Journal of Ethnopharmacology 127 (2010) 130–136

Contents lists available at ScienceDirect

Journal of Ethnopharmacology

journal homepage: www.elsevier.com/locate/jethpharm

Medicinal plants used by traditional medicine practitioners in the treatment of tuberculosis and related ailments in Uganda

John R.S. Tabuti[a,*], Collins B. Kukunda[b], Paul J. Waako[c]

[a] Institute of Environment and Natural Resources, Makerere University, P.O. Box 7062, Kampala, Uganda
[b] Sustainable Use of Plant Diversity, P.O. Box 11779, Kampala, Uganda
[c] Department of Pharmacology & Therapeutics, College of Health Sciences, Makerere University, P.O. Box 7072, Kampala, Uganda

ARTICLE INFO

Article history:
Received 17 June 2009
Received in revised form
19 September 2009
Accepted 19 September 2009
Available online 30 September 2009

Keywords:
Ethnobotany
Primary health care
Phytotherapy
Herbal medicine
Pharmacognosy
Cultural diversity
Traditional knowledge

ABSTRACT

Aim of the study: Tuberculosis (TB) remains one of the most difficult ailments to control in the world today. The emergence of drug resistant strains has made previously effective and affordable remedies less effective. This has made the search for new medicines from local traditional medicines urgent. The specific objectives of this study were to (1) identify plant species used in the treatment of TB, their methods of preparation and administration, (2) document TB recognition, and (3) document medicine processing and packaging practices by traditional medicine practitioners (TMPs).
Methods: We interviewed 32 TMPs from the districts of Kamuli, Kisoro and Nakapiripirit using a guided questionnaire.
Results: We documented 88 plant species used to treat TB. Seven of these, *Eucalyptus* spp., *Warburgia salutaris* (G. Bertol.) Chiov., *Ocimum suave* Willd., *Zanthoxylum chalybeum* Engl., *Momordica foetida* Schum., *Persea americana* Mill. and *Acacia hockii* De Wild. were mentioned by three or more TMPs. Medicines were prepared mostly as mixtures or infrequently as mono-preparations in dosage forms of decoctions and infusions. They were administered orally in variable doses over varying periods of time. The TMPs did not know how to preserve the medicines and packaged them in used water bottles. Almost all TMPs mentioned the most important signs by which TB is recognised. They also knew that TB was a contagious disease spread through poor hygiene and crowding.
Conclusions: Local knowledge and practices of treating TB exist in the districts surveyed. This knowledge may be imperfect and TMPs appear to be still experimenting with which species to use to treat TB. There is need to screen among the species mentioned to determine those which are efficacious and safe. The technology of processing, packaging and preserving traditional medicines for the treatment of TB is very basic and needs improving. The TMPs appear to be playing a significant role in primary health care delivery and this lends further justification for the ongoing Uganda government efforts to integrate the allopathic and traditional medicine systems.

1. Introduction

Tuberculosis is one of the leading causes of morbidity and mortality in the world. About 2 billion of the worlds' population is infected with *Mycobacterium tuberculosis*, the causative organism for TB. Every year more than 8 million people are infected by *Mycobacterium tuberculosis* (WHO, 2007), and worldwide, more than 1.6 million people die from TB. In Uganda 402 new cases of TB per 100,000 people were reported in 2005 (WHO, 2007). The treatment of the disease has become more complicated because of the emergency of drug resistant *Mycobacterium tuberculosis* strains. Because of the declining success of the common and cheap TB medicines, there is an urgent need to identify new medicines with which to treat TB. Plants are a good source of new medicines and searches for new medicines from plants are well justified (Balunas and Kinghorn, 2005; Fabricant and Farnsworth, 2001).

Some general ethnobotanical studies have reported a number of plants used to treat TB in Uganda (Adjanohoun et al., 1993; Ssegawa and Kasenene, 2007; Tabuti et al., 2003b). However, there have been no studies specifically focusing on documentation of traditional methods of treating TB. As a result comprehensive data on species of plants, methods of preparation and methods of administration of TB remedies is lacking. Similarly, information on efficacy and safety of widely used TB remedies is also lacking. These gaps have made the inclusion of traditional TB treatments in the national primary health care package difficult. This study addressed this gap

* Corresponding author. Tel.: +256 0414 530135; fax: +256 0414 530 134.
E-mail addresses: jtabuti@muienr.mak.ac.ug, jrstabuti@yahoo.com (J.R.S. Tabuti), ckukunda@sci.mak.ac.ug (C.B. Kukunda), pwaako@med.mak.ac.ug (P.J. Waako).

0378-8741/$ – see front matter © 2009 Elsevier Ireland Ltd. All rights reserved.
doi:10.1016/j.jep.2009.09.035

Table 1
Demographic characteristics of the respondent.

Characteristic	Frequency
Tribe	
Karimajong	12
Mufumbira	11
Mululi	5
Musoga	4
Muganda	2
Munyole	1
Religion	
Catholic	16
Protestant	10
Muslim	6
Animist	1
Formal education	
Primary	18
None	11
Secondary	4
Primary occupation	
TMP	25
Farmer	7
Politician	1
Secondary occupation	
Farmer	17
TMP	8
Politician (L.C 1 Chairman)	3
Journalist	1

by conducting a survey to exhaustively document existing traditional TB treatments in the districts of Kamuli, Nakapiripirit, and Kisoro.

This study was undertaken with the broad aim of improving TB treatments by identifying new remedies based on traditional knowledge and providing information to help TB patients, and the practitioners to make informed decisions. The specific objectives of the study were to (1) identify commonly used natural products, their methods of preparation and administration by traditional medicine practitioners (TMPs) in the treatment of TB, (2) document disease recognition by TMPs, and (3) medicine processing and packaging practices by TMPs.

2. Methods

We used an ethnobotanical approach to explore the knowledge, diagnosis and treatment practices of TB by the Traditional Medicine Practitioners (TMPs) in the districts of Kamuli, Nakapiripirit and Kisoro. A guided questionnaire interview was administered to participating TMPs who were identified with the help of district Community Development Officers, fellow TMPs and a missionary (in Nakapiripirit). The interviews elicited information on the types of materials, methods of preparation and administration of medicinal preparations in traditional treatment of TB. The inclusion criterion of the TMPs was based on their reputation to treat TB and willingness to participate in the research. All species mentioned in interviews were collected and are indexed as JRST (John Robert Stephen Tabuti). The specimens were identified by staff of Makerere University herbarium (MHU) and named according to the Flora of Tropical East Africa. The specimens are deposited at MHU. Data from the ethnobotanical data was entered in Excel and summarised into means and frequencies using SPSS 12.0.1 for windows.

Ethical approval for this study was granted by the Uganda National Council of Science and Technology (NS 141). Before interviewing any TMP, the objectives of the study, method and planned use of the information were explained to the TMPs and permission to conduct the interview was sought. Verbal consent was obtained in all cases before the interview was carried out.

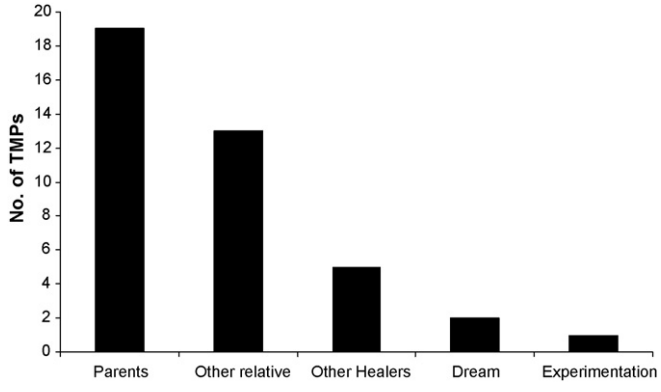

Fig. 1. Source of TB treatment knowledge by TMPs.

Table 2
Signs and symptoms by which TMPs recognise TB in patients.

Sign/symptom	Frequency
Cough lasting more than 2 months	18
Weight loss	12
Fast/laboured breathing	9
Wheezing cough	8
Standing body hair	6
Slimy sputum	5
Bloody cough	5
Chronic fever	3
Cough with vomiting	3
Sweating	2
Dehydration	2
Dry cough	2
Coiled hair	1
Loss of appetite	1
Frequent spitting	1
Malaise	1
Smelly breath	1
Tonsillitis	1
Darkening skin	1
Bone and muscle pain	1
Spiritual powers	1

3. Results

3.1. Respondents' biographic details

All together we interviewed 33 TMPs: 10 from Kidera County (Kamuli), 11 from Bufumbira County (Kisoro District) and 12 from

Table 3
Causes of TB infection according to respondents.

Cause	Frequency
Contaminated utensils	12
Congested living conditions	9
Un-boiled milk, meat and blood	7
Excessive drinking of alcohol	5
Social smoking	4
Contaminated food and beer	3
Smoking	3
Congenital	2
Drinking dirty water	2
Poor hygiene	2
Air contamination due to poor hygiene	2
Carrying heavy loads	2
Associated with fevers	1
Eating fried food	1
Eating raw foods like vegetables	1
Eating too much hot pepper	1
Untreated cough	1
Administration of vomiting drugs especially to children	1

Table 4
Plant species reported by TMPs for the treatment of TB and allied diseases. The main part used refers to part mentioned by three or more TMPs, while other parts are those parts that were mentioned by one or two respondents. Flw, flower; Fr, fruit; L, leaf; RB, root (bark); R, root (whole); SB, stem (bark); SW, stem (wood); NC, not collected.

Scientific name	Family	Local name	Collection number	Main part used	Other parts	Number of TMPs mentioning species
Eucalyptus spp.	Myrtaceae	Kalitunsi, Ekalitus	JRST 791	L	SB	9
Acacia hockii De Wild.	Mimosaceae	Kashiono	JRST 759, 790	SB	SW, Fr	6
Ocimum suave Willd.	Lamiaceae	Muhumuzanganda	JRST 726	L		6
Persea americana Mill.	Lauraceae	Ovacado	JRST 730, 788	L	SW, seed	6
Warburgia salutaris (G. Bertol.) Chiov.	Canellaceae	Mwiha, Abaki	JRST 752, 780	SB		5
Azadirachta indica A. Juss.	Meliaceae	Neem	JRST 757	Seed	L, SB, SW	4
Iboza riparia (Hochst.) N. E. Br.	Lamiaceae	Muravumba	JRST 725	L	SW	4
Euclea divinorum Hiern	Ebenaceae	Emus	JRST 770	R		4
Acacia mearnsii De Wild.	Mimosaceae	Burikoti	JRST 729	SB		3
Lantana trifolia L.	Verbenaceae	Muhengeri	JRST 745	L		3
Maytenus senegalensis (Lam.) Exell	Celastraceae	Muwaiswa	JRST 721, 799	R	RB	3
Momordica foetida Schum.	Cucurbitaceae	Luiwula/Mwishwa	JRST 708, 741	L		3
Tragia subsessilis Pax	Euphorbiaceae	Totoananyia	JRST 767	R		3
Zanthoxylum chalybeum Engl.	Rutaceae	Ntale ya dungu, Eusugu	JRST 710, 761, 777	R		3
Acanthus pubescens (Thomson ex Oliv.) Engl.	Acanthaceae	Matovu, Itojo	JRST 744	R		2
Balanites aegyptiaca (L.) Delile	Balanitaceae	Ekorete	JRST 758	SB	R	2
Carica papaya L.	Caricaceae	Amapapali	NC	L	Seed	2
Carissa edulis Vahl	Apocynaceae	Muyonza	JRST 722, 792, 800	R	RB	2
Coffea sp.	Rubiaceae	Mwanyi	NC	L		2
Cyphostemma cyphopetalum (Fresen.) Desc. Ex Wild & Drumm.	Vitaceae	Kikumba Bulema, Kihangira	JRST 733, 739	SW	L, Tuber	2
Gutenbergia cordifolia Benth. ex Oliv.	Asteraceae	Ekoutapem	JRST 763	R	L	2
Kalanchoe sp.	Crassulaceae	Chenachena	JRST 743	L		2
Mangifera indica L.	Anacardiaceae	Muyembe	JRST 785	SB		2
Ormocarpum trichocarpum (Taub.) Harms	Papilionaceae	Eseperuae	JRST 762	R		2
Acacia polyacantha Willd.	Mimosaceae	Egirigirioi	JRST 773	SB		1
Achyranthes aspera L.	Amaranthaceae	Muhurura	JRST 727	Flw		1
Achyrospermum carvalhoi Gürke	Lamiaceae	kanyamafundo	JRST 746	L		1
Allium sativum L.	Alliaceae	Garlic	NC	L		1
Amaranthus spinosus L.	Amaranthaceae	Kidodo	JRST 732	L		1
Antherotoma senegambiensis (Guill. & Perr.) Jacq. –Fél.	Melastomataceae	Mwonyo gwe ntaama	JRST 748	L		1
Asparagus africanus Lam.	Asparagaceae	Mukira gwango	JRST 717	SW		1
Aspilia africana (Pers.) C. D. Adams	Asteraceae	Emaruoit	JRST 772	R		1
Bidens pilosa L.	Asteraceae	Nyabarashana	JRST 742	Flw		1
Brillantaisia owariensis P. Beauv.	Acanthaceae	Icuga	JRST 754	L		1
Callistemon citrinus (Curtis) Skeels	Myrtaceae	Bottle brush	JRST 751	L		1
Capparis erythrocarpos Isert	Capparaceae	Muzingani omwelu, Kitunku ekitono	NC	R		1
Capparis tomentosa Lam.	Capparaceae	Muzingani	JRST 719			1
Conyza sumatrensis (Retz.) E. Walker (syn. *C. floribunda*)	Asteraceae	Jevuba	JRST 724	L		1
Cyperus latifolius Poir.	Cyperaceae	Ekekeriaut	JRST 774	R		1
Cyperus rotundus L. Subsp. *rotundus*	Cyperaceae	Ekekeriaut	JRST 776	R		1
Desmodium repandum (Vahl) DC.	Papilionaceae	Ituza	JRST 740	L		1
Dodonaea angustifolia L. f.	Sapindaceae	Musambya	JRST 749	L		1
Erythrina abyssinica Lam. ex DC.	Papilionaceae	Muyirigiti	JRST 712, 784, 811	SB		1
Euphorbia schimperiana Scheele	Euphorbiaceae	Kazagamira	JRST 747	L		1
Ficus platyphylla Delile	Moraceae	Mudodwe	JRST 707	SB		1
Gardenia ternifolia Schumach. & Thonn. Subsp. *jovis-tonantis* (Welw.) Hiern.	Rubiaceae	Ekoree	JRST 766	R		1
Gomphocarpus physocarpus E. Mey.	Asclepiadaceae	Gashaho	JRST 755	L		1
Haplocoelum foliolosum (Heirn) Bullock	Sapindaceae	Ekapaniteng	JRST 760	SB		1
Harrisonia abyssinica Oliv.	Simaroubaceae	Lushaike	JRST 703	RB		1
Helichrysum odoratissimum (L.) Sweet	Asteraceae	Lweza	JRST 750	L		1
Hoslundia opposita Vahl	Lamiaceae		JRST 713	L		1
Hygrophila auriculata (Schumach.) Heine	Acanthaceae	Buganga Bukari	JRST 735	L		1
Hypericum revolutum Vahl	Clusiaceae	Mushungwa	JRST 736			1
Iboza multiflora (Benth.) E. A. Bruce	Lamiaceae	Iseja	JRST 720, 794	L		1
Lagenaria sphaerica (Sond.) Naudin	Cucurbitaceae	Mutanga	JRST 738	L		1
Leonotis nepetifolia (L.) R. Br.	Lamiaceae	Susuni	JRST 714	L		1
Mucuna pruriens (L.) DC.	Papilionaceae	Lugenyu	JRST 706	L		1
Maerua edulis (Gilg & Gilg-Ben.) DeWolf.	Capparaceae	Eserete	JRST 768	Tuber		1
Maesa lanceolata Forssk.	Myrsinaceae	Muhanga	JRST 734	R		1
Microglossa pyrifolia (Lam.) Kuntze	Asteraceae	Kabilili akatono	JRST 711, 870	R		1
Moringa oleifera Lam.	Moringaceae	Moringa	JRST 765	seed		1
Piliostigma thonningii (Schumach.) Milne-Redh.	Caesalpiniaceae	Epapae	JRST 764	SW		1

Table 4(*Continued*)

Scientific name	Family	Local name	Collection number	Main part used	Other parts	Number of TMPs mentioning species
Plectranthus barbatus Andr.	Lamiaceae	Agacuncu	JRST 728	L		1
Pycnostachys erici-rosenii R.E.Fr.	Lamiaceae	Musindikwa	JRST 723	L		1
Rhamnus prinoides L'Herit.	Rhamnaceae	Munanira	JRST 753	L	SW	1
Rhoicissus tridentata (L.f.) Wild. & Drummond	Vitaceae	Mumara	JRST 737	L	SW	1
Securidaca longipedunculata Fresen.	Polygalaceae	Mukondwa	JRST 715	R		1
Senna siamea (Lam.) Irwin & Barneby	Caesalpiniaceae	Gassia seed	JRST 704	SB		1
Tamarindus indica L.	Caesalpiniaceae	Mukoge	JRST 705,709	L		1
Teclea nobilis Del.	Rutaceae	Luzo	JRST 718	L		1
Tragia brevipes Pax	Euphorbiaceae	Nakepian	JRST 775	R		1
Vernonia amygdalina Del.	Asteraceae	Lubilili	JRST 716	L		1
Zingiber officinale Roscoe	Zingiberaceae	Ntangawuzi	NC	R		1
Unidentified		Akaramata		L		1
Unidentified		Daktari		SB		1
Unidentified		Ekishegura		SB		1
Unidentified		Ekomait		SB		1
Unidentified		Epetet		R	SB	2
Unidentified		Esiokan		R		2
Unidentified		Kyomya	NC	L		1
Unidentified		Losaa	JRST 771	R		1
Unidentified		Loucekican		R		1
Unidentified		Mutawula		RB		1
Unidentified		Nkenku		L		1
Unidentified		omushegura		L		1
Unidentified		Ruhombo	NC	galls on stem	Thorn	1
Unidentified		Rukuraza	JRST 731	L		1

Pian County (Nakapiripirit District). Twenty-seven of the TMPs were male and the rest female. The TMPs belonged to six ethnic groups: the Karimajong, Bafumbira, Baganda, Basoga, Banyoro and Banyole tribes (Table 1). The average age was 52 years (range 28–80 years); the TMPs were mostly Christians and had attained low levels of formal education or none at all.

The TMPs stated that traditional healing was their main source of livelihood. TMP's knowledge of traditional healing, including knowledge to treat TB, is mainly acquired from parents and other relatives (Fig. 1). All TMPs interviewed ($n = 33$) belong to TMPs associations such as *Uganda ne Dagala Lyayo*. On average every TMP treats two TB patients in a month (range 1–10 patients) and charges a fee averaging UGX 5,000 (USD 3: exchange rate UGX 1700) for treatment.

3.2. Knowledge about TB

Tuberculosis is known locally as *Akafuba* (Baganda), *Olukololo* (Basoga), *Ekitundu* (Bafumbira) and *Lokudi* (Karimajong). The TMPs' diagnosis of TB is based on signs and symptoms that include a cough lasting more than 2 months, weight loss, laboured breathing and a wheezing cough (Table 2). The TMPs believe that TB is a contagious disease that is spread, primarily, through sharing contaminated food and eating-utensils, and droplet infection (Table 3). In addition to TB, all TMPs claim to treat other respiratory infections that include asthma ($n = 22$) and ordinary cough ($n = 31$).

3.3. Treatment practices and plant species used to treat TB

All the TMPs interviewed in this study use plants to treat TB. They also add rock salt (*Kisura*: *Luganda*) and a calcareous ($CaCO_3$) sediment rock (*Abolangit*: *Karimajong*). Some TMPs of Nakapiripirit add animal parts (species not identified).

We recorded a total of 88 plant species from the three districts used in TB treatments; 15 of these remain to be identified (Table 4). The families with the most species of TB plants were Lamiaceae and Asteraceae (Fig. 2). Five of the species recorded were reported by more than one TMPs and from more than one district (Table 5). Two other species, *Persea americana* and *Acacia hockii*, were reported by six TMPs, but from one district. Overall, the most frequently used plant parts are leaves, whole root and stem bark (Fig. 3).

3.4. Medicine preparation and administration

The plant medicines are processed mostly as mixtures of four or more species. In Nakapiripirit District, however, most medicines are prepared using one species (mono-preparations). The dosage forms employed are decoction, infusion and water extraction. By far the commonest dosage form is decoction. Generally no rituals accompany the treatments.

These medicines are prepared when required, and because of this most TMPs do not preserve the medicines. Some TMPs, however, add honey and *Zingiber officinale* Rosc., rock salt, and sugar to preserve their concoctions. Others dehydrate the plant parts by sun-drying. The decoctions are packaged in plastic bottles ($n = 12$), polyethylene bags ($n = 5$), newspaper ($n = 1$) and flask ($n = 1$).

The medicines are administered orally in doses that vary between 1 and 2 teaspoons/tablespoons administered 3 times a day for periods varying between 1 and 12 weeks, or until the patient recovers. TMPs assess the treatment outcomes in patients, mainly, by patient feedback and by the disappearance of TB signs. Where patients fail to improve, they are referred to hospitals.

Table 5
Most frequently used plant species in TB treatment.

Plant species	Part used	No. of TMPs	No. of districts
Eucalyptus spp.	Leaves	9	3
Ocimum suave Willd.	Leaves	6	2
Persea americana Mill.	Leaves	6	1
Acacia hockii De Wild.	Stem bark	6	1
Warburgia salutaris (G. Bertol.) Chiov.	Root bark	5	3
Zanthoxylum chalybeum Engl.	Root (whole)	3	2
Momordica foetida Schum.	Leaves	3	2

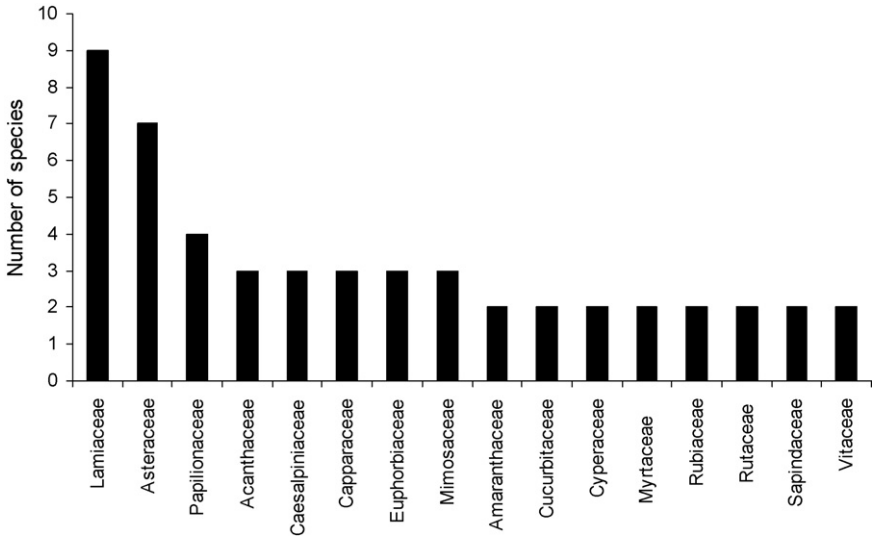

Fig. 2. Distribution of species in different plant families (only families with two or more species shown). The families Caesalpiniacea, Mimosaceae and Papilionaceae are sometimes treated as one family, family Fabaceae.

4. Discussion

4.1. Traditional knowledge of treating TB

Many species used to treat TB (88) were reported by traditional medicine practitioners (TMPs) in this study. Most of these species belonged to family Lamiaceae and Asteraceae. These families frequently stand out in medicinal plant inventories with large numbers of medicinal species. The popularity of Asteraceae is thought to be due to the large diversity of bioactive components members of this family possess; people deliberately select them because of the typical bitter phytochemicals such as sesquiterpene lactones that they often contain; and because members of this family are abundant and therefore more likely to be encountered by people and experimented on Thomas et al. (2009). The family Lamiaceae, on the other hand, is rich in aromatic oils, which are appreciated for their therapeutic values (Thomas, 2008).

Some of the species reported here have been studied and found to have activity against *Mycobacterium tuberculosis* and other species of *Mycobacterium* (Table 6a); some others, though not evaluated for efficacy, are used to treat TB and coughs in other parts of the world including Uganda (Table 6b). This wide usage, both, locally and regionally indicates that these species may be effective and safe in the treatment of TB and allied ailments. One of the recognised evidences of efficacy and safety of remedy is a long history of traditional use for treating an ailment (van Wyk and Wink, 2004).

There was low consensus regarding the TB remedies among the TMPs. Different TMPs mentioned different sets of plants for the treatment of TB and there was little uniformity in plants mentioned. This is not surprising and is widespread pattern reported from many parts of the world. This low consensus among the TMPs is probably because some TMPs are still experimenting and are not sure about which plants to use for the treatment of TB. According to Thomas (2008), traditional medicine knowledge is difficult to learn and to transfer accurately. Practitioners commonly make mistakes regarding accurate identification of medicinal plant species. Secondly, for many people, the practice of traditional medicine is not respectable and many are abandoning it (Voeks, 2007). Because of this, traditional medicine knowledge is steadily eroding in many human populations. Lastly, limited availability and accessibility of some medicinal species restricts their use and leads to loss of important traditional knowledge such as species identification.

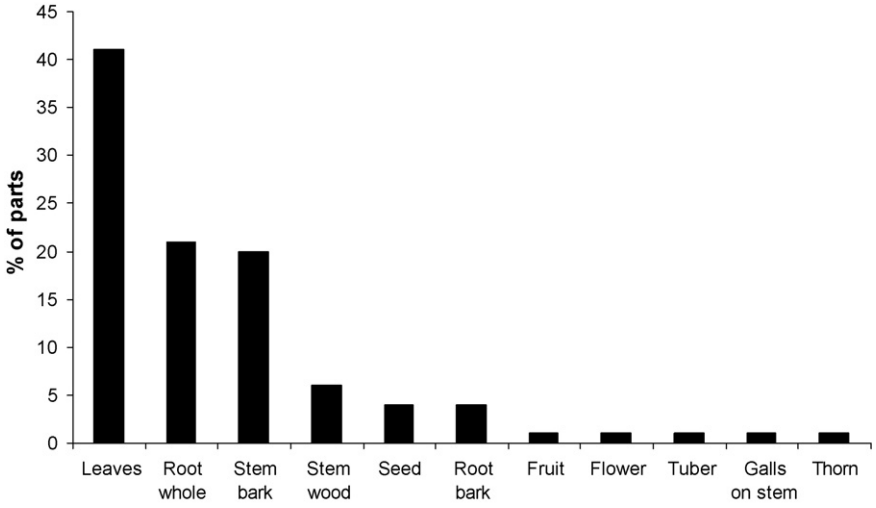

Fig. 3. Proportion of plant parts harvested.

Table 6
Species reported in this study which have been found to have activity against *Mycobacterium tuberculosis* and other species of *Mycobacterium* (a) or have been reported to treat coughs (b) in other parts of the world but lack efficacy data.

Species	Reference and notes
(a) Activity detected against *Mycobacterium tuberculosis*	
Allium sativum	Gautam et al. (2007)
Azadirachta indica	Gautam et al. (2007)
Bidens pilosa	Gautam et al. (2007)
Callistemon citrinus	Gautam et al. (2007)
Carica papaya	Gautam et al. (2007)
Mangifera indica	Gautam et al. (2007)
Maytenus senegalensis	Lall and Meyer (1999)
Helichrysum odoratissimum	Lall and Meyer (1999)
Eucalyptus spp.	Active against several species of *Mycobacterium* but not *Mycobacterium tuberculosis* (Gautam et al., 2007), Newton et al. (2000)
Achyranthes aspera	Active against *Mycobacterium smegmatis*, *Mycobacterium avium* only (Gautam et al., 2007)
Moringa oleifera	Active against *Mycobacterium phlei* only (Gautam et al., 2007)
Zanthoxylum chalybeum	Activity detected against *Staphylococcus aureus* and not *Mycobacterium* spp. (Matu and van Staden, 2003)
(b) Some species with unverified traditional medicine claims that they treat coughs	
Acanthus pubescens	Jeruto et al. (2008)
Asparagus africanus	McGaw et al. (2008)
Balanites aegyptiaca	Maregesi et al. (2007)
Capparis tomentosa	Used to treat chronic cough (Hutchings et al., 1996)
Carissa edulis	Tabuti et al. (2003b)
Coffea sp.	Tabuti et al. (2003b)
Lantana trifolia	Ssegawa and Kasenene (2007) and Tabuti et al. (2003b)
Momordica foetida	Tabuti et al. (2003b) and Adjanohoun et al. (1993)
Securidaca longipedunculata	McGaw et al. (2008)
Vernonia amygdalina	Adjanohoun et al. (1993)
Warburgia salutaris	Used to treat dry cough (Hutchings et al., 1996) and pneumonia (Jeruto et al., 2008).

Despite the low consensus observed among the TMPs, some species were used by many TMPs from different ethnic backgrounds i.e. TMPs from different districts. This is further evidence that these species may be efficacious.

4.2. The role of TMPs in primary health care and medicinal processing practices

Although statistics of the number of TMPs in Uganda are hard to come by, this number is likely to be large. For example in present day Kaliro District, Tabuti et al. (2003a), recorded more than 340 TMPs. The number of TB patients in Uganda, served by TMPs when extrapolated for all TMPs in Uganda who treat TB and for a period of 1 year, is fairly significant. This estimated large number of patients provides further evidence that TMPs have a role to play in primary heath care delivery. The ongoing government efforts to integrate allopathic medicine and TM are therefore well justified and should move forward as fast as possible.

Areas where TMPs and allopathic medicine practitioners can collaborate include training of TMPs in- and promoting the processing and packaging of medicines according to accepted national standards. The processing and packaging of medicines by TMPs is at variance with the draft Uganda National Drug Authority (NDA) guidelines. For instance, the TMPs used recycled plastic water bottles to package medicines raising the need for support so as to attain standards in processing and packaging of medicines acceptable to regulatory bodies. TMPs also had problems in preserving their medicines for long periods. This is another area where they need help.

5. Conclusions

From this study we conclude that TMPs in Uganda have knowledge to identify and treat TB using plant species. The treatment of TB using plants does not appear to be very advanced in Uganda because there was low consensus regarding the efficacious plants for treating the disease among the TMPs. This highlights the need for pharmacological evaluation of the species to determine which species are efficacious and are safe to use. Efficacy of some species has been validated, however (Table 6). Secondly, TMPs provide a critical service in the treatment of TB. This service has been recognised by government and efforts to integrate TM and AM are underway. These efforts need speeding up as they will help to enhance areas of mutual benefit like training in aspects of medicinal production including processing, packaging and storage of traditional medicines.

Acknowledgments

This research was funded by the World Health Organisation. We are grateful to the TMPs who participated in this study. We also acknowledge the District Community Officers of Kisoro and Kamuli Districts for helping us to identify the TMPs to interview. We are grateful to the staff of KACHEP who helped us to identify TMPs in Nakapripirit. Makerere University provided additional logistical support to conduct this study. We appreciate the Uganda national Council of Science and Technology for granting us permission to conduct this study (NS 141). We also thank two anonymous referees for making useful comments to this paper.

References

Adjanohoun, J.E., Ahyi, M.R.A., Aké Assi, L., Alia, A.M., Amai, C.A., Gbile, Z.O., Johnson, C.L.A., Kakooko, Z.O., Lutakome, H.K., Morakinyo, O., Mubiru, N.K., Ogwal-Okeng, J.W., Sofowora, E.A., 1993. Traditional medicine and pharmacopoeia: contribution to ethnobotanical and floristic studies in Uganda. Scientific, Technical and Research Commission of the Organization of the African Unity (OAU/STRC).

Balunas, M.J., Kinghorn, A.D., 2005. Drug discovery from medicinal plants. Life Sciences 78, 431–441.

Fabricant, D.S., Farnsworth, N.R., 2001. The value of plants used in traditional medicine for drug discovery. Environmental Health Perspectives 109, 69–75.

Gautam, R., Saklani, A., Jachak, S.M., 2007. Indian medicinal plants as a source of antimycobacterial agents. Journal of Ethnopharmacology 110, 200–234.

Hutchings, A.S., Haxton, A., Lewis, G., Cunningham, A.B., 1996. Zulu Medicinal Plants: An Inventory. University of Natal, Pietermaritzburg, Scottsville.

Jeruto, P., Lukhoba, C., Ouma, G., Otieno, D., Mutai, C., 2008. An ethnobotanical study of medicinal plants used by the Nandi people in Kenya. Journal of Ethnopharmacology 116, 370–376.

Lall, N., Meyer, J.J.M., 1999. In vitro inhibition of drug-resistant and drug-sensitive strains of *Mycobacterium tuberculosis* by ethnobotanically selected South African plants. Journal of Ethnopharmacology 66, 347–354.

Maregesi, S.M., Ngassapa, D.O., Pieters, L., Vlietinck, A.J., 2007. Ethnopharmacological survey of the Bunda district, Tanzania: Plants used to treat infectious diseases. Journal of Ethnopharmacology 113, 457–470.

Matu, E.N., van Staden, J., 2003. Antibacterial and anti-inflammatory activities of some plants used for medicinal purposes in Kenya. Journal of Ethnopharmacology 87, 35–41.

McGaw, L.J., Lall, N., Meyer, J.J.M., Eloff, J.N., 2008. The potential of South African plants against *Mycobacterium* infections. Journal of Ethnopharmacology 119, 482–500.

Newton, S.M., Lau, C., Wright, C.W., 2000. A review of antimycobacterial natural products. Phytotherapy Research 14, 303–322.

Ssegawa, P., Kasenene, J.M., 2007. Medicinal plant diversity and uses in the Sango bay area, Southern Uganda. Journal of Ethnopharmacology 113, 521–540.

Tabuti, J.R.S., Dhillion, S.S., Lye, K.A., 2003a. Traditional medicine in Bulamogi county, Uganda: its practitioners, users and viability. Journal of Ethnopharmacology 85, 119–129.

Tabuti, J.R.S, Lye, K.A., Dhillion, S.S., 2003b. Traditional herbal drugs of Bulamogi, Uganda: plants, use and administration. Journal of Ethnopharmacology 88, 19–44.

Thomas, E., 2008. Quantitative ethnobotanical research on knowledge and use of plants for livelihood among Quechua, Yuracaré and Trinitario Communties in the Andes and Amazon regions of Bolivia. Ph.D. Thesis, Faculty of Bioscience Engineering, Ghent University, Belgium.

Thomas, E., Vandebroek, I., Sanca, S., van Damme, P., 2009. Cultural significance of medicinal plant families and species among Quechua farmers in Apillapampa, Bolivia. Journal of Ethnopharmacology 122 (1), 60–67.

van Wyk, B.-E., Wink, M., 2004. Medicinal Plants of the World: An Illustrated Scientific Guide to Important Medicinal Plants and their Uses. Timber press, Portland, OR, USA.

Voeks, R.A., 2007. Are women reservoirs of traditional plant knowledge? Gender, ethnobotany and globalization in northeast Brazil. Singapore Journal of Tropical Geography 28, 7–20.

WHO (World Health Organization), 2007. Tuberculosis. WHO, Fact sheet No. 104.