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Local Indigenous Knowledge, Attitudes and Practices in Processing Antimalarial Herbs: An Assessment Based on WHO Requirements

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Abstract

Whereas conventional health facilities exist, majority Tororo communities in Uganda

still employ herbal malaria treatment. Despite widespread herbal utilization, documentation about them or about herbalist knowledge, attitude and practices of herbal standardization is scanty.

The purpose of this study was to document knowledge, attitude and practices of herbalists in processing antimalarial herbs and whether these conform to WHO requirements.

A survey employing structured interviews, Key Informant interviews and focus group discussions was carried out in four Tororo sub-counties (January - February, 2010). Qualitative data was analysed by thematic content analysis and quantitative data by monovariate and bivariate analyses.

From 106 respondents, 100% were scantily knowledgeable about WHO herbal standardization. On attitude, 100% respondents feared labelling their products. While 63.2% respondents had practiced antimalarial herbalism for over ten years, practices including plant identification, collection, preparation, packaging, labelling and storage are still below WHO standards.

In conclusion, 45 antimalarial herbal species have been documented; knowledge, attitude and practices of herbalists in processing antimalarial herbs with their practices still below WHO requirements.

KEYWORDS: Antimalarial, Standardization, Herbal, Herbalist, WHO

Background

The global burden of malaria has been widely reported with approximately 350 – 500 million clinical cases occurring annually as one child dies of the infection every thirty seconds in Africa (Bell, Wongsrichanalai, & Barnwell, 2006; WHO, 2005)

For effective control world wide the pandemic requires over 2.6 billion US dollars annually compared to the merger 500 million US dollars currently available while accounting for about 40% of Africa's Public Health Expenditure (Consortium, 2006). It is estimated that in Uganda the Government spends about 50 million US dollars per year to combat malaria [8].

A recent survey in Uganda (Uganda Bureau of Statistics, 2007) showed that malaria is currently responsible for more illness and death than any other single disease in Uganda(UBOS, 2007). It accounts for up to 14 % of all inpatient deaths in Uganda and kills an estimated 70000-110000 Ugandan children annually, and at the same time it is also the leading cause of poverty in the country as a result of absenteeism from places of work, and treatment costs(MOH, 2006).

It is estimated that the majority of people in developing countries as well as a vast number of the rural communities globally depend on botanicals for their primary source of health care(Birdi, Brijesh, & al, 2008) Herbal products have been used to treat malaria for thousands of years and approximately 1600 species of plants/herbs from 160 families are documented for malaria therapy (Merlin & Gerard, 2004).

However the key weakness levelled against herbal products is the lack of standardization in terms of documented process procedures from collection, preparation, storage to administration of the products (OAU/STRC, 1991).

In Tororo, a rural district in Eastern Uganda, *Plasmodium falciparum* malaria is a big challenge due to the high malaria transmission rates (Staedke, Jagannathan, Yeka, & al., 2008). The community response to this has been to control malaria by using medicinal herbs.

The challenge with this is the lack of a standardized process of preparing the medicinal herbs from collection, processing and storage before their use in treatment of suspected cases of malaria. Even though there are WHO requirements for herbal medicine processing (WHO, 1998), what is not known is whether the practices of the herbalists conform to these standards, thus bringing to question the level of quality and safety of the products.

This paper explores the knowledge, attitudes and practices of the herbalists regarding traditional process procedures of selected medicinal plants used for the treatment of suspected cases of malaria, from collection, handling, preparation, posology, storage and comparing these practices with the internationally recognized WHO requirements. The paper further proposes a framework for standardizing the process procedures that could improve the quality and safety of herbal medicines.

Materials and Methods

Study design and setting: A cross sectional survey was carried out to generate both qualitative and quantitative data with focus on communities from rural settings in four sub counties of Tororo district, Eastern Uganda from January to February, 2010.

The community survey was conducted to determine the knowledge, attitude and practices (KAP) of the herbalists regarding malaria and standardization of antimalarial medicinal herbs.

In-depth interviews were conducted with Key district administrative leaders and members of drug regulatory bodies (District Agricultural Office, District Community Development office and National Drug Authority (NDA) – Herbal section) as they are involved in planning, and service delivery at the district.

Sampling: Tororo district was purposively sampled as the district has a high malaria prevalence with limited use of the recommended preventive measures like mosquito nets by the majority in the community, but with high use of herbal medicines.

Thereafter, a multistage sampling of herbal outlets according to the WHO, 1999 formula for sampling drug outlets/ herbalists clinics for quality analysis was used in this study. In this study, herbal outlets included herbal drug shops, herbalists' clinics, and herbalists' homesteads .

For the structured interview surveys, the sample size n was determined by the main outcome (Binary outcome) from: $n = Z_{\alpha/2}^2 P (1-P)/e^2$

Where n is the minimum sample size, $\alpha = 0.05$, Z is the Z value at $\alpha/2$, P is the proportion of the herbalists whose indigenous KAP is in agreement with WHO requirements ($P=0.5$), e is the precision (0.1). The value $Z_{\alpha/2} = 1.962$ (Approximated to 2)

By substitution, $n = 100$. We administered 106 structured interviews to 106 Tororo herbalists.

Data Collection and Handling

The survey targeted community members who were well known herbalist or healers as identified by the local community leaders.

Questionnaires in English and translated version in local dialects, (Dhopadhola and Ateso, two common dialects in Tororo district) were used by trained interviewers with good knowledge of the respective dialects.

The interviewers provided information about the study and then sought verbal consent of the respondent from the participants.

Themes explored during the interviews included: socio demographic aspects, knowledge on general malaria symptoms, knowledge of herbs for treatment of malaria including their sources and standardization, posological instructions and patient follow up post treatment.

The traditional healers/elders/men/women that have been using the herbs were requested to show and bring plants and also to sell to the team the products that they use for the treatment of malaria and related conditions from the same plants/herbs. Questions included plant parts used for treatment of malaria, frequency of use and standardization processes in traditional medicine practice. These interviews were supplemented by direct observations to herbal gardens. The place where the herbalists/guides sampled or claimed to have sampled the study plant of interest were demarcated into plots of 20x50M using community methods of planting specific special plants for that purpose.

The 20x50m plots were to serve as a reference area from which to collect plant materials using standard collection processes (Tchouto, 2004). The plants were collected and pressed prior to transportation to the department of Botany for identification.

At the end, a one day wrap-up and sensitization workshop was organized for the respondents who were then engaged in Focus group Discussions (FGDs) during the first session; followed by validation of their original information given regarding herbs they gave during the personal interviews.

The climax of the wrap up workshop included the following activities: giving tips on the importance of correct plant identification, pressing of the plant materials, non destructive collection practices and participants being asked to contribute ideas how to improve the quality of their products for better product performance against malaria for the future.

Following the identification of botanicals at Makerere University, Botany department, two of the most frequently reported as antimalarial herbs and used as a mono herbal antimalarial, were then selected for further evaluation of the process procedures by the herbalists.

Data handling and Analyses: Data from questionnaires was captured by MS Excel computer Program, cleaned and then exported to SPSS and STATA where monivariate and bivariate analyses were performed. Key variables analyzed included Knowledge, attitudes and practices regarding standardization of antimalarial herbal products; attendance of any herbal standardization course, gender, herbalist length of practice, and availability of a pro active herbalist Association, educational level of the herbalists / ownership of radios .

Qualitative data from Key informants and Focus Group Discussions were collected by taking notes of the responses of the interviews which were then organized into comprehensive notes followed by Content analyses from which major themes and sub themes were identified with key quotations, explanations and insights highlighted.

Findings were then narrated and interpreted using direct quotations to qualify the findings,(Anonymous, 2007).

Results

Knowledge about malaria, antimalarial herbs and their standardization

Tororo district (Fig.1) has, an approximated population of 455,789 with a sex ratio of 94.9% that is 94.9 males per every100 females(Anonymous, 2009/2010). Tororo population growth rate is 2.4% per year. Over all, 7% of the population is urbanized while 93% live in the rural areas(Anonymous, 2009/2010). .From a total of 106 herbalists surveyed, there were more females as compared to males.

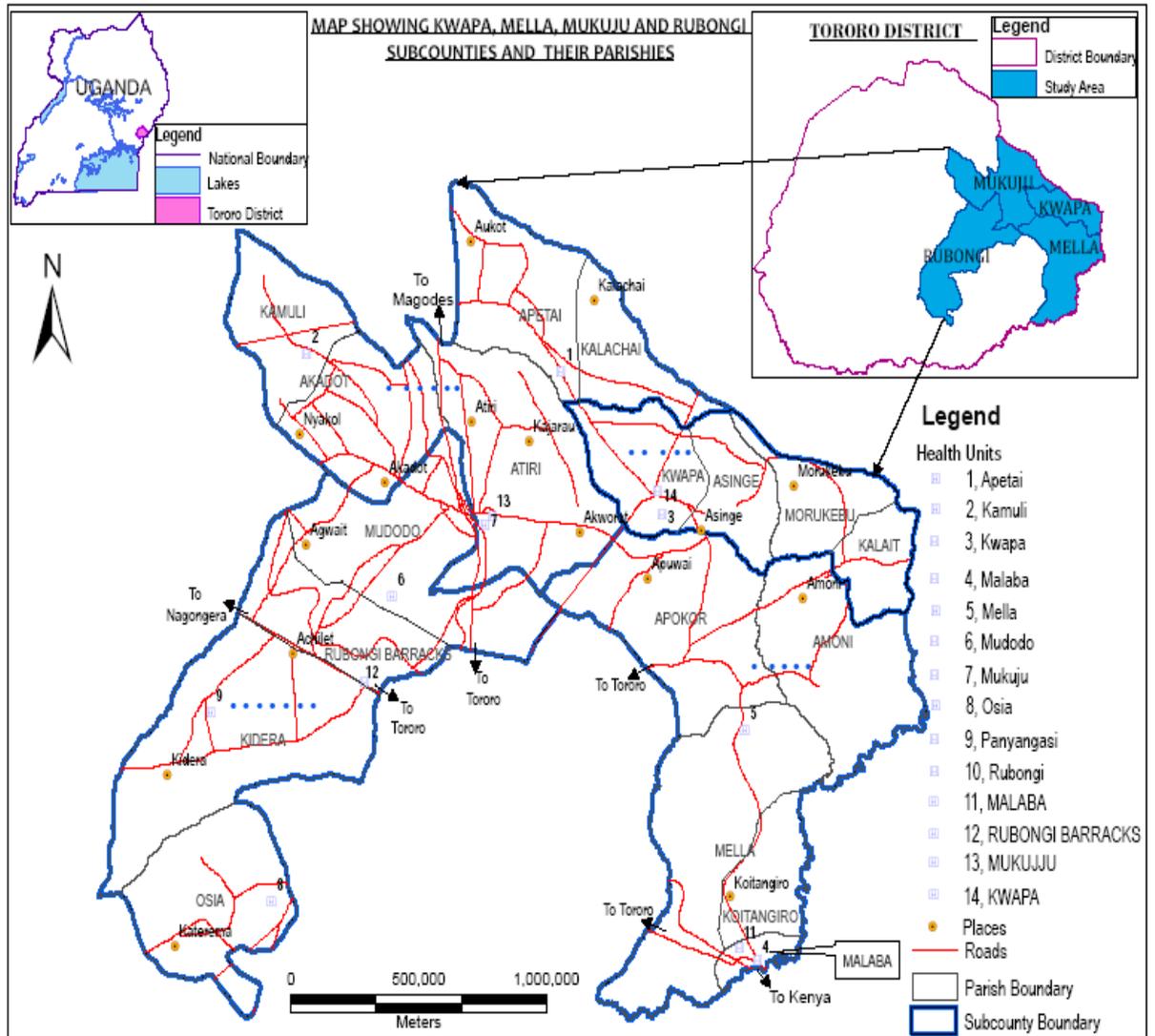


Figure 1: Mukuju, Kwapa, Mella, Rubongi study sub counties in Tororo district with respect to Tororo Municipality

Only 17% of the respondents attended any refreshers course, (Fig.2).However, bivariate analysis shows that course attendance is not dependent on gender ($P>0.05$) but upon herbalist length of practice, and availability of a pro active herbalist Association ($P<0.05$).

The availability of a pro active herbalist Association on the other hand was shown not to depend on the educational level of the herbalists / ownership of radios or herbalist length of practice ($P>0.05$).

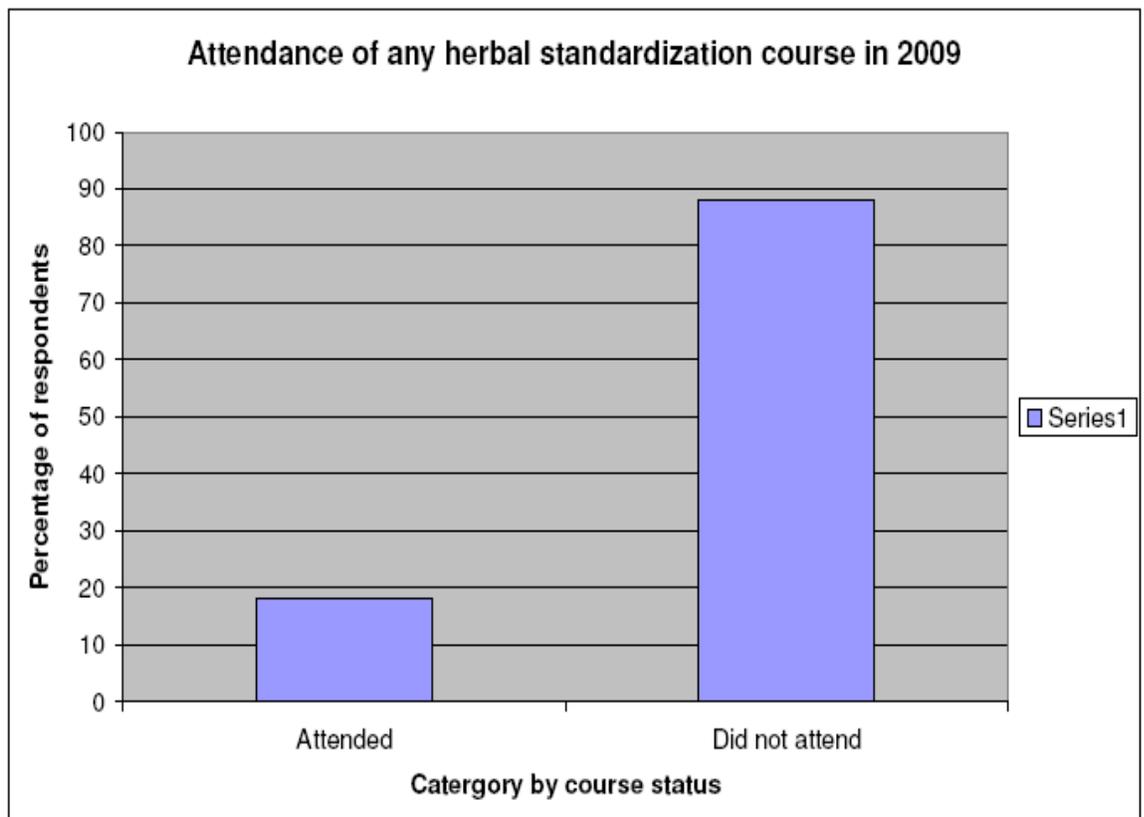


Figure 2: Percentage respondents who attended 2009 herbal standardization course (17%) versus those who did not (83%)

Moreover, this study documented 45 species from 27 families as useful in the management of malaria in the rural Tororo (table 1).

Of these, nine Species were cited 3 or more times and used as poly herbal combination. Most of the herbal products were from leaves (34%), followed by the roots (28%), root bark (12.8%). The shoot bark contributed to 6.4% while the whole plant was 4.3%. Additional file 1 provided shows this in more details.

Table 1: Diversity of botanicals in malaria management in four Sub counties of Tororo district

Table 1: Diversity of botanicals for malaria management in four Sub counties of Tororo district

Local names	DIALECT	FAMILY	SCIENTIFIC NAME	Frequency of mention	Parts used
Lajoli	Dhopadhola	Aloaceae	<i>Aloe</i> sp.	1	L
Osagare	Dhopadhola	Anacardiaceae	<i>Rhus natalensis</i> Krauss	1	N/C
Ocuga	Dhopadhola	Apocynaceae	<i>Carissa edulis</i> Forssk.	2	R
Mbirambira	Dhopadhola	Asteraceae	<i>Coryza sumatrensis</i> (Retz.) E. Walker	1	L
Poso	Dhopadhola	Asteraceae	<i>Crassocephalum mannii</i>	2	L
Lawbonyo	Dhopadhola	Asteraceae	<i>Schkuhria pinnata</i> (Lam.)Thell	6	WP
Atabaajwogi	Ateso	Asteraceae	<i>Schkuhria pinnata</i> (Lam.)Thell	5	WP
Kwekwe	Ateso	Asteraceae	<i>Tegetes minuta</i> L.	1	L
Ekadwarati	Ateso	Asteraceae	<i>Tithonia diversifolia</i> (Hemsl.)A. Gray	2	L
Ekadwarati	Ateso	Asteraceae	<i>Vernonia amygdalina</i> Delile	5	SB +RB
Ekadwarati	Ateso	Asteraceae	<i>Vernonia lasiopus</i> O.Hoffm	4	SB + RB
Ekuduru	Ateso	Caesalpiniaceae	<i>Senna hildebrandii</i>	1	N/C
Ekiyakaket	Ateso	Caesalpiniaceae	<i>Senna hirsute</i> (L.) H. S. Irwin & Bameby	1	N/C
Ekiyakaket, Yelēyeke	Ateso; dhopadhola	Caesalpiniaceae	<i>Senna occidentalis</i> (L.)	1	R

Local name	DIALECT	FAMILY	SCIENTIFIC NAME	Frequency	Parts
Epapai	Ateso	Caesalpiniaceae	<i>Tyloglossa faglossum</i>	1	R
Njaga	Dhopadhola	Cannabaceae	<i>Cannabis sativa</i> L.	1	N/C
Eteba	Ateso	Celastraceae	<i>Maytenus senegalensis</i> (Lam.)Exell	1	N/C
Ekyamuyayt	Ateso	Chenopodiaceae	<i>Chenopodium opulifolium</i> Scrad	2	R
		Chenopodiaceae	<i>Chenopodium procerum</i> Hochst.	1	N/C
Kadete yayi	Ateso	Combretaceae	<i>Terminalia brownie</i> Fresen	1	N/C
Ekodokodoi	Ateso	Cucurbitaceae	<i>Momordica foetida</i> Schumach.	1	R
Penyi	Ateso	Dracaenaceae	<i>Dracaena fragrans</i> Ker Gawl.	1	N/C
Alakisi	Ateso	Euphorbiaceae	<i>Flueggea virosa</i> Wall	1	R
Atiko	Dhopadhola	Euphorbiaceae	<i>Phyllanthus amarus</i> Schum. and Thonn.	2	SL
Ajwoka	Dhopadhola	Lamiaceae	<i>Ocimum gratissimum</i> L.	3	L
Ekodoi	Ateso	Malvaceae	<i>Hibiscus cannabinus</i> L.	1	L
Mwarubaine/ Neem		Meliaceae	<i>Azadirachta indica</i> A.Juss.	3	L
Lira	Dhopadhola	Meliaceae	<i>Melia azadirachta</i> L.	6	L
Mbirambira	Dhopadhola	Menispermaceae	<i>Chasmanthera dependens</i> Hochst.	1	L

		Mimosaceae	<i>Acacia gerrardii</i> Benth.	1	N/C
Etiri	Ateso	Mimosaceae	<i>Acacia sieberiana</i> Scheele	2	RB
Alwi	Dhopadhola	Mimosaceae	<i>Acacia sieberiana</i> Scheele	1	RB
Elekwa	Ateso	Mimosaceae	<i>Albizia coriaria</i> Welw.	1	R,FL
Ebatata	Ateso	Mimosaceae	<i>Albizia grandibracteata</i> Taub.	1	R
Yori agaki	Dhopadhola	Papilionaceae	<i>Cajanus cajan</i> (L.) Druce	2	N/C
Poswa	Dhopadhola	Plumbaginaceae	<i>Plumbago zeylanica</i> L.	3	R
Elili	Ateso	Polygalaceae	<i>Securidaca longipedunculata</i> Fresen	2	RB
Osagari	Ateso	Rhamnaceae	<i>Scutia myrtina</i> Merr.	1	R,L
Amoo	Dhopadhola	Rubiaceae	<i>Nauclea latifolia</i> SM.	1	S,R
Ekeree	Ateso	Simaroubaceae	<i>Harrisonia abyssinica</i> Oliv.	2	R
Atulelutu	Ateso	Solanaceae	<i>Solanum incanum</i> L.	1	N/C
Ekamuli	Ateso	Verbenaceae	<i>Clerodendrum myricoides</i> R.Br.& Vatke	1	N/C
Ekidepu	Ateso		? <i>Antidesma</i>		R
Esoroi	Ateso		NID		
Mukurembe	Dhopadhola		NID		
Ekudep	Dhopadhola		NID		

KEY
L = Leaves
S = Shoot
R = Root
F = Flower
WP = Whole plant
RB = Root Bark
SB = Shoot Bark
NC = None compliant
NID = NOT IDENTI
P/USED =PART USED



Table 2 shows that the most common dosage form was aqueous mixture for oral administration (93.3%), followed by crushed root bark applied topically (4.4%) and dried root bark by inhalation with 2.2%.

Table 2: Number, method, and route of administration of herbal preparations in the management of malaria (Tororo).

Number of herbal Preparations from the study herbs/plants	% of a given preparation from the total No.of preparations (n=37)	Method of preparation & Route of Administration In malaria treatment
34	93.3	Aqueous mixture Given orally
2	4.4	Root Bark crushed Topically applied twice a day
1	2.2	Dried root bark Administered by Inhalation

Results from herbalists and opinion leaders indicate that whereas over 94% of the respondents were knowledgeable about malaria, Tororo herbalists had scanty knowledge about herbal standardization process.

This study found out that Instead of regular acquisition of new knowledge as required by WHO, 1999- there is loss of existing knowledge regarding antimalarial herbs in Tororo District. This is in agreement with the opinion of the District Agricultural Officer who put it this way:

“... Issues about standardization are welcome provided communities are educated about it... In fact it is overdue as there is indigenous knowledge loss due to secrecy among the knowledgeable. When the old people die, they go with their knowledge”

Attitudes of the herbalists in processing of antimalarial herbal medicines

Regarding attitude, this study found out that 100% of Tororo herbalists have fearful attitude about labelling their products – their practical measure against conspiracy in which would result in loss of ownership.

In fact this was an issue which raised hot arguments in the Focus Group Discussions during the wrap up workshop in which Mr. P O one of the panellists had this to say:

“A bad joke! Who would like to chase away clients like that? I mean, just labelling our products, Faah like that- our clients would just know the substance and the plants and then a client coming back to you is a fool!”

Practices of the herbalists in processing of antimalarial herbal medicines.

It was further found out that 63.2% (67/106) of the respondents had practiced in ant malaria herbalism for ten years and above (confirmed by LC1- local leaders in the communities)- portraying a certain level of safety with respect to the medicinal plant in question. This is in line with what the opinion leader from National Drug Authority (NDA) herbal desk who said:

“According to WHO, herbal products used in a given community for a named disease condition for ten years and over without any reported adverse effects are deemed safe”.

However, figure 3 shows that 66% of the respondents in their herbalist Practices including plant identification, collection, preparation, packaging, labelling and storage (using writing paper and recycled mineral water bottles) [figure not provided here] were rated below WHO standard .

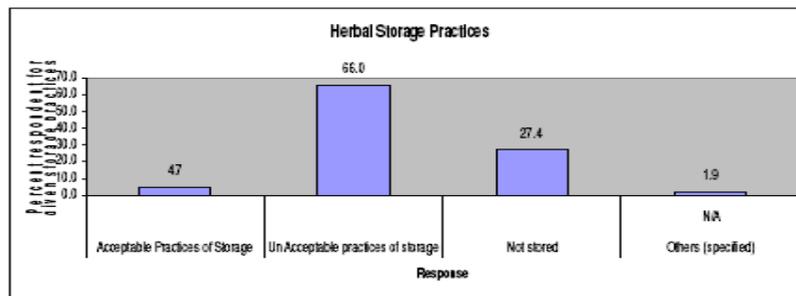


Figure 3: Percentage of respondents for given Storage practices based on WHO- NDA Guidelines

All these findings are in agreement with what the opinion leader from National Drug Authority from Uganda had to say:

“...NDA does not regulate Traditional medical practices but is charged to focus on already made and packaged products.....” and about Labels;

“..... Label with a brand name, active ingredient names, Botanical names; Indicating dosage form; dosage; indicating storage conditions; indicating date of manufacture and expiry” 2009/2010 Proposed NDA Guidelines.

Discussion

Although there were more females as compared to males with only 17% of the respondents who attended herbal standardization course in 2009, bivariate analysis shows that course attendance is not dependent on gender ($P>0.05$) but upon herbalist length of practice, and availability of a pro active herbalist Association ($P<0.05$).

The explanation for this is that a herbalist with long time of practice gets noticed and/trusted by the immediate community, village elders and the local government leaders and stands higher chances of being nominated for/being sponsored/ getting information about courses in this practice.

The availability of a pro active herbalist Association on the other hand may push for regular organised meetings/workshops/outings and trainings for the benefit of the members.

The availability of a pro active herbalist Association on the other hand was shown not to depend on the educational level of the herbalists / ownership of radios or herbalist length of practice ($P>0.05$) as the more educated/wealthier herbalist would naturally not want to associate with the non educated herbalist/poorer ones unless higher authorities intervene.

Regarding antimalarial herbs, this study documented 45 species from 27 families as useful in the management of malaria in the rural Tororo but unfortunately, the herbalists seem not to be aware of studies that have shown that harvesting of bark is a very destructive procedure of harvesting which should be discouraged as it leads to the death of the individual plant (Njoroge & Bussmann, 2006).

This short coming again appears to be as a result of failure of acquisition of knowledge during their practice as very few of them have attended herbal standardization course which the authors believe can be attained by encouraging the herbalists to join and pro actively participate in a herbalist Association.

Interestingly, this study found out that Instead of regular acquisition of new knowledge as required by WHO, 1999- there is loss of existing knowledge regarding antimalarial herbs in Tororo District. A point in case arising from this study regarding one of the most frequently mentioned plant- *Schurriah pinnata* being referred to as “chloroquine” by most herbalists having “lost its local name” somewhere along the way during the course of time.

Most of the Tororo herbalists now refer to it as “chloroquine” because it is as “bitter and effective as chloroquine” – one of the longest used first line conventional antimalarial in Uganda in the recent past to which the *Plasmodium falciparum* organism has now developed resistance.

These findings are in agreement with recent studies by Njoroge and Bussmann who observed that most of herbs used in Central Kenya though for other disease conditions are undocumented and under a threat of disappearing(Njoroge & Bussmann, 2006). The apparent reason for this loss of important data in Tororo district is lack of documentation of these important botanicals which this study has attempted to address.

As far as attitude is concerned, this study found out that Tororo herbalists have fearful attitude about labelling their products – their practical measure against conspiracy which would result in loss of ownership.

However, it is common knowledge that in Uganda we have well labelled herbal products from India and China for various ailments whose manufacturers have not lost the right to ownership of their products.

Furthermore, herbalists in Kenya exhibit a different attitude probably because they have been exposed to trainings and transparent collaboration with research institutions (Mwangi, 2010). In our opinion, this attitude is prevalent because the Tororo herbalists have not been exposed to knowledge about patenting and ownership rights.

We also think that there is a need for natural products research scientists in academia to strengthen transparent collaborations that benefits both the local communities and research and academic institutions in Uganda to allay these fears.

Furthermore, the existence of a strong, vibrant and pro active herbalist Association would be a good avenue for organizing workshops and seminars to share knowledge, experiences, grievances and learn about patenting policies, travel elsewhere and learn and seek responsible government bodies and authorities for protection of the members.

Whereas over 63% (67/106) of the respondents had practiced in ant malaria herbalism for ten years - portraying a certain level of safety with respect to the medicinal plant in question, these findings seem to contradict claims by one of the non-governmental organization (NGO) operating in Uganda- that they train Traditional Medical Practitioners (TMPs) how to package their products, among other things.

This apparent contradiction is probably due to the fact that the NGO has only concentrated on traditional birth attendants (TBAs) and those TMPs specializing in addressing HIV/AIDS and not malaria(Kaye, Munobwa, King, Nambooze, & Kyeyune, 2004).

In our opinion, this anomaly is prevalent because of high poverty level, failure of the Tororo herbalists to unite and form pro active Association as well as not having had any standardization course on medicinal plants used for treatment of malaria fevers in Tororo.

Conclusions

While Tororo herbalists are knowledgeable about malaria, there is not only loss of indigenous knowledge about some ant malaria medicinal plants but also lack knowledge about standard processing procedures as required by the WHO for their preparation.

Furthermore, while this study has documented over 40 diversity of botanicals for malaria management in four Sub counties of Tororo district, it has revealed that Tororo herbalists have fearful attitude (suspicion) for labelling their products and majority use unacceptable storage practices.

Herbalist practices including plant identification, collection, preparation, packaging, labelling and storage are still below WHO set standard.

It is strongly recommended that the Uganda Ministry of Health and Uganda Ministry of culture, Youth and gender initiate training programs for Tororo Traditional Healers/herbalists to address issues raised in this study

Competing interests

All the authors above have no competing interests

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References

- Anonymous. (2007). Research methods and clinical Epidemiological course. University of London.
- Anonymous. (2009/2010). *Tororo district population*. Tororo.
- Bell, D., Wongsrichanalai, C., & Barnwell, J. W. (2006). Evaluating Diagnostics. Guide for diagnostic evaluation. *Nature Review Microbiol*, 1, s7-s20.
- Birdi, T. J., Brijesh, S., & al, E. (2008). Approaches towards preclinical testing and standardization of Medicinal plants [Electronic Version].
- Consortium, T. M. (2006). *The malaria Consortium Annual Review 2004-2006*. London: Malaria Consortium.
- Kaye, R. M., Munobwa, J., King, R., Nambooze, R., & Kyeyune, P. (2004). *Using Knowledge, attitude and Practices (KAP) survey results as a basis for implimenting a traditional healers HIV/AIDS training program by THETA in four districts in Uganda*. Paper presented at the Int Conf AIDS.
- Merlin, L. W., & Gerard, B. (2004). Traditional herbal medicines for malaria. *BMJ*, 329, 1156-1159.
- MOH. (2006). *Insect treated materials (ITMS) as malaria control strategy*. Kampala: Uganda Ministry of Health
- Mwangi, J. W. (2010). *East African Endowments for natural product- based Health products: Untapped economic opportunities*. Paper presented at the (2010 GIBEX-East Africa) -Botanicals: From Research to Commercialization Olive Gardens Hotel, Nairobi, Kenya-East Africa.
- Njoroge, N. G., & Bussmann, W. R. (2006). Traditional Management of ear, nose and throat (ENT) diseases in Central Kenya. *Journal of Ethnobiology and Ethnomedicine*, 2(54).
- OAU/STRC. (1991). *Inter-African Symposium on traditional Pharmacopoeia and African medicinal plants*. Paper presented at the 4th OAU/STRC Inter-African Symposium on traditional Pharmacopoeia and African medicinal plants, Abuja - Nigeria.
- Staedke, S. G., Jagannathan, P., Yeka, A., & al., e. (2008). Monitoring malaria safety and tolerability in clinical trials. A case study from Uganda. *Mal J*, 7, 107.
- Tchouto, M. G. P. (2004). *Plant diversity in Central African rain forests. Implications for biodiversity conservation in Cameroon*. Unpublished PhD Thesis, Wageningen, Netherlands.
- UBOS. (2007). *Uganda demographic and health survey, 2006*. Retrieved. from.
- WHO. (1998). *Quality control methods for medicinal plant materials*.
- WHO. (2005). *World Malaria Report 2005*. Geneva: WHO and UNICEF.