STUDIES ON PREVENTIVE AND CURATIVE ETHNOVETERINARY REMEDIES APPLIED BY THE RENDILLE/ARIAAL AND GABRA COMMUNITIES OF MARSABIT DISTRICT, KENYA.

GEORGE JOSIAH WAMWERE-NJOROGE (BVM)

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN VETERINARY EPIDEMIOLOGY AND ECONOMICS

DEPARTMENT OF PUBLIC HEALTH, PHARMACOLOGY AND TOXICOLOGY,
FACULTY OF VETERINARY MEDICINE,
UNIVERSITY OF NAIROBI, KENYA

DECLARATION

This thesis is my original work and has not been presented for a degree in any other University

.... 30/06/2004
George Josiah Wamwere-Njoroge (BVM) Date

This thesis has been submitted for examination with our approval as the supervisors

.... 5/7/2004
Prof. J.M. Gathuma Date
BVSc, MSc, PhD

.... 5/7/2004
Prof. F.M. Njeruh Date
BVM, MSc, PhD

.... 05/07/04
Dr. P.M. Kitala Date
BVM, MSc, PhD

DEDICATION

This work is dedicated to my beloved wife Eunice and sons, Josiah and Godfrey Ernest who had to endure my long absence from home while doing my research project at Marsabit.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LISTS OF PLATES

ACKNOWLEDGEMENTS

Within the many organisations and institutions I interacted with during my studies, certain individuals merit special thanks. I am indebted to Prof. J.M. Gathuma, Prof. F.M. Njeruh, and Dr. P.M. Kitala, my University supervisors for their fatherly and enthusiastic support, advice and encouragement throughout my study programme. I also thank Mr. F. Chabari, the then Team Leader, MDP/GTZ, for not only providing the original stimulus to my idea of an ethnoveterinary study but also for his guidance and concern throughout the study period. Thanks also go to Dr. L.M. Ariithi, the former District Veterinary Officer-Marsabit District, for his understanding and encouragement. I also thank collaborating scientists at KARI's National Arid Lands Research Centre (NALRC) – Marsabit, for their constructive comments during our many centre-based forums. Special thanks go to Dr. J.C. Njanja for his encouragement during the course of the study.

Many thanks are extended to many individuals, organisations and institutions without whose contribution and support during my study and research project, this thesis would not have been possible. First is the European Union (EU), through Agriculture/Livestock Research Support Programme (ARSP II) based at KARI headquarters and the GTZ-supported, Marsabit Development Programme (MDP). The EU through the ARSP-II co-ordination Unit (CU) generously supported my field research project while MDP/GTZ paid the tuition fees for my MSc studies at the University of Nairobi. Their support is greatly appreciated.

This acknowledgement would be incomplete without thanking Drs. R. Kiome (Director–KARI) and H. Recke of the ARSP-II coordination unit (CU) at KARI headquarters for allowing me to access the EU funds. I wish to thank my field assistants S. Changayo, H. Lesila, F.K. Naida, and laboratory technicians G. Nduhiu and J. Macharia (both of the Department of Public Health, Pharmacology and Toxicology (PHPT) Upper Kabete Campus - University of Nairobi, for their invaluable contribution during my field and laboratory work, respectively.

Lastly, I acknowledge with gratitude the willingness of all the pastoralists and livestock traditional healers who agreed to share their knowledge during the various interviews. I wish to mention here that theirs is a priceless gift to the scientific world. May our heavenly father richly bless you all.

ABSTRACT

This study was undertaken to take stock of the existing traditional veterinary knowledge and practices among the Rendille/Ariaal and Gabra ethnic groups of Marsabit District and to determine the antibacterial activity of some of their herbal remedies after water and ethanol extraction. Increasing alternatives for prophylactic and therapeutic inputs and services against livestock diseases/ailments among the resource poor pastoral communities of Marsabit District was the main objective of the work. The specific objectives were 1) Identification of livestock traditional healers (LTHs) among the Rendille/Ariaal and Gabra communities of Marsabit District and assessment of the level of existing veterinary knowledge (EVK) and practices; 2) collection, documentation and botanical identification of the plant species and materials that were considered usable for managing livestock diseases by the study communities; 3) screening of all the medicinal plants cited for antibacterial activity.

The inventorized data were collected through participatory rural appraisal (PRA) workshops at the "*Manyatta*" level and residential workshops for specifically identified livestock traditional healers (LTHs). Some of the outputs from the PRAs were lists of renowned LTHs and crude data on the ethnoveterinary knowledge (EVK) as viewed by the general public. In addition, lists of important livestock diseases per species among the study communities were also generated at the *manyatta* workshops. The PRA workshops identified the renowned LTHs, who were used to fine-tune the raw data documented during the *manyatta* PRAs. The LTHs also collected herbal plants voucher specimens for sensitivity tests and for botanical identification. The well and disc reservoir methods for antibacterial sensitivity tests were used with water and ethanol as the extracting solvents. *Micrococcus lutea* and *Bacilus cereus* were used as the test microorganisms grown on Muller-Hinton agar.

In total, 72 plant species in 34 families were inventorized as medicinal plants applied by the two communities in the prevention and cure of more than 20 livestock diseases. Some non-plant-based folk veterinary practices were also documented and included salty soils and salty waters. In addition, manipulative techniques were also reportedly applied in traditional management of diseases and other animal ailments. These included surgical intervention, branding, and general massage. *Burseraceae*, *Caparidaceae*, *Euphorbiaceae*, *Mimosoideae* and *Solanaceae* were the five most common plant families

used by the two communities. These 5 plant families accounted for 22 of the 72 medicinal plant species identified. Most of the diseases/ailments treated using the plant, the non-plant-based and/or manipulative indigenous veterinary remedies were divided into six broad but distinct categories, namely, digestive disorders; respiratory disorders; traumatic external injuries and ectoparasites; reproductive problems and infertility; eye infections; and mineral deficiencies.

There were more Gabra pastoralists (82%) who used indigenous remedies as their first line of treatment than were Rendille/Ariaal pastoralists (59%) who also used indigenous remedies as their first line of treatment. Women appeared to play an insignificant role as LTHs as only 3 out of the 30 LTHs (10%) identified from the Gabra community and 4 out of the 24 LTHs (17%) from the Rendille/Ariaal community were women. Specialization of the LTHs from both communities was evident. Areas of specialization included general practioners, bone setters, camel diseases specialists and specialists on camel dystocia and infertility.

Sensitivity tests revealed that some of the herbal plants used by the two communities had very high antibacterial activity. Out of the 72 plant species cited as medicinal by both study ethnic groups, only 36 (50%) were available for screening for antibacterial activity. Out of these, 21 were from Rendille/Ariaal community and 15 from Gabraland. Roots of *Terminalia brownii* from Rendille/Ariaal region showed the highest activity against *M. lutea,* with an inhibition zone (diameter) of 24mm and 25mm with ethanol and water extracts, respectively, using the disc reservoir method. Using the well reservoir method, the roots of the same herb showed an inhibition zone of 24mm and 23mm with ethanol and water extracts, respectively. Water extract of *Balanites aegyptiaca* leaves from Gabraland using the disc reservoir method gave an inhibition zone of 10mm and 7mm against *B. cereus* and *M. lutea,* respectively. Under the same extraction method, fruits/seeds of *Solanum incanum* showed inhibition zones of 9mm and 9mm for *B. cereus* and *M. lutea* respectively. Of the 15 medicinal plants from Gabraland, an extract of whole shrub of *Cucumis dipsaceus* gave the highest inhibition zone (14mm) with *B. cereus* compared to 7mm showed by *M. lutea* after ethanol extraction in well reservoir method. The water extraction of *Commiphora flaviflora* stem gave 10mm and 9mm against *B. cereus* and *M. lutea,* respectively.

Based on these findings, it is concluded that rich traditional veterinary practices among the Rendille/Ariaal and Gabra communities of Marsabit District exist and that some of the medicinal plants used by these ethnic groups contain demonstrable antibacterial activity. Given that modern veterinary drugs are not likely to be readily available to these communities in the near future, there is a need to conduct clinical trials using the indigenous remedies in an effort to asses their efficacy and to develop dosage recommendations of the proven ones. This will offer alternatives to modern veterinary inputs, leading to improved animal health care delivery for the resource poor pastoralists of Marsabit District and other ASAL areas of Kenya.

CHAPTER 1

INTRODUCTION

Since ancient times, plants have been an important source of both preventive and curative medicinal preparations for humans and animals. Plants form the biggest source of products used in folk human and veterinary practice (Derry *et al.*, 1999). The Egyptians and Chinese knew the curative properties of plants since 2800 BC. Use of medicinal properties of plants before the advent of modern medicine is recorded by the Hebrews, Greeks and Romans. Hypocrates, a graduate of an Egyptian priest doctor, founded the Greek School of Medicine at Kos around 400 BC (Mutta, 1996). He used aromatic plants to combat plagues that devastated Athens during his lifetime in the third century BC (UNESCO, 1997). Most of the existing multi-national pharmaceutical companies were started a century ago by selling crude plant extracts (Mez-Mengold, 1971). In addition, most of the synthetic drugs in use today had their generic molecule isolated from plants first, before development of their synthetic equivalents. It is worth noting that man and animals have historically relied on plant-based products for their ethnoveterinary and medical therapies for centuries.

The World Health Organization estimates that up to 80% of the world inhabitants depend on traditional remedies to meet their basic health needs (WHO, 1978). Most of these traditional remedies involve use of plants or their active principles. According to Cox and Balick (1994), about a quarter of all the prescription drugs currently offered for sale in the developed countries still use active ingredients derived from plants. In Germany, for example, nearly half of all prescription drugs produced are initially derived from plant raw materials (Ayensu, 1978).

In order to efficiently utilize plants as medicines, man has had to discriminate between poisonous and non-poisonous materials in his vicinity (Trease and Evans, 1978). This is because in many communities many plants regarded as poisonous are also used as food and/or herbal remedy materials and dramatically, in homicide or trial by ordeal (Dalzziel, 1937). The differences between a concoction being safe or poisonous depend on the part of the plant used, mode of preparation, the route of administration and the dosage regime. Due to the refinement of traditional knowledge on healing over the years, the healers can draw a clear line for safe usage of most herbal materials.

In 1977, the 30th World Health Organization assembly adopted a resolution urging Governments to give adequate importance to utilization of traditional systems of medicine (WHO, 1978). It was recommended that this should be accompanied by appropriate regulations as suited to their national health systems (Bizimana, 1994). This declaration was due to the recognition of the important role played by folk medicine especially in developing countries where advances in health development are yet to guarantee health care to the majority of the population. According to Bizimana (1994), there are two main reasons for turning attention to folk medicine. Firstly, as the gap widens between the poor and the rich countries, the poor countries can no longer afford to meet the cost of drugs. Secondly, in many parts of the world, there is a growing preference for plant-based drugs instead of the synthetic drugs. The human health care is ahead of animal health in this regard. The endorsement by the 1977 WHO assembly was reiterated at the "Alma Atta Conference" of 1978 organized by WHO and UNICEF (WHO, 1978). This conference drew the now famous "Alma Atta Declaration" which resolved to urge the member states to:

- Initiate comprehensive programmes for identification, evaluation, cultivation and conservation of medicinal plants used in traditional medicine;
- Ensure quality of drugs derived from traditional plant remedies by employing modern techniques and applying suitable standards and good manufacturing practices (Odera, 1997).

This stand was bolstered in 1988 by the Chiang Mail (Thailand) declaration, which urged all stakeholders to "Save plants that save lives" (Heine and Heine, 1988).

In most traditional societies, there is no clear division between traditional veterinary and human medicine (Schwabe, 1978). In many parts of the World, the same plants are used to treat both livestock and humans. This is even more evident in pastoral societies where, because of the vital economic and cultural functions of livestock in these societies, animals provide the model for medical knowledge (Lewis and Elvin-Lewis, 1977).

In both developed and developing countries, there is increased search for "ethnoscience" alternatives to the current modern therapeutics that were a few decades ago considered as major scientific breakthroughs. This has led to dramatic growth of interest in ethnoveterinary medicine over the last two decades. In the western part of the world, this is indicated by the emergence of recognised professional societies such as the American Holistic Veterinary Medical Association, the American Veterinary Chiropractic Association and the International Veterinary Acupuncture Society (McCorkle *et al.*, 1996). In third world countries, the emphasis in ethnoveterinary medicine is mostly due to the increasing cost of modern veterinary services and at times total lack of veterinary inputs and services in some areas, especially in the arid and semi-arid lands (ASAL) regions of Africa. With the current concern by consumers on the effects of synthetic drug residues in animal products and by-products, emphasis on the use of plant-based products will continue to rise (McCorkle *et al.*, 1996).

Approximately 70 to 80% of the people in developing countries use traditional medicine as a source of health care (Cunningham, 1997). The same estimate holds true for Africa especially in the semi-arid zones where there exists other constraints to the accessibility of conventional medical and veterinary care. The importance of plants as a source of man's "Materia Medica" in Africa is indicated by the fact that majority (85%) of the African traditional practitioners use plant-based drugs (Mutta, 1996). Up to 75% of the Kenyan people use traditional therapies Wanyama (1997a). Studies by Intermediate Technology Development Group (ITDG) and International Institute of Rural Reconstruction (IIRR) (ITDG and IIRR, 1996) indicate that some communities in Kenya traditionally relied on indigenous practices to keep their herds healthy and that one of the key practices has been the use of medicinal plants.

According to Wanyama (1997a), the Samburu and Turkana communities of Samburu District, Kenya, are capable of treating over 15 livestock diseases and ailments by utilising more than one hundred medicinal plants. This clearly indicates the importance of ethnoveterinary medicine in this remote district. Given that Marsabit District is more disadvantaged in terms of remoteness than Samburu, there is likely to be more reliance on traditional remedies. It is this realisation that led to the initiation of the present investigations in Marsabit District, in order to identify the existing veterinary knowledge and practices.

The overall goal of the present study was to enhance utilisation of preventive and curative traditional remedies/practices with the aim of increasing accessibility of locally available alternatives for improved animal health care delivery among the resource poor pastoral communities of Marsabit District. The specific objectives were:

1. To identify livestock traditional healers (LTHs) and assess the nature of ethnoveterinary knowledge and practices among the Rendille/Ariaal and Gabra communities of Marsabit District, Kenya;

2. To collect, document and botanically identify the plant species and materials that are considered usable for managing livestock diseases by the Rendille/Ariaal and Gabra communities;

3. To screen all the availlable medicinal plants among the ones cited in 2) for antibacterial activity.

CHAPTER 2

LITERATURE REVIEW

2.1 Herbal flora and the environment

The Stockholm Conference on "Human and Environment" in 1972, for the first time in human history, placed the issue of environment on the agenda of the world governments (UNESCO, 1997). Since that conference, governments have worked out modalities for improving the environment. For herbal practices this was a landmark declaration, since herbal plants had continued to disappear over the years, especially in arid and semi-arid lands (ASAL) where the use of herbal medicines is widely practised. The loss then, as it is today, was due to frequent droughts, increasing human and animal population, deforestation and degradation, leading to severe soil erosion and desertification. Twenty years after the Stockholm Conference, the Rio Conference on "Environment and Development" in 1992, recognised the role played by all the stakeholders in the process of planning, managing and utilising the environmental resources sustainably. Among the three major documents signed by heads of states at the Rio conference was the "Biological Diversity Convention", under which, medicinal plants fall. The increasing destruction of natural habitats was, and still is, threatening the survival of many valuable plant species in many parts of the world (Lanly, 1982; Seyani, 1987). Furthermore, great dependence on plant resources to feed the world and treat diseases, especially in the developing countries, has also continued to endanger valuable plant species. This unfortunate situation is made worse in third world countries with high human population growth rates. It is in these countries where poverty is endemic and the majority of the populace have to exploit the environment in order to survive, however destructive this may be. The world is losing plants due to deforestation for woodfuel, agriculture, timber and construction materials for both human and livestock, overgrazing and overharvesting. These activities have resulted in some medically valuable plants being threatened with extinction.

The outputs from the Stockholm and Rio conferences on environment, have not only led to improvement in the conservation of the environment, but have also raised awareness on the need for controlled utilization of environmental resources, especially in the developed world. Unfortunately, conservation of the enviroment is far from being realized in developing countries, where natural resources are, unfortunately, viewed as inexhaustable. This trend may be reversed through identification of important plants, then deliberate efforts could be made towards their conservation and establishment where ecological conditions allow. Such an endeavour, will assist in halting the ever-increasing environmental degradation and thus contribute to increased biodiversity, especially in ASAL regions of the world. The whole world should move in this direction especially after realization that the majority of the world inhabitants, numbering over 6 billion, rely on the traditional knowledge of plants, animals, insects, weather patterns and farming systems for either food, medicine or both (WHO, 1978). The World Health Organization (WHO, 1978) estimates that 80% of the world population continues to depend on traditional knowledge for their medical needs. Mutta (1996) observes that two thirds of the worlds' people would not survive without the foods provided through indigeneous knowledge of the biodiversity in their ecosystem and landscape. In fact, some 150 drugs from North American indigenous communities have been incorporated into the modern USA pharmacopoeia (Kloppenburg, 1988).

Most of the synthetic drugs developed by the western pharmaceutical companies have their roots in the original chemical structure isolated from plants and there is a correlation between the traditional therapeutic use of the plants and the active compounds found in plants after isolation of the active ingredients (Ibrahim, 1986). For example, out of the 120 active compounds found in plants and used in western medicine, 74% have the same therapeutic use in traditional practices (Moran, 1994). Consequently, indigenous practices have made, and will continue to make, important contributions to the advancement of agriculture, medicine and biotechnology (Mutta, 1996).

2.2 Research on medicinal plants

Any attempts to identify prospective medicinal plants must start with searching for results of studies already undertaken. History is important, since the past gives us the key to the present and helps in planning for the future (Mutta, 1996).

Up to early 19th century, plant-based drugs were used while raw, crude or as simple extracts. It was not until after morphine was isolated from opium (*Papauer somnifenum* and *Papauer setigerum* of the family *Papavaraceae*) that research on medicinal plants gradually diverged into research on plant medicines (Mutta, 1996). Since then, research became increasingly oriented towards the chemical aspects of the medicines and the isolation and manufacturing of pure compounds like strychnine, caffeine and quinine. Medical science was revolutionalized when advancement in synthetic chemistry led to increased utilization of synthetic products instead of plant-based drugs. Most of the synthesized drugs were, and still are, based or modelled on compounds occurring in plants, which have been used for hundreds or thousands of years in folk medicine. This downward trend in utilization of plant-based drugs continued untill the discovery of the potent alkaloids in *Catharanthus roseus* of the family *apocynaceae* with marked oncolytic properties in 1957 (Benard, 1967). This discovery, together with increasing search for biodegradable products in favour of synthetic molecules, changed orientation of research completely. In addition, the search for other anti-carcinogenic agents of plant origin enhanced research towards plant-based products.

2.3 Research on ethnoveterinary medicine

In veterinary medicine, little has been achieved in utilisation of folk veterinary medicine in comparison to human health (Bizimana, 1994). This could partly be due to lack of information on traditional practices. Thus, collecting, recording, and comprehending indigenous disease remedies, taxonomies and other folk veterinary knowledge is urgently needed. Identifying and analysing plants that are used as medicines by local people is a useful approach to identifying biologically active substances. Testing for the effectiveness and safety of local medicines can be corroborated through phytochemical and pharmacological analysis (Martin, 1995).

Ethnoveterinary medicine, sometimes also called veterinary anthropology, constitutes one branch of ethnoscience that deals with folk beliefs, knowledge, skills, methods and practices pertaining to the health care of animals. According to McCorkle *et al.* (1996), ethnoveterinary research is the holistic, inter-disciplinary study of local knowledge and its associated skills, practices, beliefs, practitioners, and social structures pertaining to the health care and healthful husbandry of food, work and other income-producing animals. Although veterinary arts have evolved whenever and wherever people and animals coexisted, as a named and recognized area of academic interest, ethnoveterinary medicine has a very recent history (Bierer, 1955). With the exception of some work in ethnopharmacology, only in the mid 1970s did significant numbers of researchers began to systematically investigate folk beliefs and practices in veterinary medicine (McCorkle, 1986). This scenario is unfortunate since ethnoveterinary practices play a key role in animal health care of many communities in the world. In deed, in most traditional societies, there is no clear division between traditional veterinary and human medicine (Schwabe, 1978). Estimates show that 70 to 90% of the Kenyan population rely on traditional medicine (Obado and Odera, 1992). Dependence on ethnoveterinary health remedies is more in the tropics where the climate and weather patterns favour a great variety of herbal plants than in the temperate climates. This provides a strong argument for devoting considerable resources and time to research on existing veterinary knowledge.

2.3.1 Evolution of ethnoveterinary and folk medical practices

The first systematic description of herbal drugs and medicinal plants for therapeutic use was elaborated by the famous Greek botanist and doctor, Pedanios Dioskorides, in his classical volume "De materia medica", in 100 A.D. Christian Monks and Nuns were later involved in the propagation and cultivation of medicinal plants in monasteries, all over Europe from around 500 A.D (Odera, 1997). The databases developed in the monasteries in time became important ingredients for all medical treatments.

To date, traditional human and animal health care continues to be dispensed along with modern medicine in many countries (Koppell, 1990; Pujol, 1993). Pujol (1993) reports that in Taiwan, preference is given to traditional medicine, which is believed to be more effective in human health care than modern drugs. Although ethnoveterinary remedies had served man well for many years, the discovery of modern ethnotherapeutics in the 20th century led to reduced importance or abandonment of traditional veterinary practices in both developed and developing world, in favour of the newly discovered powerful, conventional alternatives (*McCorkle et al.,* 1996). Despite the limitations of modern chemotherapeutics, especially in the developing countries, their use was encouraged in the developing countries through colonisation and development efforts. The colonizers put in place organized modern veterinary activities in the colonies (Baumann, 1990). The new structure had, and still has, no place for folk practices. The colonial administrators ensured that traditional veterinary and medical practitioners were erroneously termed as witchdoctors and sorcerers. This led to the enactment of "The Witchcraft Act" Cap. 67 of the Laws of Kenya of 12th November 1925, which has since been revised in 1962 and 1981(*McCorkle et al*., 1996). This Act, which was meant to outlaw witchcraft, gave the law enforcement agents grounds to ignorantly harass the traditional healers, to the detriment of the evolution of the ethnomedical and ethnoveterinary practices. The negative attitude towards indigenous veterinary and medical knowledge has continued to be echoed by professionals, the elite and other opinion leaders even decades after independence.

Traditional veterinary remedies remain handicapped by lack of focused research, outdated statutes, professional ignorance and biased public opinion. For this trend to be reversed, there is a dire need for undertaking ethnoveterinary research among our people. This is based on the premise that, veterinary art must, out of necessity, evolve whenever and wherever peoples and animals co-exist. The pastoral communities best exemplify this coexistence. They have lived by and for their livestock. Traditionally, most of their food requirements have been almost entirely derived from the livestock. This exemplifies how important livestock health is to them. In addition, the high rate of environmental degradation, mainly due to increase in both human and livestock population, frequent droughts, increasing insecurity common in many pastoral communities, often leading to non-utilization of some pasture land, has led to loss of important medicinal flora.

There is a need, therefore, for studies aimed at revitalisation and conservation of the knowledge and natural resource diversity on which traditional veterinary medicine was, and still is, based. This is possible since the older generation of stock raisers are still available to provide this information. The demise of the older generation without transmission of the traditional knowledge could lead to the extinction of this important information. This is even more serious in tribes like the Gabra where healing knowledge is a preserve of some specific family lines, hence the indigenous knowledge (IK) bank is limited only to a few people within the healing family lines.

2.3.2 History of traditional vaccination

Historical records indicate that the Chinese were the first to develop a crude vaccine. They used a technique known as violation, which involved inoculation with a small piece of infected material from a mild case to vaccinate against human small pox (Odera, 1997). Violation techniques spread quickly to Europe and other parts of the world culminating in testing of the cowpox-based vaccine by Edward Jenner in 1776. In Africa, when the continent was struck by Contagious bovine pleuropneumonia (CBPP) in the mid 18th Century and Rinderpest just before colonization, African stock keepers moved quickly to develop useful home-made vaccines in a relatively short period of only 30–50 years (McCorkle *et al.,* 1996). Such a breakthrough in folk veterinary practices came as a result of careful observation of a relationship between exposure to a given disease and survival of the exposed individuals, an indication of the appreciation of immune status development. This exemplifies the richness of ethnoveterinary knowledge inherent among the African livestock keepers (McCorkle *et al.*, 1996).

2.3.3 Current status of research on ethnoveterinary medicine and folk medical practices

Traditional medicine is experiencing a revival in the veterinary sector (McCorkle *et al.*, 1996). About a decade ago, the Asian office of the Food and Agriculture Organization (FAO) recognized the importance of ethnoveterinary medicine and commissioned a number of investigations on its status in six Asian countries (FAO, 1984a; 1984b). These studies revealed that ethnoveterinary medicine practices could be usefully incorporated into animal health services. In China, attempts have been made for many years to integrate traditional and modern medicine in human health care.

These studies and many others carried out in other continents show the existence of traditional and modern veterinary medicine side by side. As with most local knowledge systems, information on ethnoveterinary medicine is rarely systematically codified in written form, hence literature on this subject has not been readily available. However, in recent years, literature on medicinal plants used in the tropics has proliferated. This ranges from exhaustive books on practically all scientific and traditional aspects in a country or an area to those based mainly on information about traditional use (Mutta, 1996). These publications indicate greater interest in, and acceptance of traditional human and veterinary practices, which were previously relegated to the confines of outdated and repugnant practices.

2.3.4 The future of ethnoveterinary research

Indigeneous medical and veterinary knowledge plays a big role in maintaining and managing the health of man and animals all over the world. Unfortunately, most of this knowledge only exists in verbal traditions. In most societies, it is passed from one generation to the next orally. Consequently, only a small fraction is available to science. Hostettmann (1991) reports that among the approximately 250,000 known flowering plant species, only less than 10 per cent have been subjected to investigations for secondary metabolites. As a result, the biological or pharmacological effects of most of these plant species are not known to date (Hedberg, 1987).

The contribution of the useful isolates already obtained from plants is known. In fact, most of the synthetic drugs in use today are based on original molecules isolated from plant products. However, only 7% of those plant species known have been properly investigated pharmacologically (Hedberg, 1987). Investigations towards this direction offer great hope to science in future, especially if the screening of plants for medical and veterinary use is strictly directed towards those plants used in folk medical and veterinary practices instead of random screening which is wasteful in time and resources. Perdue *et al.* (1970) showed that screening of plants used in traditional medicine gives significantly higher proportions of interesting substances than random screening. Devoting more resources into screening of known medicinal plants will translate into discovery of their therapeutic abilities. Once plants of such value are identified, their conservation and sustainable utilization can be instituted. Mutta (1996) states that the dwindling medicinal plant species of the world must soon be biologically evaluated and conserved before many become extinct. There is a notable upsurge of programmes designed to identify these plant species, both in the developed and the developing countries. It is noteworthy that the WHO (1978) long acknowledged that if its goal of "Health for all by the year 2000" was to be achieved, traditional medicine was to play an important role in primary health care. This, in itself, was a stimulus towards enhanced incisive research into this area of science. Furthermore, in this era of "Biodiversity Concern", promotion of identified medicinal plants will go a long way in revitalising the already deciminated world flora and fauna.

2.4 Indigenous knowledge (IK) and ethnoveterinary practices

Warren (1991) defines indigeneous knowledge (IK) as the local knowledge that is unique to a given culture or society. It is the basis for local level decision-making in agriculture, health care, food preparation, education, natural resource management and a host of other activities in rural communities. Indigenous knowledge contrasts with the international knowledge system generated by universities, research institutions and private firms. Flavier *et al.* (1995) defined indigenous knowledge as the information base for a society which facilitates communication and decision-making. According to the latter definition, indigenous information systems are dynamic and are continually influenced by internal creativity and experimentation as well as by contact with external systems. The World Bank Report (1998) on indigenous knowledge for development, identifies herbal medicine as a good example of indigenous knowledge that has affected the lives of people around the globe for centuries. Indigenous knowledge represents an important component of global knowledge on varied development issues and provides the basis for problem-solving strategies for local communities, especially the poor. Hence, any poverty eradication strategy that does not recognise, and incorporate indigenous knowledge in its strategy, is destined to fail (World Bank, 1998).

Ethnoveterinary knowledge (EVK) is that part of indigenous knowledge that deals with folk beliefs, knowledge, skills, methods and practices pertaining to the health care of animals (Mathias-Mundy and McCorkle, 1989). In many regions of the developing world, farmers/pastoralists are not able to access conventional drugs, either due to their prohibitive cost or remote settings of their dwellings (Lawrence *et al.,* 1980). In such situations, many ethnoveterinary techniques provide viable and locally available alternatives, which are also cheaper than their modern equivalents. Mathias-Mundy and McCorkle (1989) observed that "knowledge of local knowledge" improves communication between development personnel and the beneficiaries and facilitates and enhances the beneficiaries' participation.

As mentioned above, screening of plants known to hold traditional medicinal value yields much more concerning its medicinal abilities than plants sampled at random (Hedberg, 1987). Consequently, one of the many contributions of indigenous knowledge would be to identify all the existing veterinary knowledge today, for tomorrow may be too late. This is especially true of the third world countries where wholesale indiscriminate adoption of western culture has destabilised the natural medium of passage of this knowledge. For the first time in the history of our traditional systems, we stand the risk of relegating this important treasure into extinction. There is, therefore, an urgency to dig out the inherent folk knowledge within our indigenous libraries and urgently make it available to scientists, farmers/pastoralists and all other interested parties (Mutta, 1996).

Mathias-Mundy and McCorkle (1989) enumerated three aspects of ethnoveterinary medicine study. One aspect centres on how different societies explain disease and how they perceive human/animal relationships. This kind of study concentrates on the systematic analysis of culture's ethnoetiologies, beliefs, diagnosis, treatments and preventive measure for livestock diseases. This reveals a great deal about the culture itself. Another aspect of EVK focuses on its importance as a scientific resource. Many plants and materials used in traditional medicine have valuable potential in modern medicine. There are some important drugs that were originally discovered through ethnomedical research including: Quinine (picrotoxine), a powerful stimulant for the respiratory centre; strophanite (for heart disease); salicylic preparation (e.g., aspirin used for rheumatism and as a general analgesic) (Mathias-Mundy and McCorkle, 1989). The herbs *Comburetum mucronatum* and *Mitragyna stipulosa*, which were used in Ghana as folk medical remedies against the Guinea worm, are now considered as the treatment of choice against this disease (Ibrahim, 1986). The third aspect of ethnoveterinary medicine, which has evoked a lot of interest in the recent past, is derived from its potential for offering locally viable, acceptable, workable and sustainable agricultural development opportunities especially in the third world.

2.5 Ethnoveterinary knowledge in Kenya

What is known of ethnomedicine and ethnopharmacology in vast areas of Africa is relatively little, although the application of the herbs for internal and external medical uses has always been a major factor in the practice of medicine (Ayensu, 1978). In Kenya, there has been a well-established range of indigenous practices employed to maintain or to regain livestock health. These traditional animal health-care practices include: use of medicinal plant materials; surgical techniques; management practices; and rituals/beliefs employed by various Kenyan communities. Khayota (1998) estimates the number of people using traditional medicine in Kenya at 75% of the total population. Kenyan communities, like any other third world ethnic groups, have traditionally relied on indigenous practices to maintain their livestock health for centuries (ITDG and IIRR, 1996). Among the communities where studies have been undertaken include: Samburu

(Wanyama, 1997a; Wanyama, 1997b); Maasai (Shcwabe, 1978); Kamba (Grandin *et al.,* 1991), Luo and Luhya (McCorkle, *1996*) and the Mijikenda peoples (Mutta, 1986; Delehanty, 1989). In Kenya, most of the rural communities abound with a wealth of knowledge about medicinal plants. The level of existing practices currently depends on the level of infiltration by westernization, accessibility to modern services (in terms of physical access and affordability), level of "western education", and nature of the production system.

Kenyans continued to enjoy their ethnoveterinary practices until the advent of modern therapies. Modern medicine was modelled on the western values and was thus insensitive to traditional virtues. The sophistication and urbanization of western culture baptised ethnomedical and ethnoveterinary practices as "mystic". This was confounded by the coming of the Christian missionaries who indiscriminately condemned traditional healers and their trade without any scientific basis (Mutta, 1996). As a result, several generations of Africans that went through the colonial system of education, especially the mission schools and colleges, still retain the notion that traditional healers were savages and primitive (Good, 1987). As a follow-up, and aided by the missionaries, the colonial administrators vigorously enacted some legislation to minimise or ban the use of some traditional therapies. Although Kenya has been independent for about 40 years, the scenario is no different to date. Presently, this is because the current education system was, and is still, based on the British system that did not and still does not, recognize the role of indigenous knowledge in research and development. Veterinary graduates from veterinary schools are therefore ignorant of the existence of ethnoveterinary knowledge.

There is a lot Kenya can learn from other countries. Europe and Japan, for example, developed their traditional medicine to the present modern medicines as a buildup on their folk medicine while China and India developed their traditional health-care systems alongside modern medicine (Mutta, 1996). Based on the positive and negative lessons learned by these countries, Kenya can develop a traditional healing system that combines the advantages of all the other systems. This is strengthened by the results of studies of traditional healing systems in the tropics over the last two decades which indicate an increasing conceptual sophistication and sensitivity to the gains in knowledge and understanding that are realized through interdisciplinary approaches in research (Good, 1987). This is only possible after intensive research focusing on indigenous healing systems.

Another drawback of traditional healing systems is that the formal education system depicts indigenous knowledge systems as retrogressive and out-dated. In addition, the ever-increasing rural-urban youth migration has severed family links and traditional structures and compromised the knowledge and the natural medium of passage. As a result, a number of traditional healers are aging and dying without heirs.

2.6 Sources of antibiotics

Lancini *et al.* (1995) reported that most antibiotics are products of the secondary metabolism of three main groups of microorganisms: eubacteria, actinomycetes and filamentous fungi; only a few antibiotics are produced by higher fungi, algae, lichens, animals and plants. Mutta (1996) observed that more than one half of the antibiotic principles discovered to date are produced by actinomycetes. Antibiotics in this group include chloromycetin, streptomycin and tetracyclines. Penicillin, which is not only the most studied antibiotic but also the least toxic, falls in the group produced by *Fungi imperfecti*.

The polypeptide-based antibiotics, though the most toxic, are of practical importance because of their high potency. This class of antibiotics is produced mainly by bacteria of the *Genus Bacillus*. Green plants produce about 10% of the known antibiotics, although their activity, as a rule, is weak and none has been found to be of practical importance (Mutta, 1996). About 4% of the known antibiotics are produced by basidiomycetes and a small number by lichens. The discovery of various antifungal substances in plants has aided in the understanding of resistance to decay in certain trees such as cedar (*Thuja occidentalist*)(Nickell, 1959) and *Chlorophora escelsa* (korzybski *et al.,* 1967).

All antimicrobial substances from higher plants have been found to be either toxic to animals or not competitive therapeutically with the products of microbial origin and that they have low potency and narrow spectrum of activity (Nickell, 1959). Despite their low use in systemic medicine, antibiotics from higher plants are widely used in ethnomedical and ethnoveterinary systems in management of infection in humans and animals worldwide (Watt and Breyer–Brandwjk, 1962; Turner, 1975; Gelfand *et al.*, 1985; Kokwaro, 1993).

2.7 Microorganisms and test microbes

The microbial world is very complex and competitive. The intricate and complex warfare among organisms is reflected by the many strategies used to achieve predominance in an environment (Mutta, 1996). Some strains are prototrophic, i.e., they can survive on few and simple nutrients. Other strains, like enteric bacteria, secrete toxins, which inhibit or discourage competitors from surviving around their designated niche while others are natural producers of naturally occurring antibiotics and therefore suppress the growth of a large number of possible competitors. *Eschelichia coli,* the most well known intestinal commensal, exists comfortably in animals and the environment, as well as in a variety of healthy humans/animals and/or the diseased. For others, like *Mycobacterium tuberculosis,* the organisms are totally adapted to coexist with humans / animals and have no natural environmental habitat (Mutta, 1996).

Most bacteria and yeast can be cultivated on standard Mueller-Hinton Agar (MHA). The choice of test organisms depends greatly on the purpose of the investigation. For general investigation, the test organisms selected would be as diverse as possible and preferably representative of all-important groups of pathogenic bacteria. For preliminary screening for antibacterial activity, the most sensitive microbes, such as *Micrococcus lutea* and *Bacillus cereus* should be used (Brander *et al.,* 1982).

2.8 Antibiotics and antimicrobial agents

Antibiotics were originally referred to as substances produced by a living organism and which at low concentrations were antagonistic to the growth of other microorganisms. However, with the synthesis of some antibiotics, e.g., Chloramphenical, the more general term "antimicrobial agent" is preferred since it covers substances of both natural and synthetic origin (Brander *et al.,* 1982). Therefore, to be more inclusive, antibiotics could be defined as low-molecular weight organic substances that in very low concentration inhibit the growth of microorganisms (Brander *et al.,* 1982). Some antibiotics are bacteriostatic, i.e., they inhibit the growth of the bacterial population while others actually kill the bacterial cells and are thus referred to as bactericidal.

The primary importance of antibiotics is their classical use as chemotherapeutic agents against pathogenic microbes. Chemotherapy, the drug treatment of infectious diseases, is based on the ability of the antibiotics (and of some other chemical substances) to inhibit the multiplication of the infecting microbe without an intolerable toxic effect on the cells or the metabolic functions of the host organism (Lancini *et al.*, 1995). The inhibition makes it easier for the body's defences to overcome infection.

Many antibiotics have been successfully used in combating infectious diseases in man and animals. Antibiotics may be divided into those with broad and those with narrow antibacterial spectra. Another division could be based on their toxicity. Due to toxicity, only about 5% of the antibiotics discovered to date can be used clinically. Most of the investigated antibiotics are effective against gram-positive microorganisms and a small number against gram-negative and acid-fast microorganisms (Mutta, 1996). Some antibiotics are active against protozoa, spirochaetes and plants and animal viruses while a few possess anthelmintic and/or insecticidal properties (Brander *et al.*, 1982).

2.8.1 Detection of antibiotics

Antibacterial activity can be demonstrated by observing growth responses of various microorganisms to plant tissues or extracts, which are placed in contact with them. The activity of an antibiotic is defined and measured in terms of its ability to inhibit the growth of a microbial population (bacteria, fungi and protozoa). According to Hostettmann (1991), detection of antibacterial activity in extracts needs fulfillment of three conditions. First, the plant extract must be brought into contact with the cell wall of the microorganisms, which have been selected for the test. Secondly, conditions must be adjusted to allow growth of the microorganisms when no antibacterial agents are present. Thirdly, one must select an appropriate means of judging the amount of growth, if any, made by the test organisms during the period of time chosen for the test.

Methods (Brander *et al.*, 1982) for detecting antibacterial activity are many and can be categorized into:

(1) Diffusion–the inhibition of radial growth on an agar medium in a petri dish;
(2) Dilution-growth in liquid culture which can be measured as increase in dry weight shown by increased optical density at a given wavelength;
(3) Autobiographic methods.

All these tests give an indication of the presence or absence of substances with antibacterial activity in the plant extract. The level of potency of the active ingredients inherent in the extract can only be determined by use of pure extracts applying standardized methods.

The radial growth method is the most popular (Hostettmann, 1991). For preliminary screening methods, a simple diffusion test gives a clear zone where no growth occurs. In most studies, inhibition zones are compared with those obtained for standard antibiotics. This is useful in establishing the sensitivity of the test organism, but a comparison of the antibacterial potency of the samples and antibiotics cannot be drawn from these results. This is because a highly active substance may cause a large inhibition zone even where it occurs in quite small amounts or a large zone of inhibition may be caused by a substance of comparatively low activity but present in high concentration in the plant extract. For higher precision while testing, all other extraction solvents except water, should always be tested simultaneously with the plant extracts to make sure that the solvents do not have antibacterial properties in the test system.

Most biological tests depend on use of an agar-based medium seeded with selected strains of microorganisms. Standard and known dilutions of extracts are placed in wells in the agar and the plate is incubated at an appropriate temperature. Antibiotics and extract diffuse from the wells into the surrounding agar, hence producing a zone in which no bacterial growth occurs. The size of the zone visible to the naked eye is proportional to the concentration of the antibacterial agent present. This can be calculated by reference to a series of known standards (Brander *et al.,* 1982).

In the diffusion technique, two types of extract/antibiotic reservoirs could be used (Brander *et al.,* 1982). One may use a filter paper disc (6.0mm in diameter) containing a measured amount of the plant extract to be tested. The disc is brought into contact with an inoculated agar medium. The plate is incubated overnight at 37°C. The plant extract diffuses from the disc into the agar. The microorganisms grow, forming a turbid surface of confluent or semi-confluent colonies. These procedures must be carried out under strict aseptic conditions to exclude any undesirable microorganisms from being introduced into the plates. A clear zone, also refered to as a "transparent halo", indicates a positive test. The clear zone around the disc is where the concentration of the extract is higher hence bacterium growth is inhibited. The diameter of the transparent halo (growth inhibition zone) relates to the susceptibility of the microorganism to the extract. The inhibition diameters are measured and the microorganism is generally classified as sensitive, intermediate or resistant according to how large the inhibitition halo is.

Instead of filter paper discs, wells can be made on dried agarose using standard coak-borers 6 mm in diameter (Brander *et al.,* 1982). The test agent is then filled into the wells using capillary tubes and the inoculated plates incubated at 37°C overnight. The sensitivity assessment protocol is the same for both methods. The 6.0mm standard size of the disc and the coak-borers is taken as the cut-off point. In the well method, care should be taken not to overfill the wells since this interferes with the reading of results.

2.9 Participatory methods

Participatory rural appraisal (PRA) is similar to rapid rural appraisal (RRA) but it is more process-oriented. The PRA was defined by the 1985 International Conference at Khon Kaen University (Thailand) as "any systematic activity designed to draw inferences, conclusions, hypothesis or assessments, including acquisition of new information, in a limited period of time" (Grandstaff and Grandstaff, 1987). Whereas RRA is basically a tool to plan for people after having consulted them and analysed their situation, PRA aims at empowering local people to manage their own affairs. Chambers (1992) enumerates the positive aspects of using PRA methods as: visual sharing of diagrams prepared by the rural people; local control over the type of information being recorded and disseminated; better rapport and understanding between all players; relative ranking and scoring of problems and perceived solutions. Others are openness of approach and more enjoyable methods used than the traditional long questionnaire approach, which usually results in interview fatigue. The PRA also allows creativity and supports decentralisation of efforts and diversity, hence allowing and enabling people to determine what fits their specific needs (Leers, 1993).

The PRA methods are common because they have an underlying philosophy of capitalising on participants' unique understanding of their pastoral production system. This approach accomplishes this by using a variety of diagramming tools that allow a pastoralist to describe, to the best of his or her ability, the details of their production activities. The process of diagramming provides a medium of communication for illiterate participants who rarely speak even the national language. Furthermore, it encourages the pastoralists to take an active role in investigation. In PRA, there is often a subtle shift in power between all the stakeholders participating in the meeting. The pastoralist adopts a position of "teaching" and the investigator plays a more passive role of "listening and learning". This is believed to provide better quality data than those obtained through more conventional survey techniques (Kirsopp-Reed, 1994).

CHAPTER 3

MATERIALS AND METHODS

3.1 Description of the study area

The study area was Marsabit District in the Eastern Province of Kenya. The district has an area of 66,000 Km^2 of which 4,956 Km^2 covers Lake Turkana on the district's western border. Marsabit District borders Turkana District to the west, Samburu and Isiolo districts to the South, Wajir District to the east and Moyale District to the northeast. In the north, it borders Ethiopia (Figure 3.1). Out of the total surface area, 55,950 Km^2 is rangelands. Arable land constitutes 1,650 Km^2 and only 3% of the district receive moderate rainfall to sustain crop production under rainfed agriculture. Rainfall has become erratic in the recent years. The area under crop is about 3,512 hectares, of which 50 hectares, mainly found on the eastern side of Mt. Marsabit, is under irrigation. The total irrigable land, based on the Songa area potential, is 693 hectares (MDP/GTZ, 1999).

Out of the total human population of 125,000 in the district, 45% are nomadic pastoralists, while the rest are semi-nomadic or agro-pastoralists. Mt. Marsabit area holds over 20% of the total human population of the district because of its hospitable climate. The district is divided into five 5 administrative divisions according to the Marsabit District Development Plan (1997-2001) (Table 3.1; Figure 3.2).

Table 3.1: Administrative structure of Marsabit District of Kenya by divisions.

Division	Area (km^2)	No. Of locations	No. Of Sub-locations
North Horr	18,401	5	8
Maikona	19,329	5	8
Laisamis	11,547	5	14
Loiyangalani	9,717	4	10
Central	2,050	6	11
Lake Turkana	*		
Total	**61,044**	**25**	**51**

* Of the total surface area of Marsabit District (66,000 KM^2), Lake Turkana occupies 4,956 KM^2.

Figure 3.1: Map of Kenya showing the location of Marsabit District in relation to other districts of Kenya.

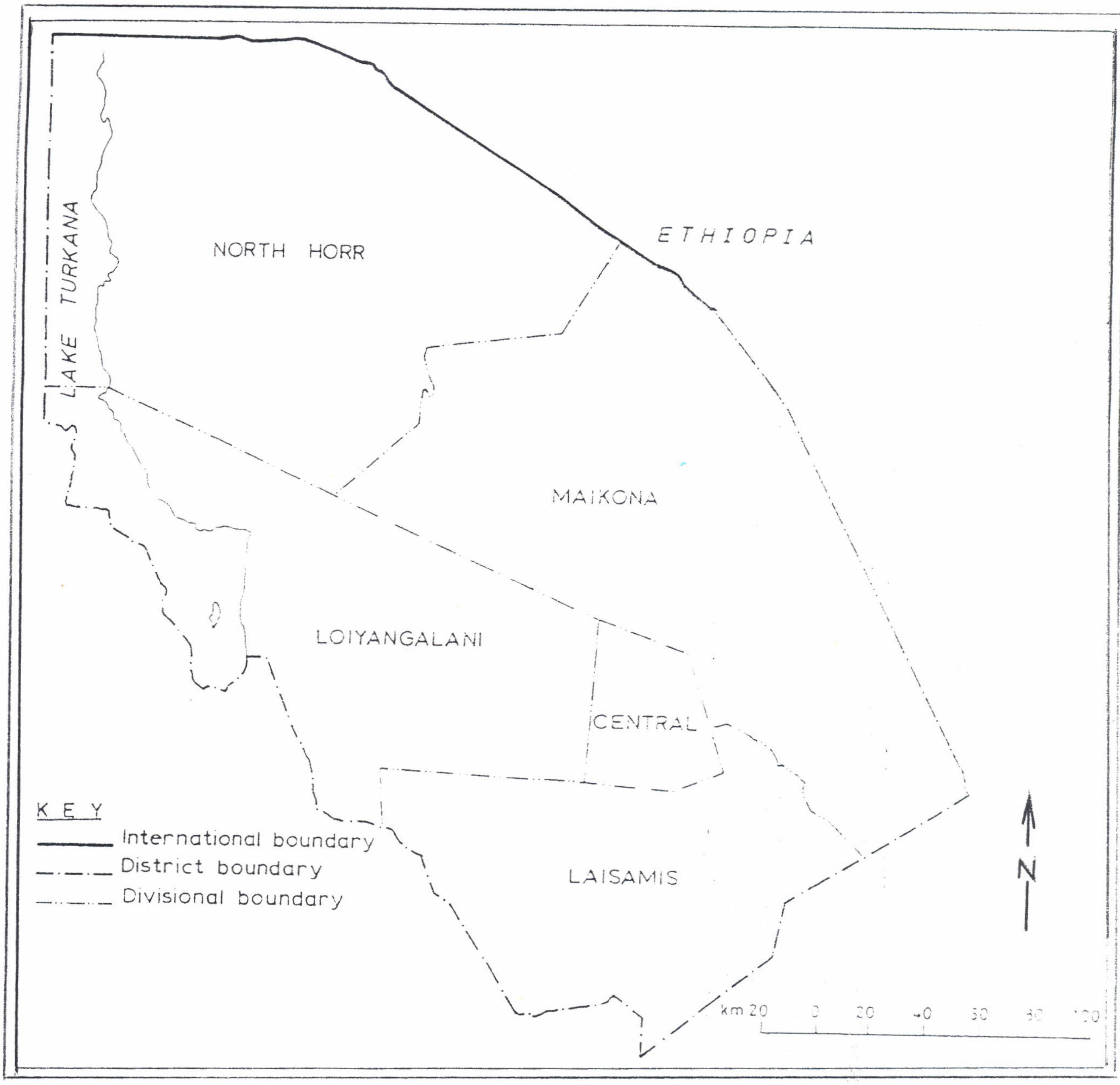

Figure 3.2: Map of Marsabit District of Kenya showing divisional administrative boundaries.

Most of Marsabit District constitutes an extensive plain lying at 530-760 metres above sea level. The District lies within a large climatic region, which affects Somalia, northern Kenya and eastern Ethiopia. This climatic region is the most arid region in East Africa. Rainfall is generally low, especially at lower elevations. At North-Horr (1333m), the mean annual rainfall between 1961 and 1987 was 150 mm (Tablino, 1999). Herlocker (1979) observed that most of Marsabit District lies below 300 m above sea level and falls within an ecological zone known as semi-arid (Table 3.2).

Table 3.2: Ecological zones of Marsabit District, Kenya.

Zone	Condition/Type	Area (%)	Estimated Area (Ha)
III	Sub-humid	1	76,858
IV	Semi-arid	2	164,698
V	Arid	28	2,042,227
VI	Very arid	69	5,034,199

Herlocker (1979), writing extensively on the physical features of Marsabit, observes that primary vegetation types in the district are apparently well correlated with climate but modified to some extent by geology and geomorphology. There are nine primary vegetation types that have been identified in the district, namely, barren land, annual grassland, dwarf shrub-land, shrub-land, wood-land, perennial grassland, evergreen to semi-decidous bush-land and evergreen forest (Marsabit District Profile Report, 1986).

Chalbi desert (Figure 3.3) consists mainly of the barren land vegetation type. Growth of plants in this desert is inhibited by the accumulation of salts remaining after evaporation of seasonal floodwaters that flow from southern Ethiopian highlands. Lack of vegetation cover makes Chalbi desert a true desert. Annual grassland is the most extensive vegetation type in the district. It is mainly found in areas that occur below 1000m elevations and occurs primarily in shallow, poorly developed, stony, loam to clay-loam soils. The annual grassland and the barren land vegetation types share the driest climate in the district. Medicinal plants rarely occur within these vegetation types. Dwarf shrub-land is the most extensive vegetation type. Shrub that does not exceed one metre in height dominates this vegetation. The most dominant shrubs are *Duosperm evemophilum* and *Indigofera spinosa. Shrubland* is the next most extensive vegetation type and consists of short decidous shrubs (less than 6m in height), a herb layer and annual grasses. *Accacia refficiens* dominates this vegetation type. This type of vegetation is found in loam to clay loam lava-derived soils at high elevations on major mountains and gneissic derived sandy / silty soils at lower elevations (Herlocker, 1979).

Annual grassland, dwarf shrub-land and shrub-lands are the main vegetation types in Marsabit District. These three vegetation types, together with the barren land, occupy the driest parts of the district. The other vegetation types found in the wetter parts of the district are bush-land, woodland, perennial grassland, evergreen to semi-decidous bushland and evergreen forest. The bush-land vegetation types occur mainly on the rocky slopes and pediments of the Nyiro, Kulal and Ndoto mountains and consists of a mixture of decidous trees and shrubs. The vegetation is dominated by trees and moisty decidous thorn trees 5-5m high. The perennial grassland occurs in the upland areas like the Hurri Hills. This vegetation type is dominated by *Themeda triandra* and *Chrysopogon plumulosus*. The evergreen to semi-decidous bushland vegetation type occurs entirely on the wetter upper elevations of the major mountains in the district and is most extensive on the arid windward sides (southern and eastern faces). The main species here include *Aspilia mossambiceneis*, *Carissa sp., Euclea divinnum, Harrisonia abyssinica* and *Lippia ukambansis* (Herlocker, 1979). The evergreen forest occupies the tops of the mountains. At this elevation, rainfall is highest, evaporation lowest and fog and mist are common. The most dominant tree species is *Cassipourea malosana*. It is within the wetter vegetation types that most of the medicinal plants occur. These vegetation types also serve as major sources of woodfuel and building materials for the high human population resident in these areas.

3.2 The peoples of Marsabit District

Marsabit District is multi-ethnic, inhabited by nine ethnic groups. The main groups include the Boran, Rendille, and Gabra. The minor groups include Turkana, Samburu, Burji, Somali, Daasnarch, and Ariaal. For the purposes of this study, only Rendille/ Ariaal and Gabra tribes will be described.

3.2.1 The Rendille

The Rendille inhabit the southern half of Marsabit District (Heine and Heine, 1988). They occupy the semi-arid and arid plains between Lake Turkana in the west, Marsabit Mountain to the east, the Ndoto Mountains in the south and the Chalbi Desert in the north (Figure 3.3). Their neighbours are the Samburu/Ariaal to the south, the Boran to the southeast and east, the Gabra to the north and Turkana to the west. At the southern and southeastern fringes of their territory, they border with the young ethnic population called the Ariaal.

The Rendille resemble the Samburu community of Samburu District in their culture. This is thought to be due to frequent social interactions and intermarriages between the two ethnic groups. The need for collective defence against the hostile Turkana, who are an archenemy of both tribes, forced them to form political and military alliances during the pre-colonial period. They graze their livestock along the lowlands of their tribal territorial domain while their ally (the Samburu) occupies the forest zones of Kulal and Ndoto Mountains and Maralal massifs. Both the Samburu and the Rendille move freely into one another's territory for grazing purposes, depending on the need at the time. Rendille are traditionally camel and small stock keepers, but they also keep limited numbers of cattle. Although they have a slightly better environment than the Gabra, theirs is equally harsh compared to the other pastoral communities in Kenya. Their language belongs to the same group of lowland east Cushitic group. Other members of this group are the Somali and Boni. The Rendille used to practice nomadic pastoralism. However, past unilateral development efforts by donors have encouraged settling of households in focal centres to the detriment of the environment. Currently, there are no true Rendille mobile families. They now practice partial nomadism where families settle in focal settlements like market centres while herds move out with the youth (*morans*) in search of pastures. The Rendille are said to be distantly related to the Somali ethnic group, an allegation Rendille elders denounce.

3.2.2 The Ariaal

The Ariaal is a population of about 10,000 people. Fratkin (1997) describes them as a pastoral society of northern Kenya who form a bridge culture between the highland cattle keeping Samburu tribe (Maa-speaking) and the lowland Rendille camel-pastoralists (cushitic speakers). Ariaal is a relatively young ethnic group resulting from inter-marriages between the Samburu and Rendille people.

Many Ariaal families descend from the larger Rendille people who are a tightly integrated society that formerly subsisted exclusively on camel, goats and sheep. The Ariaal are also closely related to the Samburu people of Samburu District. The Ariaal, Samburu and Rendille share similar cultural features, including segmentary descent organisation (where each community is made of distinct and autonomous clan families) and the institution of named age-sets (Fratkin, 1980). As a result, the Ariaal have adopted a culture, which is borrowed from both of their two mother cultures. This is typically shown by the kind of livestock species that they keep. Whereas Samburu and Rendille are traditionally cattle and camel keepers respectively, the Ariaal keep both livestock species. However, there exists individual family emphasis of some specific aspects of their mother cultural practices, which is mostly dependent on which ethnic background the father of the family comes from. This is because the Ariaal is a patriachial society. For the Rendille, the Ariaal people speak Samburu language and are affiliated with the Samburu clan and age-sets, and are thus considered to be Samburus by the Rendille who call them "ARIAAL". Yet, because they also speak fluent Rendille language and keep camels as well as cattle, the Samburu treat them as Rendilles and call them "MASAGARA". The Ariaal will call themselves by any of these terms (Ariaal, Masagara, Samburu, Rendille or even Maasai) (Fratkin, 1997). The Ariaal live in close proximity to the mountains in rugged and isolated areas made up of both mountains and lowland desert terrain and graze their cattle in the highland valleys of the Ndoto Mountains and along the riverines of Milgis and Merille seasonal rivers. Camels are herded at the flat lowlands below these mountains.

3.2.3 The Gabra

Tablino (1999) refers to the Gabra as the camel nomads of northern Kenya. They are a small tribe of nomadic pastoralists who live in the arid lowland plains of northern Kenya and partly in the higher lands of southern Ethiopia. According to Tablino (1999), the Gabra are rich in three aspects: (1) a marvellous capacity to survive under very harsh conditions; (2) a well-knit social system that allows each person to gradually assume responsibilities, and play their role, taking full part in the life of the tribe; and (3) a complex body of rituals, songs and ceremonies full of symbolism and poetry.

Over most of Gabraland, excluding Kulal and Marsabit Mountains, the median rainfall is 15 -20 mm per year. This is clearly reflected in the vegetation types prevalent in these areas (Tablino 1999). Generally, a brief but intense explosion of rain usually follows long months of increasing dryness. This is the cycle that determines the geophysical aspect of the area, and how the few people (one per km^2) live here. In the more fertile areas, *Acacia commiphora* shrub predominates, tangles of plants all fearsomely spiny. But the vast lava-rubble strewn plains are virtually treeless. There is not a single permanent river in the whole of Gabra area, making it one of the most arid, barren and uninhabited areas of Kenya (Tablino, 1999). Because of this nature of vegetation cover, the main source of medicinal plants for the Gabra is the higher areas of Mt. Kulal, Mt. Marsabit and Hurri Hills, which rise to 2335 m, 1865 m and 1685 m, respectively. The saline Chalbi desert which has an area of 948 km^2 and goes down to 435-500m above sea level, is part of their ancestral inheritance and is a major source of mineral supplements as well as minerals used for traditional remedies against skin diseases and other ailments. Unlike the Rendille, the Gabra gather in smaller settlements of ten to fifteen families. They live day and night with their herds and flocks, moving whenever it becomes necessary in search of fresh pastures in their vast semi-desert territory.

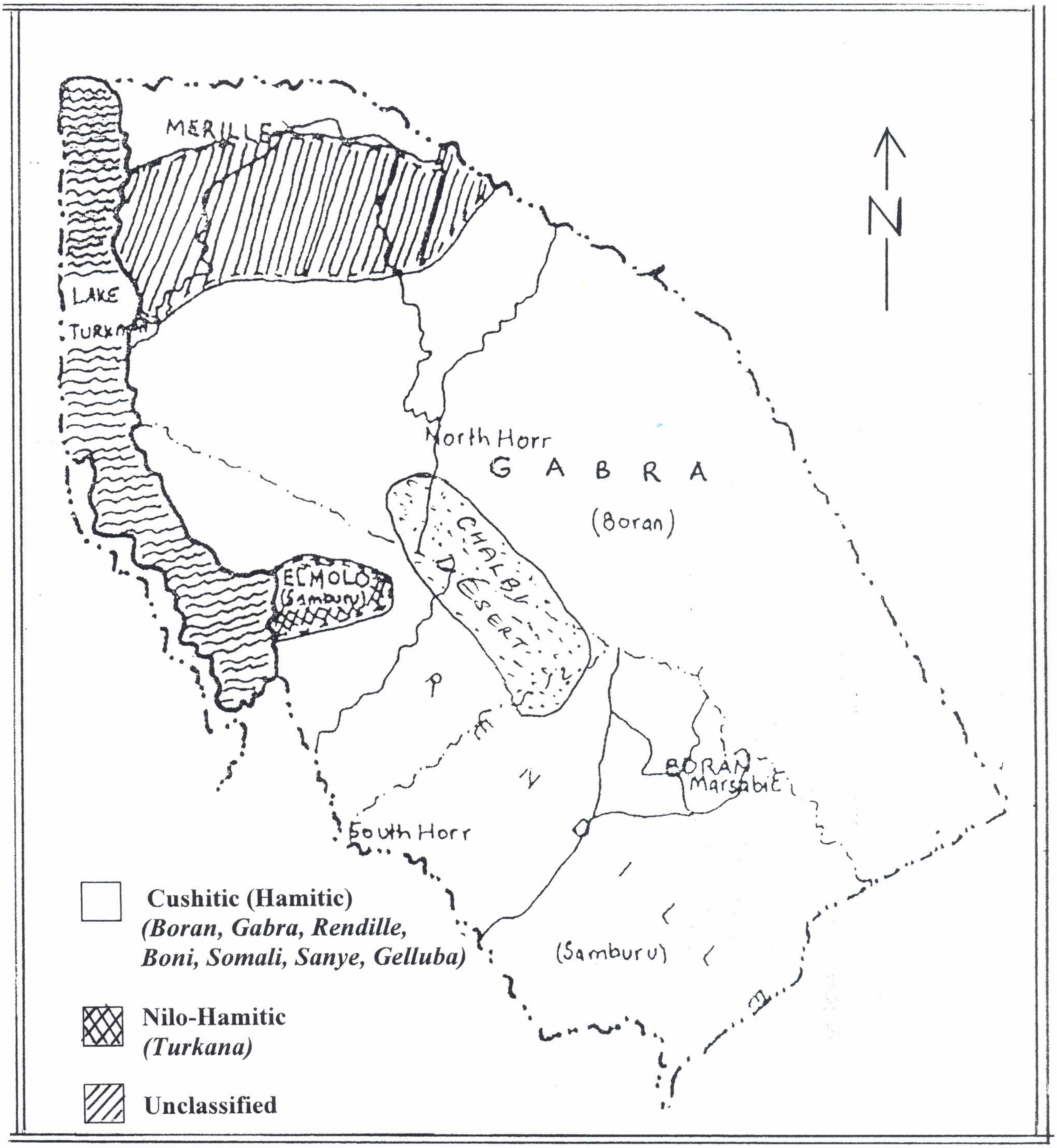

Figure 3.3 Map of Marsabit District of Kenya showing the ethnographic distribution

3.3 Inventory of ethnoveterinary practices

An inventory of ethnoveterinary practices was conducted to identify and document veterinary botanical knowledge of the Rendille/Ariaal and Gabra livestock traditional healers (LTHs). The methods used were participatory rural appraisal (PRA); interviews (general and guided) and discussions; field surveys and voucher plant specimen collection guided by the livestock traditional healers. The study was conducted in residential workshops for the livestock traditional healers. The workshop programme included a session for collection of plant voucher specimens for onward transmission to the East African Herbarium for identification and/or confirmation. The data on all the traditional remedies was recorded in the local language by two documentalists and later translated into English and botanical names. Subsequently, fine-tuning was done after comparing notes from the two documentalists.

3.3.1 Preliminary survey

Before the PRA workshops, thorough preliminary studies were conducted in all the sub-locations of the Rendille/Ariaal and Gabra ethnic groups to obtain baseline data. Several visits were made to develop a personal relationship with the general communities and the herders. Other objectives of the visits included: to get acquainted with the study areas; select the actual study manyattas (villages) within each sub-location; and also to discuss the study objectives with the chiefs, sub-chiefs and village elders. Finally, these consultative meetings identified the best approach of conducting the surveys in a participatory manner. Due consideration was given to cultural and traditional beliefs and the prevailing season. Also, the study teams' views and aspirations based on the expected results were considered. In order to create an atmosphere of trust, the survey teams had to exhibit a genuine sense of recognition and respect for the livestock traditional healers and their "profession". To achieve this, they had to consider them as equals and show seriousness in understanding them in terms of their ideas and values. More often, they had to consider the programme and aspirations of the healers more than theirs. The field teams were required to set aside any mask or "presumed professional superiority" that may in any way create barriers between the livestock traditional healers and other team members as recommended by Lipp (1989). The initial visits were also supposed to identify all the stakeholders. This was because the study was intended to be done, not only in close partnership with the local people, but also with community-based organisations (CBOs), non-governmental organisations (NGOs), and religious groups.

3.3.2 Sampling of the study villages (*manyattas*) and households

A list of all sub-locations in Laisamis and Loiyangalani divisions (for the Rendille /Ariaal) and North Horr and Maikona divisions (for the Gabra) was obtained from the District Development Office, Marsabit. Out of the twenty-four sublocations in Laisamis and Loiyangalani divisions, ten were picked at random and out of the 16 sublocations in Maikona and North-Horr divisions, six were selected at random. Three *manyattas* (villages) were selected in each sub-location for the field investigations. Within each manyatta, one third of the total households (one typical *manyatta* has an average of 9 households) were selected at random for the semi-structured interviews. At the end of the survey a total of 16 PRA sessions had been conducted with an average attendance of 40-50 participants per session. *Manyatta* selection was purposive based mainly on two considerations, the most important being presence of a traditional livestock healer or a renowned family of healers. The other consideration was the response of the village opinion leaders to the study proposal. The unit of study was the "*manyatta*". In this study, a household was taken as a family unit with a household head and children as well as owning livestock whose management decisions are made within the family unit. Additional data on the number of households, human population size and the number of people per household in each division were obtained from the records of the Marsabit District Development Plan (1997-2001).

3.3.3 Selection of respondents

Gender balance in gathering the information in the selected manyattas was crucial. This was because in these two pastoral communities, men and women have different roles in livestock care and livestock health management. For example, among the Rendille/Ariaal and Gabra pastoralists, the care of the small stock and the young ones of all livestock species falls under the traditional job description of women. Thus, they are likely to be more knowledgeable in identification of diseased animals and/or disease management of the categories of livestock they are mostly concerned with. It was therefore necessary to identify "women" as a separate target group for the survey. Besides, women are known not to contribute when interviews are conducted in mixed groups, since they leave much of the talking to men.

The other consideration was selection of respondents based on age, families' lineage and community opinion on ones expertise in the art of traditional healing. At the end of the selection session, the most knowledgeable people on traditional veterinary practices were classified into several categories namely, general practitioners, livestock species specialists (for example, camel specialist), and specialists in specific procedures/conditions.

3.3.4 Interviews and discussions

The term "interviews" here refers to asking people about their beliefs and lifestyles, in open-ended, semi-structured or checklist-guided discussions (Mutta, 1996). Respondents gave extensive responses to a series of general or specific questions, some of which had been prepared in advance while others were generated naturally as the discussions progressed. In-depth interviews were held with the livestock traditional healers during the residential workshops held two weeks after the PRAs. Some of the information obtained through the semi-structured interviews included: characteristics of the EVK as applied by the two study communities; traditional vaccination; forms of folk treatment; indigenous knowledge in disease diagnosis and classification; traditional knowledge on poisoning; the determinants of the choice of veterinary inputs and services in livestock treatment; and the important livestock diseases.

In addition, the interviews gave an insight into how EVK expertise and skills are transferred from one generation to the next; and indicated why the existence of this knowledge differs between the two study communities. For example, the SSIs revealed why EVK exists as common knowledge among the Rendille/Ariaal ethnic group while it is a highly classified piece of information among the Gabra community.

3.3.4.1 Selection of translators

The selection of the translators was crucial since their performance determined the success of the interviews. They had to translate back and forth between the two languages and also between the different professionals and cultural backgrounds. They had the role of linking all the stakeholders in communication. The person selected as the translator had to be acceptable to the community under study and also from within the community. For accuracy in translation, the translator selected had to have profound knowledge of the English language and be familiar with technical terms and the topics under discussion. This was achieved by use of local people who are trained in animal health and/or range science. Some frequently used technical words were identified and their Rendille/Gabra equivalent names sought. Finally, the translators were sensitised on their critical role and their kingpin position as the facilitators of the interviews.

3.3.4.2 Identification and selection of enumerators

Enumerators were selected from the members of the same pastoral community under study. The criteria for selection included: residence and ownership of livestock within the community; "sharpness of mind" which was judged by the incisiveness of their questions as well as their decisive answers to questions; ability to read and write in English and Kiswahili; and ability to clearly interpret discussions into their local language equivalent. The interviews were conducted during "under-the-elders'-tree-PRA-workshops", held during the day. Any issues that needed to be clarified in the completed interviews were attended to every evening.

3.3.5 Conducting participatory rural appraisal (PRA)

Participatory rural appraisal (PRA) was used as the main method for gathering information from the community. This was through PRA workshops ("under-the-elders'-tree-workshops") and from different identified user groups. There were two PRA teams of five facilitators each. Two of the group members had to have immense knowledge of the local language including a thorough understanding of the local proverbs and parables.

Before the PRA workshops, the two teams were trained in a day's seminar using the same questions that were to be used during the interviews. In addition, an exhaustive discussion on the appropriate PRA tools and any other issues related to the field surveys was undertaken.

In this study, the "under-the-elders'-tree-PRA-workshops" identified the known livestock traditional healers (LTHs) within the various manyattas. This was done through focused group discussions (FGD) and interviews. The discussion groups were composed of both men and women as well as separate groups based on gender, age-sets and traditional roles. Separate groups helped to capture opinions and views between different categories.

Throughout the PRA sessions, deliberate attempts were made to create an atmosphere that encouraged the participants to actively share their experiences, take in other's suggestions and critically reflect, and challenge the information provided by all the stakeholders. To encourage complete participation of all participants, certain norms were identified and agreed upon. These included: following traditional meeting norms like opening and closing meetings with prayers offered by the pastoralists themselves; self-introduction of participants; and listing of expectations of all participants at the beginning of the meetings. Respect for every participants' contribution during the plenary discussions was upheld in all sessions. Sessions were made short to ensure that the pastoralists had time to chew "tobacco" as well as to "stretch" themselves. Lastly, there was always a recap of the day's proceedings before the end of each day and at the beginning of each new day.

A community participatory map was obtained by asking each of the two-focused group discussion (FGDs) to sketch a map of Huri-Hills community to show the layout of Huri-Hills as one of the PRA sites. Each of the FGD was also asked to draw a map of

Marsabit District and indicate major sources of medicinal plants/materials in the district. Each pair of these maps were collapsed to make one final copy. The participants used natural markers like leaves and stones to indicate these sources. Semi-structured interviews were used during the participatory mapping exercise. In addition, the interviews were used to bring out the time of the last outbreak of the most devastating livestock disease in the last 50 years as perceived by the community. Some specifically identified groups, for example women, morans, livestock traditional healers (LTHs) were also interviewed separately. The PRA survey groups walked, together with some representatives of the community, along a route determined during the mapping exercise. The objective of the transect walk was to identify and assess the frequency of occurence of medicinal plants and collect plant voucher specimens. The sampling of the medicinal plant specimens was carefully done to ensure cross-checking of the information earlier enumerated during the PRAs discussions.

3.3.6 Identification of plant voucher specimens

Two approaches were used to verify the information gathered from the PRA discussions: LTHs' residential workshops; and the field excursions. The first step was to read the local name of the plant listed during the interviews to the respondents, who in turn were asked to show the named plant in the field. Secondly, after collecting the plants from the field as listed during the PRA workshops, the respondents were asked to give the local name equivalent. This cross-checking enabled the survey team to tell whether the information given in both sessions agreed.

3.3.7 Livestock traditional healers'(LTHs) workshops

Two workshops were held approximately two weeks after the PRA exercises. One workshop was for twenty LTHs identified among the Rendille/Ariaal and the other for twenty LTHs from the Gabra community. During the residential workshops, the LTHs brought some herbal preparations that they had prepared at home (home-made preparations) for antibacterial sensitivity tests. The LTHs' residential workshops were used to verify the information gathered during the PRA workshops and field excursions. The workshop sessions were programmed in such a way that there were "in-house" sessions, followed by sessions out in the field. This made it easy for the LTHs to discuss with the survey teams traditional remedies in class and travelling to identify the medicinal herbs in the field. The two methods (mentioned in 3.3.6) for providing a check in identification of plants were repeated in these workshops. During the field sessions, plant voucher specimens were collected following the East African Herbarium collection guidelines (Mutta, 1996).

3.3.8 Collection of plant voucher specimens

The plant voucher specimens were collected in triplicate and labelled under the headings English name, vernacular name, locality, altitude, habitat and description of the plant details that are not apparent from the specimen. Other inclusions in the label were frequency of occurrence, collector's name, and date of collection. The objective of the voucher specimen was to facilitate the identification of the family, genus, and species of the plants collected. Care was taken to collect good quality specimens. Each voucher specimen contained a representative sample of the plant, which included stems, leaves, roots, flowers, fruits and other plant parts that were characteristic of the species. Whenever possible, whole plants or entire branches were included so that the overall architecture of the plant could be observed. After collection, each plant specimen was pressed between absorbent papers and dried in the field and put in a folder together with its field notes. The plants were submitted for identification/ confirmation to the herbarium botanists at the East African Herbarium, based at National Museums of Kenya, Nairobi. Harvesting of medicinal plants was carefully undertaken to ensure that the survival of the harvested stand was not compromised.

3.3.9 Signing of agreement with pastoralists/stockowners and LTHs

Indigenous knowledge and especially that which is used in preventive and curative remedies is rightfully a property of the study community. For this reason, and in conformity with the moral requirements of intellectual property rights (IPR), which recognises peoples' right to their property, an agreement was signed between the researcher and representatives of the source communities. This was to give the researcher consent to carry out research among the two communities and to eventually report the results back to them. The agreement set out the terms for absolute recognition of these communities and the LTHs as partners in this study (Appendix 1).

3.4 Testing for antibacterial activity

The aim of the sensitivity tests undertaken in this study was to test antibacterial activity of crude ethanolic and water extracts of plant species collected and identified from the Rendille/Ariaal and Gabra ethnic territory. The antibacterial sensitivity tests were also done on the home-made herbal preparations brought by the LTHs.

3.4.1 Plant sample preparation in the field

About one kilogramme of the plant parts and other materials used in traditional remedies were collected in the field according to the method of Mensah *et al.* (1990). The sample materials were carefully prepared to ensure that as little as possible of the plants/materials' chemical composition was altered. Care was also taken to ensure that selected plants were free of bacterial, fungal or small insects infestation that could easily interfere with the results of subsequent chemical analysis (Martin, 1995).

The plant parts used included the bark, fruits, flowers, roots, trunk, leaves as well as plant exudates. The roots and the trunk were debarked and chopped into smaller pieces using a machete. The resultant material was air-dried for several days, turning it severally daily to check against turning mouldy. The completely dried material was packed carefuly in plastic paper bags and transported to the Department of Public Health, Pharmacology and Toxicology, University of Nairobi, for analysis.

3.4.2 Preparation of the test extract

Two methods of extraction were used: water and ethanol extraction.

3.4.2.1 Water extraction

Water extraction was carried out according to the method of Brander *et al.* (1982). Fifty grams of the test herbal material was weighed. Leaves were first ground with an Arthur

R.H. Thomas grinder (Arthrus H. Thomas Co. Phila, Pa. USA). The contents were put in glass beakers and boiled in water for 30 minutes. Ten millilitres (mls) of the concentrated extract were placed in universal bottles, frozen overnight, and freeze-dried using Edwards Freezer (Dryer model EF03) for 2 days. The dried contents were reconstituted with just enough distilled water to dissolve all the dried powder. Adding distilled water little by little and shaking achieved this. The reconstituted extract was used for the sensitivity tests.

3.4.2.2 Ethanol extraction

Ethanol extraction was carried out according to the method of Brander *et al.* (1982). Fruit samples were crushed using mortar and pestle, then filtered via a gauze-cloth before extraction. Leaf sample extracts were filtered via a guaze-cloth before concentration. Fifty grams of the test herbal material was mixed with 50 mls ethanol in conical flasks. The flasks were placed in a water bath at 50°C overnight. The extracts were transferred into round-bottomed flasks for vapourisation and concentration, using a rotor vapour. Distilled water was added little by little to the flasks, which were shaken to dissolve the dried contents completely. The resultant preparations were used for the sensitivity tests.

3.4.3 Test microbes and drugs used as standards in sensitivity tests

Since the investigations reported here was a preliminary screening for antibacterial activity, *Micrococcus lutea* ([1]NCTC No.8340) and *Bacillus cereus* ([2]ATCC No. 11778) were selected as standard test microbes, due to their high sensitivity. Oxytetracycline Hydrochloride (100 mg) combined with Sodium Formaldehyde Sulphoxylate 0.15% (Alamycine® 10% - Norbrook-UK) and Procaine Penicillin 200gm in combination with 250 mg Dihydrostreptomycine and 1.5 mg Nipasept (Penstrep® Norbrook–UK) were used as standard drugs. Nipasept is included, as antimicrobial preservative in Penstrep while Sodium Formaldehyde Sulphoxylate is an antioxidant in Alamycin 10%.

[1] National collection of type culture

3.4.4 Antibacterial screening of plant extracts

The disc diffusion assay method was used according to Brander *et al.* (1982). Crude samples were tested against the two standard microoganisms, *Micrococus lutea and Bacillus cereus.* The test microorganisms were grown on blood agar overnight. Two colonies of each bacterial species were placed in pre-sterilised and cooled Mueller-Hinton Broth (MHB) and incubated at 37°C for 15 minutes. The broth preparation was well mixed using a Voltex Reamix 278a at 2000 rpm for 1 minute. Using sterile swabs, the bacterial suspension was spread onto pre-prepared Mueller-Hinton Agar (MHA) plates.

Filter paper discs of equal diameter (6mm) were cut from whatmann filter paper number 2 (medium filter speed) using a paper punch. A hundred milligrams of the dried extract was redisolved in 1.0 ml-distilled water to make a concentration of 0.1 gm/ml. Twenty mls of the extract for each plant sample was impregnated into pre-prepared filter paper discs. The filter paper discs impregnated with the plant extract were placed onto the inoculated MHA. A filter paper dissolved in a 2ml ethanol solvent and another in 2ml distilled water were also placed onto the same inoculated MHA plates together with the samples, as negative controls. A filter paper disc impregnated with 2ml of Penicillin-Streptomycin and another with 2ml of Oxytetracycline Hydrochloride preparations were placed on separate plates as positive controls. This was because preliminary screening had shown that, when placed on the same plate with the sample, the inhibition zone of the standard drug overlapped that of the test sample making the results difficult to interprete. Each pair of plates (one with the sample plus the negative controls and the other with positive controls) was incubated overnight at 37°C.

The other method used for antibacterial sensitivity test was the well method (Brander *et al.*, 1982). Wells were made on dry inoculated agarose using standard coak-borers of 6mm diameter. The wells were filled with the extracts using capillary tubes. Corresponding number of wells were filled with Penicillin–Streptomycin and

---

[2] American type culture collection

Oxtretracycline Hydrochloride preparations, which acted as positive controls. Some wells were also filled with distilled water and ethanol separately as negative controls. The inoculated plates were incubated overnight at 37°C.

All these procedures were carried out in a sterilised fume hood with laminar flow to ensure that no undesired bacteria were introduced into the plates. At the end of the incubation, zones of inhibition were measured in mm around the filter paper discs and wells.

3.4.4.1 Reading sensitivity test plates

Each pair of the plates was read after 24hrs incubation. A clear zone around the wells or discs indicated positive results after overnight incubation at 37°C. The transparent halo related to the susceptibility of the microorganisms to the extract as well as being proportional to the concentration of the test extract. The growth inhibition zone was any clear zone beyond the well or disc diameter. The well or disc diameter measuring 6.0 mm was consindered as the "cut-off" point. The growth inhibition zone of each of the test extract and that of its positive control were measured in millimetres (mm).

3.5 Data handling and analysis

All data were entered and handled in Microsoft EXCEL 2000 software. The data were then exported to Statistix statistical package to generate descriptive statistics and for computing the chi-square statistic and odds ratios (OR) in tests of associations between the ethnic groups and their practices.

CHAPTER 4

RESULTS

4.1 Characteristics of the study areas

The characteristics of the study areas are displayed in Table 4.1. As seen from Table 4.1, the human density expressed as the number of people per household was fairly uniform across the two ethnic groups.

Table 4.1: Characteristics of the study areas by ethnic group in Marsabit District, Kenya, 2001.

Ethnic Group	Division	No. of Households	Human Population size	No. of people per household
Gabra	Maikona	4,863	16,297	3.4
	North Horr	6,090	23,576	3.9
Rendille/ Ariaal	Laisamis	6,489	23,863	3.7
	Loiyangalani	4,160	16,175	3.9

4.2 Important livestock diseases among the Rendille/Ariaal and Gabra ethnic groups.

Documentation of the ethnoveterinary data bank of the Rendille/Ariaal and Gabra communities revealed that there were over 20 livestock diseases and ailments/ disorders. These livestock diseases were grouped into six broad categories: digestive disorders; respiratory disorders; traumatic external injuries and ectoparasites; reproductive problems and infertility; eye infections; and mineral deficiencies. Diarrhoea/calf scours, rumen impaction and worm infestations were included in the digestive malfunction category. Skin conditions and ectoparasite infestations included wounds, abscesses, fungal infections, ticks and fleas/lice infestations, and biting flies. The category of respiratory conditions were cough and pneumonia, while reproductive ailments include pyometra/metritis, retained afterbirth and infertility problems. The diseases and conditions affecting the various animal species kept by both ethnic communities are displayed in Table 4.2. As shown in Table 4.2, important diseases and conditions affecting the same species of animal in decreasing order of importance were different according to the ethnic community. In cattle the important diseases were Rinderpest, Foot and Mouth Disease (FMD) and contagious bovine pleuropneumonia (CBPP) for the Rendille/ Ariaal whereas for the Gabras, they were diarrhoea, cough and blackleg.

Table 4.2: Distribution of important livestock diseases by species as perceived by the Rendille/Ariaal and Gabra communities of Marsabit District, Kenya, 2001.

Ethnic Group	Species	Diseases
Rendille/Ariaal	**Camel**	Trypanosomosis, cough and mange
	Cattle	Rinderpest, foot and mouth disease (FMD) and contagious bovine pleuropneumonia (CBPP)
	Sheep	Worms, ectoparasites (mange/lice/fleas) and diarrhoea
	Goat	Contagious caprine pleuropneumonia (CCPP), mange and pox
	Donkey	Trypanosomosis, pneumonia and tetanus
Gabra	**Camel**	Haemorrhagic septicaemia, trypanosomosis and generalised pyogenic conditions
	Cattle	Diarrhoea, cough and blackleg
	Sheep	Diarrhoea, cough and blackleg
	Goat	Contagious caprine pleuropneumonia (CCPP), coenuriasis and orf
	Donkey	Strangles, coenuriasis and wounds/hyena bites

4.3 Participatory rural appraisal (PRA)

4.3.1 Participatory community mapping

Four maps were sketched on the ground by the two focused-group discussions (FGDs). Two of the maps represented the Huri-Hills community while the other two showed the sources of herbs in Marsabit District. Each pair of the map was collapsed into a final copy as shown in Figures 4.1 and 4.2. Figure 4.1 shows the map of Huri-Hills community while Figure 4.2 shows the map of Marsabit District indicating the various sources of ethnoveterinary herbal materials.

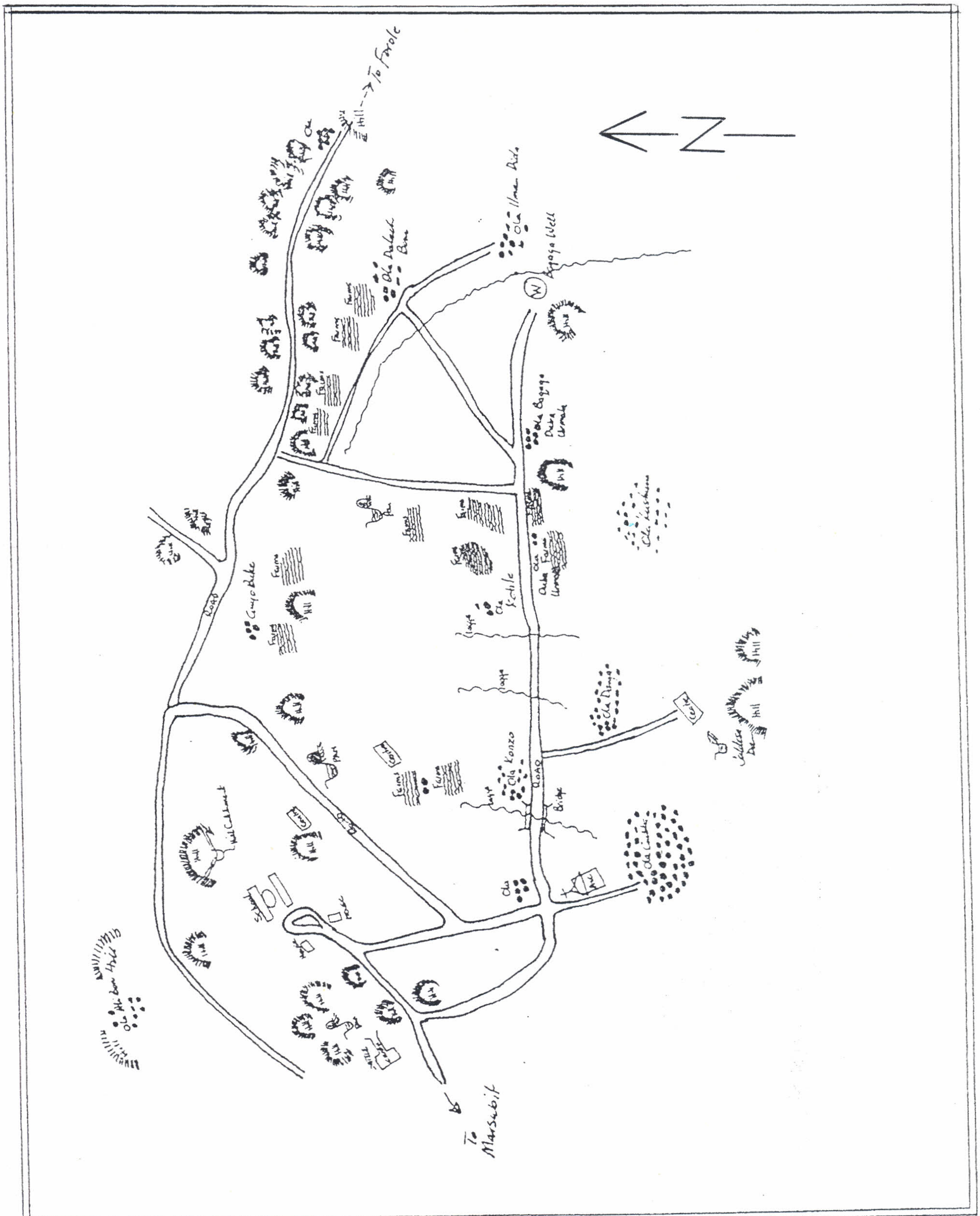

Figure 4.1: A community participatory map of Huri-Hills of Marsabit District, Kenya, 2001.

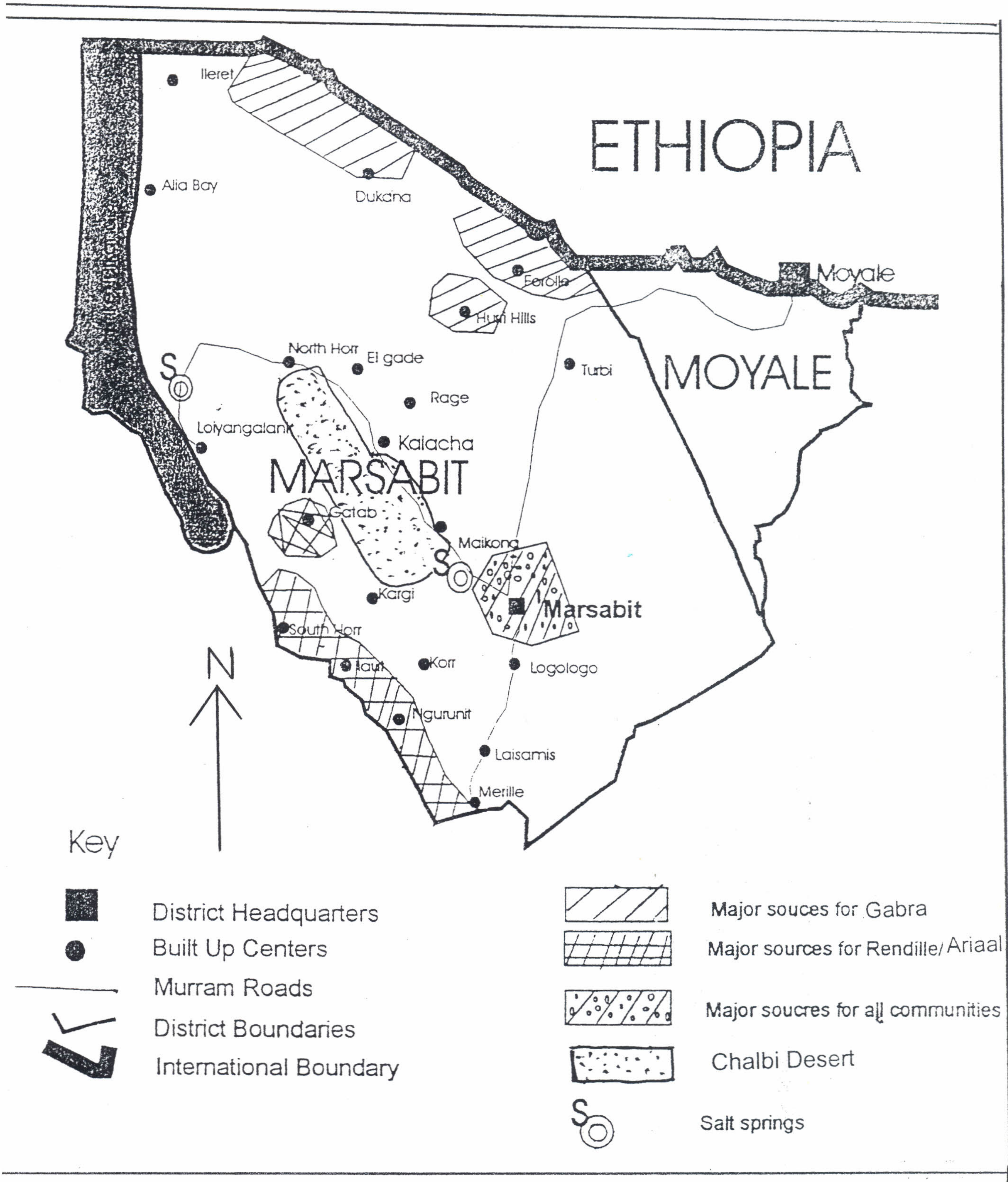

Figure 4.2: Map of Marsabit District drawn by members of two focused-group discussions showing the main sources of ethnoveterinary herbal materials in the district.

4.3.2 Semi-structured interviews (SSIs)

The number of respondents for the semi-structured interviews was 106 (56 in Rendille/Ariaal and 50 in Gabra land).

4.3.2.1 Characteristics of existing veterinary knowledge (EVK) as applied by the Rendille/Ariaal and Gabra communities

The data enumerated through the semi-structured interviews showed that the characteristics of the existing veterinary knowledge between the two study communities varied on aspects like existence/custodians of EVK within the community, its acquisition and transfer, gender involvement, and within and between species specialization. The most important characteristics are summarized in Appendix 2.

4.3.2.2. Indigenous knowledge on livestock poisoning

The Rendille/Ariaal and Gabra pastoralists have a sound understanding of poisoning and poisonous plants. Some of the strategies reportedly adopted to address plant poisoning included avoidance of pastures with poisonous plants, which could be seasonal or total, depending on whether the poisoning history indicates a seasonal or perennial pattern. The respondents also reported that they experienced more cases of poisoning during the dry seasons when animals were desperate and fed on whatever was available. At such times, livestock were said to forage on vegetation that they would not normally feed on and often this resulted in plant poisoning.

4.3.2.3. Traditional description of disease

In the traditional description of diseases, a separate name was given to distinct livestock diseases. This came out clearly during the PRAs. However, in some cases, different diseases were thought to be the same. This was mainly because diseases are traditionally named using clinical signs and thus, signs common to various diseases were taken for a disease entity. For example, among the Rendille/Ariaal any ailment that manifest itself with CNS signs is taken to be *sirgo* (coenuriasis), while among the Gabra community any condition that affects the udder is assumed to be *budha* (meaning that it is caused by "bad eye", hence refered to as "bad eye disease").

4.3.2.4. Traditional diagnosis, classification of livestock diseases and folk treatment techniques

In indigenous veterinary practice among the two study communities, diagnosis followed a specific protocol, similar to the modern veterinary practice. This reportedly included physical examination of the animal (if possible) and/or a clear history narration as guided by systematic oral questions. History taking formed an important aid to successful diagnosis of livestock diseases for both communities. To make a diagnosis, a lot was reportedly borrowed from previous similar cases with similar manifestations. For most pastoralists interviewed, diseases were diagnosed by palpation, listening, looking, and smelling.

Once a diagnosis was made, the prescription was usually in the form of a single-herb preparation protocol or a combination of concoctions. The dosage determination and administration protocol was usually in known and familiar measuring gadgets. For example, a handful of roots or dry leaves boiled in three one-kilogram "[3]*kimbo can*" container of water to obtain an equiverlent of five 300 mls soda bottles. The dosing regime also recommended the frequency and duration of treatment. However, most of the herbal preparations were administered only once.

In the Rendille/Ariaal traditional healing art, treatment is acompanied by close monitoring of the patient by the herders/stockowners, using some traditionally defined milestones. These indicators include: appetite of the sick animal for water and pasture since the time of treatment; the nature of the faeces and urine; walking/standing gait and alertness among others. This is usually reported back to *manyatta* elders in the evening and discussed at the *naabo* (Rendille/Ariaal traditional parliamentary sitting whose sessions are held every evening at the centre of each *manyatta*) and the way forward for the sick animal is discussed and determined. This mode of operation gurantees availability of the EVK skills to the whole Rendille/Ariaal community. For the Gabra ethnic group, these responsibilities are vested on the traditional healer. S/he

[3] Kimbo can is a container for a popular cooking fat in Kenya.

keeps track of the sick animal through constant consultation with the herder/stockowner and decides on what course of action to take. The large community is not involved and the knowledge is only available to a specific member (s) of the healing families.

The traditional healing system for all the study communities were divided into several broad classifications, namely, internal abdominal disorders, chest, head and problems of the bones. The other important classification of disorders were those which manifested externally on the skin, such as skin infections, wounds and abscesses. Topical applications were indicated for these conditions. In case of persistent skin lesions, both topical and oral preparations were traditionally prescribed. Branding and/or surgical interventions were also undertaken in conjunction with the topical applications. Eye infections and traumatic eye injuries were another distinct classification. Eye treatment involved preparation of eye drops and/or powders, prepared from leaves, roots and/or barks. Surgical excision and/or branding was also carried out, especially in cases of recurring cancerous growths.

Infertility and retained afterbirth was another major area of concern for the pastoralists interviewed. There existed clear-cut indigenous recognition of the relationship between retained afterbirth and subsequent infertility, especially delayed return to oestrus. All the study communities agreed on the use of *Salvadora persica* herb for the expulsion of retained afterbirth. It was reported that the herb expelled retained afterbirth in 3–4 hrs after oral administration.

Besides herbal treatment for infertility, good nutrition was reportedly prescribed, including mineral supplementation. The pastoralists recognized mineral deficiency as a livestock ailment that hindered livestock productivity and reportedly moved quickly from an area whenever mineral deficiency was suspected. The indicators of mineral deficiency reportedly included licking of urine, restlessness, eating of soil from anthills, loss of appetite, chewing of bones and increased straying in search of salty plants and salty water. Other signs that were reportedly not very common included reduced water intake, reduced milk yield, and feeding and/or licking of stones/rusty objects. Usually, provision of minerals was prescribed in such cases. There were several sources of mineral(s) enumerated by the stockowners. These included salty water springs, salty soils, salty plants and commercially acquired magadi salts. The Rendille/Ariaal and Gabra communities usually used what their environment could offer and rarely bought commercial mineral licks. Salty waters, mostly found at Korole springs at the end of the Chalbi Desert (Figure 4.2) were utilized by the Rendille (mainly for camels). Salty plants, especially *Salsola dendroides* (*Hardum*), were more accessible to most livestock species, including the lactating ones. Gabra stockowners used the salty water available at Maikona and Kalacha wells. There also existed salty wells along the edge of the Chalbi Desert. Along the same areas, there existed salty plants like *Cadaba ruspalii ("Qadu")* and *Salsola dendroides* (*"Hardum"*), which were utilized by Gabra livestock as well.

A simple oral historical profile on the single most important livestock disease outbreaks in the last fifty years indicated that an outbreak of Rinderpest that is estimated to have occurred in the early 1960s was the most devastating and left permanent memories of heavy losses of cattle that has been passed on through the subsequent age-sets, since then.

4.3.2.5. Forms of treatment in traditional veterinary practice

Folk veterinary practices were classified into mortal and immortal. The material (mortal) form of treatment entailed use of natural products like herbal plants, mineral salts and salty plants/waters. It also involved careful and specific manipulative techniques like bone-setting and handling difficult gynaecological/obstetrical complications. Surgical intervention, was done mostly by specialized LTHs. Non-material (immortal) form of treatment included spitting on the sick animal, reciting the Koran (for Muslims) or praying for the animals (for the Christians). It also involved mounting of purification ceremonies or observance of some taboos, especially if witchcraft was implicated as the cause of the ailment(s).

4.3.2.6. Traditional vaccination

Among the Gabra pastoralists, traditional vaccinations reportedly existed for some livestock diseases. For example, for generations, the Gabra reportedly vaccinated against contagious caprine pleuro-pneumonia (CCPP) by taking a small piece of lung from a sick goat and through an incision, burying it under the skin behind the ear. Also, in case of Foot and Mouth Disease (FMD), they reportedly used the scrapings from the infected wounds to rub on the hair of the healthy animals. This was thought to protect the healthy animals against FMD infection.

4.3.3 Factors influencing the choice of treatment among the Rendille/Ariaal and Gabra pastoralists

The proportion (82%) of the interviewed Gabra pastoralists who used indigenous remedies as their first line of treatment was significantly higher ($P<0.05$) than the proportion (59%) of the Rendille/Ariaal pastoralists who used indigenous remedies as their first line of treatment (Table 4.3). Gabra pastoralists were 3 times more likely to use traditional remedies as their first line of treatment than were the Rendille/Ariaal pastoralists. The reasons given by both ethnic groups for resorting to the use of traditional remedies were: the high cost of modern drugs (56% Gabra and 43% Rendille/Ariaal), availability of traditional remedies (18% Gabra and 38% Rendille/Ariaal) and a strong belief in traditional remedies (26% Gabra and 19% Rendille/Ariaal). There were no significant differences between the two ethnic groups with regard to reasons for resulting to the use of traditional remedies as the first line of treatment.

Table 4.3: Utilization of traditional remedies compared to modern veterinary inputs among the Rendille/Ariaal and Gabra communities of Marsabit District, Kenya, 2001.

Type of treatment	Ethnic group		Total
	Rendille/Ariaal	Gabra	
	No. of respondents	No. of respondents	
Traditional	33	41	74
Modern	23	9	32
Total	56	50	106

4.3.4 Distribution of livestock traditional healers among the Rendille/ Ariaal and Gabra communities

A total of 24 and 30 LTHs from the Rendille/Ariaal and Gabra communities respectively, were identified. The names, sexes, and areas of specialization are displayed in Appendix 3. Women appeared to play an insignificant role as LTHs in both communities with only 3 out of the 30 LTHs (10%) from Gabra and 4 out of the 24 LTHs (17%) from the Rendille/Ariaal areas being LTHs. Specialization of healers among the two study communities was evident (Table 4.4).

Table 4.4: Distribution of livestock traditional healers by area of specialization and sex among the Rendille/Ariaal and Gabra communities of Marsabit District, Kenya, 2001.

Area of specialization	Ethnic group				Total
	Rendille/Ariaal		Gabra		
	Males	Females	Males	Females	
General practitioners	14	4	7	1	26
Bone setters	5	0	7	1	13
Camel Diseases	1	0	9	0	10
Camel dystocia and infertility	0	0	4	1	5
Total	**20**	**4**	**27**	**3**	**54**

The proportions of camel disease specialists among the Gabra and Rendille/Ariaal communities were 30% and 4%, respectively. This difference was significant ($P < 0.05$). Gabras were almost 10 times more likely to be camel disease specialists relative to the Rendille/Ariaal. General practitioners were more among the Rendille/Ariaal (75%) than they were among the Gabras (27%). This difference was significant ($P < 0.05$). The Rendille/Ariaal were 8 times more likely to be general practitioners than were the Gabras.

4.4 Inventory of ethnoveterinary practices applied by the Rendille/Ariaal and Gabra ethnic groups of Marsabit District, Kenya.

In total, 72 medicinal plant species in 34 families were identified (Appendix 4). Out of the 53 medicinal plants applied by the Rendille/Ariaal, 36 were used against both human and livestock ailments and 17 were used exclusively for human ailments. All the 19 medicinal plant species identified among the Gabra community were used against both human and animal diseases/ailments. Pictures showing some of the medicinal plant species identified are shown in Plates 4.1, 4.2, 4.3, 4.4, 4.5 and 4.6.

The PRAs also revealed a variety of non-plant-based ethnoveterinary materials and remedies (Appendix 5) as well as folk manipulative techniques applied by the Rendille/Ariaal and Gabra communities (Appendix 6).

Plate 4.1: A picture of *Acacia nilotica* tree, the bark of which is used to make a preparation for treating bites and other penetrating wounds by the Gabra and Rendille/Ariaal ethnic groups of Marsabit District, Kenya.

Plate 4.2: A picture of *Euphorbia heterochroma*, the milky exudate of which is used to manage septic gangrenous wounds by the Gabra and Rendille/Ariaal ethnic groups of Marsabit District, Kenya.

Plate 4.3: A livestock traditional healer harvesting roots of *Olea africana,* which are used for smoking the udder of cattle and camels in cases of mastitis, by the Gabra and Rendille/Ariaal ethnic groups of Marsabit District, Kenya.

Plate 4.4: A livestock traditional healer searching for the roots of *Salvadora persica* which are used for the treatment of retained afterbirth in cattle and camels by the Gabra and Rendille/Ariaal communities of Marsabit District, Kenya.

Plate 4.5: A livestock traditional healer with bark and leaves of *Ficus sycromonus* used to treat pyometra and metritis in camels by the Gabra and Rendille/Ariaal ethnic groups of Marsabit District, Kenya.

Plate 4.6: A picture of a Gabra livestock traditional healer displaying herbal preparations at a livestock traditional healers' workshop in Marsabit District, Kenya, 2001.

4.5 Antibacterial sensitivity test results of medicinal plants collected from the Rendille/Ariaal and Gabra communities

4.5.1 Antibacterial sensitivity test results of home-made medicinal plant preparations as used by the livestock traditional healers

A total of 30 homemade preparations were tested for antibacterial activity. Out the 30 samples presented, only 7(23%) were found to be active against *Micrococcus lutea* (Table 4.5). The active plant samples were *Acacia Sahel*, *Sanseviena robusta*, *Terminalia brownii*, *Solanum incanum*, *Commiphora pauli*, *Solanum indicum and Withania somnifera*. Of the remaining samples, 12(40%) were highly contaminated with various microorganisms as evidenced by bacterial growth on incubation, while 11(37%) showed no activity. The highest inhibition measuring 22mm was shown by *Withania somnifera*.

Table 4.5: Results of antibacterial sensitivity test results of home-made preparations of medicinal plants as used by the Rendille/Ariaal and Gabra livestock traditional healers of Marsabit District, Kenya.

Botanical name	Part of the plant used	Antibacterial activity	Inhibition zone (mm)
Salvadora persica	Roots	No activity	-
Balanities aegyptiaca	Leaves	Contaminated	-
Acacia tortilis	Bark	Contaminated	-
Euclea schimperi	Stem	No activity	-
Acacia Sahel	Bark	Active	12
[a]*Withania somnifera*	Fruits	Contaminated	-
Zanthoxylum chalybeum	Seeds	No activity	-
Lawasonia inermis	Roots	Contaminated	-
Solunum coagulans	Fruits	No activity	-
Melia azardrach	Tuber	Contaminated	-
Sanseviena robusta	Leaves	Active	9
Aloe secundiflora	Leaves	No activity	-
Euclea divinorum	Stem	No activity	-
Hildebrandtia sepalosa	Roots	Contaminated	-
Cucumis sp.	Stem	No activity	-
Olea africana	Bark	No activity	-
Adenium vulgaris	Stem	No activity	-
Cissus sp	Stem	Contaminated	-
Aloe sp.	Leaves	Contaminated	-
Cissus quadrangularis	Stem	Contaminated	-
Ipomoes sp	Leaves	No activity	-
Terminalia brownie	Roots	Active	15
[b]*Withania somnifera*	Fruits	No activity	-
Albezia anthelmintica	Roots	Contaminated	-
Solanum incanum	Fruits	Active	18
Commiphora pauli	Stem	Active	10
Acacia nilotica	Bark	Contaminated	-
Commiphora africana	Stem	Contaminated	-
Solanum indicum	Fruits	Active	13
[c]*Withania somnifera*	Fruits	Active	22

a*Withania somnifera* sampled at Karare

[b]*Withania somnifera* sampled at Huri Hills

[c]*Withania somnifera* sampled at Namarei

4.5.2 Laboratory results of antibacterial sensitivity tests of ethanol and water extracts of medicinal plants

A total of 36 medicinal plants were tested; 21 from the Rendille / Ariaal and 15 from Gabra regions, respectively.

4.5.2.1 Antibacterial sensitivity test results of ethanol and water extracts in disc reservoirs of medicinal plants collected from the Rendille/Ariaal areas

The sensitivity test results of the ethanol extracts in disc reservoirs of the 21 herbal preparations collected from the Rendille/Ariaal area, are shown in Table 4.6. Three and 7 ethanol-extracted samples showed activity against *M. lutea* and *B. cereus*, respectively while 7 and 5 water-extracted samples showed activity against the two test microorganisms, respectively. Only *Terminalia brownii* showed activity against both test microorganisms for both types of extracts. Ethanol-extracted preparation of *Terminalia brownii* and water-extracted preparation of *Zanthoxylum chelybeum* showed quite high activity (24mm and 23mm, respectively) against *M. lutea* (Plates 4.7 and 4.8). *M. lutea* was more sensitive to ethanol and water extracts of *Terminalia brownii* with an inhibition zone of 24mm and 25mm, respectively compared to *B. cereus* that showed an inhibition zone of 12mm and 11mm with the same preparation, respectively.

Table 4.6: Antibacterial sensitivity test results of ethanol and water extracts of medicinal plants applied by the Rendille/Ariaal community of Marsabit District, Kenya, using disc reservoir method.

Plant species	Part of the plant used	Inhibition zone(mm)			
		Ethanol extract		Water extract	
		M.lutea	*B.cereus*	*M.lutea*	*B.cereus*
Melia Azadarach	Tuber	- (40)	- (38)	8 (41)	8 (33)
Albizia anthelmintica	Roots	- (41)	- (40)	- (41)	- (30)
Ficus natalensis	Bark	- (39)	- (29)	8 (39)	23 (29)
Cissus quadrangularis	Stem	- (38)	7 (36)	- (38)	- (30)
Indigofera sp	Seeds	- (39)	- (30)	- (39)	- (30)
Salvadora persica	Roots	- (40)	8 (32)	- (40)	- (35)
Commiphora flaviflora	Gum	- (39)	- (41)	- (39)	- (42)
Cucumis dipsaceus	Stem	8 (41)	7 (30)	- (41)	- (30)
[1]*Maerua denhardtiorum*	Bark	- (40)	- (30)	- (40)	- (30)
[2]*Maerua denhardtiorum*	Bark	- (45)	- (39)	- (43)	- (40)
[1]*Olea africana*	Bark	7 (40)	- (30)	- (40)	- (32)
[2]*Olea africana*	Bark	- (40)	- (31)	- (40)	- (32)
Zanthoxylum chalybeum	Fruits	- (33)	- (29)	23 (37)	7 (29)
Acacia nilotica	Bark	- (39)	- (39)	12 (44)	15 (32)
Terminalia brownii	Roots	24 (37)	12 (29)	25 (39)	11 (39)
Balanites aegyptiaca	Leaves	- (40)	10 (34)	10 (40)	- (30)
Euclea schimperi	Stem	- (43)	- (29)	- (43)	- (29)
Solanum incanum	Fruits	- (40)	- (30)	10 (40)	- (30)
Withania somnifera	Fruits	- (40)	7 (31)	- (53)	- (31)
Carissa endulis	Leaves	- (39)	- (40)	- (41)	- (41)
Acacia tortolis	Bark	- (41)	7 (29)	- (41)	- (29)

( ) Represents the inhibition zone of the standard drugs used as positive controls

[1]*Maerua denhardtiorum* plant sample from Ngurunit area

[2]*Maerua denhardtiorum* plant sample from Karare area

[1]*Olea africana* plant sample from Ngurunit area

[2]*Olea africana* plant sample from Karare area

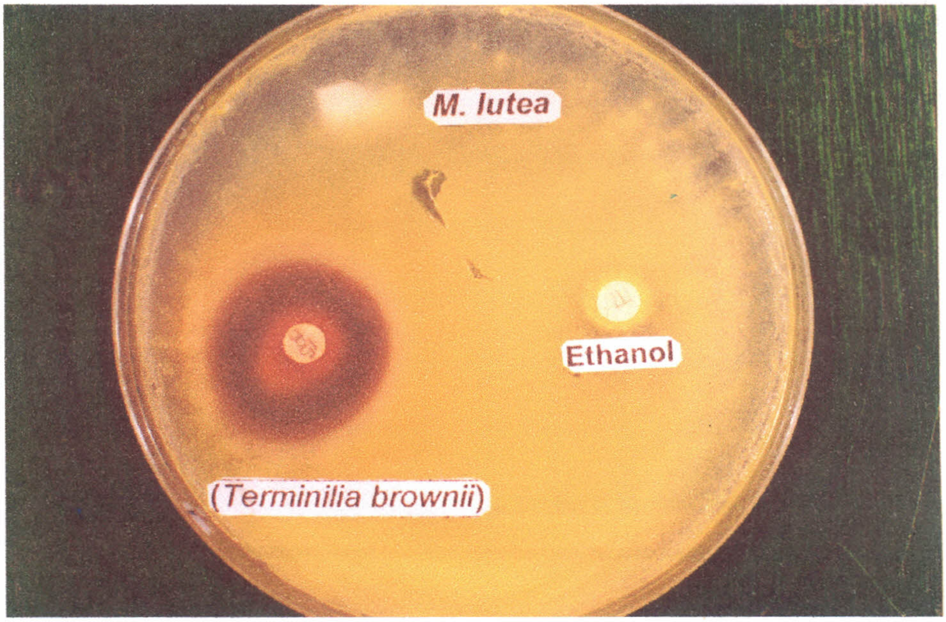

Plate 4.7: A photograph of a petri dish showing the inhibition zone of ethanol extract of *Terminalia brownii* against *M. lutea* with ethanol as a negative control in disc reservoirs.

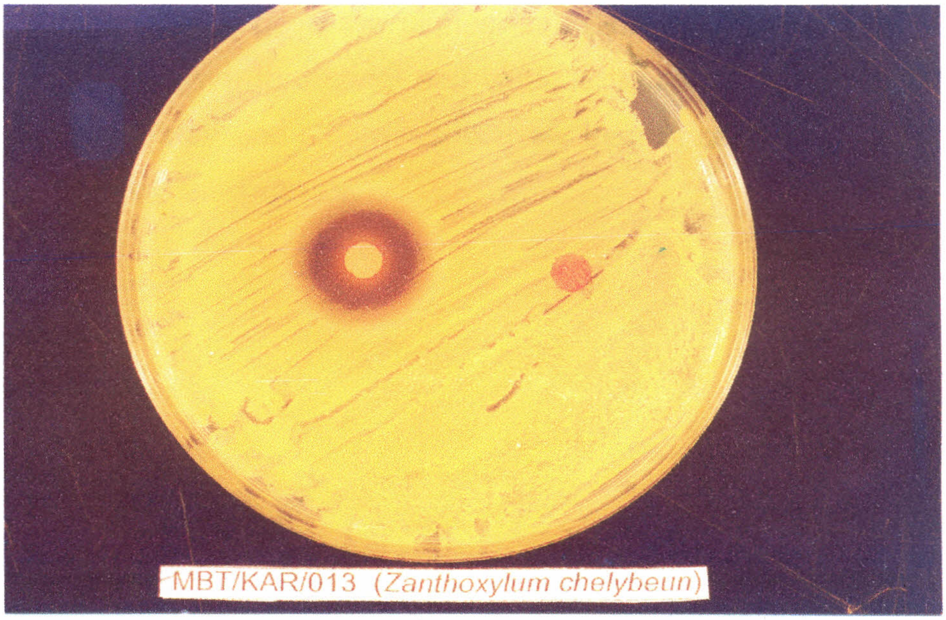

Plate 4.8: A photograph of a petri dish showing an inhibition zone of water extract of *Zanthoxylum chalybeum* against *M. lutea* with water as a negative control in disc reservoirs

4.5.2.2 Antibacterial sensitivity test results of ethanol and water extracts of medicinal plants collected from the Rendille/Ariaal area in well reservoirs

Five ethanol extracts showed activity against both *B. cereus* and *M. lutea* in well reservoirs while 5 and 4 water extracts showed activity against both test micro-organisms, respectively (Table 4.7). *Ficus natalensis* and *Terminalia brownii* showed inhibition to both test microorganisms for both types of extracts. Ethanol extract of *Terminalia brownii* showed the higest inhibition against *M. lutea* (24mm) while the water extract of *Acacia nilotica* gave the highest inhibition of 28mm against *B. cereus*. *M. lutea* was more sensitive to ethanol and water extracts of *Terminalia brownii* with an inhibition zone of 24mm and 23mm respectively than *B. cereus* with an inhibition zone of 12mm and 14mm, respectively.

Table 4.7: Antibacterial sensitivity test results of ethanol and water extracts of medicinal plants applied by the Rendille/Ariaal communities of Marsabit District, Kenya, using well reservoir method.

Plant species	Part of the plant used	Inhibition zone(mm)			
		Ethanol extract		Water extract	
		M.lutea	***B.cereus***	***M.lutea***	***B.cereus***
Melia Azadarach	Tuber	- (32)	- (30)	- (30)	13 (31)
Albizia anthelmintica	Roots	- (30)	- (32)	- (30)	- (31)
Ficus natalensis	Bark	13 (34)	12 (32)	12 (35)	11 (32)
Cissus quadrangularis	Stem	- (33)	- (29)	- (32)	- (33)
Indigofera sp	Seeds	- (31)	- (30)	- (30)	- (32)
Salvadora persica	Roots	- (33)	- (32)	- (33)	- (32)
Commiphora flaviflora	Gum	- (32)	- (32)	- (31)	- (32)
Cucumis dipsaceus	Stem	- (31)	- (29)	- (32)	- (31)
[1]*Maerua denhardtiorum*	Bark	- (30)	- (31)	- (31)	- (31)
[2]*Maerua denhardtiorum*	Bark	- (32)	- (33)	- (32)	- (31)
[1]*Olea africana*	Bark	11 (32)	10 (32)	- (31)	- (30)
[2]*Olea africana*	Bark	- (31)	- (33)	- (31)	- (31)
Zanthoxylum chalybeum	Fruits	- (30)	- (31)	- (30)	- (35)
Acacia nilotica	Bark	- (33)	- (32)	15 (39)	28 (30)
Terminalia brownii	Roots	24 (31)	12 (29)	23 (40)	14 (31)
Balanites aegyptiaca	Leaves	12 (40)	10 (43)	- (31)	- (29)
Euclea schimperi	Stem	15 (43)	15 (29)	- (30)	- (30)
Solanum incanum	Fruits	- (13)	- (31)	19 (32)	- (31)
Withania somnifera	Fruits	- (35)	- (31)	- (31)	- (30)
Carissa endulis	Leaves	- (39)	- (31)	19 (40)	- (32)
Acacia tortolis	Bark	- (31)	- (30)	- (31)	- (31)

( ) Represents the inhibition zone of the standard drugs used as positive controls

[1]*Maerua denhardtiorum* plant sample from Ngurunit area

[2]*Maerua denhardtiorum* plant sample from Karare area

[1]*Olea africana* plant sample from Ngurunit area

[2]*Olea africana* plant sample from Karare area

4.5.2.3 Antibacterial sensitivity test results of ethanol and water extracts of medicinal plants collected from the Gabra area in disc reservoirs

Five and 4 of the water extracts and 6 and 3 of the ethanol extracts showed activity against *M. lutea* and *B. cereus*, respectively. Both the water and ethanol extracts of *solanum incanum* showed an inhibition zone of 9mm for both test microorganisms (Table 4.8). Water extract of *Balanites aegyptiaca* showed the higest inhibition against *B. cereus* (10mm). As seen from Table 4.8, the difference between the inhibition zones shown by both the water and ethanol extracts against *M. lutea* and *B. cereus* was fairly small.

Table 4.8: Antibacterial sensitivity test results of ethanol and water extracts of medicinal plants applied by the Gabra community of Marsabit District, Kenya, using disc reservoir method.

Plant species	Part of the plant used	Inhibition zone(mm)							
		Water extract				Ethanol extract			
		M.lutea		*B.cereus*		*M.lùtea*		*B. cereus*	
Solanum sp	Fruits/ Roots	-	(40)	-	(41)	-	(40)	-	(39)
Aloe sp.	Stem	-	(41)	-	(40)	-	(45)	-	(40)
Balanites aegyptiaca	Leaves	7	(30)	10	(34)	7	(33)	8	(34)
Acacia mellifera	Stem	-	(40)	-	(40)	-	(40)	-	(40)
Solanum indicum	Fruits/ Roots	7	(40)	7	(39)	7	(41)	7	(40)
Croton macrostachysus	Bark	8	(42)	-	(40)	7	(42)	-	(42)
Commiphora flavifora	Stem	-	(40)	-	(41)	-	(40)	-	(41)
Cucumis dipsaceus	Stem	7	(40)	-	(40)	7	(40)	-	(40)
Solanum nigrum	Fruits/ Roots	-	(42)	-	(42)	-	(40)	-	(42)
Withania somnifera	Fruits/ Roots	-	(41)	-	(40)	-	(40)	-	(40)
Cissus sp	Stem	-	(43)	-	(42)	-	(40)	-	(41)
Solanum incanum	Fruits/ Roots	9	(45)	9	(44)	9	(43)	9	(40)
Boscia cariaceae	Stem/ Roots	-	(41)	-	(39)	-	(40)	-	(39)
Cordia sinensis	Stem	-	(41)	-	(41)	-	(40)	-	(41)
Balanites lineariifolia	Leaves	-	(40)	7	(40)	7	(40)	-	(40)

( )Represents the inhibition zone of the standard drugs used as positive controls.

4.5.2.4 Antibacterial sensitivity test results of ethanol and water extracts of medicinal plants collected from the Gabra area in well reservoirs

Three and 2 of the water extracts and 7 and 6 of the ethanol extracts showed activity against *M. lutea* and *B. cereus*, respectively. Both the water and ethanol extracts of *Commiphora flaviflora* showed inhibition to both test microorganisms. Ethanol extract of *Cucumis dipsaceus* showed the highest inhibition against *B. cereus* (14mm) (Table 4.9). Plate 4.9 shows the inhibition of a water extract of *Cucumis dipsaceus* against *B. cereus.*

Table 4.9: Antibacterial sensitivity test results of ethanol and water extracts of medicinal plants applied by the Gabra community of Marsabit District, Kenya, using well reservoir method.

Plant species	Part of the plant used	Inhibition zone(mm)			
		Water extract		Ethanol extract	
		M.lutea	*B.cereus*	*M.lutea*	*B. cereus*
Solanum sp	Fruits/ Roots	- (43)	- (42)	- (40)	- (44)
Aloe sp.	Stem	- (36)	- (37)	8 (39)	- (36)
Balanites aegyptiaca	Leaves	- (33)	- (34)	7 (31)	11 (33)
Acacia mellifera	Stem	- (36)	- (40)	- (36)	- (36)
Solanum indicum	Fruits/ Roots	8 (26)	- (33)	- (28)	- (26)
Croton macrostachysus	Bark	- (38)	- (38)	6 (38)	- (36)
Commiphora flavifora	Stem	10 (39)	9 (42)	7 (42)	8 (41)
Cucumis dipsaceus	Stem	- (36)	7 (36)	7 (44)	14 (44)
Solanum nigrum	Fruits/ Roots	- (41)	- (41)	9 (40)	9 (41)
Withania somnifera	Fruits/ Roots	- (40)	- (41)	- (40)	- (40)
Cissus sp	Stem	- (41)	- (40)	- (39)	- (38)
Solanum incanum	Fruits/ Roots	7 (44)	- (43)	7 (45)	8 (44)
Boscia cariaceae	Stem/ Roots	- (39)	- (39)	- (39)	8 (39)
Cordia sinensis	Stem	- (37)	- (37)	- (35)	- (38)
Balanites leanriifolia	Leaves	- (43)	- (43)	- (42)	- (42)

( )Represents the inhibition zone of the standard drugs used as positive controls.

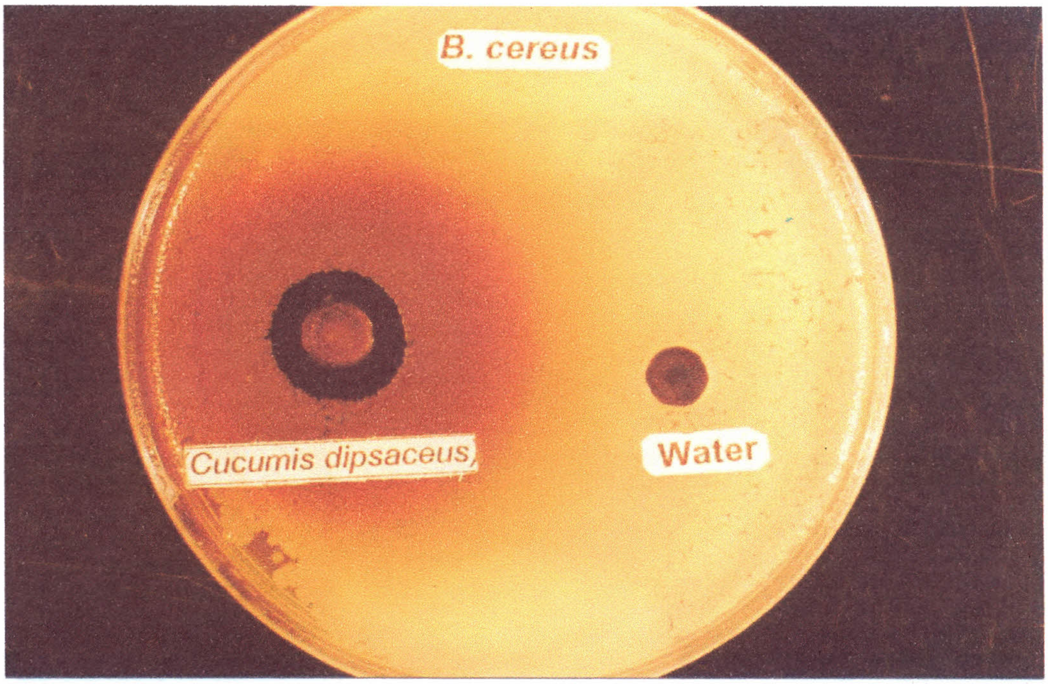

Plate 4.9: A photograph of a petri dish showing the inhibition zone of water extract of *Cucumis dipsaceus* against *B. cereus* with water as a negative control in well reservoir.

4.5.2.5 Results of standard drugs used in the antibacterial sensitivity tests

The growth inhibition zone of the positive controls of each pair of the plates was measured and this was taken as a measure of antibacterial activity of the standard drugs used. The results are displayed in brackets in Tables 4.6 - 4.9. As seen from Plate 4.10, the growth inhibition zones of both drugs merged, hence presenting difficulties in reading of the results. This was the reason why the positive controls were set on separate plates.

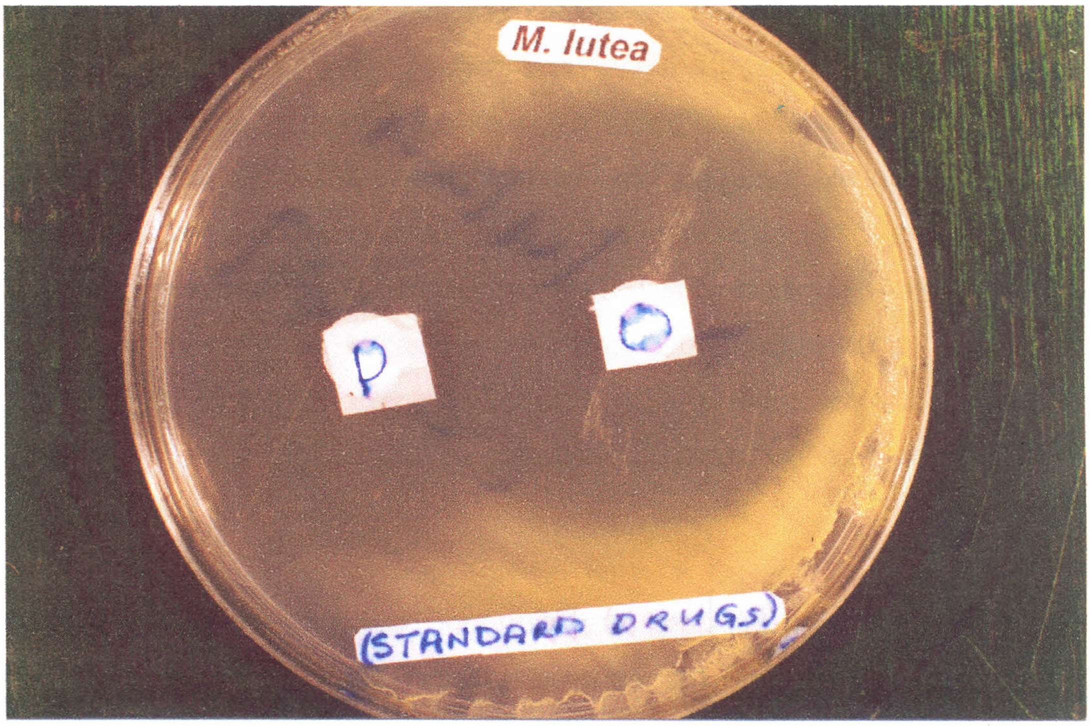

Plate 4.10: A photograph of a petri dish showing inhibition zones of standard drugs (Penstrep® (P) and Alamycin® (O)) as positive controls against *M. lutea* in disc reservoir.

CHAPTER 5

DISCUSSION

All the pastoralists interviewed during both the PRAs and LTHs workshops were very resourceful. Contrary to the initial fears that it would not be easy to document knowledge on folk veterinary medicine, most respondents turned out to be open, with straight forward discussions.

Among the two pastoral communities under study, ethnoveterinary remedies were the first and, mostly, the only line of action against most livestock ailments. The data obtained during the PRAs and the residential workshops organized for the 54 LTHs revealed existence of a rich body of EVK within the two study communities. The way of life of pastoralists and their often-disadvantaged location are the most likely contributing factors for the continuous development and religious utilization of EVK among the Rendille/Ariaal and Gabra communities. Heavy reliance on EVK among pastoralists has also been reported by McCorkle *et al.* (1996) who concluded that the heavy reliance on EVK was mostly due to remote settings. Comparative analysis of EVK practices between the two study communities indicated fundamental differences. For example, EVK in Rendille/Ariaal existed as general knowledge while among the Gabra, it occured within specific family lines.

The Gabra displayed a high ingenuity and precision in the livestock healing art with specific lines of specialization. The science of LTHs specialization in this community was more developed than that of the Rendille/Ariaal ethnic group. The Gabra had within and between species specialists. Some within species specialists were, for example, bone/fracture dystocia and small stock specialists and cattle and/or human healers. In addition, the Gabra also had both general and specialized practitioners' categories, which were well-defined. The general practitioners referred cases that they were unable to handle to the specialists for expert attention, a classical referral system similar to the modern veterinary set-up in all aspects. This was consistent with the findings of Bizimana (1994) that in many cultures, healers of human diseases often treated animals. However, just as in modern veterinary medicine, a line could be drawn between the various levels of specialization. In many African cultures, specialization in indigenous healing art varies from community to community (McCorkle, 1986).

In the Rendille/Ariaal community, majority of the healers were general practitioners. This was presumably because the EVK knowledge was shared freely within the community. The practice was mainly carried out by the herdsmen who treated various ailments/diseases by applying what was common knowledge or belief among most Rendille/Ariaal herdsmen. The progress of the treated animal was closely monitored and the results discussed among the "*Manyatta*" stockowners. This follow-up protocol has not only helped to refine the EVK knowledge over the years, but has made it available to the whole community.

The Rendille/Ariaal, who are traditionally camel and small stock keepers, subsist in an area that offers very limited vegetation varieties. However, due to their close interaction with their Samburu neighbours, they have assimilated and intergrated Samburu's EVK into their traditional healing art. This has enriched the Rendille/Ariaal EVK with a variety of both lowland and highland herbal flora, compared to the Gabra community. Their indigenous healing knowledge is limited to a large extent to the camels, sheep and goats. In deed, the Rendille/Ariaal do acknowledge the more superior camel-healing knowledge of the Gabra camel specialists, whom they consult from time to time.

Both healers of animals and humans in both communities were of either sex. However, there were more men livestock traditional healers than women. This could be due to the fact that in many pastoral communities, the care and general well-being of livestock is the prerogative of men and thus, animal health-care falls under the traditional role of pastoral men. However, the healing knowledge could be available to women as well, but their treating practice was restricted to only the animals they traditionally care for, for example, small ruminants, young stock and the sick of all species. Although pastoral women played a big role in preparation of herbal recipes, the final decision regarding actual treatment was a preserve of men. This observation agrees with the findings of

Schwabe (1978) that labour division within a pastoral setting is such that each individual is responsible for all classes of livestock under his/her care.

The semi-structured interviews revealed that the Rendille/Ariaal and Gabra pastoralists believe in both natural and supernatural (mortal and immortal) causes of diseases. Thus, traditional prevention of livestock diseases was undertaken using different approaches, as dictated by the perceived causes of the illness. If immortal cause was suspected or "diagnosed", prevention was through performing of rites and observation of taboos. Similar findings have been reported among the Fulani of northern Nigeria by Bizimana (1994). In case of specific disease diagnosis, for example, tick infestation, ticks were removed and tick-infested areas avoided and/or animals were washed with herbal concoctions believed to have acaricidal effect. For the Gabra community, traditional vaccinations against contagious caprine pleuropneumonia (CCPP) have reportedly existed for generations. This finding is in agreement with other studies undertaken in other parts of Africa, where traditional vaccination of camels against camel pox have been reported among the Tuareg of northern Africa (Bizimana, 1994).

In the traditional description of diseases and disease causation, a different name was given for each of the livestock diseases described during the PRAs. However, in some cases, different diseases were regarded the same. This was partly because diseases were named using clinical signs and thus, signs common to various diseases could be regarded as a disease entity.

In indigenous veterinary practice, diagnosis followed a specific protocol similar to modern practice. This included physical examination of the animal and/or a clear history narration as guided by systematic oral questions. History taking formed an important aid to successful diagnosis of livestock diseases. To make a diagnosis, a lot was borrowed from previous similar cases with similar manifestations. For most pastoralists interviewed, diseases were diagnosed by palpation, listening, looking and smelling. Once a traditional diagnosis was made, the prescription was usually in form of a single herbal preparation protocol or a combination of concoctions.

The choice of which type of remedy to use between modern and indigenous depended on the availability of money to purchase drugs and the distance to be covered in order to procure drugs in relationship to availability of herbs. More Gabras used indigenous remedies as their first line of treatment, than did the Rendille/Ariaal. The remote setting of most pastoral dwellings, the rampant insecurity and the non-cash economy practised in most pastoral regions were likely limiting factors for the use of modern remedies. This could explain why more Gabras than Rendille/Ariaal used indigenous remedies as the former are more disadvantaged interms of accessibility.

Generation of lists of important livestock diseases among the various species of livestock reared gave varied data between the two study communities. This was in contrast to what would be expected, since the Rendille and the Gabra communities subsist on a similar range environment (eco-zone VI and VII). The differences could partly be explained by the fact that, whereas there are no true Rendille/Ariaal nomadic pastoralists today, the Gabras are still nomadic, trekking and herding their livestock across their traditional grazing home range including southern Ethiopia. Thus, the livestock disease challenges encountered by the Gabras were likely to be different from those of the Rendille/Ariaal who were permanently settled in specific locations. The Rendille/Ariaal livestock move within certain radii that gave them easy access to their settlements, water and pasture. This pattern of settlement could be the reason why mange and ticks were serious problems to Rendille/Ariaal camels while the problems were not ranked highly by the Gabra herders.

In most of the livestock species, helminths, ticks, mange and eye infections were common health problems across both communities. The high prevalence of these infections could be due to the fact that pastoralists were generally reluctant to spend money on livestock health issues that were not life-threatening. The high prevalence of eye infections may have been due to the vegetation type prevalent in the grazing environment of both communities. The vegetation type was composed of dwarf shrubland and shrubland mixed with various species of acacia woodland. This kind of vegetation could have been the source of traumatic eye injuries during grazing.

Rinderpest was ranked by the Rendille/Ariaal as the foremost problem for the cattle, although they reportedly had not witnessed the disease in the recent past. However they still considered it important, given the heavy losses they incurred during the last outbreak. The PRA oral historical profile tool estimated the last outbreak to have occurred in the early nineteen sixties. Contagious caprine pleuropneumonia (CCPP) was ranked as the most important goat disease by both study communities. Plant poisoning was also common in both sheep and goats in both communities. The Rendille/Ariaal also reported it in cattle. Poisonings were reportedly common during prolonged droughts, which are unfortunately becoming a common phenomenon in Marsabit District. During such periods, livestock moved to unfamiliar grounds, thus accessing new herbage, which turned out to be poisonous. Furthermore, most poisonous trees and shrubs reportedly remained evergreen even during the worst droughts. Due to desperation for lack of other foraging materials within their vicinity, livestock fed on what they would not forage on under normal circumstances with the resultant plant poisoning.

The most common donkey diseases reported by the two communities were trypanosomosis, strangle-like disease, lameness and wounds, mainly as a result of hyena bites or saddle sores. Among most pastoralists of Marsabit, donkeys were rarely herded like other livestock species. Most of the time they were left loose in the range, day and night till they were needed for transport. This exposed them to a lot of risks, especially hyena attacks.

Inventory of ethnoveterinary plants and materials revealed that there were over 20 livestock diseases/ ailments / disorders that were treated using 72 species of plants, either singly or in combination with other plant species or folk materials. The five most common plant families used among the study communities were the *Burseraceae, Caparidaceae, Euphorbiaceae, Mimosoideae* and *Solanaceae*. Some of the plant species in the family Burseraceae were shown to posses antibacterial activity. Similar findings have been reported among the Mijikenda people of coastal Kenya by Mutta (1996).

The Rendille/Ariaal and the Gabra used *Commiphora africana* for treatment of retained afterbirth. The same herb is used in West Africa as part of the ingredients for treatment of piroplasmosis and trypanosomosis (Bizimana, 1994). The Rendille/Ariaal used its gum for fixing fractures and bone-setting, while the Tuareg of northern Africa used it as part of other ingredients against mange in camels (Bizimana, 1994).

The species reported in the family Capparidaceae included *Maerua denhardtiorum*, *Boscia coriacea*, *Capparis tomentosa and Capparis cartileginea*. *B. Coriaceae* and *C. tomentosa* were used to treat intestinal disorders that were manifested by lack of defaecation due to a "hard" faecal syndrome, and subsequent bloat in cattle and camels. Desta (1993) reported similar utilization among the tribes of the Ethiopian highlands, who use the roots of *C. tomentosa* for managing abdominal disorders.

The common usage of similar plant species indicated that they had long been recognized as specific remedies to specific ailments. The fact that these communities were not neighbours and yet used the same plants not only displayed the ingenious ability of man to manipulate and utilize whatever was at his disposal to manage his life and that of his animals, but also emphasized the importance of such herbs as sources of medicine. As noted by Martin (1995), many researchers argue that commonality of use, whether arising through independent discovery or interaction between peoples of different cultures, is directly related to the degree of effectiveness of a traditional remedy.

Croton macrostachyus, *Euphorbia heterochroma* and *Euphorbia samburuensis* were the medicinal plant species reported in the family *Euphorbiaceae*. Some species in this family were used for skin conditions. Others like *Croton macrostachyus* were used to treat wounds, while *Croton dichogamus* was used to expel retained afterbirth. Fungal infections like streptothricosis and protozoan diseases like trypanosomosis were treated with *Euphorbia heterochroma*. Other plants, e.g., *E. samburuensis* and *E. triaculeata* were used against contagious caprine pleuropneumonia (CCPP) and impacted rumen (anaplasmosis-like disease), respectively. *C. macrostachyus* have been reported to be used by the Maasai as an anthelmintic as well as a laxative in cases of difficult defeacation (McCorkle *et al.*, 1996).

Both the Rendille/Ariaal and the Gabra communities used *Albizia anthelmintica*, in *Mimosoideae* family as an anthelmintic. It was reported to be highly potent and religiously reliable as a traditional anthelmintic. Bizimana (1994) reported the use of the root of this species of plant in Tanzania for treatment of tapeworms infection in humans and livestock. The Turkana of Kenya uses its stem for treatment of cattle diarrhoea (Bizimana, 1994). Most of the other members of this family were the *Acacia species*, which included *A. nilotica, A. tortilis, A. nubica, A. seyal and A. melliphera.* These species were used to treat wounds, calf rejection, ectoparasite infestations and eye infections. Some of the most reliable herbs among the two study ethnic groups were found in this family. *Acacia species* produced gummy exudates from the bark, branches and stems. The gums were reported to have potent effects, hence justifying the traditional use for disorders (Watt and Breyer-Brandwijk, 1962). The two communities used dry gum of several species of *acacia* by burning to produce smoke that is used as fly repellant as well as for perfurming homes. The inner bark of *A. melliphera* was used by the Rendille/Ariaal against stomach disorders in man and livestock. The same use was reported in Senegal and Niger (Bizimana 1994).

Solanum incanum, Solanum nigrum, Solanum indicum, Solunum coagulans and Withania somnifera were the important species in the family *Solanaceae*. The two communities used most of these species to manage wounds. One of the species, *Withania somnifera,* was used to expel retained afterbirth in addition to its use in management of wounds. These uses were in agreement with the reports of Derry *et al.* (1999) who documented the use of the twigs, leaves and berries of this herb on donkeys, in management of saddle sores and girth galls in Tanzania.

Among the two ethnic groups, there also existed folk manipulative techniques, such as bone-setting and treatment of calf rejection. Bizimana (1994) reported use of both non-plant-based materials and manipulative techniques in management of wounds, sores and ulcers in Mauritania, Mali and Senegal.

The sensitivity test results of the home-made concoctions indicated that the preparations by the LTHs lacked a standard recipe, in addition to displaying low antibacterial activity. This could be deduced from the different efficacy levels shown by the concoctions. High contamination of these preparations was also evident. This reflected the unhygienic conditions under which the LTHs prepared their concoctions.

The sensitivity test results of the ethanol and water extracts of medicinal plants gave varied data. The results indicated that, the type of extraction solvent as well as the reservoir used, could be a major determinant of the efficacy of the resultant extract. Although both water and ethanol solvents, which were used as negative controls, were found to have no effect against any of the test microbes, they seemed to contribute to the efficacy of the preparations. This could explain the reason why some medicinal plants showed high activity with one type of extraction but very limited activity or none at all with a different type of solvent. Also, some preparations showed activity in some reservoirs while they were not active in a different type. In addition, different herbal extracts acted against the two test microbes differently; some were active on both, while others were only active on either of the two test microorganism. The test microorganisms showed different sensitivity, in different types of the reservoirs and the solvents. This inconsistency has been reported in Kenya (Mutta,1996), Nigeria (Ibrahim, 1986) and Asia (Mensah *et al.*, 1990).

CONCLUSIONS AND RECOMMENDATIONS

This study has revealed the existence of active livestock traditional healers, as well as documenting the rich ethnoveterinary practices among the Rendille/Ariaal and Gabra communities of Northern Kenya. In addition, the study has also confirmed that herbal plants utilized in traditional veterinary practice among the study ethnic groups had demonstrable antibacterial activity. Consequently, the following recommendations are made:

1. There is a need for further research in form of clinical trials to validate the efficacy of these remedies;

2. There is a need to develop treatment regimes and dosage guidelines for the proven remedies. This should be based on locally available gadgets (e.g., how many handfuls of roots should one boil in how much water to obtain how much bottles of soda to get an effective dose?);

3. The active ingredients in these medicinal plants should be determined and characterized;

4. The possibility of using medicinal plants for the rehabilitation of badly degraded range environment should be explored. This should take into account the ecological requirements of each plant;

5. Awareness creation on appropriate harvesting techniques for medicinal plants is needed, in order to avoid damage of some plants, thus creating dangers of extinction.

REFERENCES

Ayensu, E.S. (1978). Traditional livestock practice. In: Ed. E.S Ayensu, *Medicinal plants of West Africa,* Reference Publications in Algonae. Michigan. USA. pp.117-118.

Baumann, M.(1990). The nomadic animal health auxiliary system (NAHA–System) in pastoral areas of central Somalia and its usefulness in epidemiological surveillance. PhD. Thesis, University of California, Davis, USA.

Benard, J. (1967). Treatment of leukemia and allied diseases caused by natural products. *Llyoydia,* ***30:***111–123.

Bierer, B.W. (1955). In: Ed. B.W. Bierer, *A short history of veterinary medicine,* University Press. Michigan State. pp. 35-57.

Bizimana, N. (1994). Medicinal plants. In: Ed. N. Bizimana, *Traditional Veterinary Practice in Africa.* GTZ, Eschborn. pp. 269-321.

Brander, G.C., Pugh, D.M., Bywater, R.J. and Jenkins, W.L. (1982). Anthelmintics. In: *Veterinary applied pharmacology and therapeutics* (5th edition). Bailliere Trindall, East Sussex, U.K. pp. 470-502.

Chambers, D. (1992). Rural appraisal: rapid, relaxed and participatory. discussion paper 311. Bringhton: IDS.(I).

Cox P.A. and Balick, M.J. (1994). The ethnobotanical approach of drug discovery. *Scientific American,* **271*:*** 82 – 87.

Cunningham, A.B. (1997). Botanical inventories, traditional knowledge and medicinal plants: In: *Proceedings of the UNESCO workshop on conservation and utilization of indigenous medicinal plants and wild relatives of food crops,* UNESCO, NAIROBI. pp.102–133.

Dalzziel, J.J. (1937). The useful plants of West Tropical Africa. London Crown Agents. IT publications, London. pp. 235.

Delehanty, J. (1989). In: Ed. J. Delehanty. Methods and results from a study of local knowledge of cattle diseases in coastal Kenya. *Ethnoveterinary research and development.* London. It Publishers. pp. 88–116.

Derry, B. B., Otsyina, R. and Ng'atigwa, C. (1999). Medicinal trees. In: Ed. B. Derry, *Indigenous knowledge of medicinal trees and setting priorities for their domestication in Shinyanga region.* Tanzania, ICRAF (Nairobi). pp 76- 81.

Desta, B. (1993). Ethiopian traditonal herbal drugs. Part II: Antimicrobial activity of 63 medicinal plants. *Journal of Ethnopharmacology,* ***39:***129-139.

FAO, 1984(a). Traditional (Indigeneous) systems of veterinary medicine for small farmers in India. Bangkok, FAO-RAPA.

FAO, 1984(b). Traditional (Indigeneous) systems of veterinary medicine for small farmers in Thailand, Bangkok, FAO-RAPA.

Flavier, J.M. Slikkerreer, L.J., and Brokensha, D. (1995). Indigenous knowledge. In: Ed J.M. Flavier, *The cultural dimension of development: Indigenous knowledge* system. London: Intermediate Technology Publications. pp. 479 – 487.

Fratkin, E.M. (1980). Concept of health and diseases among Ariaal/Rendille. PhD Thesis. University of London, London, UK.

Fratkin, E.M. (1997). The Ariaal. In: Ed. E.M Fratkin, *The Ariaal. A pastoral society of Northern Kenya.* London Crown Agents. London.

Gelfand, M. M. S., Drummond, R. B. and Ndemera, B. (1985). In: Ed. M. M. Gelfand, *The traditional medical practitioner in Zimbabwe.* Mambo Press, Harare, Zimbabwe. pp.411.

Good, C.M. (1987). Patterns of traditional medicine in rural and urban Kenya. In: Ed. C.M. Good, *Ethnomedical systems in Africa: Patterns of traditional medicine in rural and urban Kenya.* New York. The Guilford press. pp. 354.

Grandin, B.E., Thampy, R. and Young, J. (1991). Village animal health care. In: Ed. B.E. Grandin, *Village animal health care: A community based approach to livestock development in Kenya.* London, IT publications Ltd.

Grandstaff, T.B. and Grandstaff, S.W. (1987). A conceptual basis for methodological development in rapid rural appraisal. In: *Proceedings of the 1985 International Conference on Rapid Rural Appraisal (Khon Kaen University - Thailand*). pp 69-88.

Heine, B. and Heine, I. (1988). *Plant concepts and plant use*–Part III; Rendille plants (Kenya) – Verleag Breiten Bach–Germany.

Hedberg, I. (1987). Research on medicinal plants of the tropics–past, present and future. In: *medicinal and poisonous plants of the tropics. Proceedings of symposium 5 – 35 of the 14th International Botanical Congress, Berlin, August 1987.* Pudoc Wageningen. pp 152.

Herlocker, D.J. (1979). *Vegetation of the Southwestern Marsabit District, Kenya*, UNESCO (IPAL) Technical Report D–1, Nairobi. pp. 68.

Hostettmann, K. (ed.) (1991). *Assays for Bioactivity. Methods in plant biochemistry* W1.6. Academic Press, London. pp 360.

Ibrahim, M.A. (1986). Traditional veterinary practice in Nigeria. In: Eds. R. Von Kaufmann, S. Chater, and R. Blench. Livestock systems research in Nigeria's sub-humid zone. *Proceedings of the 2nd ILCA/NAPRI symposium held in Kaduna, Nigeria, from 29th October–2nd November 1984.* ILICA, P.O. Box 5689, Addis Ababa, Ethiopia. pp. 189–203.

Intermediate Technology Development Group (ITDG) and International Institute of Rural Reconstruction (IIRR) (1996). *Ethnoveterinary medicine in Kenya: Field manual of animal health care practices.* Intermediate Technology Development Group and International Institute of Rural Reconstruction, Nairobi–Kenya.

Khayota, B. (1998). *A report on the botanical identification and literature search on medicinal plants from Samburu District.* Intermediate Technology Development Group – Kenya.

Kloppenburg, J.R. (1988). First the seed. In: Ed. J.R. Kloppenburg, *The political economy of plant biotechnology.* Yale University Press, New Haren, NY, USA. pp 167–169.

Kokwaro, J.O. (1993). *Medicinal plants of East Africa*, 2nd Edition. East African Literature Bureau, Kampala, Nairobi, Dar es Salaam. pp. 401.

Koppell, C.R.S. (1990). *The major significance of 'minor' forest products. The local use and value of forests in the West African humid forest zone.* FAO, Rome. pp. 65-70.

Kirsopp-Reed, K. (1994). A review of PRA methods for livestock research and development. *PRA notes*, **20(60):** 11-36.

Korzybski, T., Kowszyk–Gindifer, Z. and Kurylowilz, W. (1967). *Antibiotics origin, nature and properties, volume 1.* Pergamon Press, Warszawa.

Lancini, G., Parenti, F. and Gallo, G.G. (1995). *Antibiotics: A multi disciplinary approach*, Plenum Press. New York and London. pp. 278.

Lanly, J.P. (1982). *Tropical tree resources: FAO forestry paper No.30.* FAO, Rome, Italy.

Lawrence, J.A., Foggin, C. M. and Norval, R.A.I. (1980).The effects of war on the control of livestock diseases in Rhodesia (Zimbabwe). *Veterinary Record*, **10:** 82-85.

Leers, P. (1993). *A resource mannual for trainers and practioners of participatory rural appraisal (PRA).* Birmingham: Development Administration Group. University of Birmingham. (9).pp. 124-130.

Lipp, P.J. (1989). Methods of ethnopharmacological field work. *Journal of Ethnopharmacology*, **25:** 139–150.

Lewis, W.H. and Elvin–Lewis, M.P.F. (1977). *Medical Botany* – John Wiley and Sons– New York .pp.182-185.

Marsabit District Profile Report (1986). *District Social–Cultural Profile Project.* Government Printers. Nairobi.

MDP/GTZ. (1999). *GTZ–Marsabit Development Programme Activity Report (1999), Marsabit. pp.108-129.*

Marsabit District Development Plan (1997-2001). *Marsabit District Development Plan.* Ministry of Planning and National Development: Rural Planning Department, Office of the Vice-president. Government Printers. (1997). Nairobi. pp.61-120.

Mathias–Mundy, E. and McCorkle, C.M. (1989). Introduction to ethnoveterinary medicine. In: Ed. E. Mathias–Mundy, *Ethnoveterinary medicine: An annotated Bibliography*–Bibliographies in Technology and Social change, No. 6: Iowa State University, Ames, Iowa 50011, USA.

Martin, G.J. (1995). *Ethnobotany: A methods manual.* Chapman and Hall.London. pp. 72.

McCorkle, C.M., Mathias E. and Schillhorn van keen, T.W. (1996). Ethnoveterinary research and development. In: Ed. C.M. McCorkle, *IT studies in indigenous knowledge and development*: Intermediate Technology Publication. pp.173-193.

McCorkle, C. M. (1986). An introduction to ethnoveterinary research and development. *Journal of Ethnobiology* **6 (1):** 129–149.

Mensah, J.L., Lagarde, I., Cesehin, C., Michel, G., Gleye, J. and Fourshe, I. (1990). Antibacterial activity of the leaves of *Phyllanthus discoidens. Journal of Ethnopharmacology*, **29 (1990).** 130–133.

Mez–Mengold, L. (1971). *A history of drugs:* Totowa, N.J., Parthenon Publishing. USA.

Moran, K. (1994). Biocultural diversity conservation through the healing forest conservancy. In: *Intellectual properties rights (IPR) for indigeneous peoples. A source look creaves,* T. (ed.) Society for applied anthropology, Oklahoma. pp. 274.

Mutta, D.N. (1996). Antibiotic screening of plants used to treat infectious diseases in Kenya: MSc Thesis – University of British Columbia. British Columbia.

Nickell, L.G. (1959). Antimicrobials of vascular plants. *Economic Botany,* **13:** pp 281 – 318.

Obado, E.A.O. and Odera, J.A. (1992). Management of medicinal plants resources in Nyanza Province. Opportunities for renewal and promising conservation strategies. *A paper presented at a national workshop on traditional medicine, Its practice and the law in Kenya*, Lake Bogoria, Kenya. November 4th – 6th 1992.pp.152 159.

Odera, J.A. (1997). Traditional beliefs, sacred groves and home garden technologies. Adapting old practices for conservation of medicinal plants. *Proceedings of a UNESCO workshop on indigenous medicinal plants and wild relatives of food crops;* UNESCO, Nairobi. pp. 109-122.

Perdue, R.E.Jr., Abbort, J.B.J. and Hartwell, J.L. (1970). Screening plants for antitumour activity. A comparison of two methods of sampling herbaceous plants, *Lloydia*, **33:**1–6.

Pujol, J. (1993). *Natural Africa,* Natural Healers Foundation, Durban. South Africa.

Schwabe, C. W. (1978). *Cattle, priests and progress in medicine. The wesley W. spink lectures on comparative medicine, vol. 4.* University of Minnesota press, Minneapolis, Minnesota, USA. pp. 34-38.

Seyani, J.H. (1987). The conservation of plant genetic resources in Malawi. *A paper presented at The international training workshop on "Plant Genetic Resources Conservation in Africa*. Lusaka. Zambia. pp.18.

Tablino, P. (1999). *The Gabra; Camel nomads of Northern Kenya*: Pauline publications, Africa.

Turner, N.J. (1975). *Food and Plants of the British Columbian Indians; Coastal peoples. British Columbia Provincial Museum handbook No. 34.* Royal British Columbian Museum, Victoria. British Columbia. pp 253.

Trease, G.E. and Evans, W.C. (1978). *Pharmacognosy (11th edition).* Tindall. London UK.

United Nations Education and Scientific Organisation (1997). Conservation and utilisation of indigenous medicinal plants and wild relatives of food crops. UNESCO office – Nairobi.

Warren, D.M. (1991). *Using indigenous knowledge in Agricultural Development.* World Bank discussion paper No.127–Washington, D.C. The World Bank. pp. 189-211.

Wanyama, J. (1997a). *Confidently used ethnoveterinary knowledge in Samburu. Book I.* Intermediate Technology Development Group. Nairobi. Kenya.

Wanyama, J. (1997b). *Confidently used ethnoveterinary knowledge in Samburu. Book II.* Intermediate Technology Development Group. Nairobi. Kenya.

Watt, J.M. and Breyer–Brandwijk, M.G. (1962). *The medicinal and poisonous plants of Southern and Eastern Africa*. E.A. Livingstone Ltd. Edinburgh and London-UK. pp.1457.

World Bank (1998)). *Consultant report on indigenous knowledge for development: Framework for action*. Knowledge and learning centre-Africa Region. World Bank. USA.

World Health Organization (1978). Declaration of ALMA-ATTA. International conference on primary health care. Alma–Atta, USSR, September, 1978. WHO. Geneva.

APPENDICES

Appendix 1: Research agreement between pastoralists of Marsabit District, Kenya, and the researcher, 2001.

This is to allow Dr.George Josiah Wamwere-Njoroge, the Project Veterinarian MDP/GTZ and a student at the Department of Public Health, Pharmacology and Toxicology (PHPT) of the University of Nairobi, to use my/our camels/herds for research on ethnoveterinary practices. He will further write his MSc. thesis and publish and /or carry out further investigation as situation may demand. We have agreed to be collaborators and will share the results and own the outcome of the research as joint authors, researchers and donors.

Stockowner/LTH... Sign ....

Village/*Manyatta*................Location................ Division..............

Address: ....

Researcher..Sign ....

Institution ....

Date: ....

Address: ....

Appendix 2: Characteristics of the existing veterinary knowledge as applied by the Rendille/Ariaal and Gabra ethnic groups of Marsabit District, Kenya, 2001.

	ETHNIC GROUP	
Practice	**Rendille/Ariaal**	**Gabra**
Existence of EVK within the community	➢ EVK is generally available to every stockowner/herder ➢ Individual interests and efforts enables some people to be more knowledgeable than others	➢ EVK is exclusively found within certain family lines (healing families) ➢ It can never be leaked to other families since it is religiously protected (It is a taboo to leak it outside the family line).
Transfer of EVK knowledge (acquisition of EVK)	➢ Continuous consultation as livestock health issues emerge leads to knowledge being available to everybody. ➢ Traditionally, it is transferred from the elders to the youths using the "age-sets" passage as the entry point	➢ Strictly from father to the favourite son (or daughter, though rarely) through the family line
Stage/age to enter active practice as a fully recognized healer	➢ Any age can practice so long as you have the knowledge. In any case one is free to consult any one at any time.	➢ Specifically after the demise of parent teacher ➢ Training is by accompanying him on his practice errands. ➢ When very old, he can begin to send you but in both cases the payments are made directly to him.

Appendix 2: Continued

Specialization of the EVK practitioners	➢ Exist to some extent in form of • Bone setters • Livestock health care • Human health care ➢ Specialization is not very elaborate between and within species ➢ There seems to be more specialization within the Ariaal than the Rendille. This is usually guided by the family descent: Rendille descent – camel specialist) (Samburu descent – Cattle specialist)	➢ Very clear-cut specialization exists. Both in between and within species for example Camel specialists. Among them we may have further specialization into • Camel dystocia/fetotomy specialist • Camel breeding/infertility specialists/mating assistant • Cattle/shoats specialist • Bone setters etc ***Note:*** Among the Gabra there exists recognized consultants especially for camels who are not only consulted by the other healers within the community but also by outsiders (like Rendille)
Gender involvement in traditional livestock health care	➢ For the Ariaal of Samburu descent, both men and women are involved in livestock health care of all livestock species though not at the same level ➢ The Ariaal of Rendille descent do not get involved in the camel affairs. However, women are involved in livestock health care of other species.	➢ Camel health care is exclusively done by men ➢ Few women are involved in health care of cattle/shoats (especially those of renowned healers family line) ➢ More women practitioners are found in human health care but are only those within healer's family lines

Appendix 3: Distribution of livestock traditional healers by *manyatta*, sex, ethnicity, and area of specialization among the Rendille/Ariaal and Gabra communities of Marsabit District, Kenya, 2001.

Name of Livestock Traditional Healer	Manyatta of Origin	Sex	Ethnicity	Specialization
Sibilet Lekadaa	Olturot	M	Rendille/Ariaal	General Practitioner
Lesaran Ogom	Olturot	M	Rendille/Ariaal	General Practitioner
Letamarjan Lesitan	Gatab	M	Rendille/Ariaal	General practitioner
Dido Kinyere	Kargi	M	Rendille/Ariaal	General Practitioner
Manterian Legara	Ndigir	M	Rendille/Ariaal	General Practitioner
Lengima Litapijon	Merille	M	Rendille/Ariaal	General Practitioner
Leriso Leteitan	Merille	M	Rendille/Ariaal	General Practitioner
Lesub Lenairoki	Lontorio	F	Rendille/Ariaal	General Practitioner
Leerio Inam	Lontorio	M	Rendille/Ariaal	General Practitioner
Leringan Lemuoga	Ndigir	M	Rendille/Ariaal	General Practitioner
Akiboran Lesigilan	Matarrbah	M	Rendille/Ariaal	General Practitioner
Holia Arandidhe	Matarrbah	M	Rendille/Ariaal	Bone-setter
Lekoyo Lesas	Ngurunit	M	Rendille/Ariaal	General Practitioner
Leroi Haringura	Ilaut	M	Rendille/Ariaal	General Practitioner
Mzee Lengoloi	Ilaut	M	Rendille/Ariaal	Bone-setter
Malkach Lukitarakino	Ngurunit	F	Rendille/Ariaal	General Practitioner
Lboi Lemago	Ilaut	M	Rendille/Ariaal	General Practitioner
Mzee Adiyakishe	Ngurunit	M	Rendille/Ariaal	General Practitioner
Mzee Lemadada	Ngurunit	M	Rendille/Ariaal	Bone-setter
Mzee Lempunik	Ngurunit	M	Rendille/Ariaal	Bone-setter
Galdello Gahanteh	Tubcha	M	Rendille/Ariaal	Camel Specialist
Haruleh Machan	Nahagan	F	Rendille/Ariaal	General Practitioner
Lkupunto Lenkat	Lorora	F	Rendille/Ariaal	General Practitioner
Namwugolo Lekante	Olturot	M	Rendille/Ariaal	Bone-setter
Ruchii Dalacha	North Horr	M	Gabra	General Practitioner
Bonaya Yattani Wato	North Horr	M	Gabra	Bone-setter
Sorah Bonaya Huri	North Horr	M	Gabra	Camel practitioner
Dibo Algole	Dukana	M	Gabra	General practitioner
Hassan Dika	Dukana	M	Gabra	Small stock specialist
Galgallo Elema	Dukana	M	Gabra	camel Infertility specialist
Yattani Guyo	Balesa	M	Gabra	Camel specialists
Budha Dokata	Balesa	M	Gabra	General practitioner

Appendix 3: Continued

Sori Katelo Elema	Balesa	F	Gabra	Camel dystocia
Barille Tuye Umuro	Kalacha	M	Gabra	General Practitioner
Yattani Rasa	Kalacha	M	Gabra	Camel herbal specialists
Katelo Konchoro Abudo	Kalacha	M	Gabra	Camel dystocia
Guyo Gorai Bora	El-Hadi	M	Gabra	Camel dystocia specialist
Wario Racha Kuna	El-Had	M	Gabra	General practitioner
Dabasso WarioGuracha	El-Hadi	M	Gabra	Bone-setter
Molu Boraji Guyo	El-Gade	M	Gabra	Camel specialist
Roba Rekes Galgallo	El-Gade	M	Gabra	Bone setter
Abudho Boraji Guyo	El-Gade	M	Gabra	General practitioner
Salesa K. Abagana	Turbi	M	Gabra	Camel diseases specialists
Kalla Diba Guyo	Turbi	M	Gabra	Camel specialist
Dollo Diba Guyo	Turbi	F	Gabra	General practitioner
Katelo Boru	Bubisa	M	Gabra	Camel specialist
Guyo Ali Kontoma	Bubisa	M	Gabra	Bone setter
Mamo Elema Qampee	Bubisa	M	Gabra	Camel specialists
Huqa Sora Duba	Huri-Hills	M	Gabra	Fractures/Dislocation repair
Wario Boru Damballa	Forole	M	Gabra	Camel specialist
Abudho Huqa Adano	Forole	M	Gabra	Camel dystocia specialist
Dido Koke Kiro	Forole	M	Gabra	Camel bone-setter
Katelo Dokata	Maikona	M	Gabra	General practitioner
Edin Haro Boru	Maikona	M	Gabra	Fracture setting

Appendix 4: Distribution of ethnoveterinary medicinal plants by family/species and formulation, dosage regimes, and diseases treated as applied by the Rendille/Ariaal and Gabra ethnic groups of Marsabit District, Kenya, 2001.

Family/species	Local names		Part of the plant used	Preparation, dosage regimes and administration protocol	Diseases/ ailments treated
	Rendille	Gabra			
Acanthaceae 1. *Blespharis linarifolia pers.*	Lemaruk Har ja	Barat	Stem and leaves/ twigs	Stem, leaves and twigs are crushed, boiled in water, cooled overnight and given orally	Retained after -birth
2. *Blepharis ciliaris*	Lemaruk Lmarik	---------	Stem, leaves	Boiled in water, cooled overnight and given orally in the morning	Stomach disorders
Agavaceae 3. *Sansevieria robusta* N.E. Br.	Eima	Jake	Succulent leaves	Crushed and soaked in water overnight to make a wound washing solution	Wounds
Anacardiaceae 4. *Rhus vulgaris*	---------	Dabobiss	Fruits	Crushed, soaked in water overnight, sieved and given orally	Stomach disorders
Apocynaceae 5. *Carissa edulis (forsk.) vahl*	Godhom bor	Dagams	Leaves	Crushed, soaked in water overnight or boiled in water to make a solution for washing wounds/abscesses	Wounds Abscesses
6. *Adenium vulgaris*	Dawaraba	Obe Sarba ar	Stem / leaves	Soaked in water overnight to make a wound washing solution	Wounds

Key:

-------- Means that no name(s) were availlable

Appendix 4: Continued

Balanitaceae 7. *Balanites pedicellaris*	Kulum	Badan	Leaves	Soaked in water and sieved through a clean cloth then used as an eye drop	Eye infections
8. *Balanites aegyptiaca*	Luai Kulum	Baddan	Leaves	Crushed into an eye powder or soarked in water, filtered to make an eye drop	Eye infections
Burseraceae 9. *Commiphora flaviflora*	Dawahad odo	Wara	Gum	Fresh gum is mixed with milk or blood and applied onto a well set fracture Four flat pieces of wood are tightly tied around the fructure area for seven days	Fracture setting ***NB:*** When the gum dries it acts as a Paster of Paris (PoP)
10. *Commiphora sp,*	Hagar Ramo	Hamess	Bark	Crushed bark boiled in water, cooled then administred orally	Calf scours Diarrhoea
11. *Commiphora africana (A. rich.) Engl. S.I.*	Gaddayan Barr	Agarsu	Bark	Bark boiled in water, cooled overnight and given orally in the morning	Retained after -birth

Key:

-------- Means that no name(s) were availlable

Appendix 4: Continued

Boraginaceae *12. Heliotropium albohispidum Bak*	------------	-----------	Roots	Roots chopped into small pieces, soaked in water and few drops put into the eye daily till healing is achieved	Eye infections
13. Cordia sinensis	Gaertidahan	Mader	Stem	Stem boiled in water, cooled overnight and given orally	Retained after-birth
14. Cordia monoica Lam.	------------	Mader	Leaves	Leaves soaked in water overnight, filtered and the solution used as an eye ointment	Eye infections
Caesalpinioideae 15. *Delonix elata (L) Gamble*	Lupupontoi Bubunto	Kalkach Sukela	Bark	Bark ground into a powder and applied onto the wound directly.	Wounds
Capparidaceae *16. Maerua denhardtiorum*	------------	----------	Bark	Bark soaked in water overnight and given orally	Bloat
17. Boscia coriaceae pax	Nyaror Lyoror Nyoror	Kalkach	Bark / Roots	Bark or roots boiled in water, cooled and given orally for 3 – 5 days	Anaplasmosis-like disease
18. Caparis tomentosa Lam.	Loturudei	Gorrah-gel	Roots	Roots boiled in water, cooled and given orally	Stomach disorders
19. Caparis cartileginea	-----------	-----------	Leaves/ Roots	Leaves / roots boiled in water, cooled overnight and administered orally for five days	Calf scours Diarrhoea

Key:
-------- Means that no name(s) were availlable

Appendix 4: Continued

Combretaceae 20. *Terminalia brownii fres.*	----------	Biness	Leaves/ Roots	Boiled in water to make a wound washing solution	Wounds
Convolvulaceae 21. *Ipomoea sp*	Geikaba hen	Kalala	Whole plant	Whole plant (which grows on trees as a parasite) is chopped into small pieces, boiled in water, cooled, then given orally as a single dose	Retained after birth
22. *Hildebrandtia sepalosa*	Nyirman	---------	Roots	Boiled in water, cooled overnight and given orally in the morning	Stomach disorders
Cucurbitaceae 23. *Cucumis dipsaceus*	Ngalayoi	Ayawe	Roots	Grind roots/whole plants, mix with water and shake completely till it foams, then administer orally	Any poisoning case that shows CNS signs
24. *Cucumis sp*	Ngalayoi	Ayawe	Roots	Roots are soaked in water overnight, then, animals are washed with this solution using the soaked roots as the scrubbing brush	Ticks Mange Biting flies
Ebeneceae 25. *Euclea divinorum*	Ngengi	Miesa	Roots	Handful of root covers boiled in water, cooled and administered orally for three days	Any condition that presents with bloat/constipation
26. *Euclea schimperi*	Gei kabbehe -n	Miesa	Stem	Stem soaked in water overnight, then given orally as a single dose	Stomach disorders

Key:

-------- Means that no name(s) were availlable

Appendix 4: Continued

Euphorbiaceae *27. Croton macrostachysus Hochst. Ex Del.*	Parmaal a	Bakanis	Bark	Grind dried bark into powder which is applied onto wet wound	Wounds
28. Euphorbia heterochroma	Dolo Tii-Arabet Darken	Harken	Leaves / stems	A traditional toothbrush is used to apply the milky exudate around the wound/injured area. Leaves / stems can be soaked in water overnight or boiled, cool overnight, sieved and administer evey morning	Septic wounds/ gangrenous wounds Trypanosomosis Streptothricos
29. Euphorbia samburiensis	Dolo	Harken	Tuber	Burn the tuber on direct fire, remove outer cover, cut into small pieces and soak in water till the solutions turns brown, and given orally	CBPP in cattle and CCPP in goats
30. Euphorbia triaculeata	Dolo	Harken	Stem	Stem boiled in water, cooled, milk is added and administered orally	Impacted rumen
31. Croton dichogamus Pax	Dolo	Harken	Leaves	Leaves are boiled in water, cooled overnight and given orally after sieving	Retained after-birth
Labiatae (comiaceae) *32. Plectranthus ignarius Schmeint.*	---------	Barbari sa	Leaves	Leaves soaked in water overnight and wash the wound with the solution	Wounds

Key:
-------- Means that no name(s) were availlable

Appendix 4: Continued

Liliaceae *33. Aloe secundiflora Engl.*	Yahar	Argesa	Succulent leaves	Break the stem and drop the fluidy exudates directed into the eye or ear	Eye and ear infections
34 Aloe sp	Yahar	Chake/ Algi	Succulent stem/ leaves	Tapped exudate is mixed with water and applied directly onto the skin/ wound Administered orally in case of helminths treatment	Ectoparasites/ Biting flies Worms
35. Asparagus sp aff. Setaceus	----------	----------	Leaves	Crush the leaves and apply the paste onto the wound	Wounds
36. Gloriosa superba	----------	----------	Bark	Bark boiled in water, cooled and the solution used to wash the wound dailly till healing occurs	Hyena bites/ penetrating fresh/septic wounds
Lythraceae *37. Lawsonia inermis*	Ilam Halam	Ur'ur	Leaves/ stem/roots	Boiled in water and the solution used to wash the calves	Lice/fleas

Key:
-------- Means that no name(s) were availlable

Appendix 4: Continued

Minespermaceae *38. Momordia trifoliate*	----------	-----------	Succulen t stem	Succulent stem is crushed into a paste and applied onto the wound or all over the body Soaked in water overnight and given orally to coughing donkeys	Wounds Insect repellant Cough in donkeys
Mimosaideae *39. Albizia anthelmintica Brongn.*	Hapacho	Awachu Hawacho	Roots	Dry root cover (bark of the root) is ground, soaked in water, filtered and the solution given for three days	Woms and other stomach disorders
40. Acacia nilotica (L) Del. Subsp. Sabalata (vetke) Brenan)	Mirgi Gillorit	Burgege Burkekeh	Bark	Bark is soaked/boiled in water till it turns brown and the solution applied directly onto the wound	Bites and penetrating wounds
41. Acacia tortilis (forsk.) Hayne	Dadach	------------	Bark	Fresh inner part of the bark is folded into a roll, placed into the birth canal and part of the inserted roll is tied to the tail to prevent it from getting sucked into the uterus	Calf rejection
42 Acacia nubica Benth	Holia Holieh	Wanga Wangai	Dry gum	Mix dry gum with water to make a gel that is applied all over the body	Ectoparasites
43 Acacia hockil De wild	-----------	-----------	Dry gum	Mix dry gum with water to make a gel that is applied onto the predirection sites	Ticks

Key:
-------- Means that no name(s) were availlable

Appendix 4: Continued

44. *Acacia seyal Del*	Fulai	Wachu Wacho-dina	Gum	Mix gum with water to form a jelly which is applied onto the pre-direction sites	Ticks
45. *Acacia melifera (Vah/Benth)*	Bilhil	Sabansa-gurad Sabansa	Bark / roots	Bark/roots are ground into a powder then applied into the eye directly	Eye infections
Moraceae 46. *Ficus natalensis (Mig.) Hochst.*	Adha	Odha	Bark	Bark is cut into small pieces and soaked in water overnight. Sieved and given orally. Can be crushed, boiled in water till it turns brown, cooled and administered orally for 3 days Root cover boiled in water till the mixture turns brown, cooled overnight and administered orally	Pyogenic conditions Internal abscesses Pyometra Retained after-birth (RAB)
47. *Ficus thorningis blum*	---------	---------	Bark	Same as *Ficus natalensis*	Same as *Ficus natalensis*
48. *Ficus sycomorus L.*	---------	Oda	Bark	Same as *Ficus natalensis*	Same as *Ficus natalensis*
Moringaceae 49. *Moringa sp. nov.*	Saforra	Safarra	Berries	Dried berries ground into powder and given as a powder	Debilitating condition

Key:

-------- Means that no name(s) were availlable

Meliaceae *50. Melia azadarch*	Warantha	----------	Tuber	Peel the tuber, slice it into small pieces and dry in the sun. Boil in water, cool and give orally daily for seven days	Diseases that manifest with wasting away.
Myrsinaceae *51. Myrsine africana L*	Yakhakhu-ra Kanko	Hanqu	Seeds	Dry seeds are crushed into a powder and administered orally as dry powder, followed by some little water to aid in swallowing	Diseases showing progressive emaciation e g worms
Olacaceae *52. Olea hochstetteri Bak. (O. capensis)*	-----------	Arges	Bark	Bark boiled in water, cooled overnight and given orally as a single dose	Retained afterbirth
53. Olea africana Mill.	Ejer	Ejas Ejerisa	Bark	Bark boiled in water, cooled over-night. and given daily for one week	Internal abscesses

Key:
-------- Means that no name(s) were availlable

Appendix 4: Continued

Papilionoideae 54. *Indigofera sp.*	Hanhanis	--------	Seeds	Seeds are ground into powder and administered orally as a powder followed by little water to aid in swallowing	Pyometra Internal abscesses
55. *Erythrina burttii*	Gadaha Bureti	--------	Bark	Boiled in water and given orally	Stomach disorders
Ramnaceae 56. *Rhamnus prionoides*	----------	--------	Bark	Boiled in water and given orally	Stomach Disorders
Rutaceae 57. *Zanthoxylum chalybeum Engl.*	Gorgor	Gada	Seeds	Dry seeds are ground and a handful of powder thrown into the mouth, followed by little water to aid in swallowing	Used as a broad spectrum antibiotic in camels and cattle Also in humans
58. *Caucanthus auniculatus*	Gei-lahawet	--------	Seeds	Seeds are ground into powder, then given as dry powder followed by little water to aid in swallowing	Emaciated animals/humans.
Salvadoraceae 59. *Salvadora persica*	Yayai Haich Yayayay	Athee Addi	Roots / leaves	Fresh/dry root cover or leaves are boiled in water, cooled overnight, sieved and administred orally daily for three days	Retained after-birth in the camel and cattle
Simaroubaceae 60. *Harisonia abysinica Oliv.*	Mirgi	--------	Seeds contained in pods	Roasted seeds are ground into a powder which is then applied onto wet wounds	Wounds

Key: -------- Means that no name(s) were availlable .

Appendix 4: Continued

Solanaceae 61. *Solanum incanum L*	Yahura	Iddi wata	Seeds/ Fruits used when dry or fresh Roots	Roasted seeds are ground into a powder which is then applied onto a wet wound Fresh fruits are crushed to make a paste which is applied directly onto the wound Roots boiled in water till the solution turns brown, cooled overnight and given orally	Wounds NB:The powder can be mixed with milk or animal fat to make a jelly which is easier to apply
62. *Solanum nigrum*		Iddi gaga	Fruits	Dry fruits are crushed into powder, little water is added to make a paste, and then apply directly on the wound.	Wounds
63. *Solanum indicum*	Yahura	Iddi loni	Fruits	Dry fruits are crushed into powder, little water is added to make a paste, and then apply directly on the wound.	Wounds
64. *Solanum coagulans*	Yahura	Iddi loni	Fruits	Dry fruits are crushed into powder, little water is added to make a paste, and then apply directly on the wound.	Wounds
65. *Solanum sp.*	Soluss/ Addi Goranto	---------	Fruits	Dry fruits are crushed into powder, little water is added to make a paste, and then apply directly on the wound.	Wounds
66. *Withania somnifera*	Yahura	Iddi	Fruits	Dry fruits are crushed into powder, little water is added to make a paste, and then apply directly on the wound.	Wounds
Sterculiaceae 67. *Dombeya goetzenii*	-------	-------	Bark	Bark boiled or soaked in water overnight and given orally	Calf scores Diarrhoea

Key: -------- Means that no name(s) were availlable

Appendix 4: Continued

Tiliaceae 68. *Grevia similis K. Schum*	----------	Aroresa	Bark	Bark soaked in camel urine for 24 hours and the solution used to wash the affected areas	Mange in camels
Verbenaceae 69. *Plectranthus igniarius*	----------	Baaya	Fruits	Fruits crushed and soaked in water overnight and given orally in the morning	Pneumonia like condition
70. *Clerodendum myricoides*	---------	----------	Stem	Soaked in water overnight and used to wash wounds	Wounds
Vitaceae 71. *Cissus quadrangularis*	Lolodha	Chobi	Dry or fresh (Succule-nt) crippling stem	Dry stem ground into a powder, mixed with water and the solution used to wash the wound dailly till healing occurs Fresh succulent stem is crushed and soaked in water till it foams. It is applied onto the wound directly till the wound heals or used to wash as an acaricide	Wounds Extoparasitss (especially fleas/lice)
72. *Cissus sp.*	Lolodha	Chobi	Stem	Crushed stem soaked in water overnight, then applied on the wound directly	Wounds

Key: -------- Means that no name(s) were availlable

Appendix 5: Distribution of non-plant ethnoveterinary materials by name and source, dosage and diseases treated as applied by the Gabra and Rendille/Ariaa community of Marsabit District, Kenya, 2001.

Name of Material	Source	Preparation, dosage regime and route of administration	Diseases/ailments treated
Shells of dead snails	Found along most of the lowland	Crushed into a powder which is applied directly into a pre-washed eye/wounds	Wounds and Eye infection in both animals and man
Table sugar	Shops	Sugar ground into fine powder and applied directly as an eye powder	Eye infections
Salty waters and salty plants e.g. *Salsola, dendroides*	Korole springs and salty springs near Loiyangalani town	Animals taken to drink salty water or fed on salty plants when worms are seen in faeces or when they show signs of mineral deficiency	Worms Mineral deficiency
Skin of mountain kudu, zebra or giraffe	Skin of kudu, zebra or giraffe that has been dried for a long time	Dry skin is roasted, ground into powder, mixed with a handful of ground seeds of *Myrsine africana,* administered orally, followed by little water to assist in swallowing.	Trypanosomosis in cattle
Sheep fat mixed with ground seeds of *Myrsine africana*	Sheep fat	Sheep fat is boiled with ground seeds of *Myrsine africana*, cooled and smeared onto the wound	Fresh wounds Abscesses after draining
Sheep fat	Fat from the tail of the sheep	Sheep fat from the tail is fried, cooled and then given orally till recovery occurs	Anthrax and blackquarter
Dried tobacco leaves	Tobacco leaves	Dried tobacco leaves are soaked overnight, sieved and administered orally	Suspected cases of poisoning.
Fresh blood and milk	Blood mixed with milk	Blood mixed with milk after bleeding stirred to mix completely, then administered orally.	Diarrhoea with blood in calves.
Chalbi salt *"Muludhe"*	*Muludhe* is a salt from Chalbi Desert	Grind *Muludhe* and give one handful orally.	Worms Poisoning.
Dead millipede worm	Dead and dry millipede	Grind dead dry millipede worm into a powder, which is applied into the eye as an eye powder.	Eye infections

Appendix 6: Manipulative ethnoveterinary techniques applied by Rendille/Ariaal and Gabra ethnic groups, of Marsabit District, Kenya, 2001.

Disease/Condition/ ailment	How the procedure is carried out	Remarks
Calf scours	The rectum is branded with a "red hot metal bar".	Diarrhoea stops immediately
Trypanosomosis	Bleeding of about 5 litres of blood	Blood consumed as food
Leeches	Animals denied water for 3 consecutive days, and then tobacco is mixed with water and the mixture poured into the mouth. Can also be removed by hand	The leeches detach and drop out after 3 days. At times they die
Ticks	Hand picked and burned Avoid tick infested pastures Avoid wild animals of similar types	Reduces tick infestation
Bloat	Give one litre of milk to an adult cow. Can also pierce the left side of the animal with a spear	The piercing causes immediate relief
Calf rejection	Partial stitching of the rectal opening. Can also close both ears by tying	Both of these procedures cause discomfort and in the process the dam pays attention to its calf
Stimulation of milk let down after the death of a calf	Flay the calf hide, dry it and always place it in front of the lactating dam when milking	The dam responds as if its calf is alive
Diseases/ailments showing swelling of tissues / wounds	Brand using hot stones, metal bar or succulent plants e.g. *Euphorbia sp*	Branding is very effective in inflammed lesions