SURVEY OF INDIGENOUS KNOWLEDGE ON GATHERING, PROCESSING AND USE OF EDIBLE WILD MUSHROOMS FOR HOUSEHOLD FOOD SECURITY AND INCOME GENERATION IN MASASI, TANZANIA

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ABSTRACT

A survey was conducted in Masasi town and Ndanda in Masasi District, Tanzania on the importance of indigenous knowledge on gathering edible wild mushrooms (EWM) and its contribution to household food security and income. A total of 333 farmers (255 females, 78 males) with age ranging between 30-50 years were interviewed using pre-tested structured questionnaire. More than 92% of farmers were knowledgeable on EWM. The study indicated that 91% of respondent farmers consumed EWM; more than 89% appreciated EWM as food source; more than 80% purchased EWM; more than 67% regarded EWM gathering as income generating activity and more than 58% of farmers consumed processed EWM. More than 70% of farmers in Masasi town and Ndanda? were found consuming EWM that were prepared as relish, or stew, or soup and were eaten with rice or maize, cassava or sorghum stiff porridges. During wet season, EWM were eaten up to three times per week. More than 89% of farmers processed EWM mainly by sun-drying and stored them in plastic bags or wrapping in the newspapers or in clay pots. Masasi district community lacked oyster mushroom cultivation technology because no training had been conducted on this new crop. Since EWM was regarded as a household food security, 66% Masasi and Ndanda farmers, respectively were eager to learn oyster mushroom cultivation technology as a new crop.

Key words: oyster mushroom, food source, consumption, processing

INTRODUCTION

Recent investigations have shown that over 2,000 species belonging to thirty genera of basidial fungi (mushrooms) are considered edible (Feofilova 1998). Mushrooms have been appreciated as a table delicacy since ancient times (Houghton 1885; Buller 1914). During rainy season, wild edible mushrooms grow naturally in most parts of Tanzania. Members of various communities, especially women and children gather mushrooms to be used as relish. Some of the mushrooms are sun-dried to be used during 'off-season' period. 'Off-season' period is accompanied with very dry season without any vegetables for relish. Alternative sources of relish instead of vegetables are deployed, which include dried edible wild mushrooms (EWM). The common ones are *Cantharellus* spp., *Termitomyces* spp., *Lactarius* spp., and *Rusula* spp. (Härkönen *et al.* 1995, Engola *et al.* 2002). The wild edible mushrooms however, are reported to be seasonal

(Härkönen *et al.* 1995, Engola *et al.* 2002 and Packham *et al.* 2002); and the seasonality is determined by moisture availability. Similarly, Munishi *et al.* (2007) reported that availability of indigenous wild mushrooms is controlled by moisture availability. Furthermore, Packham *et al.* (2002) found that some species occur once after every five years.

In recent years there has been rapid structural and infrastructural development both in urban and rural areas. Farmers have been expanding their farmland partly also due to population increase (PHDR 2009). These developments have continuously been shrinking the forest cover and hence reducing the quantities of mushrooms that have been collected from the wild (PHDR 2009). Due to these reasons, wild edible mushrooms have been over-exploited especially during rain season. However, instead of depending solely on wild mushroom gathering, new technologies of cultivating mushroom indoors have been invented. One mushroom variety that can be cultivated by most farmers and entrepreneurs in Tanzania and indeed in Africa is oyster mushroom. Cultivation of oyster mushroom is gaining popularity because it is easy to grow and requires less capital investment when compared to button mushrooms (*Agaricus bisporus)* (Chang and Mshigeni 2001). Although Sub-Saharan Africa, including Tanzania is generally warm, by choosing the right species, edible mushrooms can be cultivated in various tropical climatic types (Chang and Mshigeni 2001). However, most species are cultivated in temperate and subtropical regions of the world (Chang and Mshigeni 2001). The technology of artificial cultivation of oyster mushroom is somewhat a recent innovation, which can be exploited to improve social as well as economic status of small scale farmers (Chang and Mshigeni 2001)

Oyster mushroom can utilize a wide range of agricultural wastes due to its great adaptability and has short growth cycle. The cultivation of oyster mushroom on agricultural wastes is considered as potential source of income, an alternative food production, provision of employment, and recycling of agricultural wastes. Mushrooms can be grown on small scale and space of a farmer's house and yet generate income that aids in family support. Mushrooms are a good source of cheap protein, vitamins and minerals. The use of agricultural wastes as substrates is important, because most of these residues remain unused. In Tanzania, after harvesting annual crops (maize, rice, beans, sorghum, cotton, bananas etc), the crop residues are burned, which most of the time leads to wild fires that cause a great loss of valuable trees, other vegetations, peoples homesteads and killing of wild animals. After mushroom cultivation, agricultural wastes can be converted into animal feed or organic fertilizer and accordingly, they could be recycled and their protein recovered for human food and wealth creation.

The aim of this study was to survey indigenous knowledge on gathering, processing and use of EWM and its contribution to the household food security. The study also explored the possibility of introducing a new technology of oyster mushrooms cultivation instead of relying only on EWM.

METHODOLOGY

The study was conducted in Masasi township and Ndanda in Masasi District. The District which is one of 6 districts of Mtwara region is located between latitudes 10^0 and 12^0 south and longitudes 36^0 and 38^0 east. Other districts are Mtwara urban, Mtwara rural, Newala, Tandahimba and Nanyumbu. Masasi District is divided administratively into 5 divisions, 22 wards

and 156 villages. The district is bordered to the north by Lindi region, to the East by Newala and Nanyumbu districts, to the South by Mozambique and to the West by Ruvuma region. It has 347,908 inhabitants. The district Headquarter is located at Masasi Town in the north-western part of the district. Masasi's main ethnic group is the Wamakua. However, as is the case of all urban areas in Tanzania, Masasi Township and Ndanda are composed of people with various ethnicities. Ndanda Township is famous for quite large Missionary activities. Masasi District is known for its famous Makonde cavings and cashew nuts.

Agriculture is the predominant economic sector in Masasi district. About 80% of the agricultural production is done by small holder farmers. The main staple food crops are cassava, sorghum, millets, maize and paddy. Cash crops include cashew nuts, sesame and coconut. The major source of plant proteins are pigeon peas, groundnuts, cowpeas (Mtwara Region 2008) and EWM although these are not mentioned in the reference. The EWM are collected as forest food products and are a source of livelihoods including home consumption and sale. Most of Masasi district is covered by grasslands and miombo woodlands, a distinctive characteristic of the rest of districts in Mtwara region where thick bushes are common (Mponda et al. 2001). Masasi has a great agricultural potential because of good soils and rainfall. The climate of the district is characterized by dry season (May-November) and rainy season (December-April). The mean annual rainfall is 900 mm while temperature ranges between 25-32^{o}C. The district lies 470 m.a.s.l. with almost always humid weather, hot days and cool nights and normally December is the hottest month. Cool nights are a suitable condition for mushrooms.

Masasi District was selected based on the fact that Mtwara region is one of the marginalized and poorest regions in Tanzania. About 38% of households live below poverty line (PHDR 2005). The 2001 statistics on regional per capita income shows that Mtwara is among the three most deprived regions in the country (PHDR 2005). Children below five years of age and infant mortality statistics in Masasi district are also high signifying low levels of nutritional and health services uptake. The infant mortality rate is 134/1000, which means that out of 1,000 live births, 134 lose their lives before they reach one year. The under-five mortality rate is also high25 deaths per 1,000 live births (PHDR 2005). Mtwara region is also among the three regions with low Human Development Index (HDI[1]). When Human Poverty Index (HPI[2]) figures are used, the same conclusions as with HDI are drawn.

In many parts of Masasi district crop residues remain un-utilized after harvesting field crops. It has been observed that over 70% of agricultural and forest crop residues are conceived as waste materials (Chang and Mshigeni 2001). Most of these agricultural wastes are burned and cause environmental degradation because of fire going wild and destroying flora and fauna of the district. Masasi people could utilize these wastes to produce oyster mushrooms. Farmers could

[1] Human Development Index (HDI) a summary measure of human development which measures the average achievements in three basic dimensions of human development: a long and healthy life, measured by life expectancy at birth; knowledge, measured by adult literacy rate (with two-thirds weight) and the combined primary, secondary and tertiary gross enrollment (with one-third weight); and decent standard of living, as measured by GDP per capita.

[2] Human Poverty Index (HPI) measure deprivations in the three basic dimensions of human development which include lack of long and healthy life (vulnerability to death at a relatively early age, as measured by probability at birth of not surviving to age 40), lack of knowledge (exclusion from the world of learning and communication, as measured by adult illiteracy rate), and lack of decent standard of living (lack of access to overall economic provisioning), as percentage of the population not using improved water sources and percentage of children under five who are under weight (combine in un-weighted average).

gain income by selling mushrooms to the neighboring districts and regions.

A survey to collect information on the cultural, social and gender issues surrounding collection and consumption of wild edible mushrooms was conducted in Masasi district in Ndanda and Masasi wards. The choice of these wards communities was undertaken in collaboration with government agricultural extension authorities from the district office. Ndanda and Masasi communities are well known for collecting, processing and consuming EWM. A structured questionnaire seeking information on knowledge on EWM, processing and consumption was administered to 333 randomly selected farmers. Out of 333 respondent farmers, 129 were from Masasi township while 204 were from Ndanda township.

Data from survey were analysed using SPSS 12.0 for windows computer software. Descriptive statistical analysis was carried out by using a sub-programme "Frequencies" for univariate analysis to obtain variabilities of dependent and independent variables and sub-programme "Crosstabs" for bivariate analysis to determine the association of selected factors with knowledge on EWM. In frequency distribution tables, number of respondent farmers falling in particular attributes such as social-economic factors, gathering, processing and utilization with their respective percentages were shown.

RESULTS

Demographic characteristics of farmers

A total of 333 respondent farmers were interviewed in Masasi and Ndanda of whom 255 (77%) were female and 78 (23%) were males (Table 1). Respondent farmer's age in Masasi ranged between 23 to 65 years with a mean of 44.4 years while in Ndanda the range was between 21 and 77 years with a mean of 46 years. Majority of farmers had primary eduction (56% in Masasi, 72% in Ndanda). Twenty one percent and 7% of respondent farmers from Masasi and Ndanda respectively had college education,. Results from livelihood sources indicated that 68% and 73% of farmers in Masasi and Ndanda were self-employed in agricultural activities, which are mainly crop-based farming and livestock keeping. Ndanda had the least salary earners (3%) and more pretty traders (24%) compared to Masasi (16% salary earners or pretty traders). Both locations had higher frequency of female respondent farmers than males.

Table 1: Characteristics of interviewed farmers in Masasi district

Parameter	**Category**	**Masasi**		**Ndanda**		***Mean***
		n	%	n	%	%
Gender	Male	18	14.0	60	29.4	21.7
	Female	111	86.0	144	70.6	78.3
Age	Youth (<29)	18	14.0	27	13.2	13.6
	Adult 1 (30 - 50)	78	60.5	117	57.4	59.0
	Adult 2 (51 - 64)	33	25.6	33	16.2	20.9
	Old (>65)	0	0.0	27	13.2	13.2
Education	Adult education	6	4.7	9	4.4	4.6
	Primary education	70	55.8	147	72.1	64.0
	Secondary education	15	11.6	12	5.9	8.8
	College education	27	20.9	15	7.4	14.2
	Past standard 4 or 8	9	7.0	6	2.9	5.0
	No education	0	0.0	15	7.4	7.4
Source of livelihood	Farming	108	48.6	208	61.5	81.9
	Livestock keeping	42	18.9	39	11.9	18.1
	Salary earning	36	16.2	9	2.8	55.1
	Petty trading	36	16.2	78	23.9	15.4
Household size	1-6 members	105	81.4	168	82.4	9.5
	7-14 members	24	18.6	36	17.6	28.2

Indigenous knowledge and collectors of EWM

There was significant difference ($P \leq 0.005$) in most of parameters used to assess indigenous knowledge on EWM in the surveyed households in Masasi and Ndanda (Table 2). The household members from both communities consume EWM (95% Masasi, 93% Ndanda) and are knowledgeable on EWM (95% Masasi, 89% Ndanda). Mushrooms are appreciated as food source in households from both communities (88%, Masasi, 90% Ndanda). Less than 20% gather mushrooms from the wild while more than 80% purchase them from the gatherers. EWM are regarded as an income generating activity and was highly rated by 58% and 77% of respondent farmers in Masasi and Ndanda, respectively). On average, about 58% of all respondent farmers consume processed EWM (Table 2).

Table 2: Parameters used to assess indigenous knowledge of edible wild mushrooms in the household in Masasi district

Parameter	***Category***	***Masasi***		***Ndanda***		***Mean***
		n	%	n	%	%
All household members consume EWM	No	6	4.7	15	7.4	6.2
	Yes	117	95.1	186	92.5	91.6
Source of wild edible mushrooms	Gather from the wild by myself	21	17.9	33	18.0	17.95
	Buy from gatherers	93	79.5	150	82.0	80.75
Household EWM collectors	Boys	4	3.0	10	4.7	3.85
	Men	8	6.0	25	12.5	9.25
	Girls	28	21.7	61	29.7	25.7
	Women	89	69.3	108	53.1	61.2
Consume processed wild mushrooms	No	60	46.5	75	37.3	41.9
	Yes	69	53.5	126	62.7	58.1
Wild edible mushrooms as income generating activity	No	54	41.9	48	23.5	32.7
	Yes	75	58.1	156	76.5	67.3
Wild mushroom as household food source	No	15	11.6	21	10.3	10.95
	Yes	114	88.4	183	89.7	89.1
Knowledge on EWM	No	6	4.7	21	10.3	7.5
	Yes	123	95.3	183	89.7	92.5

Table 3 shows that more than 68% of households from both communities, consume EWM that are prepared as stew or vegetable and are eaten with rice (23% Masasi, 10% Ndanda), maize stiff porridge (67% in Masasi, 60% in Ndanda), cassava stiff porridge (8% in Masasi, 10% in Ndanda) or sorghum stiff porridge (none in Masasi, 2% in Ndanda).

During wet season, wild mushrooms are eaten up to three times (64% in Masasi, 90% in Ndanda) per week. An average of 7% of household members from both communities does not consume EWM because of fear of poisonous mushrooms (2%), some had never tried (2%) and others (12%) just don't like mushrooms (Table 3)

.**Table 3:** Farmers response on wild mushrooms utilization

Parameter	**Category**	**Masasi**		**Ndanda**		***Mean***
		n	%	n	%	%
Consume wild mushrooms	No	6	4.7	15	7.4	6.1
	Yes	117	90.7	186	92.5	91.6
Frequency per week during wet season	Once	36	30.8	6	3.2	17.0
	Twice	6	5.1	12	6.5	5.8
	Thrice	75	64.1	168	90.3	77.2
Food items consumed with wild mushrooms	Rice	27	23.0	18	9.7	16.4
	Maize stiff porridge	78	66.7	111	59.7	63.2
	Cassava stiff porridge	9	7.7	18	9.7	8.7
	Sorghum stiff porridge	0	0.0	3	1.6	1.6
Mode of mushroom relish prepared	Stew	33	28.9	51	27.9	28.4
	Relish	78	68.4	132	72.1	70.3
	Soup	3	2.6	0	0.0	2.6
Reasons for not consuming wild mushrooms	Fear of poisonous mushrooms	9	7.0	3	1.5	4.3
	Never tried	3	2.3	0	0.0	2.3
	Don't like them	6	4.7	3	1.5	2.4

EWM processing and storage

EWM after collection are blanched in salty water, drained and dried in the sun until they become crispy dry before packaging in local pots or plastic containers and stored for future use (Table 4). Plastic bags ranked highest (33% Masasi, 88% Ndanda) as storage containers. Reasons for processing EWM were to increase shelf life (33% in Masasi), to improve hygine (33% in Masasi, 57% in Ndanda), to ease handling (33% in Masasi, 29% in Ndanda), and it is one of the consumer preferences (14% in Ndanda).

Table 4: Farmers response on wild mushrooms processing and storage

Parameter	**Category**	**Masasi**		**Ndanda**		***Mean***
		n	%	n	%	%
Process wild mushrooms	Yes	9	7.3	36	17.6	12.5
	No	114	92.7	168	82.4	87.6
Mode of processing	Drying in the sun and store	9	95.5	30	83.3	89.4
	Blanching with salty water and drying in the sun	0	0.0	6	16.7	16.7
Reasons for wild mushroom processings	Increase shelf life	3	33.3	0	0.0	33.3
	Hygienic	3	33.3	12	57.1	45.2
	Easy to handle	3	33.3	6	28.6	31.0
	Consumer preference	0	0.0	3	14.3	14.3
Package dried mushroom	Yes	9	75.0	21	70.0	72.5
	No	3	25.0	9	30.0	27.5
Packaging materials	Plastic bags	3	33.3	18	85.7	59.5
	News papers	3	33.3	0	0.0	33.3
	Clay pots	3	33.3	3	14.3	23.8

Table 5: Farmers response on wish for training on oyster mushrooms production technology

Parameter	Category	Masasi		Ndanda		*Mean*
		n	%	n	%	%
Ever received training on oyster mushrooms production technologies	No	87	67.4	204	100.0	83.7
	Yes	42	32.6	0	0.0	16.3
Wish for oyster mushroom production training	No	12	9.5	39	19.4	14.45
	Yes	114	90.5	162	80.6	85.6
Reasons to lack of knowledge on oyster mushroom production technology	No training has been offered	72	55.8	198	97.1	76.5
	Too occupied to learn on new crop	9	11.1	3	1.5	6.3
	Not interested	0	0.0	3	1.5	1.5
Reasons for wish for oyster mushroom production technology	New crop	18	14.3	24	12.7	13.5
	Income generation	12	9.5	15	7.9	8.7
	Household food security (relish)	93	73.8	111	58.7	66.3
Areas of interest if training is to be offered	Production	9	7.1	24	11.9	9.5
	Utilization	3	2.4	3	1.5	2.0
	Production and utilization	114	88.4	162	80.6	84.5
	Processing	0	0	12	6.0	12.0

DISCUSSION

Indigenous knowledge and collectors of EWM

The consumption of EWM as a food by rural communities in Tanzania has been documented by Härkönnen (1995; 2003) and Olila *et al.* (2007). Masasi communities are knowledgeable on local wild mushrooms. Elsewhere, mushrooms are regarded as 'white vegetables' or 'boneless vegetarian meat' (IOMMS 2008). There are several authorities at present who believe that traditional sources of proteins such as beef, pork or poultry would no longer be able to meet nutritional demand and mycoproteins shall increasingly contribute to the nutrition of humans (Trinci 1991). This is also true for Tanzanians where legume grains constitute the principal dietary sources of proteins and other nutrients for majority of the people. In many developed countries, efforts have been made to raise protein production levels to meet the food requirements of the growing populations (Oei 1996). Such efforts cannot fulfill the goal of meeting the food and nutritional requirements if other appropriate alternatives are not considered. On the other hand, the poisonous mushrooms are not easily distinguished from edible ones. Some families in parts of Tanzania have experienced tragic loss of their beloved ones due to consumption of poisonous wild mushrooms.

The reports by Mponda *et al.* (2001) and Harkonen *et al.* (1995) indicate that women and girls are more involved in collection of forest food products including mushrooms and that mushrooms is an important vegetable during the rain season. Mponda *et al.* (2001) documented 25 local edible mushroom species that are collected by Masasi district communities. The common ones are *Cantharellus* spp., *Agaricus* spp., *Termitomyces* spp., *Lactarius* spp., and *Rusula* spp. (Härkönen et al. 1995; Engola *et al.* 2006). The EWMs are however available only during wet seasons due to adequate moisture availability (Munishi *et al.* 2007; Engola *et al.* 2006; Packham *et al.* 2002; Härkönen *et al.* 1995). Furthermore, it has been reported that some wild mushroom species occur once after every five years (Härkönen *et al.* 1995). However, there is a concern that with increase in population,

more land where wild mushrooms could be found is brought under cultivation, a practice that jeopardizes availability of mushrooms to community. For community to have continuity in mushroom availability throughout the year, knowledge on mushroom cultivation technology is vital. Hand in hand with capacity building on mushroom cultivation technology, an effort is required to domesticate non-mycorrhizal mushrooms to increase diversity of domesticated mushrooms.

In Southern zone of Tanzania, where Masasi is located, traditional beliefs and customs require that mushroom gatherers should pray before initiating collection in the forest. Three reasons for this practice were advanced namely: gatherers could not get lost especially when the area of collection was in a forest; to avoid being harmed by wild animals especially snakes; and that forest/bushes would provide enough mushrooms (Mponda *et al.* 2001).

Poisonous wild mushrooms that cause tragedy to the family members occur in some areas in Tanzania. Mushroom poisoning (mycetism) refers to deleterious effects from ingestion of toxic substances present in non-edible mushrooms. The symptoms vary from slight gastrointestinal discomfort to death. Mushroom poisoning is usually the result of ingestion of wild mushrooms after misidentification of a toxic mushroom for edible species. Even very experienced wild mushroom gatherers can sometimes mistakenly pick and consume or sell poisonous species. Mushroom hunting is faced with many dangers not only poisonous mushroom species but also snake attacks. All poisonous mushroom species are mycorrhizal in nature and are sometimes introduced with exotic tree species that carry mycelia with them in their roots. Every mushroom gatherer should be familiar with the three most dangerous groups of Fungi, which are *Amanitas*, the false morels and little brown mushrooms (Alexopoulous 1996).

This study has indicated that men and women collect wild mushrooms but women and girls took more responsibility. Women and girls gather EWM and prepare them as relish for household consumption. Food preparation in the household has been a traditional obligation for women and girls. These results indicate that women are probably more interested on EWM because are relish providers to the households.

Not only women and girls collect EWM from the wild, but also it has been reported elsewhere in Tanzania and Africa that men also do collect mushrooms (Oei 2003; Harkonen *et al.* 1995). The reason for women mushroom gatherers to be accompanied with girls is to pass-on local mushroom knowledge from one generation to another (Mponda *et al.* 2001; Harkonen *et al.* 1995).

EWM processing and storage

Wild gathered mushrooms are seasonal crop, and for that matter local community process them for future use especially during dry season. Wild mushroom processing technology is practiced by other communities in other locations like the *Wahehe* communities in Iringa (Harkonen *et al.* 1995). 'Off-season' period is accompanied with very dry season without any vegetables for relish. According to climate data, Masasi is normally dry for 7 months (May-November) and during this period of time relish availability is expectedly scarce. A bad year with unpredictable rain season the lean season could be prolonged. Mushroom processing technique could be improved by using solar driers to dry mushrooms. Solar driers accumulate heat reaching as high as 63^0C which can dry mushrooms faster than nomal sunshine to reduce moldy mushrooms.

CONCLUSION AND RECOMMENDATION FOR FURTHER RESEARCH

EWMs are widely consumed by household members from the two surveyed communities. The knowledge on identification, collection and processing of EWM has been observed from the study area. However, EWM gathering is associated with many risks to the gatherers, consumers and environment. The sustainable way of getting enough mushrooms throughout the year for Masasi district community and to avoid these risks is to cultivate them but the study indicated lack of knowledge on oyster mushroom cultivation technology.

In the physical observation made for fresh gathered and dried mushrooms, Southern zone of Tanzania is rich in local mushroom biodiversity that requires scientific identification and documentantion. Most importantly of all, an effort it is required to domesticate some of those speicies which are non-mycorrhizal. Mycorrhizal mushrooms do not grow in the artificial media used in the laboratories.

Lack of knowledge on oyster mushroom cultivation technology in Masasi district is the reason why mushrooms are still gathered from the wild. Gathering mushrooms from the wild is perpetuated by the fact that even the simple appropriate cultivation techniques that require low start-up capital that uses locally available materials are not known to those who would wish to grow mushrooms. These include simple mushroom houses constructed using locally available materials and the use of crop residues like cereal straws that remain in their farms after each year's harvest. The study indicated that 86% of respondent farmers in Masasi district wanted to change from mushroom gatherers to mushroom growers in order to avoid afore-mentioned risks associated with. Equally, they preferred to have stable income though modern cultivation and selling of oyster mushrooms.

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