adult cattle
Acanthaceae	*Justicia exigua*	Kayayana	herb	L	-To about 0.2kg, add ½ L water and slightly boil	Drench 150-300mls
Ebenaceae	*Euclea latidens Sapt.*	Omutsikizi	shrub	R	-Pound about 0.5kg of roots, add 1L of water and boil	Drench 100-300ml to before feeding
Asphodelaceae	*Aloe sp*	Akagagi /Rukaka	shrub	L	-10 leaves boiled in 5L of water	Drench 2.5L to adult cattle

Key: R=root; L, leaves; F=fruit; WAP=whole aerial plant, RT=root tuber, S=seeds, SP=sap, SB=stem bark; G=grass; NC= Not collected for identification

The herdsmen and women (54% and 41%) respectively were most responsible for health monitoring and herd disease management though women seemed more knowledgeable on herbal medicine than their counterpart men. Though few young people were knowledgeable about herbal medicine, some were very knowledgeable and knew their growing habitats. It was observed that people above 40 years old were more knowledgeable and appreciating herbal medicine than young people. However, irrespective of age and gender, all members staying with the herbalists were knowledgeable about herbal medicine. The study established that overdosing with herbal medicine

occurred and it mostly manifested as severe diarrhea/or vomiting (humans), shivering and weakened joints.

Perception on efficacy and risks of medicinal plants

Majority (54%) of the participants believed some plants were very efficacious and they might be better than conventional drugs on market. A relatively high (44%) number of the respondents were unsure of potential risks. They thought herbal drugs were always beneficial, safe and natural. However, they quickly acknowledged that effectiveness varied depending on the plants used. According to community ranking the top five most effective plants and less toxic effects of the 37 anthelmintic plants were *V.amydgalina* (13.9%), *Z. chalybeum* (12.3%), *E. heterophylla* (10.6%), *R.tridentate* (5.8%) and *Secamone africana* (5.3%)

Sources, Preparation and administration of herbal medicine

The majority (70.3%) of these plants were shrubs and trees, harvested mainly (78.2%) from the wild populations while 21.2% were cultivated around homesteads or selflessly protected in gardens. Remedies from these plants were prepared mainly as decoctions and infusions and administered in a variety of ways. The frequent methods of medicine preparations were by pounding fresh plant material and adding fresh cold water or in combination with boiling (81.1%), given as feed additive (16.2%) and as eye drop 2.7%. Oral drenching was the major (91.9%) route of administration. Topical application is used in form of eye drop and smoke fumigation is also used when treating thelezia parasites in cattle. Water was the solvent of choice in all preparations. Whenever roots were used they were boiled before they were administered.

The study also established that the same plants used for helminthes control were also used to treat other diseases and conditions of man and livestock. Some of the commonly used plants with multiple use included *Zanthoxylum chalybeum Engl., Vernonia amygdalina Del., Tetradenia riparia (Bernth) E.A., Carica papaya* L., *Curcubita maxima*, *Hoslundia opposita Vahl*, *Molinga olifera, Jatropha curcao L., Cannabis sativa L., and Nicotiana tobacum* L. For instance, *Z.chalybeum* was reportedly used to treat malaria, odontitis, toothache, measles, cough, sore throat and constipation. *V.amygdalina* was used to treat bloat in goats and cattle in addition to being used for treating malaria, as ant-foaming agent in gaseous stomachs, nutriceutical values and maintenance of early weaned and/or orphaned calves, kids and children. Although some of these plants have medicinal values, they were also reportedly used as food and/or vegetables. Example of such plants used included *Curcubita maxima* and Carica papaya. The leaves and sap from *C. papaya* were reportedly used to tender and soften women's hands and also for steam bathing newly born babies to protect against skin diseases of the young like heat rushes. The leaves of papaya were also used as soap in times of scarcity. The leaves from *Tetradenia riparia* and *Cannabis sativa* were used to treat irritating cough in both humans and livestock. The community acknowledged using *Jatropha curcas* and *H. opposita* to treat both open and closed wounds in addition to *H. opposita* being very important in postpartum healing of uterus in women. *N. tobaccum* was used for psychotic benefits in those accustomed individuals while old women in communities chew the leaves and administer drops of its juice to children to treat worms, stimulate appetite and/or induce vomiting when necessary.

Challenges in using traditional knowledge and herbal medicine in livestock disease management

Despite the value of indigenous technical knowledge in livestock disease management, there were a number of challenges faced by the practitioners (Figure 4). Other threats had been

identified as deforestation (56%), changing land use (24%), termite invasion (7%), overgrazing (5%), medicine trafficking and poor harvesting (6%) and persistent drought (2%). All these affect the availability of the medicinal plants in the area.

The community noted that some important medicinal plants had disappeared or reduced from their environment while some exotic species had been introduced. Some of the plants that had disappeared or reduced included; *Vernonia amygdalina*, *Kigelia africana*, *Phytolacca dodecandra*, "Kafunkura", "Essanguura", "Entookenkuru", "Omukabara", "Omutiima gw'ensi", "Ntungaani", "Omuyonza" and "Akabombo". This was supported by researcher's failure to collect most of these plants' specimen from the area for identification during our field exploration. The participants attributed the cause of disappearance to poor harvesting, changing land use, deforestation, overgrazing, and poverty, lack of land furrowing and destruction of wetlands.

Traditional Knowledge transfer and its threats

It was established that transfer of traditional technical knowledge (ITK) had been majorly from elders or parents (93.7%) to the young trusted children or persons, and learning from friends by passive and/or active observatory participation (6.3%). The threats to indigenous knowledge sustainability were identified as adoption of western medicine (30%), lack of interests by young generation (28.2%), secrecy by experts (10.8%), immigration & mixing culture (10.2%), lack of promoting policy (7%) and others (8.8%).

Discussion

The study established that that relatively few women turned up for the focus group discussion though they were the majority of the key informants. This was probably attributed to the long distances to the meeting places and the several domestic roles women play. Pastoral women have been marginalized and given limited opportunity to participate *and benefit from public decision-making* events. In addition, in majority pastoral communities, women are not freely allowed to participate in public debates and this discourages them from turning up to such gatherings. This finding agrees with the observation by (Mussa 2004). The high percent of women knowledgeable in disease diagnosis, ethnopharmacology and herding practices was attributed to their direct contact and processing of livestock products and their role in animal husbandry and care. Such specialized technical knowledge is tied to the division of labour in the society. This was in agreement to the observations by Antonio and Ahmed (2010).

Women usually owned small ruminants, poultry and pigs and are culturally responsible for milking animals, processing the milk and generally looking after family stock (ADF 2002; Antonio and Ahmed 2010). Women and children were less secretive in sharing knowledge. It was also noted that the people staying with herbalists all know the medicine and this was attributed to the fact that they were the ones in charge of harvesting or collecting them. This had given them hard earned experience in disease diagnosis and management since they were always limited in resources and extension support in most societies. In addition, women and children were more close to the elderly who were more knowledgeable and willing to share their knowledge to them than the suspecting youthful men. Safilios-Rothschild (1983) observed that the role of women in livestock production was well documented in sub-Saharan Africa. Antonio and Ahmed (2010) noted that although women's roles were primarily traditional animal care such as nurturers and healers, the men controlled the use of conventional drugs. This probably explains their traditional knowledge strengths compared to men.

The high level of household (65%) deriving their livelihoods from livestock and livestock related enterprises and supplemented by cereals and root crops was attributed to the climatic conditions of the area. The livestock species kept in the study compared well with what was reported by ADF (2002). The livestock production systems were shaped by prevailing biophysical and socio-cultural environments. The selection of enterprises and management system proceeded cumulative years of experience that developed from active observation by the society (UBOS 2009; Benson and Mugarura 2010). The low rainfall and recurrent droughts cannot sustain or support other crops in the area. Steinfeld et al (2006) made observation that livestock was more sustainable in drylands than crops andwithout external inputs they were traditionally in sustainable equilibrium with environments.

Disease prevalence and Ethno-diagnosis

A multitude of diseases and conditions reported in the area may be attributed to type of climate, production system and government privatization of veterinary extension services especially on diseases that used to be controlled by government through routine vaccination. Increased costs and limited extension services lead to "self medication" leading to drug abuse and possibly disease resistance (Koma 2000). Further, the habitat plays a great role in the existence of some diseases like trypanosomosis due to their harboring of the disease vector- tsetse flies (Magona et al 2008). The communities were able to correctly diagnose majority of livestock disease sighting the same clinical signs that had also been highlight in a number of scientific documents such as Blood et al (1994). The communities' ability to diagnose diseases was achieved through experience though sometimes was by trial and error on past cases. Mis-diagnosis was also possible leading to poor management of the disease.

Medicinal plants used in livestock helminthes control

A relatively high number of the population in the study area still use medicinal plants in livestock healthcare and was always given as first line of action before veterinary consultation took place. Koma (2000), Dahlberg and Trygger (2009), Lagu and Kayanja (2010) reported that illiteracy, drug costs and inaccessibility of anthelmintics and other extension services contributed to reasons for reliance on indigenous medicine. The present study reported 37 medicinal plant species used by the people in the cattle corridor in Uganda. The study findings revealed the existence of rich biodiversity in the cattle corridor and a wealth of traditional knowledge existing in the community. Knowledge of medicinal plants among communities in Nakasongola, was still preserved and it was conveyed to young generation through apprenticeship which agreed with observations by Kokwaro (1993). Younger people learnt from elders through consultation, observation and discussion. However, the low percent of people solely using herbal medicine probably directed to traditional knowledge replacement by increasing modern veterinary medicine extension, livelihood changes and environment degradation as was also reported by Shen et al (2010). The global food security and food sovereignty for communities across the world bases on biodiversity which provides ecosystem services. Sustainable exploitation of these services requires the knowledge of traditional communities without which meeting future demands could be impracticable (MEA 2005).

Nakasongola community was rich in knowledge of medicinal plant biodiversity evidenced by the many plants used as anthelmintics. The several plants reportedly anthlemintics are also used to treat other conditions. For instance, *Vernonia amygdalina* Del has been reportedly used in pregnancy, fevers and malaria treatment (Nalule 2000; Tabuti et al 2003; Kamatenesi-Mugisha et al 2006). Huffman and Seif (1989) reported that chimpanzees use *V.amygdalina* to relieve

themselves of stomach pain. The relatively high proportion of people using medicinal plants (Figure 3) probably indicated the immense trust and significance of the bio-diversity to the community attested after long experience. Although, the use of medicinal plants to treat diseases in livestock was generally low (13%), the community acknowledged a fall back to herbal medicine following scientific research done and the associated nutriceutical advantages and the global mobilization and increasing market.

Kabatabazi (2010) stated that, "the loss of indigenous knowledge systems could be one of the greatest tragedies of our age." The decline could be attributed to a number of issues including; high adoption of conventional drugs, difficulty in tracing the needed plants, lack of knowledgeable people and information concealment, and lack of documented information on the use of medicinal plants, selfishness and request for payment in return of knowledge sharing. Mussa (2004) observed that invasion of western systems and involvement of pastoralists in administrative domain; weaken the traditional system, in some instances totally replaced by modern systems.

Some of the plants used by the Nakasongola community have also been reportedly used in other Ugandan communities. Nalule (2000) documented a total of 73 plants used for treating 19 livestock diseases of which 11 plants are used for helminthes control. Bizimana (1994) documented 54 plants used in helminthes control in Iteso. Katunguka-Rwakishaya et al (2004) documented 22 plants used to treat livestock helminthes. Wasswa and Deogratious (2006) reported 21 plants used as anthelmintics in ethnoveterinary practice, ten of which were also reported in this study. Other studies on plants used as anthelmintics in the region giving interesting reading include but not limited to Mbaria (1998), Gakuya (2001), Lagu and Kayanja (2010). A survey carried out in Asian countries by different authorities listed 223 useful plants of which 23 were used as anthelmintics against intestinal helminths (Hammond et al 1997). Waterman et al 2010 reported 17 plant species used for treatment of intestinal infections in Sub-Saharan Africa of which 12 plant species they confirmed their anthelmintic activity. However, Iwu, (1993), cautioned that variations in the treatment of diseases and use of medicinal plants existed among different tribes even among herbalists in the same locality.

The prevalence of the same knowledge by different communities probably indicates the importance of the plant involved. Furthermore, the cultural mixing that had occurred over time with consequent sharing of traditional knowledge may explain the widespread knowledge. Yet it was also possible that cultural infiltration of a specific culture by outside cultures weakened the indigenous knowledge. Similar observations were made by Kabatabazi (2010).

The widely used plant parts in the preparation of remedies are the leaves, roots, whole plant, stem bark & fruits parts in that order. The popularity of these parts especially the roots, stem barks and whole plant had negative consequence from both ecological point of view and from survival of the medicinal plant species (Nalule 2000; Mesfin et al 2005). The present study findings indicated leaves and roots were most used. A plant whose roots were most used is more susceptible to extinction than that whose leaves and fruits are used unless proper conservation and sustainable measures are considered.

Preparations, dosage and administration of medicinal plants

The communities in the study area used medicinal plants to cure human and livestock diseases and revealed different methods of preparation and modes of application. They had developed several methods of application or administration of medicinal plants depending on the particular disease to be treated. Iwu (1993) reported the methods are dictated by the nature of the illness and the plant

part used. Some of the routes of administration of anthelmintic as practiced by the community include oral drenching, as feed and ocular application as in Thelezia infestation. He further acknowledges the drug is usually drunk for internal conditions or applied topically for external infections. The same methods were well documented in Blood et al 1994 and have also been reportedly used by other communities (Grades et al 2008).

In some cases fresh plants are harvested, finely chopped and mixed with feed, e.g. *Carica papaya* young fruits and *Vernonia amydgalina.* Most of the preparations in the study area were drawn from a single plant or mixture of more than one plant. Mixing plants may enhance effectiveness through synergism(Kaufman et al 1999). However, lack of dose and dosage standardization was noted in the study area and this agreed with findings of the studies by Katunguka-Rwakishaya et al (2004) and Mesfin et al (2005).

Community usage, perceptions on benefits and risks of using herbal medicine

The majority of respondents had used herbal medicines, either for human and/or livestock disease management. Usage stands at 65% for those who use bothherbal and conventional drugs and 13% for those who solely use herbal medicine and the rest use conventional drugs.

Broadly speaking, women and the most economic disadvantaged class are the majority users of herbal medicine.

Despite a high number of respondents in different focus group discussion acknowledging using herbal medicine, a relatively high (44%) number of the respondentswere unsure of potential risks in using herbal medicine as they believe it is always beneficial, safe, and natural than harmless. Similar perceptions were reported by a study conducted by Ipsos-MORI (2008). However, majority (56%) of herbalists acknowledged that misuse of some herbs can lead to severe toxicity which majorly manifest as vomiting, diarrhea, joint weakness and convulsions especially in human beings. Muscle tremors, shivering and diarrhea were also common in livestock following excessive administration of some herbal medicine. Reports on adverse reactions to herbal medicines are well documented in the study by Dunne (2009).

Constraints and challenges of using herbal medicine

The study established that some herbal medicine is good but a wide range of dosage exists. This makes its standardization is a challenge. Medicinal plants possess pharmacological properties and therefore possible therapeutic effects (Singh and Bhandari 2000). However, some drawbacks to traditional medicine have been reported among others including; incorrect diagnosis, imprecise dosage, low hygiene standards, the secrecy of some healing methods and the absence of written records about the patients. Sujon et al 2008 reports that major problems associated with the use of herbal medicine relates to lack of scientific evaluation. Cultural infiltration has also been identified as a threat to indigenous knowledge as it leads to the erosion of human intellectual capital. This concurs with observation made by Kabatabazi (2010) who noted that the movement of people is leading to loss of farming communities, languages and indigenous cultures.

Majority of respondents (65%) also revealed that most times it is not possible to diagnosis the disease and also pinpoint out the herb responsible for the biological effect since most times they use more than one herb in a single condition. Though participants in the study were able to identify large Nematodes and trematodes types by their location on/in the body such as liver ducts, eyes

and intestines or rumen or feaces, they are not keen to identify the cestodes according to clinical signs and location.

Toxicity cases were also acknowledged to occur especially with failure to follow instructions. For instance they reported use of *Cassia occidentalis and Cassia didimotrya and Cyphostemma adenocaule* to cause severe diarrhea and/or vomiting. Some studies have also reported death resulting from administration of *C. occidentalis* (Martin et al 1981). In addition, the use of multiple preparations in a single disease with no specific target makes it difficult to single out the role and contribution of each medicinal plant species hence generalizing the medicinal value. Inconsistency in the use of plants in terms of quantity, and combinations with other plants could overshadow ant-parasitic value of a single plant. It is difficult to isolate the plant responsible for treating due to mixing of many plants. Similar observations were made by Athanasiadou et al (2007) who also suggested that prior to incorporating medicinal plants in parasite control scientific community should provide evidence on medicinal value and address the inconsistence issues. This has led young generation not embracing use of medicinal plants due to lack of knowledge on basis of action. The lack of policy on intellectual property rights discourage people with knowledge from revealing the knowledge while at the same time the national governments have not promoted use of indigenous knowledge. WIPO (2002) held similar views that a multiplicity of measures are needed some of them intellectual property (IP) related to protect, preserve and promote traditional knowledge.

Implications of ethnopharmacological practices for livestock-based livelihoods

Traditional knowledge is much more than simply the knowledge of certain plants or animals as it linked to the spiritual world, ecosystems and to the biological diversity within and without territories and societies. Many countries rely on medicinal plants for the health and well being of its population (UNESCO (1996). World Health Organizations reports that 70-80% of the world's population rely on herbal medicine. Socioeconomic factors such as low education levels and lack of access to conventional healthcare have been cited as important reasons for reliance on indigenous medicine (Dahlberg and Trygger 2009). The plant metabolite products are responsible for pharmacological effects of medicinal plants as was reported by (Dunne 2009). It is also reported that 25-40% of all pharmaceutical prescription drugs contain plant derived ingredients at least in United States (Wikipedia 2010). These provide a high opportunity for people with indigenous knowledge in medicinal plants. However, pharmaceutical industries have always taken advantage of unsuspecting populations of their resources and knowledge with no financial gain.

Medicinal market demand has led to an increased pressure on the natural resources impacting on medicinal plants sustainability. Habitat loss and over harvesting are generally the most serious threats to medicinal plant biodiversity (Hamilton 2003). These threaten communities whose livelihoods are livestock-based yet faced with a multitude of economic and environmental stresses. However, natural products market developing is likely to stimulate a conservation initiative in a cause–effect manner yet benefiting the local populations and avoiding rural communities' exploitation. Sheldon and Michael (1998) made similar observations.

Quality and standardization of ethnopharmacological practices is as important as preservation and conservation of indigenous knowledge. Standardization of medicinal plants' utilization in livestock management is urgently needed not only to improve efficacy and promote conservation but also safeguard animals and animal products' consumers. Currently, natural habitats of many valuable plants are being lost to other land uses or being degraded as a result of population

pressure. This subjects the livestock-based livelihoods to bouts of diseases' attacks and low productivity threatening food security and other livelihood needs.

Women are the poorest of the poor because of their narrow resource base yet are the keepers of traditional knowledge and cultural practices includingethnoveterinary practices due to their closeness to livestock. Development of sustainable natural products based on their knowledge would not only avail them income and improve livestock productivity, but also improve their participation in research for development and provide them opportunity for source of income in a partnership venture to improve their welfare.

More ethnopharmacological practices assessment are needed at varying levels, including individual, community, projects and institutional levels and should include analysis of institutional capacity; biological effectiveness; social effectiveness; feasibility and intellectual property rights. Any assessment system must be sensitive to issues of national sovereignty and the rights of local and indigenous peoples, and is only likely to be effective if it has the support and involvement of local and indigenous peoples. The strategies and measures should be adopted in the future, such as community-based validation of ethno-veterinary medicine, broad network building and knowledge sharing.

Conclusions and recommendation

- The study has indicated that, Nakasongola communities are rich in traditional knowledge on medicinal plants diversity and have used them to treat livestock helminthosis and other ailments though dosage standardization and knowledge on causes of diseases is inadequate. Hence, plants have become the most revered and treasured friends of the community although their conservation is seriously threatened to local extinction. Perhaps limited profound knowledge on plant species used to treat livestock helminthes explains the persistent helminthes prevalence in free ranging stocks despite the existence of ethnopharmacological practices and traditional veterinary knowledge in the region.
- The persistent use of plants by pastoralists in treating livestock helminthes is indicative that some of the herbs are potent, which may guide the discovery of new affordable, culturally acceptable anthelmintics. Loss of medicinal plants and the associated knowledge will hamper the existing healthcare system in the area. For traditional medicine as alternative to conventional medicine, studies to validate community claims on efficacy and determine dosage of the plants are urgently needed. Scientific studies are urgently needed to determine efficacy, appropriate dosage and toxicity in order to address the high helminthes prevalence and resistance causing persistent low productivity of livestock in drylands. Scientific explorations that provide evidence–based information will guide in setting up sustainable livestock extension services and biodiversity conservation policies. Helminthes incidences are projected to increase in the face of climate change. This therefore, calls for rethinking sustainable livestock helminthes management probably one based on locally available resources.
- Partnership approaches between researchers/institutions, extension workers, industry, local communities and NGOs - should be promoted as a means of developing and promoting safety use of anthelmintic plants for sustainable livestock production and improved livelihoods in drylands of Uganda.
-

Acknowledgements

The study was funded by the Regional Universities Forum (RUFORUM), Association of African Universities (AAU), and Makerere University. The authors are sincerely thankful to the sponsors of this project. An appreciation is also extended to research assistants and the Nakasongola agro-pastoral community who provided their traditional knowledge during the survey.

References

African Development Fund 2002 Appraisal Report. National Livestock productivity Improvement Project. Republic of Uganda. UGA/PAAL/2002/02

Adebisi O R 2008 Gastro-Intestinal Helminths and Public Health: Overview of a Neglected Sector. The Internet Journal of Veterinary Medicine. Volume 4 Number 2**.** Retrieved fromhttp://www.ispub.com/journal/the_internet_journal_of_veterinary_medicine/volume_4_number_2_2/article/gastro_intestinal_helminths_and_public_health_overview_of_a_neglected_sector.html

Antonio R and Ahmed Sidahmed 2010 International Fund for Agricultural Development's Livestock Position Paper Livestock planning, challenges and strategies for livestock development in International Fund for Agricultural Development. Retrieved from www.ifad.org/lrkm/factsheet/livestockpaper.pdf

Athanasiadou S, Githiori J and Kyriazakis I 2007 Medicinal plants for Helminth parasite control: facts and fictions. Animal (2007), 1:9, pp1397-1400

Benson T and Mugarura S
2010 Livestock Development Planning in Uganda: Identification of Areas of Opportunity and Challenge. Interna tional Food Policy Research InstituteDiscussion Paper 01008

Bizimana N 1994 Traditional Veterinary Practice in Africa. ISBN 3-88085-502-1 (GTZ).

Bizimenyera E S, Swan G E, Eloff J N, Meyer S and Naidoo V 2008 Efficacy of Peltophorum africanum sond. (Fabaceace) extracts on Haemonchus contortus and Trichostrongylus colubriformis in sheep. Journal of Animal and Veterinary Advances, 7 (4): 364-371, 2008. Retrieved from http://medwelljournals.com/abstract/?doi=javaa.2008.364.371

Blood D C, Radostitis O M and Gay C C (Eds) 1994 Veterinary Medicine. A text book of the diseases of Cattle, Sheep, Pigs, Goats and Horses. 8th Edition. Bailliere Tindall. Oval Road, London. ISBN: 0 7020 1794 9

Cabaret J, Bouilhol M, Mage C 2002 Managing helminths of ruminants in organic farming. Review article. Veterinary Research, 33 (2002) 625–640. DOI: 10.1051/vetres:2002043

Chambers R 1992 Discussion Paper.311. Rural Appraisal, rapid, relaxed and participatory. Institute of Development Studies

Coles G C, Jackson F, Pomroy W E, Prichard, R K, von Samson-Himmelstjerna G, Silvestre A, Taylor M A and Vercruysse J 2006 The detection of anthelmintic resistance in nematodes of veterinary importance. Veterinary Parasitology, Volume 136, Issues 3-4, 31 March 2006, pp167-185. PMID: 16427201

Dahlberg A and Trygger S 2009 Indigenous Medicine and Primary Health Care: The Importance of Lay Knowledge and Use of Medicinal Plants in Rural South Africa. Human Ecology 37: 79-94.

Dunne F J 2009 The 'Natural Health Service': Natural does not mean safe. **Advances in Psychiatric Treatment.** 15: 49-56. Doi: 10.1192/apt.bp.107.005272

Gakuya D W 2001. Pharmacological and clinical evaluation of the anthelmintic activity of *Albizia anthelmintica* Brogn, *Maerua edulis* De wolf and *Maerua subcordata* De wolf plant extracts in sheep and mice. Doctor of philosophy Thesis, University of Nairobi

Gilleard S J 2006 Understanding anthelmintic resistance: The need for genomics and genetics. International Journal of Parasitology Volume 36, (12):1227-1239

Githiori J B 2004 Evaluation of anthelmintic properties of ethno-veterinary plant preparations used as livestock dewormers by pastoralists and small holder farmers in Kenya. Doctoralthesis Swedish University of Agricultural Sciences, Uppsala 2004. Acta Universitatis Agriculturae Sueciae Veterinaria 173. ISBN: 91-576-6666-0

Gradé T J, Arble B L, Weladji R B and van Damme P 2008 Anthelmintic efficacy and dose determination of *Albizia anthelmintica* against gastrointestinal nematodes in naturally infected Ugandan sheep. Veterinary Parasitology Volume 157: 267-274

Hamilton A 2003 Medicinal plants and conservation: issues and approaches. Paper presented to International Plants Conservation Unit World Wildlife Foundation, UK.

Hammond J A, Fieding D and Bishop S C 1997 Prospects for plant anthelmintics in tropical veterinary medicine. Veterinary Research Communications 2: 213-228

Holland J and Blackburn J (Eds.) 1998 Whose Voice? Participatory research and policy change. Intermediate Technology Publications (1998)

Huffman M A and Seifu M 1989 Observations on illness and consumption of a possibly medicinal plant *Vernonia amygdalina* (Del.), by a wild Chimpanzee in the Mahale Mountains National park, Tanzania. In: *Primates,* **30**(1): 51-63, January, 1989.

Ibrahim M A, Nwude N, Ogunsusi R A and Aliu Y O 1984 Screening of West African plants for anthelmintic activity. International Livestock Centre for Africa Bulletin, 17, 19-23

Ipsos MORI 2008 Public perceptions of herbal medicine. General public qualitative and quantitative research. November 2008. Medicines and healthcare Products Regulatory Agency (MHRA). Ipsos MORI report results on herbal medicines. Retrieved from www.mhra.gov.uk/home/idcplg?IdcService=GET_FILE

Iwu M M 1993 Handbook of African medicinal plants. 4266 ISBN 0-8493-4266-X. CRC Press. Boca Raton Ann Arbor London Tokyo

Kabatabazi P 2010 Challenges facing indigenous knowledge. Blackherbals.com. Retrieved from http://www.blackherbals.com/challenges_facing_indigenous_kno.htm

Kamatenesi-Mugisha M and Oryem-Origa H 2006 Medicinal plants used to induce labour during childbirth in western Uganda. Journal of Ethnopharmacology, Volume 109, Issue 1, 3 January 2007, pp 1-9.

Katunguka-Rwakishaya E, Nalule K S and Sabiiti E N 2004 Indigenous Knowledge in Ethnoveterinary Medicine in Southwest Uganda. DHP Publication series No.9, March 2004

Kaufman P B, Cseke L J, Warber S, Duke J A, Brielmann H L 1999 Natural Products from Plants. CRC Press, Boca Raton, FL

Kokwaro J O 1993 Medicinal Plants of East Africa. 2nd Edn. Kenya Literature Bureau, Nairobi.

Koma L M P K 2000 Can Private Veterinarians survive in Uganda. Book chapter In: Africa's Changing Markets for Health and veterinary services. The new institutional Issues. Edited by D K Leonard. ©Macmillan Press Ltd. 2000. ISBN 0-312-23266-7

Lagu C and Kayanja F I B 2010 Medicinal plant extracts widely used in the control of Newcastle disease (NCD) and helminthosis among village chickens of South Western Uganda. Livestock Research for Rural Development. Volume 22, Article #200. Retrieved December 1, 2010, from http://www.lrrd.org/lrrd22/11/lagu22200.htm

Magona J W, Walubengo J and Odimin J T 2008 Acute haemorrhagic syndrome of bovine trypanosomosis in Uganda. Acta Tropica Volume 107 (2): 186-191

Martin B W, Terry M K, Bridges C H, Bailey E M Jr 1981 Toxicity of *Cassia occidentalis* in the horse. Veterinary and Human Toxicology 1981. 23 (6):416-7.

Mathias E, McCorkle C M, Schillhorn van Veen T W 1996 Introduction: Ethno-veterinary Research and Development. In: Ethnoveterinary Research and Development. C.M. McCorkle, E. Mathias and W.T. Schillhorn van Veen (Eds.). Intermediate Technology Publication 103/105 Southampton Row, London, UK, pp1-23.

Mbaria J M 1998 Studies of pharmacokinetics, anthelmintic efficacy and acute toxicity of pyrethrins in sheep and dogs and pyrethroids analysis in air. Doctor of Philosophy Thesis, University of Nairobi

Mesfin T, Debela H, Yehenew G 2005 Survey of medicinal plants used to treat human diseases in Seka Chekorsa, Jimma Zone, Ethiopia. Ethiopian Journal of Health Science Volume 15 No 2. July 2005.

Millennium Ecosystem Assessment 2005 Ecosystems and Human Well-Being: Current State and Trends: Findings of the Condition and Trends Working Group. Millennium Ecosystem Assessment Series Vol. 1. Island Press ISBN: 9781559632287

Ministry of Agriculture, Animal Industry and Fisheries, Uganda; Uganda Bureau of Statistics 2009 Uganda agricultural census GIS Database. Kampala, Uganda. Ministry and Agriculture Animal Industry and Fisheries and Uganda Bureau of Statistics

Ministry of Agriculture, Animal Industry and Fisheries, Uganda; Uganda Bureau of Statistics; Food and Agriculture Organization of the United Nations; International Livestock Research Institute; and World Resources Institute 2010 Mapping a Better Future: Spatial Analysis and Pro-Poor Livestock Strategies in Uganda. Washington, DC and Kampala: World Resources Institute. Published by World Resources Institute, 10 G Street NE, Washington, DC 20002, USA. ISBN: 978–1–56973–747–7. Available online at www.wri.org.

Mussa M 2004 A comparative study of pastoralist parliamentary groups: Case study on the pastoral affairs standing committee of Ethiopia. Retrieved fromwww.nri.org/projects/pastoralism/Ethiopia_PPG_final.doc

Nalule A S 2000 Ethno-veterinary and Phytomedicinal practices among the Bahima community in Uganda. Test of Indigenous Knowledge using plants anthelmintics. Master of Science Thesis, University of Nairobi

Rudqvist A and Tobisson E 1991 Popular participation in natural resource management. development Studies Unit. Working Paper No.11. Department of Social Anthropology, Stockholm University

Safilios-Rothschild C 1983 Women in sheep and goat production and marketing. Expert consultation on women in food production, FAO, Rome, (Mimeograph pp 15).

Sheldon J and Michael J B 1998 Ethnobotany and the search for balance between use and conservation. In Intellectual Property Rights and Biodiversity Conservation: An Interdisciplinary Analysis of the Values of Medicinal Plants. Timothy M. Swanson, eds. pp 45-62. Cambridge University Press

Shen S, Qian J and Ren J 2010 Ethnoveterinary plant remedies used by Nu people in NW Yunnan of China. Journal of Ethnobiology and Ethnomedicine 2010, 6:24. Doi:10.1186/1746-4269-6-24.

Singh G K and Bhandari A 2000 Textbook of Pharmacognosy (As per Education Regulation 1991). ISBN: 81-239-0692-7. CBS Publishers and Distributors, India

Ssewannyana E, Kabi F, Masembe C, Nabukenya I and Mwebembezi 2010 Current status of Brucellosis and helminthosis in cattle and goats in the southwestern rangeland zone ofUganda. Proceedings of the 3rd International e-Conference on Agricultural BioSciences 2010, pp 62 – 63

Steinfeld H, Wessenaar T and Jutzi S 2006 Livestock production systems in developing countries: status, drivers, trends. Steinfeld H, Wessenaar T and Jutzi S 2006 Livestock production systems in developing countries: status, drivers, trends. Scientific and Technical Review of office of International des Epizooties, 25 (2): 505-516.

Sujon M A, Mostofa M, Jahan M, Das A R and Rob S 2008 Studies on medicinal plants against gastroinstestinal nematodes of goats. Bangladesh Journal of Veterinary Medicine (2008). 6 (2): 179–183. Doi: 10.3329/bjvm.v6i2.2333. Retrieved from http://www.banglajol.info/index.php/BJVM/article/view/2333/2046

Tabuti J R S, Dhillion S S and Lye K A 2003 Ethnoveterinary medicines for cattle (***Bos indicus***) in Bulamogi county, Uganda: Plant species and mode of use. Journal of Ethnopharmacology 88: 279-286. doi:10.1016/S0378-8741(03)00265-4

Taylor-Powell E and Renner M 2003 Analyzing qualitative data. Madison, WI: University of Wisconsin Extension. Retrieved from http://learningstore.uwex.edu/pdf/G3658-12.pdf

Uganda Bureau of statistics and Ministry of Agriculture Animal Industry and Fisheries 2008 The National Livestock census. A summary report of the National Livestock Census, 2008

Uganda Bureau of Statistics 2009 Profiles of Higher Local Governments. The Republic of Uganda

United Nations Educational, Scientific and Cultural Organization (**UNESCO) 1996** Culture and Health Orientation Texts-World Decade for Cultural Development. 1998-1997, document CLT/DOC/PRO-1996, Paris France p 129.

Wasswa P and Olila D 2006 The in-vitro ascaricidal activity of selected indigenous medicinal plants used in ethno veterinary practices in Uganda. African Journal of Traditional, Complementary and Alternative Medicines 3 (2) pp 94 – 103. Bionline International Africa. Ethnomedicines Network ISSN: 0189-6016

Waterman C, Smith R A, Pontiggia L and DerMarderosian A 2010 Anthelmintic screening of Sub-Saharan African plants used in traditional medicine. Journal of Ethnopharmacology, Volume 127, Issue 3, 17: 755-759. doi:10.1016/j.jep.2009.11.025

Wikipedia 2010 Medicinal Plant Conservation. Endangered Plants and Ecosystems-Plant Conservation Derived Medications. Retrieved fromhttp://www.libraryindex.com/pages/649/endangered=plants-ecosystems-PLANT-CONSERVATION.html

Wolstenholme A J, Fairweather I, Prichard R, von Samson-Himmelstjerna G and Sangster N 2004 Drug resistance in Veterinary helminthes. Trends in Parasitology 20, pp 469–476.

World Intellectual Property Organization (WIPO) 2002 Integrating intellectual property rights and development policy. Report on the commission of intellectual property rights. London, September 2002.

World Health Organisation (WHO) 2010 Climate change and human health. Retrieved from http://www.who.int/globalchange/ecosystems/biodiversity/en/index.html

Received 12 October 2010; Accepted 5 January 2011; Published 1 February 2011