SOME PHARMACOLOGICAL ACTIVITIES OF SELECTED MEDICINAL PLANT SPECIES USED FOR TREATING CATTLE DISEASES IN KABIRA SUB-COUNTY, RAKAI DISTRICT

By

Dennis Kamoga

BSc (Ethnobotany)

A DISSERTATION SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES FOR THE AWARD OF A DEGREE OF MASTER OF SCIENCE (BOTANY) OF MAKERERE UNIVERSITY

MARCH 2010

DECLARATION

To the best of my knowledge and belief, the material contained herein this thesis is of personal efforts and originality, with exclusions where due acknowledgment has been made. I the undersigned below certify that this work has not been forwarded to any tertiary/ university institution for the award of a degree.

Student: Dennis Kamoga

Signature……Date…….

Supervisor 1. Professor Hannington Oryem-Origa

Signature……Date…….

Supervisor 2. Dr. Francis Ejobi

Signature……Date…….

DEDICATION

This work is dedicated to the pastoral farmers of Kabira sub-county in Rakai district who allowed me document their Traditional Knowledge on medicinal plants.

ACKNOWLEDGMENT

My sincere thanks are extended to my supervisors; Professor Hannington Oryem-Origa and Dr. Francis Ejobi for guiding me through the research process with all their long accumulated knowledge, skills, experiences and intellect. More thanks go to Dr. Francis Ejobi for his mentorship and collaboration with VicRES that supported me financially to conduct the research study. I pay special tributes to VicRES staffs; Professor Zadoc Oguttu, Dr. Charles Sokille and Ms. Nightighale Mirembe for their moral support that enabled me accomplish the research study tasks. Immemorable thanks also go to my family, Mr. and Mrs. Muwonge-Bukenya, Sisters and Brothers for their prayers. I also thank the support staffs of Makerere University, particularly in the Departments of Botany, and Veterinary Pharmacology and Physiological Sciences who accorded me with the assistance I deserved during the study.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

The study was undertaken with an overall objective of investigating use of medicinal plants in traditional management of cattle conditions / diseases with emphasis on helminthiasis and bacterial related infections in Kabira Sub-county, Rakai district.

Life forms of the medicinal plant species, habitats of harvest and levels of harvest were observed and recorded. With respect to the overall objective, prioritization of key medicinal plant species as used in managing both helminthiasis and bacterial related infections was done using Participatory pair wise ranking technique.

Methanolic extracts of priority medicinal plants that were tested *in-vitro* against helminthiasis (*Ascaris suum*) and bacterial related infections showed the following results. Among the four tested medicinal plant extracts, against *A. suum*, *Clerodendrum rotundifolium* Oliv. and *Carissa edulis* (Forssk.) Vahl. showed biological activity of more than 50% mortality rate at concentration of 1.2 mg/ml and 1.6 mg/ml respectively. The percentage mortality rates were 1 to 3 times higher compared to extracts of *Myrica kandtiana* Engl. and *Erythrina abyssinica* Lam. ex D.C. At intervals of 36 hours and 48 hours, *C. edulis* had the greatest percentage mortality rate overall, followed by *C. rotundifolium. E. abyssinica* had the lowest activity at 36 hours. However, both *M. kandtiana* and *E. abyssinica* showed comparably similar mortality rates at 48 hours for concentration of 1.2 mg/ml and 1.6 mg/ml. Variability in percentage mortality rates for the two medicinal plants was observed at concentration of 0.8 mg/ml, where *Myrica kandtiana* had a mortality rate one time higher than of *E. abyssinica* at both 36 hours and 48 hours. The standard drug (albendazole), had a higher percentage mortality rate of 12.5% against *C.edulis* and *C .rotundifolium* at 0.8 mg/ml at both 36 hours and 48 hours. At 1.2 mg/ml (albendazole) and *C. edulis* had similar mortality, while for *C. rotundifolium* mortality of less than 12.5% compared to albendazole was observed at 48 hours. At 1.6 mg/ml, albendazole, *C. rotundifolium* and *Myrica kandtiana* had 100% mortality at 36

hours and 48 hours, while for *C.edulis* and *E.abyssinica* less than 12.5% mortality was observed compared to albendazole at 36 hours interval.

All the three bacterial species were susceptible to only four methanolic extracts of *M.kandtiana, Entada abyssinica* Steud ex D.C, *Rubus steudneri* Schweinf. and *Solanum aculeastrum* Dunal. *Staphylococcus aureus* and *Escherichia coli* were susceptible to *Sesamum anguistifolium* (Oliv.) Engl. and *Sapium ellipticum* (Hoscht.) Pax., while restricted activity to *Staphylococcus aureus* was observed with *Erythrina abyssinica*. Overall, *Rubus steudneri* showed the highest level of susceptibility, followed by *Entada abyssinica* and then *Myrica kandtiana, Sesamum anguistifolium* and *Erythrina abyssinica* had the least activity. Comparison of the standard drug (gentamycin) with methanolic extracts of all the seven medicinal plant species, only showed relatively similar levels of susceptibility with *Rubus steudneri*.

Overall *Rubus steudneri* and *Erythrina abyssinica* had the lowest MIC values, 0.03125 µg/ml similar to that of the standard drug (gentamycin). Thus, the two methanolic extracts had the highest biological activity against *Staphylococcus aureus* and *Pseudomonas auroginosa*. Consequently *Myrica kandtiana* and *Entada abyssinica* had MIC value of 0.0625 µg/ml against *Staphylococcus aureus* and *Pseudomonas auroginosa*. With 0.0625 µg/ml which was the second least concentration to 0.03125 µg/ml for the standard drug, *Myrica kandtiana, Entada abyssinica, Rubus steudneri* and *Erythrina abyssinica* were more potent compared to the medicinal plant *abyssinica* extracts of *Solanum aculeastrum, Sesamum anguistifolium* and *Sapium ellipticum* with high MIC values above 0.0625 µg/ml. For *E.coli* growth, 0.0625 µg/ml was observed as the least MIC for *Myrica kandtiana, Solanum aculeastrum, Sesamum anguistifolium* and Sapium, an indication that the four plant extracts had the highest activity against this test bacterium.

The *in-vitro* studies of methanolic extracts of the selected medicinal plant species on *Ascaris suum* and the three species of bacteria were conducted as a preliminary proof to support their use in traditional management of both helminthiasis and bacterial related infections.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the study

In Uganda, the livestock industry contributes 5.2 percent of the national Gross Domestic Product (NAPE, 2009), but there is potential for increasing production if disease control and management strategies are appropriately undertaken. Diseases are a major hindrance to cattle productivity and production. Helminthiasis and bacterial related infections expose cattle to mortality risks thereby putting farmers at a loss.

Pastoral farmers in the remote and inaccessible areas of Kabira sub-county in Rakai district, Central Uganda, possess knowledge of local application of medicinal plants for the control and management of livestock (cattle) diseases and other related health conditions. Plants are an indispensable source of both preventive and curative medicinal preparations for humans and their domestic animals (Kokwaro, 1976).

The use of medicinal plants for the control and management of diseases is a cheaper and readily available complement for the expensive synthetic drugs that are often in short supplies. The knowledge of medicinal plant use among the pastoral farmers is said to have been developed gradually over a period of practical experience. Such knowledge, practices and beliefs is summed as Ethnoveterinary Knowledge (McCorkle, 1986).

Ethnobotanical documentations of medicinal plant use is generally an appropriate means of identifying potential sources of new drugs. Seventy-four percent of plant-derived compounds currently used in pharmaceuticals, retained similar use as used by traditional healers (Farnsworth, 1988; Moran, 1997). Plants used in traditional medicine are two to five times likely to be pharmacologically active than those randomly screened (Mathias *et*

al, 1996). The use of ethnobotanical leads in drug search has received increasing attention (King, 1992), because key plant species for pharmacological tests are identified with ease. There are higher prospects for discovering new chemical ingredients with pharmaceutical potential.

The presentation of results in this work is premised on local knowledge and skills of medicinal plant use owned by the pastoral farmers in Kabira sub-county. A general inventory of medicinal plants used was documented. Candidate plants for validation studies were then identified. The study aimed at making a scientific intervention, to validate some selected medicinal plants used for the treatment of livestock (cattle) diseases, with a bias on helminthiasis and bacterial related infections. Anthelminthic and anti-bacterial activity of the selected plants was done *in-vitro.* This was intended to trigger future in-depth research studies to evaluate effectiveness and safety of such medicinal plants. In anticipation, this would enable to establish herbal remedies that could be used confidently for the control and management of helminthiasis and bacterial related infections.

1.2 Statement of the problem

Most livestock farmers in Uganda are resource-poor. It is therefore, important that disease control strategies are aimed at making it affordable and readily available to farmers. This cannot be achieved by adopting disease control strategies that are totally dependant on imported drugs and pesticides, but those based on cheaper, safer and sustainable methods of disease control such as the use of locally and naturally derived drugs from plants.

Indeed the need to utilize drugs and pesticides from local plants is increasingly becoming more important, not only because of the high cost of imported chemicals and drugs but the availability of these imported drugs has become erratic as their importation has to compete for the meagre foreign exchange with other vital imports required for industrial and social development.

From the preliminary survey made the pastoral farmers in Kabira sub-county use a variety of medicinal plants for treatment of helminths and bacterial related infections. The indigenous knowledge (I.K) underlying this kind of science has not been explored to the benefit of farmers, to cause significant improvement in their wellbeing. Scientific interventions are required to enhance and develop the existing I.K, into a more reliable and widespread strategy for the control of and management of helminths and bacterial related infections. Validation studies of the locally used medicinal plants in Kabira sub-county will help to identify potential sources of herbal based drugs that could be confidently used.

Much as local use of medicinal plants for treating helminths and bacterial related infections exists in Kabira sub-county, their conservation status is not known. Motivation and value to study the conservation status of such medicinal plants can be realized if their local use is scientifically proven. Otherwise potentially useful medicinal plant species may become prone to threats of endangerment before scientific interventions are made. This is in belief that people love to conserve what they know is of use to them.

There is increasing threat to wild plant resources and their habitats because of over exploitation (Hoft *et al*, 1999). Natural habitats represent repositories of medicinal plants and indigenous ethnobotanical knowledge. These biotic and cognitive resources are threatened by vegetation (forest) removal and culture change (Durning, 1992; Voeks, 1996).

Ethno veterinary information like any other form of traditional knowledge is orally transmitted from generation to generation, and hence in danger of extinction as older people die and younger generations fail to learn the traditional way of life. This situation is worsened by rapid socio-economic, technological and environmental changes (Tabuti *et al,* 2003). Indigenous knowledge (IK) about uses of wild plant resources such as medicinal plants is disappearing fast from traditional communities (Bagine *et al.,* 1997). Therefore,

validation studies of selected medicinal plants for treating helminths and bacterial related infections will also lead to research initiatives geared to studying conservation issues.

1.3 Overall objective of the Study

To investigate the use of medicinal plants in traditional management of cattle diseases with emphasis on helminthiasis and bacterial related infections in Kabira sub-county, Rakai district.

1.4 Specific Objectives

1. To document medicinal plants of value used in traditional management of cattle diseases in Kabira sub-county, Rakai district.
2. To test *in-vitro* antibacterial activity of selected medicinal plants used in treatment of bacterial related infections in cattle.
3. To test *in-vitro* anthelmintic activity of selected medicinal plants used in treatment of helminths in cattle.

1.5 Research questions

- Is there extensive knowledge and use of medicinal plants in treating livestock diseases in Kabira sub-county?
- Do some plants possess high pharmacological activity?

1.5 Significance of the study

The study was aimed at generating useful data on medicinal plants that could be confidently used for the treatment of helminths and bacterial related infections. The results of this study will provide some baseline data, which could lead to further research, and

hopefully development of natural products for control and management of helminths and bacterial infections. In the long-run this could help resource-poor farmers to improve and maintain good health care and improve production of their livestock through enhanced use of cheaper and locally available medicinal plants. Hence improvement in livestock production, increase in food (proteins) security and increase in income among the farmers through sale of livestock products

1.6 Scope of the study

The study covered the farming (pastoral) communities in Kabira sub-county in Rakai district, central Uganda. It was centered on documenting indigenous knowledge about medicinal plants used for treating livestock (cattle) diseases and other health conditions, field collection and scientific identification of medicinal plant species, and testing for *in-vitro* biological activity of extracts of selected plant species, on both helminths and bacterial organisms.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 General overview of medicinal plant use

Preparations derived from plants were the original therapeutic interventions used by man to control diseases, both within humans and livestock. According to Mathias *et al.*, (1999), introduction of western medicine in the developing countries by missionaries and colonizing powers displaced local systems of animal and human health care. However, the expensive costs of conventional drugs and their short supplies, makes their affordability difficult. As a result, the majority of the world's poor population find themselves seeking for local health care systems. World Health Organization (WHO) estimates that 80% of the world's people, mostly in poor and less-developed countries depend on traditional medicine for their primary healthcare requirements (IUCN, 1993). These estimates are likely to be the same for livestock as well.

Curative properties of plants for livestock diseases have been recorded in several different parts of the world. In Africa serious and sustained scientific interest in traditional livestock healthcare systems, and related management practices begun in the 1980s (Sollod and Knight, 1983). Information about medicinal plants is mostly in documented form as applied by the farmers. Evidence of their effectiveness and safety is not well published in scientific literature.

Fulani herdsmen have been involved in the treatment of animal diseases prior to the onset of modern medicine (Fajimi and Taiwo, 2005). The Fulani, in the north western province of Cameroon complement their livestock health care using medicinal plants namely; *Kigelia africana* for brucellosis and mastitis, *Entada abyssinica* for foot and mouth disease, babesiosis and worms, *Khaya anthotheca* for black quarter, brucellosis and worms, *Solanum aculeastrum* for worms, *Cassia occidentalis* for worms, black quarter and babesiosis (Toyang *et al.*, 1995). However, no specified parts of these plants used

were cited. Weiser (1994) reported that seeds of *Cassia occidentalis* have strong antimicrobial activity against *Staphylococcuss aureus, Bacillus subtilis, B. protens* and *Vibrio cholerae.* Such pharmacological activity supports that plants used in traditional medicine have potent medicinal properties.

In East Africa, un known parts of *Aerva persica* and *Clerodendrum myricoides* are used in the treatment of East Coast Fever, while *Erythrococca bongensis* and *Monsonia anguistifolia* are used for black quarter disease (Kokwaro, 1976)**.** In Tanzania, traditional medicine use by the Maasai pastoralists was reported for the treatment of livestock diseases such as brucellosis, rinderpest and foot and mouth disease (Marecik, 1998). The bark extract of *Albizia anthelminthica* locally used by pastoral farmers in Kenya to treat worms, was found to decrease faecal egg counts of *Haemonchus contortus* in sheep by 34% (Githori *et al.,* 2003). In Kenya, the use of traditional plants among the Samburu and Turkana has shown that several cattle diseases such as diarrhea, cough and mange are treated (Wanyama, 1997; ITDG and IIRR, 1996). According to Anonymous (1999), in Butana region of Northern Sudan, deadly diarrhea in small ruminants is traditionally treated with a drench made from *Acacia nilotica* pods. For helminthosis, *Citrullus colocynthis* seeds are added to drinking water for livestock. A drench of strong tea or *Coronopus niloticus* seeds is given for retained placenta. Foot rot lesions are treated with *A. nilotica* preparations; while for retained placenta-cows are fed on ground parts of *Cissus quadrangularis.*

2.2 Medicinal plant use in livestock health care in Uganda

Despite immense progress in modern medicine, many rural people in Uganda still rely on plant derived preparations for primary health care needs and those of their domesticated animals (Farnsworth and Morris, 1976; Olila, 1993). The use of medicinal plants for the treatment of cattle diseases, mostly in the eastern districts of Uganda has been documented

in literature (Tabuti *et al.,* 2003*;* Ejobi *et al.,* 2004). In their scholarly works, several plant species are cited for the treatment of different diseases. *Abrus precatorius* stem and root bark are used for treating cataract and gastrointestinal worms respectively. *Steganotaenia araliacea* root extract has been reported to be useful against East coast fever in Bulamogi, while the stem bark is said to possess antidiarrheal properties in Teso region.

Tuwangye and Olila (2006) also reported the anthelminthic activity of some plants used by the Banyankole herdsmen in south western Uganda. Among the Karimojong pastoralists, *Albizia anthelminthica* is traditionally used against gastrointestinal worms in cattle, and studies by (Grade and Longok, 2000) validated that the plant is efficacious against helminths.

Other species documented in literature include; *Carissa edulis* whose roots are used for East coast fever, Leaves of *Leonitis nepetifolia* are used for mastitis and cramps in the udder, while the leaves of *Clerodendrum rotundifolia* are commonly used by farmers for internal parasites in goats and cattle. *Senna occidentalis* for diarrheoa and worms. Neuwinger (1994), also cites the use of *S. occidentalis* for worms in Uganda and other African countries. Many of the drugs used for the removal of helminths are plant products, which have been used since ancient times (Gibson, 1965). The aqueous leaf extract of *Tephrosia vogelii* has also been observed in Teso region for the treatment of mange. In Toyang *et al.* (1995), *T. vogelii* is reportedly used against mange, ticks and black quarter by the Fulani pastoralists, while the root and seeds are used against ticks on animals (Hutchings *et al.,*1996).

The poor prevailing economic situation in Uganda with particular reference to Kabira, coupled with remoteness and inaccessibility of inhabited areas of the pastoral farmers, makes access of veterinary services difficult. This drives farmers to using medicinal plants

as alternative therapies for the control and management of cattle diseases and other health conditions. The use of medicinal plants has solution to many diseases, and it is free and locally available (Mathias-Mundy and McCorkle, 1989). Popularity of medicinal plant use by the farmers is influenced by failures to access modern drugs. About 15-20 percent of the livestock populations in developing nations hardly enjoy regular and affordable access to modern veterinary medicine (Mathias *et al*., 1999).

Livestock animals infested with substantive helminths loads often suffer a multitude of problems such as diarrhea, poor weight gains, respiratory problems and mortalities in severe cases (Schmidt and Larry, 1985). Helminths can potentially affect productivity and production in livestock. Veterinary professions have tried to control helminthiasis by administration of synthetic drugs (Sebuguzi, 2000).

Animal parasites are developing resistance to the previously efficacious conventional drugs (Maingi *et al.,* 1996). Research studies on locally used medicinal plants may yield solutions to the growing resistance of disease causative agents against existing pharmaceuticals. Herbal remedies are known to be broad spectrum and may have a solution to the developing resistance of pathogens to conventional drugs (Mwale *et al.,* 2005).

Validation studies of selected herbal therapies for the treatment of helminthiasis and bacterial related infections by the pastoral farmers can be leads to the discovery of new alternative chemical ingredients for use.

2.3 Development and challenges of herbal medicine use in livestock health care

Quite a number of plants are locally used for the treatment of several diseases of livestock. Major forms of preparation of the remedies are mostly decoctions and macerations. However, little has been done to assess their effectiveness and safety (Alte, 1993). Concerns about the need to assess efficacy, quality, safety and standardization of doses in ethnoveterinary medicine were observed as prudent (Tabuti *et al.*, 2003). Little has been done to test pharmacological activity of most medicinal plant species to validate efficacy, yet demands for natural products and curiosity to discover new drugs from plants is on the rise globally. Validation of ethnoveterinary medicines in non-laboratory animals is still in its infancy and needs to be greatly expanded (Mathias *et al*., 1999).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Description of the study area

The study was conducted in Kabira sub-county, Rakai district. The remoteness of the area, the inadequate modern veterinary healthcare facilities and the diverse vegetation structures formed the criteria for selection of the study site. This was a driving force to seek for local interventions employed by the pastoral farmers in meeting health care needs of their cattle amidst the challenging environmental settings they live in.

Rakai district is located in the South Western region of Uganda, west of Lake Victoria, lying between longitude 31^{o}E, 32^{o}E and latitude 0^{o}S. Its southern boundaries are part of the international boundary between Uganda and Tanzania. It is bordered by Masaka district in the East, Kalangala District in the South-East and Mbarara district in the West and Lyantonde in the North (Available at: http://rakai.go.ug/lgprofile.html)

Kabira sub-county was selected for the study because it consists of pastoral communities of different ethnic backgrounds, with varying expertise and perceptions on use of medicinal plants in cattle health care.

Rakai district (Kabira sub-county) lies in a modified equatorial climatic zone with temperature ranges between 16^{o}-28 ^{o}C. Because Rakai borders with Lake Victoria and is in the South of the equator, it experiences relatively high rainfall of about 1250 mm per annum (Mugisha, 1998). Rakai district stands at an altitude of 1231 meters above sea level.

The district has a total area of 4908.5 km^2 of which 36,604 hectares are under forest cover. The vegetation characterizes forests, thickets, plantations, scrub, wooded grasslands and swamps. The district has a population of 471806 people, where 21303 are urban and 450,503 are rural dwellers. The main economic activities are agricultural based namely; cultivation of food crops, cash crops and cattle keeping (Fountain publishers, 2005).

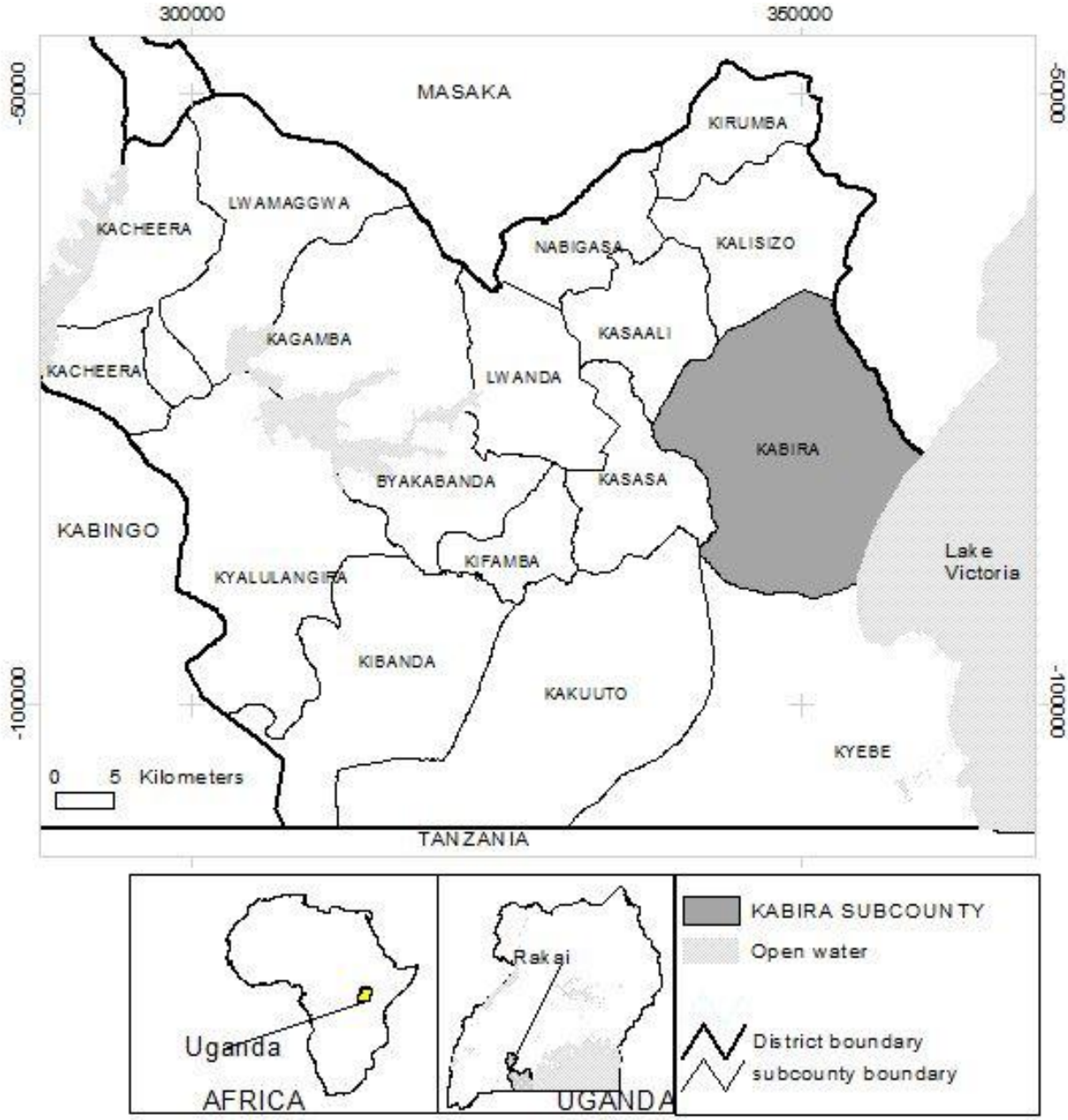

Figure 1:A map of Rakai district showing the study area in Kabira sub-county

3.2 Field survey to document medicinal plants

With the help of local leaders, key informants namely; pastoral farmers and other category of informants such as Traditional Health Practitioners (THP) knowledgeable on medicinal plants used for treating livestock diseases were identified. Selection of informants to participate in the study was dependant on their willingness to share information, and their acquaintance with medicinal plants for treating livestock diseases. Fifty informants were identified from the pastoral communities and THP in Kabira sub-county, Rakai district. Selection of informants was done with the help of local area leaders and elders, who helped to guide in identifying knowledgeable informants.

Participatory Rural Appraisal (PRA) tools namely; semi-structured interviews and group discussions were used to elicit information on medicinal plants used. All medicinal plants mentioned as useful in treating cattle diseases/ conditions were recorded. With the guidance of informants, walks within the village and in the wild were made to locate the habitats of the mentioned plants. Following a general documentation of plant species used, voucher specimens were collected and preserved in a plant press for correct identification at Makerere University Herbarium.

3.3 Prioritization of medicinal plant species for biological screening

To select medicinal plants for laboratory studies, a participatory pair-wise ranking exercise was conducted with confinement to only those plants whose use was restricted to the treatment of helminthiasis and bacterial related diseases. A prioritization exercise involving participation of the farmers was carried. Lists of important plant species used for treatment of helminthiasis and bacterial related infections were generated. Selection of plants was by agreement of farmers, where frequency of use of a given species and

comparison between different species used for treatment of the same disease/ailment were considered.

3.4 Field collection of prioritized medicinal plant materials

Two to three kilograms of fresh plant parts applied by the farmers in the treatment of cattle diseases were collected from the field and kept in white polythene bags. Using a secateur and a knife, the plant materials were chopped in small pieces, re-packed in the white polythene bags and transported to the laboratory, in the Department of Physiological Sciences, Faculty of Veterinary Medicine Makerere University. In the laboratory, the plant materials were spread on the tables, well labelled and left for drying under room temperature for 2 to3 weeks

3.5 Processing and extraction of collected plant materials.

For each dry sample of the plant materials, grinding was done using a metallic mortar and pestle to obtain fine powders. For every sample, 200 grams of the powder were soaked in 350mls of methanol in an airtight conical flask. The flask(s) was put on an electric shaker for four hours and left to stand overnight. Filtration was done using whattman filter papers. The filtrates were concentrated using a rotary evaporator with temperatures regulated between 50^{o}-55^{o}C. Dry concentrated extracts were stored in air tight sample bottle wrapped in aluminium foils and refrigerated at 5 ^{o}C.

3.6 *In-vitro* studies

In-vitro studies were done at the Department of Veterinary Physiological Sciences, Makerere University to test the biological activities of crude methanol extracts of the eight priority plants used by farmers to treat helminthiasis and bacterial related diseases in cattle. This was done to validate their claimed uses by farmers.

3.6.1 Test for anthelmintic activity

Crude methanol extracts of medicinal plant parts used specifically for treating helminthiasis were used. A medium of Goodwin's solution was prepared for use as per the standard procedures. For each extract, a series of concentrations 0.8 mg/ml, 1.2 mg/ml and 1.6mg/ml were prepared by further dilutions of 40mls, 60mls and 80 mls respectively from the stock solution of 10 mg/ml (2g/200 mls) into 500mls of Goodwins solution. Using the same procedures, a positive control of a standard drug, albedanzole (10%) was done. A negative control was also prepared with Goodwins solution.

Eight live worms (*Ascaris suum*), freshly collected from the abattoir in Wambizi-Nalukolongo were introduced in the flasks containing the different plant extract concentrations. The same was done for the positive and negative control experiments. All the flasks and their contents were immersed in an organ bath with water maintained at 37 ^{o} C throughout. Readings of the mortality rates were taken after 36 hours and 48 hours until nearly all the worms were dead. This was aimed at establishing the presence of bioactivity for the different plant extracts.

3.6.2 Test for antibacterial activity

3.6.2.1 Susceptibility test

The antibacterial assays of seven different plant extracts were ascertained using a standard method and protocols (Agar well diffusion method, Carter and Cole, 1990; Woods and Washington, 1995). Three different bacteria types namely; *Staphyloccocus aureus* (ATCC 25923), a gram positive microbe; *Escherichia coli* (ATCC 25922) and *Pseudomonas aeruginosa* (ATCC 27853) both gram negative organism were used in the assays.

Agar well diffusion method

This was carried out using Mueller- Hinton agar plates. The Mueller- Hinton agar was put in Petri-dishes after autoclaving at 121^{o}C. The agar in the Petri-dishes was allowed to cool and solidify. One to two colonies of the test organisms were respectively suspended in 5 mls of pepton water using sterile swabs. Thereafter, inoculation was uniformly done by rolling the swabs onto the agar surface.

With sterile agar borers, six wells were dug in the Mueller-Hinton plates. One hundred (100) micro-litres of plant extract were dissolved in dimethylsulfoxide (from a stock solution) were filled in the wells and allowed to stand. The plates were incubated at 37^{o}C for 24 hours. The plates were examined for the presence of zones of inhibition. For the positive extracts, the zones of inhibition were measured and expressed in millimetres (Carter and Cole, 1990; Woods and Washington, 1995). Using the same procedures, both the positive and negative control experiments were set up. For the positive control, gentamycin was used.

3.6.2.2 Determination of the minimum inhibitory concentration (MIC)

Broth dilution method

The MICs were determined using the broth dilution method (Carter and Cole, 1990; Woods and Washington, 1995). MIC was determined for only plant extracts that showed antibacterial activity using the agar well diffusion method.

One milllitre each of Mueller-Hinton broth was put in test tubes.The test tubes were then plugged with surgical cotton wool and auto-claved for one hour at 121^{o}C. The test tubes and their contents were then cooled.

Decreasing two fold dilutions of the plant extracts were prepared in Mueller–Hinton broth. A loopful of standard inoculum of test organisms (bacteria cultures) grown in Mueller-Hinton broth was then added to the plant extracts. Following the same procedures, both positive and negative control experiments were set. For the positive control, gentamycin was used, while the negative control was prepared using dimethylsulfoxide to ensure that it had no activity on the microorganisms to avoid false results.

The inoculated tubes with plant extracts were plugged with cotton wool and then incubated at 37 ^{o} C for 24 hours. The tubes were then observed for the presence of bacterial growth/ degree of turbidity. For each subsequent plant extract, the tube among the series of dilutions that did not show evidence of bacterial growth was then recorded as the MIC of that particular extract. The concentrations were noted and recorded in a tabular form. Under the same conditions each plant extract was subjected to the experimental treatments in duplicates to check for consistency of the MIC values. For each crude plant extract, three bacteria species namely; *Staphylococcus aureus, Pseudomonas auroginosa* and *Escherichia coli* were used. The same was done for the positive and negative control.

3.7 Data analysis

Microsoft excel windows 2003, was used for simple frequency analysis on the quantitative data generated from PRA exercise. The number of times a given plant was mentioned by all the respondents for treating a given disease was tallied and computed. Plant remedies were grouped against the diseases/ conditions treated. Using Microsoft excel, pie- chart and column graphs were generated.

CHAPTER FOUR

4.0 RESULTS

4.1 Medicinal plant use by the pastoral farmers in Kabira sub-county

A total of 43 plant species from 20 families were recorded as useful in managing various cattle diseases/ailments by the pastoral farmers in Kabira sub-county, Rakai District (Table 1). Of the families encountered, Asteraceae and Fabaceae had the highest number of species used, each with 7 species (these are large families whose distribution is cosmopolitan), followed by Solanaceae and Verbenaceae with 3 species each. Most medicinal plants were harvested from bushlands (34.9%), followed by rangelands (30.2%) and cultivated lands (16.3%), and swamp (13.95%). Scrubland contained the lowest number of medicinal plants. Nine medicinal plant species namely; *Carissa edulis, Myrica kandtiana, Sapium ellipticum, Clerodendrum rotundifolium, Erythrina abyssinica, Sesamum angustifolium, Solanum aculeastrum and Rubus steudneri* were the most commonly used. Common cattle conditions/ailments treated in the area were Worms (helminthiasis), diarrhoea, eye infections, East Coast Fever, retained placenta, cough, bloat, wounds and ectoparasites. In total sixteen cattle conditions/ ailments were locally diagnosed and treated by the farmers. Worms were treated with highest number of plant species (11 species), followed by East Coast Fever (10 plant species). Four conditions namely; Foster love, mange, sore throat and sprains were each treated with one plant species only. Swollen udder, ectoparasites and Newcastle disease were treated with only two plant species each.

Table 1: Medicinal plants used for management of cattle conditions/ ailments in Kabira sub-county, Rakai District

Family	Taxon (Scientific name)	Habitat	Habit	Part used	Preparation	Administration	Condition Treated
Amyrillidaceae	*Crinum kirkii*. Barker.	Range land	Herb	Bulb	Maceration	Topical	Swollen stiff udder
Apocyanaceae	*Carissa edulis* (Forssk) Vahl.	Range land	Shrub	Root	Maceration	Oral	Worms
				Leaf	Maceration	Oral	Cough
Asparagaceae	*Asparagus africana* Lam.	Range land	Herb	Root/ Leaf	Decoction	Oral	Diarrhoea
	Asparagus flagellaris. (Kunth.) Baker	Bush land	Herb	Leaf	Maceration	Oral	Sore throat
				Leaf	Maceration	Topical	Foster love between mother cow & calf
Asteraceae	*Aspilia africana.* (P.Beauv.) C.D Adams	Range land	Herb	Leaf	Decoction	Oral	Worms
	Bidens pilosa.L.	Bush land	Herb	Leaf	Maceration	Topical	Wounds
	Conyza sumatrensis. (Retz) Walker.	Bush land	Herb	Leaf	Maceration	Topical	Fresh wounds
	Microglossa pyrifolia (Lam.) Kuntze	Range land	Herb	Root	Maceration	Through Nose	East Coast Fever
				Leaf	Maceration	Oral	Worms
	Senecio mannii. Hook	Cultivated land	Shrub	Leaf	Maceration	Oral	Worms
	Vernonia amygdalina.Del.	Cultivated land	Tree	Leaf	Maceration	Oral	East Coast Fever, Worms,

.							Newcastle
				Root	Maceration	Oral	Worms
	Vernonia cistifolia. O. Hoffm	Range land	Herb	Leaf	Maceration	Oral	Bloat
				Leaf	Maceration with fruits of *Solanum incanum*	Topical	Eye infection
Basellaceae	*Basella alba.* L	Bush land	Herb	Leaf	Decoction with ordinary salt	Oral	Retained Placenta
	.			Leaf	Decoction with *Entada abyssinica* roots	Oral	Cough
Cannabiaceae	*Cannabis sativa*.L.	Swamp	Herb	Leaf	Maceration	Oral	Diarrhoea & Newcastle
Cannaceae	*Canna indica.* L	Swamp	Herb	Stem	Maceration	Oral	Retained Placenta
Cucurbitaceae	*Cucurbita sphaerica.* (Sond.) Naudin.	Bush land	Climber	Fruit	Maceration	Oral	Bloat
	Cucumis sp.	Bush land	Climber	Leaf	Maceration	Oral	Diarrhoea
Euphorbiaceae	*Euphorbia candelabrum*. Kotschy.L.C	Range land	Tree	Sap	Ointment	Topical	Ectoparasite
	Phyllanthus ovalifolia. Oliv.	Scrub land	Shrub	Leaf	Decoction with *Carissa edulis* roots	Oral	Diarrhoea

	Sapium ellipticum. (Hoscht.)Pax	Bush land	Tree	Leaf	Maceration with ordinary salt	Maceration	Retained Placenta, Cough
	Synadenium grantii. Hook.f	Scrub land	Shrub	Leaf/ stem bark	Maceration	Topical	East Coast Fever
Fabaceae	*Abrus precatorius.*L.	Bush land	Climber	Seeds	Maceration/Decoction	Oral	Worms
	Acacia sieberiana. D.C	Range land	Tree	Root	Decoction	Oral	Retained Placenta, Bloat, East Coast Fever
					Poultice mixed with milk	Oral	Retained Placenta
	Entada abyssinica. Steude ex A.Rich	Swamp	Tree	Trunk bark	Decoction	Oral	Diarrhoea
	Erythrina abyssinica. Lam ex D.C	Range land	Tree	Trunk/ Root bark	Decoction	Oral	Worms & East Coast Fever
	Indigofera arrecta. Hoscht. Ex. A.Rich.	Bush land	Shrub	Leaf	Maceration	Topical	Sprains
	Senna didymobotrya (Fresen.) Irwin & Barneby	Bush land	Shrub	Leaf	Maceration	Topical	Ectoparasite (Mange)
	Senna occidentalis L.	Range land	Herb	Leaf/Root	Decoction	Oral	Worms
Lamiaceae	*Leonitis nepetifolia* (L.)R.Br.	Bush land	Herb	Leaf	Maceration	Topical	Ectoparasite
	Ocimum suave. Willd	Cultivated land	Shrub	Leaf	Maceration	Topical	Wounds

	Hibiscus surattensis .L.	Cultivated land	Shrub	Leaf	Decoction	Oral	Anaemia in calves
Malvaceae	*Sida cuneifolia*. Roxburgh	Cultivated land	Herb	Leaf	Maceration with ordinary salt	Oral	Retained Placenta
Myricaceae	*Myrica kandtiana*. Engl.	Swamp	Shrub	Leaf/ Root	Maceration	Oral	Worms, East Coast Fever, Cough
Pedaliaceae	*Sesamum angustifolium.* (Oliv.) Engl.	Range land	Herb	Leaf	Maceration	Oral	Worms
					Decoction	Oral	Diarrhoea
Phytolacaceae	*Phytolacca dodecandra*. L.Herit	Range land	Climber	Leaf	Maceration	Oral	East Coast Fever
Poaceae	*Imperata cylindrica* (L.) P.Beauv	Swamp	Herb	Root	Maceration with *Vernonia cistifolia* Leaves	Oral	Bloat
Rhamnaceae	*Helinus mystacinus* (Aiton) E.Mey.ex Steud.	Bush land	Herb	Leaf	Maceration	Oral	East Coast Fever
Rubiaceae	*Rubus steudneri*. Schweinf.	Swamp	Herb	Root	Decoction	Oral	Cough
Solanaceae	*Nicotiana tobaccum.* L.	Cultivated land	Shrub	Leaf	Maceration with *Erythrina abyssinica* Flowers	Topical	Eye infection
	Solanum aculeastrum. Dunal.	Cultivated land	Shrub	Fruit	Maceration	Topical	East Coast Fever, Eye infection

	Solanum incanum. L.	Bush land	Herb	Fruit	Maceration	Topical	Eye infection
Verbenaceae	*Clerodendrum myricoides*. (Hoscht.) R.Br ex Vatke	Bush land	Shrub	Root	Decoction	Oral	East Coast Fever
	Clerodendrum rotundifolium.Oliv.	Bush land	Shrub	Leaf	Maceration	Oral	Worms, East Coast Fever
	Vitex madiensis. Oliv.	Range land	Shrub	Leaf	Maceration	Oral	Retained Placenta

4.2 Growth habits of the used medicinal plants species

The majority of medicinal plants recorded were herbs (44.2%) followed by shrubs (32.6%). Trees (14.0%) and climbers (9.3%) were less used as sources of medicinal plants for treating cattle diseases. The vegetation of the area was predominated by shrubs and herbs. The trees were sparsely distributed. The climbers too are sparsely distributed since they are twining plants, in search of support from trees. Because pastoral farmers are often found interacting with herbs and shrubs, discoveries regarding their medicinal applications were much more, compared to other existing life forms. Thus, the local communities' knowledge of medicinal plants seems to be generally influenced by the nature of vegetation/ flora in their surrounding environment. The over dependence on herbs as a major supply of medicinal plants, possess risks of un sustainability. Hence there is need to develop strategies that address conservation to ensure sustainability.

4.3 Medicinal plant parts used

Most of the plant parts used as sources of medicines were leaves (62.7%), because the local people found the practice to be conservationally benign. This was followed distantly by roots with only 20%. Seeds, bulbs and sap were least frequently used with only 2.0% each. Stems and fruits were also on low demand with 6.0% each being used for treating cattle diseases.

4.4 Traditional methods of processing herbal remedies

Main methods used for processing the herbal remedies were; decoction, maceration, poultices and ointment. Decoction; this process was used when working with tough and more fibrous plants/ parts such as the trunk bark and root bark. The materials were boiled in water for long period of time to soften the materials and release the active chemical constituents. Maceration was preferably used for very tender/fresh plants, that were thought to loose their active compounds on heating. The mashed or ground plant materials

were stirred in water to make a concoction. The poultices were prepared by mashing fresh plant materials. The mashed material would be applied directly on the affected part.

The ointment was locally made using cow ghee as the base. This preparation applied to only *Euphorbia candelabrum*, from which fresh sap was mixed with ghee by stirring thoroughly. Ghee was used as a base and a nullifying agent for the irritation due to the sap when used in a solitary form. In preparation of decoctions and macerations water was used through out as a solvent. In this case, the farmers worked on assumptions that the desired-active chemical constituents were water soluble in the herbal remedies they prepared.

Thirty-six (36) remedies were prepared by maceration, fourteen by decoction, while the poultices and ointment methods were applied to preparation of only one remedy each. For *Abrus precatorius,* seeds were prepared either by decoction or maceration, for oral treatment of worms. The remedies were administered in two forms. The oral form was largely used with 71.42% dominance compared to the topical form (28.52%).

4.5 Farmers' knowledge on medicinal plants used in cattle health care

Knowledge on medicinal plant use for treatment of cattle diseases/ conditions among the pastoral farmers in Kabira Sub-county was orally transmitted amongst themselves. A great majority of the farmers interviewed consisted of men and youths (boys) totalling to 33/50 (66%) as compared to women 17/50 (34%). From the 50 farmers interviewed, 41/50 (82 %) claimed to have acquired the knowledge from their ancestors who were herdsmen, while 9/50 (18 %) their knowledge was developed through trial and errors from already known medicinal plants that were used for related ailments in human health care (Table 2). Some ailments such as cough, diarrheoa, worms (helminthiasis), wounds and stiff udder occur in both human and animals, hence similarity in use of the medicinal plants.

Table 2: Mode of acquisition of knowledge on medicinal plants by farmers

Mode of acquisition of knowledge on medicinal plants	**No. of respondents**	**Percentage no. of respondents**
From ancestors	41	82
Through trial and error	9	18
Total no. of interviewed repondents	50	100

4.6 Gender acquaintance with use of medicinal plants

Generally, nearly two times more males (63.46%) than females (36.54%) were knowledgeable about medicinal plants used for treating cattle diseases. The males (16%) were most knowledgeable on medicinal plants used for treatment of worms compared to females (11.6%). The males (15.33%) still dominated in the treatment of East Coast Fever against females (3.3%), and males (9.8%) were knowledgeable in the treatment of cough compared to the females (2.93%). For the treatment of bloat, females (1.63%) had less expertise compared to males (4.6%). Females (4.4%) almost twice as many as the males (2.45%) were conversant with the treatment of wounds. For the treatment of retained placenta, the females (3.1%) were the lead informants unlike males (1.47%). Both females and males were equally knowledgeable on medicinal plants for treatment of sore throat each with a representative figure of 0.2%. For Newcastle disease, and fostering love between mother cow and calf, the males were exclusively knowledgeable with 0.82% and 0.2% respectively. To foster love between mother cow and calf, the crashed aerial parts of *Asparagus flagellaris* were applied topically on the calf. Probably the herb has a pleasant smell that attracts the mother to leak the calf and bring about the close intimacy. Treatment of anaemia was only known to 0.49% of the females (Table 3).

Table 3: Knowledge of medicinal plants use in the treatment of cattle diseases according to gender

Disease/Ailment	No. of medicinal plant species used	No. of knowledgeable respondents	No. of respondents per gender		Average percentage per gender	
			Female	Male	Female	Male
Anaemia	*Hibiscsus surattensis*	3	3	0	0.49	0
Bloat	*Acacia sieberiana*	1	0	1	1.63	4.6
	Carissa edulis	15	4	11		
	Curcubita sphaerica	10	1	9		
	Imperata cylindrica	4	3	1		
	Vernonia cistifolia	8	2	6		
Cough	*Sapium ellipticum*	4	3	1	2.93	9.8
	Ocimum suave	15	4	11		
	Entada abyssinica	26	7	19		
	Rubus steudneri	33	4	29		
Diarrhoea	*Aspagarus africanus*	12	5	7	3.8	5.9
	Cannabis sativa	10	3	7		
	Cucumis sp	4	0	4		

	Entada abyssinica	8	5	3		
	Phyllanthus ovalifolia	7	3	4		
	Sesamum anguistifolia	18	7	11		
East coast fever	*Acacia sieberiana*	10	1	9	3.3	15.33
	Clerodendrum myricoides	3	0	3		
	Clerodendrum rotundifolium	16	2	14		
	Eryrthrina abyssinica	21	5	16		
	Helinus mystacinus	2	0	2		
	Microglossa pyrifolia	21	4	17		
	Myrica kandtiana	19	3	16		
	Phytolacca dodecandra	4	1	3		
	Solanum aculeastrum	14	4	10		
	Synadenium grantii	4	0	4		
Ecto parasites	*Conyza sumatrensis*	6	0	6	0.49	1.63
	Euphorbia candelabrum	7	3	4		
Eye infections	*Solanum aculeastrum*	17	8	9	3.1	4.24

	Solanum incanum	18	5	13		
	Vernonia cistifolia	10	6	4		
Foster love	*Aspagarus flagellaris*	1	0	1	0	0.2
Mange	*Senna didymobotyra*	4	1	3	0.2	0.49
Newcastle disease	*Cannabis sativa*	2	0	2	0	0.82
	Vernonia amygdalina	3	0	3		
Retained placenta	*Acacia sieberiana*	2	2	0	3.1	1.47
	Basella alba	8	7	1		
	Canna indica	3	1	2		
	Phyllanthus ovalifolia	5	3	2		
	Sida cuneifolia	8	6	2		
	Vitex madiensis	2	0	2		
Sore throat	*Aspagarus flagellaris*	2	1	1	0.2	0.2
Sprains	*Indigofera arrecta*	3	2	1	0.4	0.2
Swollen udder	*Crinum kirkii*	2	2	0	1.14	0.4
	Leonitis nepetifolia	7	5	2		

Worms	*Abrus precatorius*	34	16	18	11.6	16
	Aspilia africana	11	3	8		
	Carissa edulis	28	7	21		
	Clerodendrum rotundifolium	8	1	7		
	Erythrina abyssinica	18	13	5		
	Microglossa pyrifolia	17	9	8		
	Myrica kandtiana	23	11	12		
	Senencio mannii	3	0	3		
	Senna occidentalis	10	6	4		
	Sesamum angustifolium	8	1	7		
	Vernonia amygdalina	9	4	5		
Wounds	*Bidens pilosa*	22	14	8	4.4	2.45
	Erythrina abyssinica	6	4	2		
	Myrica kandtiana	14	9	5		
Summations		**613**	**224**	**389**		

4.7 Biological screening

4.7.1 Selection of medicinal plants for anthelmintic studies

Using participatory pair-wise ranking, comparisons were made between the eleven species used. Referential numbers to the species were used as indicated in the entries (Table 4).

Entries of referential number indicate that the species they represent were more preferable to the species compared with. The frequencies of each species (referential number) in the table were counted and entered as scores. Following the scores, rankings were made. *Abrus precatorius* with the highest score (8) was ranked the most preferred species, followed by *Clerodendrum rotundifolium* (7 scores), then *Carissa edulis* (7 scores) as the third preferred. Both *Clerodendrum rotundifolium and Carissa edulis* have the same scores, but when compared as indicated in the table, *Clerodendrum rotundifolium* was more preferred. This gives *C. rotundiloium* a higher rank of two than *Carissa edulis. Myrica kandtiana* was ranked fourth and *Erythrina abyssinica* fifth. Least preferred on the list was *Sesamum angustifolium*. The top most five species according to the rankings were considered for in-vitro studies. However, only four out of the five species were tested against *Ascaris suum*. *Abrus precatorius* plant materials could not be obtained in sufficient materials at the period of field collections.

Table 4: Priority medicinal plants used for treatment of helminthiasis as determined through participatory Pair-wise ranking technique.

	1 *Aspilia africana*	2 *Erythrina abyssinica*	3 *Microglossa pyrifolia*	4 *Abrus precatorius*	5 *Senencio manii*	6 *Myrica kandtiana*	7 *Carrisa edulis*	8 *Senna occidentalis*	9 *Sesamum anguistifolium*	10 *Clerodendrum rotundifolium*	11 *Vernonia amygdalina*	***SCORE***	**RANK**
1 *Aspilia africana*		***2***	***3***	***4***	***5***	***1***	***7***	***8***	***1***	***1***	***11***	**3**	**10**
2 *Erythrina abyssinica*			***3***	***2***	***2***	***6***	***7***	***2***	***2***	***10***	***11***	**5**	**5**
3 *Microglossa pyrifolia*				***4***	***3***	***6***	***3***	***8***	***9***	***10***	***11***	**4**	**9**
4 *Abrus precatorius*					***4***	***4***	***7***	***4***	***4***	***4***	***4***	**8**	**1**
5 *Senencio manii*						***6***	***5***	***5***	***5***	***10***	***5***	**5**	**6**
6 *Myrica kandtiana*							***7***	***6***	***6***	***6***	***11***	**6**	**4**
7*Carrisa*								***7***	***7***	***10***	***7***	**7**	**3**

edulis													
8 *Senna occidentalis*									***8***	***10***	***8***	**4**	**8**
9 *Sesamum anguistifolium*										***10***	***11***	**1**	**11**
10 *Clerodendrum rotundifolium*											***10***	**7**	**2**
11*Vernonia amygdalina*												**5**	**7**

4.7.2 Selection of medicinal plants for antibacterial studies

Similarly as described above for the selection of anthemintic medicinal plants, the same procedures were followed. Rankings were made basing on the scores. *Solanum aculeastrum* with the highest score (19) was ranked the top most preferred species out of the twenty medicinal plant species used for treatment of bacterial related infections. Second ranked species was *Entada abyssinica* (17 scores), then *Sapium ellipticum* (16 scores), followed by *Sesamum angustifolium* (16 scores) as the fourth preferred. *Myrica kandtiana* (15 scores) was the fifth preferred, then *Rubus steudneri* (15 scores) (sixth) and *Erythrina abyssinica* (seventh). These were the top seven preferred by the farmers and consideration for *in-vitro* studies were based on this criterion (Table 5).

Table 5: Priority medicinal plants used for treatment of bacterial related infections as determined through participatory pair-wise ranking technique.

	1 S.acul	**2** S.angui	**3**R.steu	**4**V.cist	**5** N.tob	**6** Entaaby	**7** S. inca	**8** M. kan	**9** B. alba	**10** C.sat	**11** C. sum	**12** E. aby	**13** Aspa	**14** L.nep	**15** O. sua	**16** P.ova	**17** B. pil	**18** C.edu	**19** S.ellip	**20** Cuc	SCORE	*RANK*
1 Solanum aculeastrum		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**19**	**1**
2Sesamum anguistifolium			**2**	**2**	**2**	**6**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**19**	**2**	**16**	**4**
3 Rubus steudneri				**3**	**3**	**3**	**3**	**8**	**3**	**3**	**3**	**12**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**15**	**6**
4 Vernonia cistifolia					**5**	**6**	**4**	**8**	**9**	**10**	**4**	**12**	**4**	**14**	**15**	**4**	**4**	**18**	**19**	**4**	**6**	**14**
5 Nicotiana tobaccum						**6**	**5**	**8**	**9**	**10**	**5**	**12**	**13**	**14**	**15**	**5**	**5**	**5**	**19**	**5**	**7**	**13**
6 Entada abyssinica							**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**17**	**2**
7 Solanum incanum								**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**00**	**20**
8 Myrica kandtiana									**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**19**	**8**	**15**	**5**
9 Basella alba										**10**	**9**	**12**	**9**	**14**	**9**	**9**	**9**	**18**	**19**	**9**	**08**	**11**
10 Cannabis sativum											**10**	**12**	**10**	**10**	**10**	**10**	**10**	**18**	**19**	**10**	**11**	**9**

11 Conyza sumatrensis												**12**	**11**	**14**	**15**	**11**	**17**	**18**	**19**	**20**	**03**	**17**
12 Erythrina abyssinica													**12**	**12**	**12**	**12**	**12**	**18**	**19**	**12**	**13**	**7**
13 Aspagarus africanus														**14**	**15**	**13**	**17**	**18**	**19**	**20**	**03**	**18**
14 Leonitis nepetifolia															**14**	**14**	**14**	**18**	**19**	**14**	**10**	**10**
15 Ocimum suave																**15**	**15**	**18**	**19**	**15**	**08**	**12**
16Phylanthus ovalifolium																	**17**	**18**	**19**	**20**	**01**	**19**
17 Bidens pilosa																		**18**	**19**	**20**	**04**	**16**
18 Carrisa edulis																			**19**	**18**	**12**	**8**
19 Sapium ellipticum.																				**19**	**16**	**3**
20 Cucumis sp																					**05**	**15**

Note: Solanum icanum had no scores because it was not used in preference against any species, like the rest of the species.

4.7.3 Bioactivity of methanolic extracts of the selected medicinal plant species against Ascaris suum

Four methanolic extracts of *Carissa edulis* (root bark), *Clerodendrum rotundifolium* (leaves), *Myrica kandtia*na (root bark), *Erythrina abyssinica* (root bark), were tested for *in-vitro* bioactivity against *Ascaris suum***.** For each extract a series of concentrations; 0.8 mg/ml, 1.2 mg/ml and 1.6 mg/ml were used. The experiment was aimed at obtaining preliminary laboratory validation on traditional use of four medicinal plant species in the management of worms in cattle.

Table 6: Mean percentage mortality rates of *Ascaris suum* in various medicinal plant extracts

Methanolic plant extracts	**Concentration (mg/ml)**	**No. of Worms Exposed**	**Percentage Mortality rates (in hours)**	
			36 hours	**48 hours**
Carissa edulis	0.8	8	12.5	25
	1.2	8	75	100
	1.6	8	87.5	100
Clerodendrum rotundifolium	0.8	8	12.5	25
	1.2	8	75	87.5
	1.6	8	100	100
Myrica kandtiana	0.8	8	12.5	37.5
	1.2	8	50	62.5
	1.6	8	100	100
Erythrina abyssinica	0.8	8	0	25
	1.2	8	37.5	62.5

	1.6	8	87.5	100
Positive control (Albendazole)	0.8	8	25	37.5
	1.2	8	75	100
	1.6	8	100	100
Negative control(Goodwins)	0.0	8	00	00

For each extract, mortality of *Ascaris suum* was observed. Basing on the computed percentage mortality rates of *Ascaris suum* (Table 5) at intervals of 36 hours and 48 hours, *Clerodendrum rotundifolium* and *Carissa edulis* extracts generally showed more activity among the four medicinal plant species extracts. By 36 hours at concentration of 1.2 mg/ml, 50 percent mortality was observed for *Myrica kandtiana* (root bark), while 75 percent mortality was observed for *Clerodendrum rotundifolium* (leaves) and *Carissa edulis* (root bark). However, the observations were different for *Erythrina abyssinica* where a mortality rate of 62.5 percent was recorded at a concentration of 1.2 mg/ml, at 48 hours compared to the other three extracts that showed mortality of more than 50 percent at 36 hours. This implies that *Erythrina abyssinica* (root bark) was less potent compared to the other 3 medicinal plant species extracts.

4.7.4 Bioactivity of methanolic extracts of the most important medicinal plants against *Staphlyloccocus aureus, Pseudomonas auroginosa* and *Escherichia coli*.

4.7.4.1 Susceptibilty

Methanolic extracts of seven medicinal plant species namely: *Myrica kandtiana* (Boot bark), *Entada abyssinica* (trunk bark), *Rubus steudneri* (leaves) *Solanum aculeastrum* (fruit), *Sesamum anguistifolium* (leaves), *Erythrina abyssinica* (trunk bark) and *Sapium ellipticum* (leaves) were tested for *in-vitro* antibacterial activity on three different bacteria species namely; *Pseudomonas auroginosa, Staphylococcus aureus* and *Escherichia coli* (Fig 2).

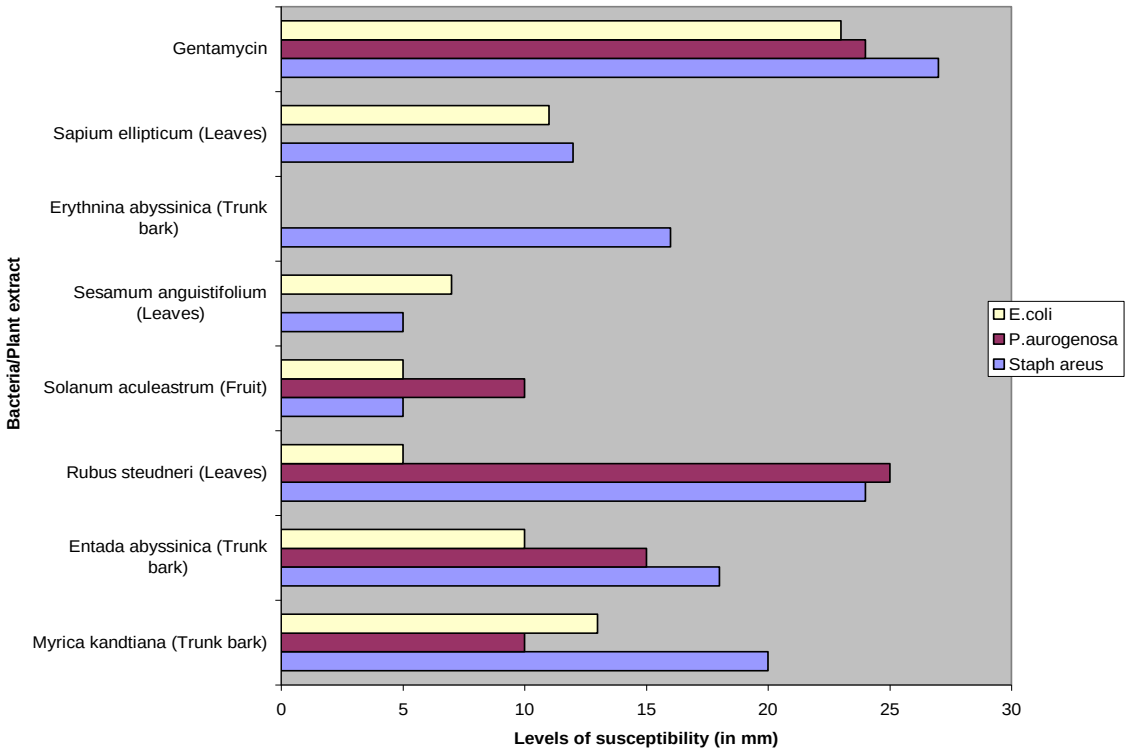

Figure 2: Susceptibility of *Pseudomonas auroginosa, Staphylococcus aureus* and *Escherichia coli* on methanolic plant Extracts

All the extracts from seven (7) medicinal plant species showed antibacterial activity on at least one or either of the test bacteria; *Staphyloccocus aureus, Pseudomonas auroginosa* and *Escherichia coli* bacteria species (Fig 2). Extracts of *Myrica kandtiana, Entada abyssinica, Rubus steudneri* and *Solanum aculeastrum* had activity on all the three bacteria species. *Sesamum anguistifolium* and *Sapium ellipticum* had activity on both *Staphyloccocus areus* and *E.coli* while *Erythrina abyssinica* showed activity on *Staphyloccocus aureus* only.

All the extracts from 7 plant species had activity on *Staphyloccocus areus*. *Staphyloccocus areus* was more susceptible to *Rubus steudneri* causing inhibition of 24 mm, followed by *Myrica kandtiana* (20 mm), *Entada abyssinica* (18 mm) and *Erythrina abyssinica* (16 mm). *Pseudomonas aurogenosa* was highly susceptible to *Rubus steudneri* (25 mm) and *Entada abyssinica* (15 mm), while for *E.coli*, susceptibility was more evident to *Myrica kandtiana* (13 mm), *Sapium ellipticum* (11mm) *and Entada abyssinica* 10 mm). Susceptibility of *E.coli* to all the 6 plant

extracts which showed activity, a relatively low variation in the diameters of inhibition zones was observed. This might be indicative of a likely similarity in the level of bioactivity and more so efficacy of the 6 plant extracts against *E.coli*.

4.7.4.2 Minimum inhibitory concentrations (MIC)

Shown in (Fig 3), are MIC values of the plant extracts on the different bacteria species. For all the 7 plant extracts, the MIC values ranged from 0.03125 µg/ml to 0.25 µg/ml.

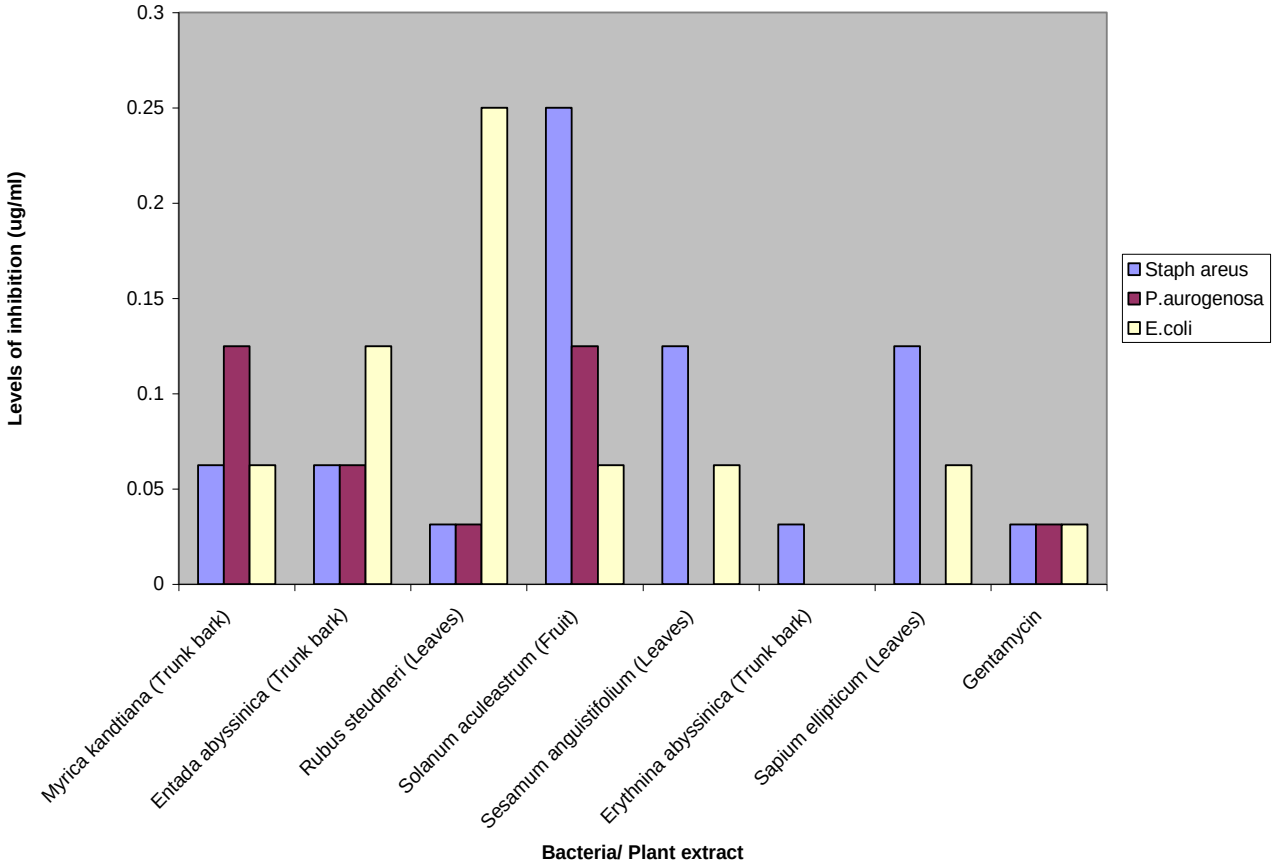

Figure 3: Relative levels of inhibition of methanolic extracts of seven plants on *Pseudomonas auroginosa, Staphylococcus aureus* and *Escherichia coli*

Overall, *Rubus steudneri* had the lowest MIC values, 0.03125 µg/ml similar to that of the positive control, gentamycin. This implies that *Rubus steudneri* had the greatest biological activity against *Staphyloccocus aureus* and *Pseudomonas auroginosa*.

Activity of *Erythrina abyssinica* against *Staphyloccocus aureus* was similar as for *Rubus steudneri.*

Among all the seven medicinal plant species extracts that inhibited growth of *Staphyloccocus areus,* both *Rubus steudneri* and *Erythrina abyssinica* had MIC values of 0.03125 µg/ml while *Myrica kandtiana* and *Entada abyssinica* had each 0.0625 µg/ml.

Similarly growth of *Pseudomonas aurogenosa* was inhibited by extracts from *Rubus steudneri* and *Entada abyssinica* at concentrations of 0.03125 µg/ml and 0.0625 µg/ml respectively. For *Myrica kandtiana* and *Solanum aculeastrum,* inhibition of growth was observed at a concentration of 0.125 µg/ml. Though only four medicinal plant species extracts were observed to be biologically active, and cause growth inhibition to *Pseudomonas aurogenosa, Rubus steudneri* and *Entada abyssinica* extracts may be good leads to pharmacological discoveries according to their MIC values.

Inhibition of *E.coli* growth was observed at least MIC values of 0.0625 µg/ml for extracts of *Myrica kandtiana, Solanum aculeastrum, Sesamum anguistifolium* and *Sapium ellipticum*. At MIC values of 0.125 µg/ml and 0.25 µg/ml for *Entada abyssinica* and *Rubus steudneri* respectively, inhibition of *E.coli* was also observed.

CHAPTER FIVE

5.0 DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Discussion

Knowledge of traditional management of cattle ailments / conditions using medicinal plants was orally communicated among pastoral farmers. The knowledge was fundamentally rooted among the men and older boys, because cattle keeping and health care management was traditionally considered as their social responsibility. Only few women shared this knowledge with men, and sometimes they acquired the knowledge by observing what the men prepared to treat the sick cattle depending on the ailments. Other pastoral farmers claim their knowledge was developed through trial and errors from already known medicinal plants that were used for related ailments in human health care. According to Booth and Leslie (1982), human and animal medicines share common roots, hence the development of veterinary pharmacology is the same as that for humans. Some ailments such as cough, diarrhoea, worms, wounds and stiff udder occur in both human and animals, hence similarity in the use of medicinal plants (Kankwiine, Pers. Comm.).

It is likely that the profound knowledge of herbal remedies in traditional cultures developed through trial and errors, and over centuries that most important cures were carefully passed on verbally from one generation to the next (Wyk and Wink, 2005). However one weakness about this is that along the course of transmission, there is a likelihood of losing some information, or distortion of some kind since indigenous knowledge is not systematically catalogued (Kokwaro, 1976). With the experienced dynamics in traditional societies, we cannot continue to rely on oral communications if we are to effectively develop and utilize medicinal plants in cattle health care and disease management.

This research work documented traditionally diagnosed cattle ailments/ diseases at symptom levels. The farmers recognized sixteen cattle ailments/ conditions, and alternative treatments using medicinal plants were recorded against them. However,

the study narrowed down to investigations of key medicinal plants for their biological activity (*in-vitro*), with respect to the medicinal plant species that were traditionally used in the treatment of helminthiasis and bacterial related infections.

Helminthiasis is a disease / condition that is due to the presence of helminths (worm) infestations in cattle. Several species of worms exist, but farmers' classification was general no matter the species. Diagnosis of helminthiasis was made by farmers basing on the presence of worms in faecal matter, diarrhoea, abnormality in positioning of fur and bulging of the stomach especially in young calves. Loss of appetite was also considered though the latter is not exclusive to helminthiasis.

For bacterial related infections, key conditions and their associated symptoms formed the basis for categorization. The key ailments that guided in selection of priority medicinal plants were cough, eye infection, diarrhoea and inflammated wounds. Cough was recognized by sudden, often repetitive spasmodic contractions of the thoracic cavity. Eye infections were recognized by abnormally moist and reddish colour of the eyes. Diarrhoea was by observation of frequent passing out of watery faecal matter, loss of appetite and in severe cases loss of body weight.

5.1.1 In-vitro biological activity of traditionally used medicinal plant species

Four and seven medicinal plant species that were traditionally believed to be more efficacious remedies among the list of plants used against helminthiasis and bacterial related infections were respectively studied *in-vitro.*

5.1.2 Medicinal plant remedies for helminthiasis

Four plant species namely; *Myrica kandtiana, Clerodendrum rotundifolium, Erythrina abyssinica* and *Carissa edulis* were so far the best known and used remedies in the treatment of helminthiasis in cattle. Besides their reported use in Kabira sub-county, literature supports similar use of these medicinal plant species elsewhere in the world.

The scientific presence of known medicinal properties also justifies their local use. *Myrica kandtiana* has not been reported in literature before for use in the treatment of helminthiasis. However, *Myrica esculenta,* a member of family Myricaceae and genus *Myrica* as *Myrica kandtiana* has been reported for use as an antihelmintic agent (Manandhar, 1995). Chemotaxonomically certain families and genera are known to possess specific secondary metabolites which tend to be similarly active in terms of their medicinal properties (Raz, 1998). This could be supportive of the use of *Myrica kandtiana* by the pastoral farmers in Kabira sub-county for the treatment of helminthiasis. Decoction of *Clerodendrum rotundifolium* roots/leaves as cited by (Kokwaro, 1976) was drunk as an antihelmintic for tapeworms in the East African region. This compliments the use of *C. rotundifolium* by the pastoral farmers. Ethno-medically, *Carissa edulis* (roots) have been cited as a traditional remedy against worms (Ibrahim *et al.,* 2005). For *Erythrina abyssinica* several medicinal properties other than those linked to antihelmintic properties have been reported (Hamill *et al.,* 2000*;* Yenesew *et al.,* 2003*;* Yenesew *et al.,* 2004). The use of *E. abyssinica* as an antihelmintic agent by the pastoral farmers in the region may be a new addition to scientific literature. Confidence in local use of medicinal plant species for the treatment of helminthiasis was majorly referenced onto *Clerodendrum rotundifolium, Carissa edulis*, *Myrica kandtiana* and *Erythrina abyssinica,* in a descending order. At this level, potency of the herbal remedies as locally used cannot in any way be defined explicitly without any scientific deductions. Nevertheless, this indigenous knowledge cannot be subjected to rejections. As cited above, the scholarly works justify that the four plant species are traditionally alternative therapies for the treatment of worms.

Following the *in-vitro* studies, preliminary proof to the local use of antihelminthic medicinal plants was ascertained. *Clerodendrum rotundifolium* and *Carissa edulis* showed more activity among the four medicinal plant species extracts. Both plant species extracts had the highest worm mortality rates, similar to albendazole. This is indicative that the two plant species were as effective as the standard drug. Considering all the four medicinal plant species extracts, higher mortality rates were observed for two medicinal plant species at lesser hours unlike for *Erythrina abyssinica* that showed a lower mortality rate. *Erythrina abyssinica* was least potent followed by *M. kandtiana.* Therefore, *Clerodendrum rotundifolium* and *Carissa edulis*

at concentrations of less than 1.2mg/ml could potentially give 50 percent mortality rates. Hence the active chemical ingredients in the respective two plant species could be more efficacious than those in *Erythrina abyssinica* and *Myrica kandtiana*. Thus, smaller concentrations of *Clerodendrum rotundifolium* and *Carissa edulis* are needed to kill *Ascaris suum* unlike *Erythrina abyssinica* and *Myrica kandtiana* where relatively higher concentrations are needed to cause a similar effect.

5.1.3 Medicinal plant remedies for bacterial related infections.

From the twenty medicinal plant species that were used for the treatment of bacterial related conditions, that affected cattle, only seven plant species were prioritised as major remedies. These are previously described in their order of importance **(Section 4.7.2).** It was through information sharing and periodical practicing in use of these medicinal plants that the farmers were able to filter and prioritise seven key species as lead herbal remedies for the treatment of bacterial related infections. However, efficacy of these remedies still remain mythical, to belief and confidently rely on for wide spread use. Conversely, scholarly works give a benefit of no doubt to cling on the belief that the seven selected medicinal plants are traditionally useful in management of bacterial related conditions. A case in point is or are unspecified parts of *Solanum aculeastrum* that are traditionally used for the treatment of bronchitis (a bacterial related infection)s in East Africa (Kokwaro, 1976). Further more, many solanaceae species generally contain solanine and other steroid alkaloids and tannins, which are reported to have curative effects for eye inflammation and antibacterial properties (Wyk and Wink, 2005). This possibly supports the claims for the use of *S. aculeastrum* as a remedy for eye infections in cattle.

Myrica kandtiana was used to treat wounds in Kabira sub-county, but no similar use is reported elsewhere. But according to Hutchings *et al.* (1996), many chemical compounds are reported to be present in family Myricaceae, to which *Myrica kandtiana* belongs. These compounds include; triterpenoids, sesquiterpenoids and tannins. Most important of all is flavonoid myritricin a compound typical to the genus Myrica. Sesquiterpenoids and tannins exhibit both disinfectant and antibacterial properties, while an isolated compound, flavonoid myrictrin from root bark of *Myrica*

cerifera is said to have antibacterial activity (Wyk and Wink, 2005). This is preliminary evidence to support the possible presence of antibacterial properties in *Myrica kandtiana* and its purported use in the treatment of bacterial related infections.

Rubus family to which *Rubus steudneri* belongs has tannins, proanthocyanins, ellagic, gallic acid, triterpenoids, saponins and glucitol, and some of these have been found to possess antibacterial activity (Hutchings *et al.,* 1996; Wyk and Wink, 2005). From a chemotaxonomic point of view, it is likely that *Rubus steudneri* whose chemistry and biological activity is not documented in scientific literature may have similar chemical constituents with antibacterial activity.

Erythrina abyssinica reported to have antidiarrhoea and antibacterial activity in mice (Hamill *et al,*. 2000). As cited in (Neuwinger, 1994), *Sapium ellipticum* roots are used for cough and abscesses while the leaves are for eye diseases and cough. Furthermore, the whole plant contains tannins, alkaloids (Haerdii, 1964). Yet tannins and alkaloids exhibit both disinfectant and antibacterial properties (Wyk and Wink, 2005), which is supportive of *S. ellipticum* use in traditional management of bacterial related infections.

Carissa edulis roots contain sesquiterpenes and phenolic compounds (Ibrahim *et al.,* 2005), which compounds are cited earlier in the text to have antibacterial properties. Further studies to give clarity on scientific evidence in support for the use of the above mentioned plant species as remedies for bacterial related infections were conducted *in-vitro* on three bacteria species namely; *Escherichia coli, Pseudomonas auroginosa* and *Staphylococcus aureus*. Each medicinal plant species extract was found to cause growth inhibition at varied MIC values. For susceptibility of *E.coli* to all the six medicinal plant species that showed activity, a relatively low variation in the diameters of inhibition zones was observed. This is indicative of a likely similarity in the level of bioactivity, and more so efficacy for the six medicinal plant species extracts against *E.coli.* With respect to *Staphyloccocus aureus*, four medicinal plant species extracts namely; *Myrica kandtiana, Entada abyssinica, Rubus steudneri* and *Erythrina*

abyssinica were suggestively ideal candidates for further pharmacological studies. This is because, at the lowest concentrations the medicinal plant species extracts were able to induce inhibition unlike three of the other medicinal plant species extracts. Four medicinal plant species extracts were observed to be biologically active, and cause growth inhibition of *Pseudomonas auroginosa*. However, only *Rubus steudneri* and *Entada abyssinica* could be good leads for pharmacological discoveries according to their MIC values.

5.2 Conclusions

There is a correlation between the traditional use and *in-vitro* activity of the four plant species as remedies for helminthiasis. *Clerodendrum rotundifolium* and *Carissa edulis* are found to be more efficacious than the other species, which provides evidence that the two species need to be studied further for the development of more reliable herbal remedies against helminthiasis.

Similarly, the traditionally used medicinal plant species for the treatment of bacterial related infections were found to cause growth inhibition on the three bacteria species at varied MIC values**.** But the best and recommended medicinal plant species for further research, basing on the overall results were *Myrica kandtiana, Entada abyssinica* and *Rubus steudneri*. These had activity on all the three bacteria species, and showed similar or slightly varied levels of inhibition on comparison with the standard drug (gentamycin). Other additional medicinal plant species could be *Solanum aculeastrum* and *Sapium ellipticum*. These showed the highest broad spectra among the seven tested plant species against *Escherichia coli, Pseudomonas auroginosa* and *Staphylococcus aureus*.

These preliminary *in-vitro* results are a scientific proof for the use of the studied medicinal plant species in traditional management of helminthiasis and bacterial related infections in cattle. However, the set up of the experiment and the results obtained can only help as a guide in future experimentations, especially regarding the

range of concentrations that could be used for the systematic conduct of acute toxicity studies to determine lethal dosages for the respective plant extracts and other toxicity tests.

5.3 Recommendations

The study encourages use of *Clerodendrum rotundifolium* and *Carrisa edulis* for the treatment of helminthiasis. The two plants are more efficacious *in-vitro* compared to *Myrica kandtiana* and *Erythrina abyssinica*. Where applicable, combinations of either *Clerodendrum rotundifolium* or *Carrisa edulis* can be adopted for use in a crude form with one or a combination of both *Myrica kandtiana* and *Erythrina abyssinica* for effective management of helminthiasis.

For the traditional treatment of bacterial related infections, the findings of the study recommend use of *Myrica kandtiana, Entada abyssinica* and *Rubus steudneri*. The three plants showed great effectiveness against bacterial growth among the seven species that were tested.

There is need for research and development on use of the five medicinal plant species for integration into the existing, yet inadequate and cost ineffective modern veterinary drugs that are hardly affordable to many livestock farmers.

Simple intermediate and applied approaches that are easily adaptable to farmers need to be developed to promote enhanced use of the tested medicinal plants in cattle health care and management.

Investigations need to be undertaken to ascertain the precise MIC values, conduct *in-vivo* trials for bioactivity and establish active ingredients in the plants that showed activity.

Toxicity studies on the best five species need to be conducted to develop confidently used herbal remedies.

REFERENCES

ALTE, O.D. 1993. Indigenous knowledge and Local Development: The

Participatory Approach, Indigenous knowledge and Sustainable Development. Regional Program for the Promotion of Indigenous knowledge in Asia, International Institute of Rural Reconstruction, Silang, Cavite, Philippines. pp 14-55.

ANONYMOUS. 1999. Veterinary knowledge and practice in Northern Sudan:

The Butana Region. Proceedings of an International Conference held

in Pune, India, on November 4-6, 1997. Volume 1: Selected Papers.

BAIF Development Research Foundation, Pune, India.

BAGINE, R., MUTHOKA, P. AND MUNGAI, G. 1997. Conservation of

Medicnal plants in Kenya. Proceedings of Conservation and Utilisation of Medicinal Plants and Wild relatives of Food crops.

BOOTH N.H and LESLIE E.M. 1982. Veterinary Pharmacology and

Therapeutics. The Iowa State University Press. AMES.

CARTER, G.R and COLE, J.R.Jr. 1990. Diagnostic Procedures in Veterinary

bacteriology and Mycology. Fifth edition. Academic Press, Inc. Harcourt BRACE JOVANORICH PUBLISHERS.

DUKE, J. A. 1992. Tropical botanical extractives. In: M. Plotking and L.

Famolare (eds.). Sustainable Harvest and Marketing of Rain Forest

Products.Island Press for Conservation International, Covelo,

California, USA. Pp. 53-62.

DURNING, A.T. 1992 Guardians of the land. Indigenous people and the

health of the earth Ed Ayres (ed) world watch paper 112. World watch, Washington DC

EJOBI, F., OLILA, D., ARIONGA, S. and KAMOGA, D., 2004. On farm validation of selected ethnoveterinary medicinal plants in the Teso farming system. A technical report submitted to the Department for International development (DFID), United Kingdom.

FAJIMI, A.K AND TAIWO, A.A., 2005. Herbal remedies in animal parasitic diseases in Nigeria: A review. *African Journal of Biotechnology Vol. 4(4), 303-307.*

FARNSWORTH, N.R. and MORRIS, R.W., 1976. Higher plants: the sleeping giants of drug development. *American Journal of Pharmacology. 148: 46-52.*

FARNSWORTH, N.R., 1988. Screening Plants for new Medicines. In: Wilson, E.O. ed Biodiversity. 83-97. National Academy Press, Washington D.C.

MANANDHAR. N.P, 1995. Medicinal Folk-Lore about the Plants used as anthelmintic agents in Nepal. In: FITOTERAPIA Vol. LXVI, No. 2. Pp 149-155.

FOUNTAIN PUBLISHERS. 2005. Uganda Information Handbook. Expanded edition 2005-2006.

GIBSON T.E., 1965. Veterinary anthelmintic medication. Lamport Gilbert and Company Ltd., London.

GITHORI, J.B., HOGLUND, J., WALLER, P.J., BAKER, R.L., 2003. The anthelmintic efficacy of the plant *Albizia anthelmintica,* against the nematode parasites *Haemonchus contortus* of sheep and *Heligmosomoides polygyrus* of mice. *Veterinary Parasitology.116, 23-34.*

GRADE, J.T. and LONGOK, A., 2000. Karamojong Scientists: Participatory

Field trial of a Local Dewormer. A paper presented at the Uganda Veterinary Association Scientific Conference: 'The Veterinary Profession and Poverty Alleviation", 28-29 September, 2000. *Available from:* www.vetwork.org.uk/cahevm.htm#grade.

HAERDII. F, 1964. Die Eingeborenen- Heilpflanzen des Ulanga-Distrikts

Tanganyikas Acta Tropica, Suppliment 8, Basil.

HAMILL.F.A, APIO. S, MUBIRU.N.K, MOSANGO.M, BUKENYA-ZIRABA.R,

MAGANYI, O.W, SOEJARTO.D.D. 2000. Traditional Herbal Drugs of Southern Uganda. *Journal of Ethno-Pharmacology*. 70. 281-300.

HOFT, M., BARIK, S.K. and LYKKE, A.M., 1999. Quantitative Ethnobotany.

Applications of Multivariate and Statistical Analysis in Ethnobotany.

People and Plants Working Paper, UNESCO.

http://rakai.go.ug/lgprofile.html

HUTCHINGS, A., SCOTT, A.H., LEWIS, G. and CUNNINGHAM, B., 1996.

Zulu Medicinal plants. An Inventory. University of Natal Press. Private

Bag X01 Scottsville 3209.

IBRAHIM.H, BOLAJI. R.O, ABDURAHMA.E.M, SHOK.M, IIYA.N and HABIB.A.G. 2005. *Chem. Class Journal*, Vol 2.Pp 15-18

ITDG and IIRR., 1996. Ethnoveterinary Medicine in Kenya. A field Manual of

Traditional Animal Health Care practices. International Technology

Development Group /International Institute for Rural Reconstruction. Nairobi, Kenya.

IUCN. 1993. Guidelines on the Conservation of Medicinal plants. IUCN, Gland,

Switzerland.

KING, S.R., 1992. Pharmaceutical Discovery, Ethnobotany, Tropical Forests and Reciprocity Integrating Indigenous Knowledge, Conservation and Sustainable Development. In: Plotkin, M and Farnolare, L. eds. Sustainable Harvesting and Marketing of Rain Forest Products. 231-238. Island Press, Washington D.C.

KOKWARO, J.O., 1976. Medicinal plants of East Africa. Kenya Literature Bureau.P.B 30022 Nairobi, Kenya.

MAINGI, N. H., BJORN, S.M., THARMSBORG, H.O., BOGH, P, NANSEN., 1996. A survey of anthelminthic aresistance in nematode parasites of goats in Denmark. *Vet. Parasitol. 66:53-66.*

MARECIK, N.O., 1998. Veterinary practices for the prevention of disease in Tanzania. In: *Indigenous Knowledge and Development Monitor.* Center for International Research and Advisory Network (CIRAN). 3: 3-8.

MATHIAS, E., McCORKLE, M., VAN VEEN, T.W.C., 1996. Introduction: Ethnoveterinary Research and Development. In: McCorkle, *et al.*(Eds.), Ethnoveterinary Resaerch and Development. Intermediate Technology Publications, London.

MATHIAS-MUNDY, E. AND McCORKLE, C.M., 1989. Ethnoveterinary Medicine: An Annotated Bibliography. Bibliographies in Technology and Social Change, No.6. IOWA State University, USA.

MATHIAS, E., RANGNEKAR, D.V. AND C.M. McCORKLE., 1999. Ethnoveterinary Medicine: Alternatives for Livestock Development. Proceedings of an International Conference held in Pune, India, on November 4-6, 1997. Volume 1: Selected Papers. BAIF Development Research Foundation, Pune, India.

MCCORKLE, C.M., 1986. An Introduction to Ethnoveterinary Research and Development. *Journal of Ethnobiology. 6(1) 129-149*.

MWALE, M., BHEBHE, E., CHIMONYO, M., HALIMANI, T.E., 2005. Use of herbal plants in poultry health management in the Mushagashe small-scale commercial farming area in Zimbabwe. International Journal of Applied Research in Veterinary Medicine. 3, 163-170.

MORAN, K., 1997. Returning Benefits from Ethnobotanical Drug Discovery to Native communities. The Healing Forest Conservancy. Washington D.C.

MUGISHA, O, R., 1998. Uganda Information Handbook. Fourth Edition Fountain Publishers, Kampala.

NAPE, 2009. THE LEATHER-TANNERY INDUSTRY IN UGANDA. Risks to the Environment and to Human Health.

NEUWINGER, H.D., 1994. African Ethnobotany. Poisons and Drugs. Chapman and Hall

OLILA, D., 1993. A study of the antimicrobial activities of *Zanthoxylum chalybeum* and *Warburgia ugandensis* - Ugandan medicinal plants. MSc Thesis, Makerere University, Kampala, Uganda. 154 pp.

RAZ. B. 1998. Isolation and Evaluation of Antiparasitic lead compounds from African Medicinal Plants. PhD Thesis.

SCHMIDT, G.D. and LARRY, S.R., 1985. Foundations of Parasitology. 3rd Edition, Times Mirror Mosby College Publishing, St. louise Missouri, USA, pp 487-488.

SEBUGUZI, F., 2000. Ethnoveterinary medicine in Gomba county, Mpigi

district: Use of medicinal plants by livestock farmers in the treatment of their animals. BSc (Vet Med.), Undergraduate Dissertation, Makerere University.

SOLLOD, A. E. AND J. A. KNIGHT. 1983. Veterinary anthropology: A herd health study in central Niger. In: Third International Symposium on Veterinary Epidemiology and Economics. Arlington, Virginia, 6-10 September 1982. Veterinary Medicine Publishing Company, Edwardsville, Kansas, USA. pp. 482-486.

TABUTI, J.R.S., DHILLION, S.S., LYE, K.A., 2003. Ethnoveterinary medicines for cattle (*Bos indicus*) in Bulamogi county, Uganda: plant species and mode of use. *Journal of Ethnopharmacology 88, 276-286*.

TOYANG, N.J., NUWANYKPA, M., NDI, C., DJANGO, S. AND KINYUY, W.C., 1995. Ethnoveterinary Medicine Practices in the Northwest Province of Cameroon. In: *Indigenous Knowledge Development Monitor*. Vol.3(3) pp 20-22. Centre for International Research and Advisory Network (CIRAN).

TUWANGYE, I. and OLILA, D., 2006. The anthelmintic activity of indigenous medicinal plants used by the Banyankole of Western Uganda. *Journal of Animal and Veterinary Advances. 5(8): 712-717.*

UGANDA GOVERNMENT. 1967. Atlas of Uganda. Published by the Department of Lands and Surveys, Uganda. Second Edition.

VOEKS, R., 1996 Tropical forest healers and habitat preference. *Economic Botany 50 (4) 381-400.*

WANYAMA, J., 1997. Ethnoveterinary knowledge among pastoralists of Samburu, Kenya. *Journal of Ethnopharmacology 38, 105-112.*

WEISER, P.A., 1994. Animal Research and Development in Animal disease

control in Eastern Sudan. Vol. 39pp. 139-149.

WOODS, G.L and WASHINGTON, J.A. 1995. Antibacterial Susceptible Tests:

Dilution and Disk Diffusion Methods. In: Murray, P.R, Baron, E.J, Pfaller, M.A, Tenover, F.C, Yolken, R.H. eds Manual of Clinical Microbiology. Sixth Edition. ASM Press, Washington D.C.

WYK. B. E and WINK.M. 2005. Medicinal Plants of the World. *An illustrated*

scientific guide to important Medicinal Plants and their uses. Timber Press,Inc.

YENESEW.A, DERESE.S, IRUNGU.B, MIDIWO.J, WATERS.N.C,

LIYALA.P, AKALA.H, HEYDENREICH. M and PETER.M.G. 2003. Flavonoids and isoflavonoids with antiplasmodial activities from the root bark of Erythrina abyssinica. *Planta Med. 69, 658-661.*

YENESEW.A, INDULI.M, DERESE.S, IRUNGU.B, MIDIWO.J,

HEYDENREICH.M, PETER.M.G, AKALA.H, WANGUI. J, LIYALA.P, WATERS.N.C. 2004. Antiplasmodial flavonoids from the stem bark of *Erythrina abyssinica*. *Phytochemistry . 65, 3029-3032*

Appendices

Appendix 1: Results of In-vitro Activity of Methanolic Extracts of Four Medicinal Plant Species on *Ascaris suum*

Plant extracts	**Concentration mg/ml**	**No. of A.suum Exposed**	**No. of worms Dead/ Time in Two replicates (in hours)**							
***Carissa edulis* (Root Bark)**			**R1**	**R2**	**R1**	**R2**	**R1**	**R2**	**R1**	**R2**
Goodwins (-ve control)	0	8	0	0	0	0	0	0	0	0
	0.8	8	0	0	0	0	0	1	2	2
	1.2	8	0	0	3	2	6	6	8	7
	1.6	8	2	2	4	4	7	6	8	8
***Clerodendrum rotundifolium*(Leaf)**										
Goodwins (-ve control)	0	8	0	0	0	0	0	0	0	0
	0.8	8	0	0	0	0	1	1	2	1
	1.2	8	3	2	5	4	6	5	7	7
	1.6	8	6	5	8	7	8	8	8	8
***Erythrina abyssinica* (Root bark)**										
Goodwins (-ve control)	0	8	0	0	0	0	0	0	0	0
	0.8	8	0	0	0	0	0	0	1	2

	1.2	8	0	0	1	2	3	2	4	5
	1.6	8	2	1	3	4	6	7	8	8
***Myrica kandtiana* (Root bark)**										
Goodwins (-ve control)	0	8	0	0	0	0	0	0	0	0
	0.8	8	0	0	0	0	1	1	3	2
	1.2	8	0	0	2	2	3	4	4	6
	1.6	8	2	2	4	5	8	7	8	8
Albendazole 10% (+ve control)										
Goodwins (-ve control)	0	8	0	0	0	0	0	0	0	0
	0.8	8	0	0	0	0	1	2	2	3
	1.2	8	1	2	3	3	5	6	8	8
	1.6	8	3	2	6	4	8	8	8	8

Appendix 2: Susceptibility of methanolic extracts of seven medicinal plant species on *Pseudomonas aurogenosa, Staphylococcus areus and Escherichia coli*

	Sensitivity levels of Extracts		
Plant Species Extract.	***Staphylococcus areus***	***Pseudomonas aurogenosa***	***Escherichia coli***
Myrica kandtiana (Root bark)	S (20mm)	S (10mm)	S (13mm)
Entada abyssinica (Trunk bark)	S (18mm)	S (15mm)	S (10mm)
Rubus steudneri (Leaves)	S (24mm)	S (25mm)	S (5mm)
Solanum aculeastrum (Fruit)	S (5mm)	S (10mm)	S (5mm)
Sesamum angustifolium (Leaves)	S (5mm)	R	S (7mm)
Erythrina abyssinica (Trunk bark)	S (16mm)	R	R
Sapium ellipticum (Leaves)	S (12mm)	R	S (11mm)

Appendix 3: Minimum Inhibitory Concentrations (MIC) of Methanolic Extracts of Seven Medicinal plant Species on *Pseudomonas aurogenosa, Staphylococcus areus and Escherichia coli*

	MIC of Extracts (in ug ml -1)		
Plant Species & Extract.	***Staphylococcus areus***	***Pseudomonas aurogenosa***	***Escherichia coli***
Myrica kandtiana (Root bark)	0.0625	0.125	0.0625
Entada abyssinica (Trunk bark)	0.0625	0.0625	0.125
Rubus steudneri (Leaves)	0.3125	0.3125	0.25
Solanum aculeastrum (Fruit)	0.25	0.125	0.0625
Sesamum angustifolium (Leaves)	0.125		0.0625
Erythrina abyssinica (Trunk bark)	0.3125		
Sapium ellipticum (Leaves)	0.125		0.0625
Gentamycin (+ve control)	0.3125	0.3125	0.3125

Appendix 4: Local names of the plant

Family	Taxon (Scientific name)	Local name (Luganda)
Amyrillidaceae	*Crinum kirkii*. Barker.	Kimondemonde
Apocyanaceae	*Carissa edulis* (Forssk) Vahl.	Muyonza
Asparagaceae	*Asparagus africana* Lam.	Kadaali-omusajja
	Asparagus flagellaris. (Kunth.) Baker	Kadaali-omukazi
Asteraceae	*Aspilia africana*. (P.Beauv.) C.D Adams	Makayi
	Bidens pilosa.L.	Ssere
	Conyza sumatrensis. (Retz) Walker.	Kafumbe-omusajja
	Microglossa pyrifolia (Lam.) Kuntze	Kafuga-nkande
	Senecio mannii. Hook	Mugangu
	Vernonia amygdalina.Del.	Mululuza
.	*Vernonia cistifolia*. O. Hoffm	Kayayana
Basellaceae	*Basella alba.* L.	Enderema
Cannabiaceae	*Cannabis sativa*.L.	Njagga
Cannaceae	*Canna indica*. L	"Akatooke"
Cucurbitaceae	*Cucurbita sphaerica*. (Sond.) Naudin.	Katanga
	Cucumis sp.	Akatanga-akatono
Euphorbiaceae	*Euphorbia candelabrum*. Kotschy.L.C	Nkukulu
	Phyllanthus ovalifolia. Oliv.	Omutulika
	Sapium ellipticum. (Hoscht.)Pax	Musasa
	Synadenium grantii. Hook.f	Lukoni
Fabaceae	*Abrus precatorius*.L.	Lusiiti
	Acacia sieberiana. D.C	Mweramanyo
	Entada abyssinica. Steude ex A.Rich	Mwolola

	Erythrina abyssinica. Lam ex D.C	Ejirikiti
	Indigofera arrecta. Hoscht. Ex. A.Rich.	Akeyoyo
	Senna didymobotrya (Fresen.) Irwin & Barneby	Mukyula
	Senna occidentalis L.	Mutanjoka
Lamiaceae	*Leonitis nepetifolia* (L.)R.Br.	Kifumufumu
	Ocimum suave. Willd	Mujaja
Malvaceae	*Hibiscus surattensis* .L.	Musaayi
	Sida cuneifolia. Roxburgh	Akakumirizi
Myricaceae	*Myrica kandtiana*. Engl.	Nkikimbo
Pedaliaceae	*Sesamum angustifolium*. (Oliv.) Engl.	Olutungotungo
Phytolacaceae	*Phytolacca dodecandra*. L.Herit	Luwoko
Poaceae	*Imperata cylindrica* (L.) P.Beauv	Esenke
Rhamnaceae	*Helinus mystacinus* (Aiton) E.Mey.ex Steud.	Mbaluka
Rubiaceae	*Rubus steudneri*. Schweinf.	Nkenene
Solanaceae	*Nicotiana tobaccum*. L.	Taaba
	Solanum aculeastrum. Dunal.	Etengolyomukiralo
	Solanum incanum. L.	Ntengotengo
Verbenaceae	*Clerodendrum myricoides*. (Hoscht.) R.Br ex Vatke	Kikonge
	Clerodendrum rotundifolium.Oliv.	Kisekeseke
	Vitex madiensis. Oliv	Mukyusa

Appendix 5: Research Questionnaire

SOME PHARMACOLOGICAL ACTIVITIES OF SELECTED MEDICINAL PLANT SPECIES USED FOR TREATING CATTLE DISEASES IN KABIRA SUB-COUNTY, RAKAI DISTRICT

a) Respondent's Particular

1. Name of respondent…….Sex (M/F) Age……
2. Education level (Illiterate; Primary; Secondary; Post secondary).
3. Location (GPS Position)……District…….County……
4. Subcounty……..Parish…….

b) Particulars about medicinal plants

1. Do you know of any medicinal plants used for treating livestock diseases/ conditions? (Yes/No).

2. If yes, list as below:

No	Plant name	Part used	Mode of preparation & use	Approx quantity used per animal	Any known side effects	Place of harvest
1						
2						
3						

4						
5						
6						
7						
8						
9						

3. What are people's attitudes towards use of medicinal plants in livestock health care?

.....

.....

.....

.....

.....