Ethnobotanical Survey of Medicinal and Pesticidal Plants used by Agro-pastoral Communities in Mbulu District, Tanzania

Michael Qwarse[1], Matobola J. Mihale[1*], Joseph, Sempombe[2], Veronica Mugoyela[2], Leonia Henry[3], and Fortunatus Sunghwa[4]

[1]Department of Physical Sciences, Open University of Tanzania (OUT), Dar es Salaam, Tanzania

[2] Department of Medicinal Chemistry, School of Pharmacy, Muhimbili University of Health and Allied Sciences (MUHAS), Tanzania

[3]Department of Science and Laboratory Technology, Dar es Salaam Institute of Technology (DIT), Tanzania

[4] Department of Chemistry, College of Natural and Applied Sciences, University of Dar es Salaam (UDSM), Tanzania

Abstract

Ethnobotanical study was carried out to establish an inventory of medicinal and pesticidal plant species currently used by agro-pastoralist communities in Mbulu district, Tanzania. The survey involved collecting information on available plant species, plant parts used, route of administration and method of preparation during use using semi-structured interviews and field observation. Sixty five plant species that belong to 41 families were identified. Dominant families in use are Fabaceae, Solanaceae, and Euphobiaceae, accounting for 43.9% of all identified species. Results indicated that 55% of the plant species are used for medicinal purposes, 29% are used for pesticidal purposes and 16% are used for both medicinal and pesticidal purposes. Forty six percent (46%) of the plants were prepared and administered orally, while 21% were administered by spotting. Whereas 27% of the plants involved the use of leaves during preparation, 22% involve the use of roots. Preparing a juice and soaking in water were the major methods of preparing medicinal and pesticidal formulations. However, ascertaining the specific amount of dose for both medicinal and pesticidal formulations was difficult. There is a need to scientifically test the plant extracts that are active against pests and pathogens. The urgency of identifying and recording this knowledge before its disappearance from the community particularly when there is advancement of farmers' age.

Key words: Indigenous knowledge, ethnobotanical inventory, pesticidal plants, medicinal plants, Tanzania.

[*]Corresponding author: E-mail matobola.mihale@gmail.com, Tel: +255 715 414 995

1. INTRODUCTION

The application of natural products as curative is as old as human civilization. Minerals, animal and plant products are the main sources of drugs, pesticides and acaricides (Rates, 2001). World Health Organization (WHO) estimates that about 80% of the people in the world depend on traditional medicine, generally herbal remedies for their primary health care needs (Muthu *et al*., 2006; Dey *et al*., 2014; Magwede *et al*., 2014). Similarly, about 60-85% of population in developing countries relies on traditional medicine for their aliments (Mohammed *et al*., 2015). In African countries, about 90% of the population relies on medicinal plants as a source of drugs (Hostettmann *et al*., 2000). However, about 25% of recommended drugs and 11% of drugs considered essential by the WHO are derived from plants. Most of synthetic drugs are also derived from precursor compounds originating from plants species (Rates, 2001). The inaccessibility or absence of modern health care facilities and cultural beliefs is the main cause of the large percent of the population to rely on traditional medicines for their primary health care. The knowledge on the use of medicinal, pesticidal and acaricidal plants is enormous and if this is not rapidly recorded and researched will soon be lost (Hostettmann *et al*., 2000).

In developing countries the use of modern synthetic pesticides and medicines is limited due to high cost and their possible adverse effects to organisms and environment in general. It is estimated that pests contribute up to 40% crop loss worldwide while the loss in the tropics is even higher (FAO, 2003). In Africa, small fields cultivated by subsistence farmers make the use of cultivated synthetic pesticides uneconomical (Mwine *et al*., 2011). As a result, the rural communities in developing countries use their local knowledge or skill to protect field crops, stored grains and livestock from damage caused by insect and mammalian pests using locally available plants and fungi in their environment. For example, the using tobacco (*Nicotiana tabacum* L.) leaves for fumigation *Sabadilla officinale* for crop protection and application of *Quassia spp* extracts against aphids started early in the 15^{th} century Thacker (2002). This plant biodiversity has traditionally served for years as renewable source of biodynamic products against pests, pathogenic organisms and disease of crops, animals and in humans. This knowledge has been passed from generation to generation and offer an effective, sustainable, low cost and environmental-friendly disease and pest management strategies (Anjorin and Salako, 2009; Adebayo *et al*., 2015). This is because, the toxic effects of many botanicals is only ephemeral in nature and disappears within 21 days, making them safe to beneficial organisms including humans (Adebayo *et al*., 2014; Adebayo *et al*., 2015). However, agricultural encroachment, deforestation, environmental degradation, indiscriminate harvesting and population growth and increased demand and consumption have increased the rate of disappearance of these beneficial plants from their habitual areas (Seid and Tsegay, 2011).

Previous studies on ethno-botanical studies in developing countries focused on indigenous plants used in veterinary and human diseases. Apparently, information on pesticidal, medicinal and acaricidal plants

altogether is very limited. Similarly, information on pesticidal, medicinal and acaricidal plants in this study area is very limited despite the diverse plant sources. The objective of this study was to document the pesticidal and medicinal plant species used by agro-pastoral societies, their families, plant parts used in the concoction preparation as well as the route of administration used. Knowledge of medicinal, acaricidal and pesticidal plant species has been diminishing over time. The extinction of the existing indigenous knowledge (IK) could be due to new social habits, absence of written records, presence of better access to modern medical and pesticidal services (Silva *et al*., 2015). Thus, there is urgency for carrying out such ethnobotanical survey to document the medicinal and pesticidal IK before disappearance taking into consideration the aging of knowledgeable personnel in these communities.

2.0 MATERIALS AND METHOD

2.1 Study Area

The study was carried out in Mbulu district, South-western Tanzania (Figure 1). The district (including Lake Eyasi) is approximately 7,695 square km, of which land is approximately 6,700 square km. The altitudes of the district range from 1,110 m to 2,250 m. This difference in altitude contributes to the wide range of climatic conditions with mean annual temperature ranging between 17.3 ^{o}C and 23.4 ^{o}C and rainfall ranging from 400mm to 1,100mm. The district is dominated by communities who practice mainly agro-pastoralism, though hunters are also available. The main socio-economic activities range from smallholder rain-fed cultivation, extensive grazing, and afforestation to mechanized rain-fed cultivation. The main crops grown in the study area include maize, beans, pigeon pea, sorghum, wheat, vegetable, fruits and coffee (Magoggo *et al*., 1994; Björnsen, 2006; Qwarse *at al*., 2016; Qwarse *et al*., 2017).

2.2 Plant Materials, Sample Collection and Botanical Identification

Data collection was carried out in Mbulu District during the rainy season from March to June 2014 and November to June 2015 cutting across various phonological periods of the plants. Semi- structured interviews and field observation were conducted to collect data pertaining to the plants' local name, plant part used, method of preparation, parts used and the diseases treated and/or pests controlled. The medicinal and pesticidal plants (wild and cultivated) whose information was collected were identified by the Botanist at the Department of Botany, University of Dar es Salaam where voucher specimens were deposited. Later the plant species were collected for bioactivity screening in the laboratory.

2.3 Data Analysis

All data were recorded in a pre-designed data sheet to reflect different objectives. Calculations and graphic presentations of data were carried out with Microsoft Office Excel, 2007.

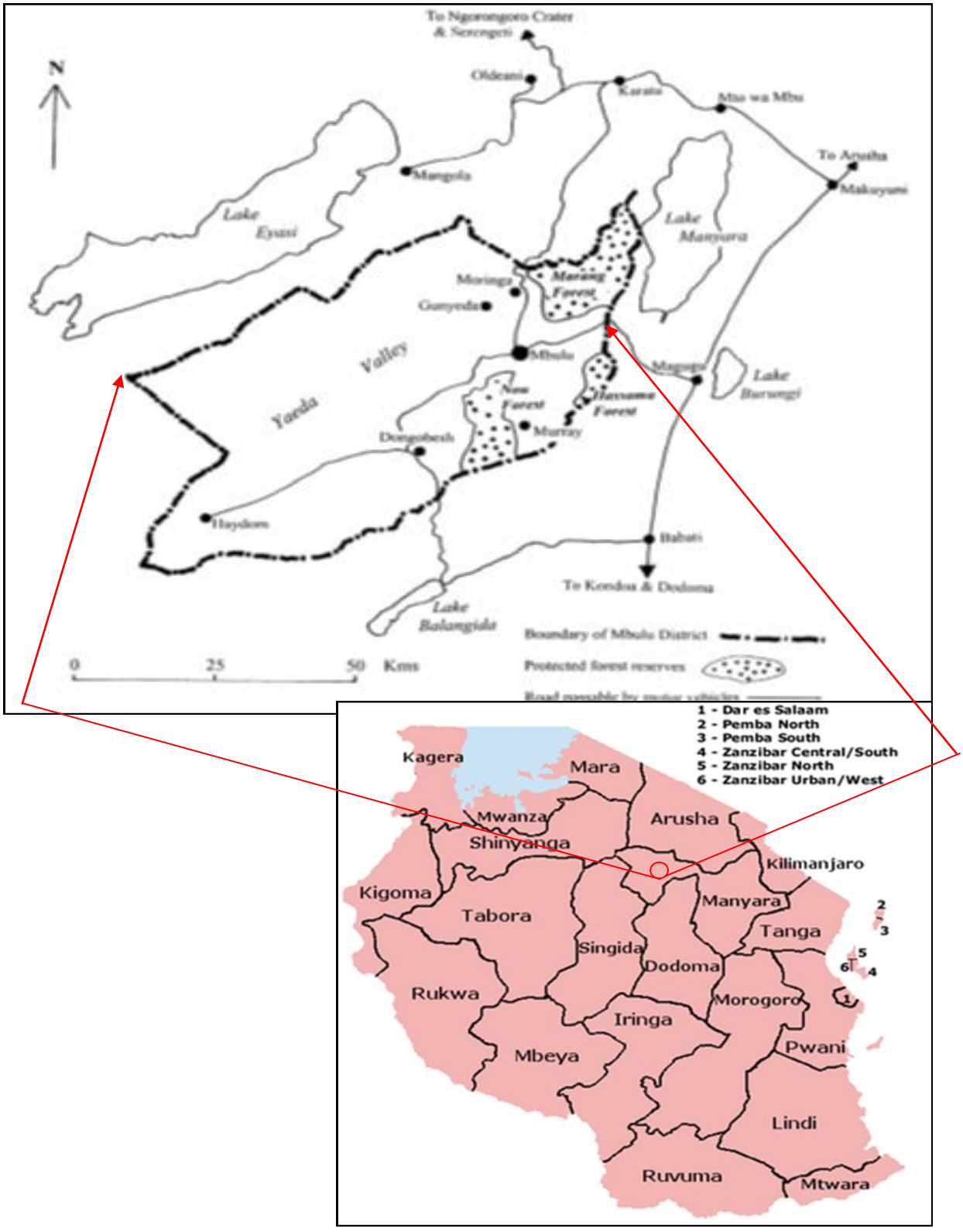

Figure 1: Map of Tanzania showing Mbulu District (Source: Modified from Google Earth)

3.0 RESULTS AND DISCUSION

3.1 Traditional Use of Plants by Agro-pastoral Communities

3.1.1 Plant Species and their Families

The survey identified sixty five (65) plant species from 41 families which are used by subsistence farmers and traditional healers in Mbulu as indicated in Table 1. Out of these, fifty five percent (55 %) of the plant species are used as medicinal agents, twenty nine percent (29 %) are used as pesticides and the rest are used both as medicinal and pesticidal agents. In total, fifty two percent (52%) of the plant species are used to treat human diseases, sixteen percent (16 %) are used for veterinary applications and thirty one percent (31 %) are used to treat crop in the field, storage and domestic pests (Figure 2).

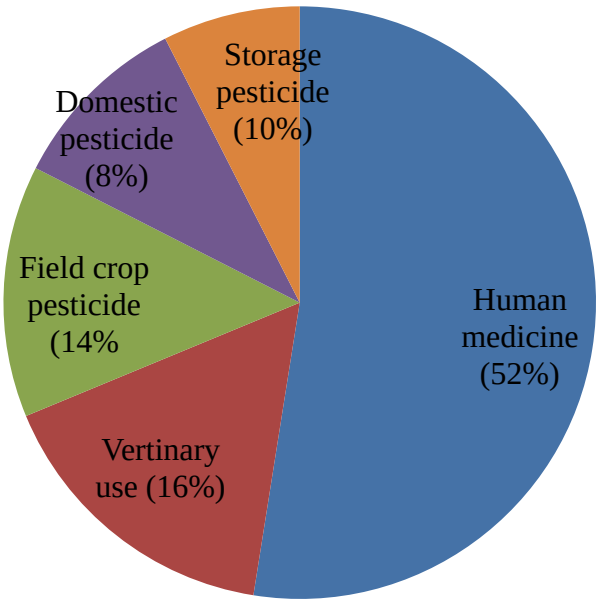

Figure 2: Use of Plant Species by Agro-pastoral communities

Most of the identified medicinal plants in the study area belong to *Minosoidaceae*, *Solanaceae*, and *Euphorbiaceae* families. These families are widespread and well supported by different climatic conditions. As a result, most are found in many natural forests in the world. Previous studies have shown that these families containing different phytochemical compounds that exhibit varying medicinal and pesticidal properties (Lui, 2003; Nalubega, 2010). For example, *Euphorbiaceae* family has phytochemical compounds that have antimicrobial and acaricidal properties (Adedapo *et al.*, 2005; Falodum *et al.*, 2006). Similarly, species in the *Solanaceae* family are known to have pharmacologically important compounds which have significant medicinal, veterinary and pesticidal activities (Osborm, 2003).

In terms of plant species, *Capsicum annum*, *Nicotiana tobacam* and *Solanum incanum* are the most widely used plant species. Researches have shown that these plant species are commonly used by farmers to treat microbial infections in poultry (Bukenya, 2007; Elujoba *et al.*, 2005; Bukenya *et al.*, 2008). This probably explains their use by agro-pastoral communities in the study area. On the other hand, *Meliaceae* and *Euphorbiaceae* are the most used species with varying pesticidal features. Like medicinal plants, these families are preferred for control of field and storage pests due to their availability, making them good candidates for pesticidal and medicinal research (Mwine *et al.*, 2011).

Table 1: Ethnobotanical use of Identified Species

ID No.	Local name (Iraqw'/ Kiswahili)	Botanical name	Family	Recorded ethnobotanical use
ES0001	Mwarobaini[a,z]	*Azadirachta indica*	Meliaceae	Pesticidal to control stored pests, veterinary in chicken and medicinal in humans
ES0002	*Piripiri* [b,x]	*Capiscum sp*	Solanaceae	Pesticidal to control field pests and veterinary
ES0003	*Bangi*[b,y]	*Tagetes minuta*	Asteraceae	Pesticidal to control stored pests
ES0004	*Tupatupa*[a,z]	*Tephrosia vogelii*	Fabaceae	Pesticidal
ES0005	*Manyari*[a,z]	*Euphorbia tirucali*	Euphorbiaceae	Pesticidal on storage pests, veterinary in cattle and poultry
ES0006	*Papai*[a,z]	*Carica papaya*	Caricaceae	Pesticidal to control field pests
ES0007	*Tumbaku/ Tumati*[b,x]	*Nicotiana sp*	Solanaceae	Pesticidal for field storage pests and veterinary to control ticks
ES0008	*Pareto*[b,x]	*Tanacetum cinerariifolium*	Asteraceae	Pesticidal to control field pests and veterinary to control ticks,
ES0009	Qalmir boo[b,y]	*Galinsoga parviflora*	Asteraceae	Pesticidal to control field pests
ES0010	*Girgirmo*[b,y]	*Croton dichogamous*	Euphorbiaceae	Pesticidal to control storage pests, medicinal to control UTI and tooth infections)
ES0011	*Mlutulutu*[a,y]	*Cassia absus*	Fabaceae/ Caesalpinioideae	Pesticidal to control field and storage pests
ES0012	Tsori[a,y]	*Albizia sp*	Mimosoidea	Pesticidal to control field pests
ES0013	*Thoxi*[a,y]	*Phytolacca dodecandra*	Phytolaccaceae	Pesticidal to control field and storage pests, medicinal to control ring worms in humans
ES0014	*Qanqari*[a,y]	*Erthrina abyscinica*	Fabaceaee	Medicinal to treat skin diseases and wound, veterinary to control diseases in cattle, seeds are poisons
ES0015	*Narmo awak*[a,y]	*Acacia hockii*	Mimosoideae	Medicinal to treat bacterial diseases and poisoning
ES0016	*Kantzi*[a,y]	*Accacia nilotica*	Mimosoideae	Medicinal to treat genital, urinary and tooth infections in humans
ES0017	*Qarbu*[a,y]	*Accacia seyal*	Mimosoideae	Medicinal in humans, source of tannins and dyes
ES0018	*Gendaryandi*[a,y]	*Adansonia digitata*	Bombaceae	Medicinal to treat malaria, goitre, cancer and diabetes
ES0019	*Tsori*[a,y]	*Albizia amara*	Mimosoideae	Medicinal as soap
ES0020	*Matopetope*[a,x]	*Annona cherimola*	Annonaceae	Pesticidal to control field pests in vegetable, fruits and seeds, medicinal to treat cancer and worms, veterinary to control worms in animals
ES0021	*Thaqay*[a,y]	*Azanza garckena*	Malvaceae	Medicinal to treat diabetes

ES0022	*Hhowi*[c,y]	*Balanites aegyptiaca*	Balanitaceae	Medicinal to control UTI and Pesticidal to control vector snails
ES0023	*Titiwi*[a,y]	*Carissa edulis*	Apocynaceae	Medicinal to treat sexually transmitted diseases (STDs), UTI and as soap
ES0024	*Warfi*[a,y]	*Catha edulis*	Celastraceae	Medicinal to treat asthma, coughs, stomach aches and chest pains and stimulant
ES0025	*Gendaamo*[a,y]	*Combretum molle*	Combretaceae	Medicinal to treat hookworms, snake bites, stomach pains, dysentery and leprosy ,as cleanser of bad smell in milk containers
ES0026	*Lagangir awak*[a,y]	*Grewia bicolor*	Tiliaceae	Medicinal to treat intestinal problems, chest pain, colds and syphilis
ES0027	*Amu*[c,x]	*Gwewia villosa*	Tiliaceae	Medicinal to treat tapeworm (fruits), increase immunity in humans and animals
ES0028	*Hhewassi*[c,y]	*Julbernardia globiflora*	Caesalpionideae	Medicinal to treat coughs and snake bites in humans
ES0029	*Mangaffi*[c,y]	*Kigelia Africana (K. aethiopum)*	Bignoniaceae	Medicinal to treat asthma, decreased weight, veterinary to control new castle in poultry, unripe fruits are poisonous.
ES0030	*Kipaa't*[y]	*Osris lanceolata*	Santalaceae	Used as perfume and as stimulant
ES0031	*Sioo*[a,y]	*Rhus natelensis*	Anacardiaceae	Medicinal to treat stomach ache, abortion and as pain killer, as poison neutralizer, body lotion and purgative ,
ES0032	*Mswaki/Fura*[a,y]	*Salvadora persica*	Salvadoraceae	Medicinal to control tooth infections
ES0033	*Furudangw*[b,y]	*Securdaca longipendunculata*	Polygalaceae	Medicinal to treat snake bite, cough, toothache, tapeworm, malaria, bacteria, veterinary to control Brucellosis and used as poisons.
ES0034	*Matharmo*[a,y]	*Syzgium guineense*	Myrtaceae	Veterinary to control worm in animals, used as source of tannin dye and fruits as food
ES0035	*Bukuumo, Sarakwi*[b,y]	*Terminalia sericea*	Combretaceae	Medicinal to treat stomach ache, diarrhea, snake bite and wounds (leaves) and bark as source of red dye
ES0036	*Slaragahhi*[a,y]	*Trema orientalis (T.guineansis)*	Ulmaceae	Medicinal to treat cough and worms, used as an antidote to poison and source of tannin
ES0037	*Baranqu*[a,y]	*Vangueria infausta*	Rubiaceae	Medicinal to treat malaria pneumonia and veterinary to control worms in animals
ES0038	*Baranqu*[a,y]	*Vangueria Madagascariensis*	Rubiaceae	Veterinary to control worms in animals
ES0039	*Sakwenay* [a,y]	*Warburgia ugandensis (W.salutaries)*	Canellaceae	Medicinal as pain killer (roots) and as curries (leaves, bark and fruits)
ES0040	*Tahhamanto, tarantu*[b,y]	*Ximenia americana*	Olacaceae	Industrial source of oil for soap, body, hair and softening leather
ES0041	*Maayangu*[a,y]	*Ximenia afra (x-americana var caffra)*	Olacaceae	Medicinal to treat cough, malaria, cancer and smooth eye inflammations

ES0042	*Morongi*[a,y]	*Xanthoxylum chaly beum*	Rutaceae	Medicinal to treat carving malaria, typhoid and bruises
ES0043	*Ghalyandi*[a,y]	*Ziziphus mucronata*	Rhamnaceae	Medicinal to treat boils, skin infection, stomach and chest complaint and booster in blood formation
ES0044	*Fitselmo*[a,y]	*Bridelia micrantha*	Euphobiaceae	Used as human medicine, Pesticidal as attractant to caterpillars and birds
ES0045	*Naamo*[b,y]	*Commiphora Africana*	Burseraceae	Veterinary to control ticks in animals
ES0046	*Ayloi*[a,z]	*Croton megalocarpus*	Euphorbiaceae	Medicinal as purgative, smoke can irritate eyes
ES0047	*Minighiti*[b,y]	*Euclea divinorum*	Ebenaceae	Medicinal to treat worms gonorrhoea in humans and control tooth infections
ES0048	*Sirongi* [b,y]	*Rhus natelensis*	Anacardiaceae	Medicinal to control tooth infections
ES0049	*Tsiti*[c,y]	*Gymneme sylvestre*	Asclepladaceae	Medicinal to treat gonorrhea and pesticidal to control snail in water
ES0050	*Hhishhinsi*[d,y]	*Chenopodium procerum hocha*	Chenopodiaceae	Pesticidal as insect repellent
ES0051	*Tloqomo*[b,y]	*Withania somnifera (L) dunal*	Solanaceae	Medicinal to treat fresh wounds
ES0052	*Giro*[,d,y]	*Leonotis mollissima*	Labiatae	Medicinal to treat ringworms in skin
ES0053	*Avitamo*[b,y]	*Solanum anguivi*	Solanaceae	Pesticidal to control sand fleas in children
ES0054	*Hhangali*[b,y]	*Solanum incanum*	Solanaceae	Medicinal to treat stomach complaints and tooth infections
ES0055	--[b,y]	*Lantana camara*	Verbenaceae	Pesticidal to control weevil in maize and sorghum
ES0056	*Xaslslaamo*[b,y]	*Cynaglossum geometrium*	Boraginaceae	Veterinary to treat measles in cattle
ES0057	Xaano umang[,y]	*Ocimum filamentosum*	Lamiaceae	Medicinal to treat amoebiasis and stomach ache
ES0058	*Xaanoumang*[b,y]	*Plumbago zeylanica*	Plumbaginaceae	Veterinary to treat measles in cattle
ES0059	Xaano umang[d,y]	*Tephrosia pumila*	Fabaceaee	Veterinary to treat measles in cattle
ES0060	*Ulwandi* [5,d,y]	*Plectranthus elegans*	Labiatae	Pesticidal to control fleas and lice
ES0061	*Elwahhoki*[d,y]	*Hoslunqlia opposita*	Labiatae	Medicinal to treat skin disease
ES0062	*Lalangidako*[a,y]	*Cassia sin neanda*	Caesalpiniaceae	Medicinal to treat malaria and skin diseases, control of worms
ES0063	*Katalaisha*[a,y]	*Terminalla stuhlmaniii*	Combretaceae	Medicinal to treat amoebiasis
ES0064	*Hangatle*[a,y]	*Cmniphrora mekari*	Burcraceae	Medicinal to treat skin disease and UTI
ES0065	*Xaano dishimo*[d,y]	*Argemone mexicana*	Papaveraceceae	Medicinal to treat skin disease

Legend: Type of plant species: a = Tree, b = Shrub, c = Climbing and d = Herb. **Sustainability**: x = Cultivated, y = Wild and z = Both cultivated and wild

3.1.2 Plant Species and their Routes of Administration

Five (5) different routes of administration were commonly used by the people in using plant species for treatment of diseases and controlling pests. These included oral, spotting, spraying, chewing, powder and inhalation of smoke from burnt plant parts (Figure 3). Out of these, forty six percent (46%) of the plants species were administered orally.

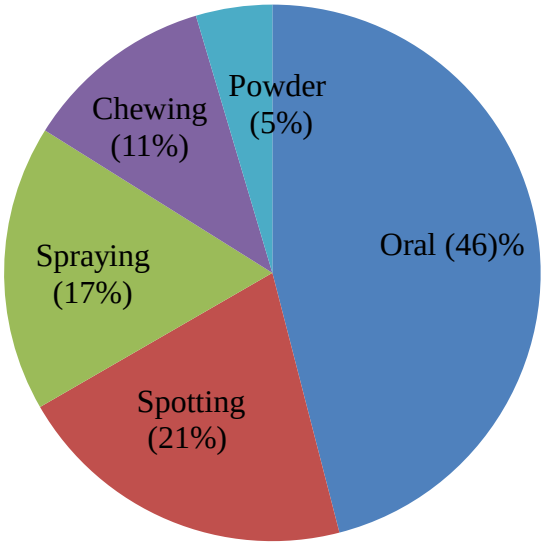

Figure 3: Use of Plant Species by Routes of Administration

Subsistence farmers and traditional healers in the study area use the oral route most frequently, followed by spotting, and spraying. This finding is in agreement with Bukenya, (2007) who reported that the most common way of preparing and administering of the biomedicine to human and animals are oral administration. This is probably due to the fact that it is easy to administer using this way and the route requires less skills (Nalubega, 2010; Seid and Tsegay, 2011; Mohammed, *et al*., 2015). However, oral and chewing methods were commonly used for treating typhoid, cholera, tuberculosis, vaginal and oral candidiasis, constipation, pain during delivery in humans (Ayyanar and Iginacimuthu, 2011; Mustapha, 2014; Mohammed, *et al*., 2015), mouth ulcers, backache, asthma, diarrhoea, female infertility, epilepsy, malaria, hypertension, stomach ache in humans as well as purgative, (Ampitan, 2013; Motlhanka and Nthoiwa, 2013; Mohammed *et al*., 2015).

Spraying method is also used in rural area to treat skin infections, inflammation, measles and rheumatism similar to a study done by Motlhanka and Nthoiwa, (2013).Similarly, spotting method is used for treatment of epilepsy, asthma cough and malaria (Motlhanka and Nthoiwa, 2013). As pesticidal method, the botanical pesticide is sprayed in the field crops and stored products to control pests similar to a study by Mwine *et al*., (2011) and Anjarwalla *et al*., (2016).

3.1.3 Variable Use of Plant Species by Parts

Twenty seven percent (27%) of the plants used in Mbulu district involve the use of leaves for making concoctions, while others like roots, fruits, seeds, barks, stems or the whole plant are also used (Figure 4). The findings in this study are in line with the results of ethno-medicinal studies reported earlier where leaves are the most used plant parts in remedial preparations (Oliva *et al.*, 2007). Generally, leaves, roots and bark contributed 70% of the plant parts used.

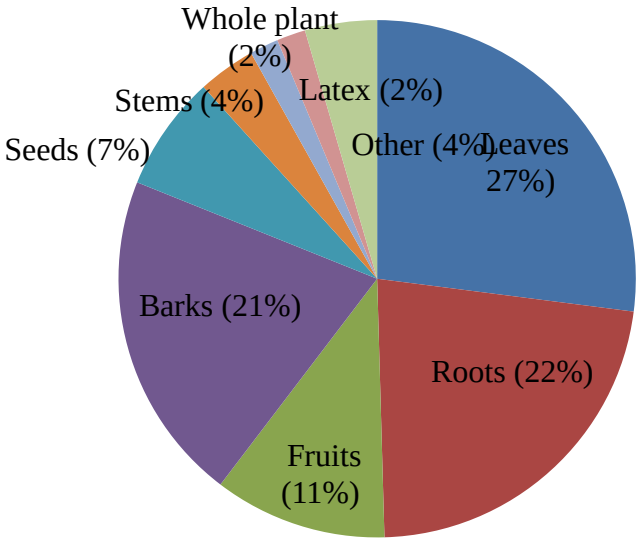

Figure 4: Use of Plant species by Parts

Despite the considerable variations of plant parts used, the leaves constituted a large portion of phytochemicals compounds (Mugisha-Kamatenesi *et al*., 2008). Recently, leaves were utilized for medicinal and pesticidal use (Quinteiro *et al.*, 2014; Kumar 2015; Bailano *et al*., 2015). Scientifically activity in leaves could be due to photosynthetic process which produce other secondary compounds which are effective against most pests and diseases in humans and animals (Offiah *et al*., 2011; Ampitan *et al*., 2013; Ayyanar and Ignacimuthu, 2011; Silva *et al*., 2015)

3.1.4 Variable use of the Plants by Method of Preparation

Thirty three percent (33%) of the plant species used are prepared by soaking in water (cold or hot). Other methods used include extracting juice, powders, burning and chewing of the plant species as indicated in Figure 5.

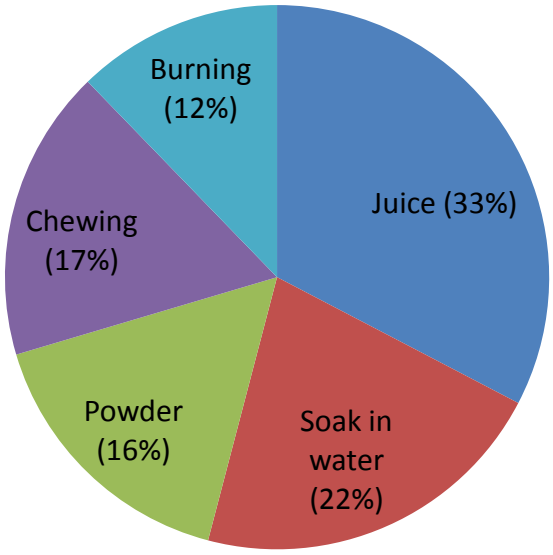

Figure 5: Use of Plant species by Method of Preparation

The study indicated that the farmers and traditional healers in Mbulu district use various indigenous practices to treat human and animal diseases as well as controlling in field and storage crop pests. Most plants are prepared in the form of juice by soaking in cold or hot water which probably requires less time. This study corroborate the study by Bukenya, (2007) which reported that making juice and administering the concoction orally is the most preferred way. The indigenous people use hot over cold water to improve the strength of extracting solvent. Since water is a polar solvent, polar compounds in plants are easily extracted while the non-polar fraction compounds remain in the matrix.

4. Conclusion

The survey revealed a vast spread of medicinal and pesticidal plant species in the study area. The native people have a good knowledge on the plants and their potency in treating different ailments and controlling pests. However, the scientific rationalization for the use of plants using certain doses is urgently needed. Apparently, the natives lack knowledge on the identity of the active compounds in the plants and their properties so that they can use better extraction method to increase potency and limit toxicity. In addition, the choice of the route of administration such as chewing versus juicing that depends on the condition of the sick person can compromise the attainment of the objective. All these need scientific improvement in order to determine the extractable active compound and hence establish a reliable dose for different illnesses as well as pests. There is a need to determine the biological potency (bioactivities) of plants species to improve their IK base in treatment of different diseases and pests. This will scientifically establish the efficacy and identify the pesticidal and medicinal plant species against specific pests and pathogens as indicated by traditional healers and farmers in study area. There is a need for the conservation of plant species with pesticidal and medicinal in the area particularly when there are human pressures for use of the plants. This ethnobotanical document will be valuable during further research and will be used as leads to new drug and pesticide discoveries.

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