SURVEY OF PRODUCTION, UTILIZATION AND PROXIMATE COMPOSITION OF SOME MINOR ROOT AND TUBER CROPS IN NIGERIA

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ABSTRACT
A survey was conducted between 2004 and 2005 to explore and collect germplasms of minor root and tuber crops grown in Nigeria. Information collected include, local names, locations, production/agronomic practices, utilization and marketing among others. Samples of materials collected were analyzed for their proximate compositions. A total of 76 turmeric, 19 Hausa potato, 13 Livingstone potato and 21 Polynesian arrowroot accessions were collected. Turmeric is cultivated and utilized in 19 states, Hausa potato 6 states, Livingstone potato two states while Polynesian arrowroot was collected from 10 states but utilized as food only in five states. The highest number of turmeric collection was obtained in Ekiti state (15.8%). While the highest collection of Hausa potato (36.8%) and Livingstone potato (69.2%) were obtained respectively from Kaduna and Plateau states, 19% of Polynesian arrowroot collections were each obtained in Plateau and Oyo states. Most of the crops are produced in smallholdings of less than 0.1 ha. Cultivation was mostly by old women except Polynesian arrowroot that was collected in the wild. The carbohydrate content (NFE) of the crops ranges between 60.23-80.40 g/100g, crude protein (7.58-14.00g/100g), total ash (3.01-6.97g/100g), calcium (0.27-0.45g/100g) and phosphorus (0.27-0.59g/100g) all on dry weight basis. These crops play key roles in the food supply system, income generation, improved health and preservation of cultural heritage of the rural household. To fully harness their potentials, the need for more research efforts in the areas of crop improvement, agronomic practices, pests and disease control, nutritional studies, post-production handling and processing was suggested.

KEY WORDS: ***Potato tumeric, production, utilization, nutrient***

INTRODUCTION

Among over 350,000 plant species, fewer than 20 "major" crop species provide for most human food needs (FAO, 1996). Within the rest of the plant species are many underutilized food crops collected in the wild or grown locally under hostile, tropical environments by small-scale farmers for centuries without fertilizers or guidance on improved practices (Rehm and Espig, 1991; Wilson, 1992). Most of these crops contribute a great deal to the food security, improved health, household income, cultural identity and sustainable ecology (Jaenicke and Hoschle-Zeledon, (2006).

In Nigeria, 16 of such minor root and tuber crops abound out of about 20 different root and tuber crops cultivated throughout the country [Asumugha and Arene, 1999]. Among these crops are Hausa potato (*Solenostemon rotundifolius* Poir), Livingstone potato or rizga (*Plectranthus esculenta* N.E. Br), Polynesian arrowroot locally called '*amora'* (*Tacca leontopetaloides* Kuntze) and turmeric (*Curcuma longa* Lim). Like other underutilized species, they are important components of subsistence farming systems in their native areas of production; they serve as means of preserving cultural heritage and have a myriad of uses such as food, animal feed, medicines, cosmetics and income generation to the rural households (IPGRI, 2004).

Despite their economic importance, there are many hindrances to the promotion and conservation of these crops. Among these obstacles are; major gaps in the knowledge about these crops and their ecology, limited

capacity to conserve and improve their yield and quality, and identification of best marketing and policy framework to enhance their use and maximize their economic value. A preliminary work carried out by Asumugha and Arene (1999) to generate baseline information on the production status of these crops was restricted to one of the production areas due to limited resources. Apart from this effort, there is no knowledge of further attempt made towards conserving these crops.

Presently, the very existence of these species is under threat because of relative neglect by science and development, and by the increase in area under production to higher yielding and better-researched crops, which in turn may lead to narrowing of livelihood options for the poor. This work is an attempt aimed at collecting, conserving and generating basic information on these crops with a view to promote their dynamic use in Nigeria and maximize their economic potentials.

MATERIALS AND METHODS

The field survey was carried out between 2004 and 2005. The purpose of the study was to collect basic information on the production and utilization of some minor root and tuber crops in all the 36 states of Nigeria. The survey was conducted in three phases. The survey adopted the Rapid Rural Appraisal method (RRA) using structured questionnaires to collect basic information on location, local name, production, marketing and utilization of the crops. The coordinates of the locations were also collected using the Global Positioning System (GPS) equipment (Fig. 1. Shows the mapping of production areas). The team traversed the major high ways, stopping at every 20-30 kilometres to collect available materials. Where necessary, villages in the hinterland, big and local markets were also visited to collect some samples along with data on marketing of the produce with the help of indigenes that served as local guides. Samples of materials collected were analyzed for their proximate compositions according to AOAC procedures [AOAC, 1990].

Chemical Analysis: Tuber and rhizome samples collected were prepared for relevant chemical analysis by size reduction, oven drying (at 60°C) until constant weight was obtained and converted to powder with a milling machine. The moisture, total ash, lipid, crude protein, Ca and P were determined according to procedures as outlined by AOAC (1990). While the total fibre content of the samples was determined by the neutral detergent procedure (AACC, 1983; Bainbridge *et al.,* 1996), the carbohydrate content (NFE) was determined by subtraction method. Data collected were subjected to descriptive analysis of simple frequency and percentage.

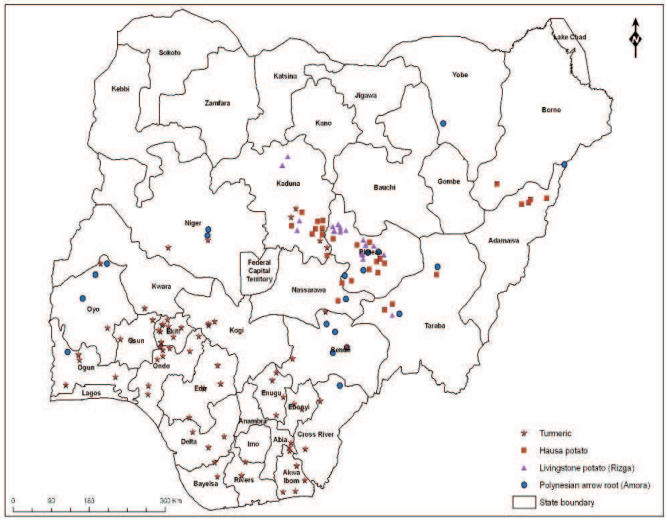

Fig.1. Map of Nigeria showing Production areas for Minor root and tuber crops.

RESULTS AND DISCUSSION

Turmeric: production, utilization and marketing

Turmeric (*Curcuma longa* Lim) was mostly cultivated in compound farms or homestead gardens in 19 states in the country (Table 1). A total of 76 turmeric accessions were collected. The highest number of collections (15.8%) was obtained in Ekiti state followed by Edo (11.8%), Ondo (11.8%), Akwa Ibom (7.9%) and Osun states (6.6%). Production is generally on small pieces of land less than 0.1 ha. However, there are pockets of areas (like Ondo, Edo and Ekiti states) where production is relatively high and is cherished as spice in soup preparation or used medicinally for treatment of malaria or yellow fever. In other areas like Kaduna, Kogi, Ebonyi and Cross River states cultivation is carried out on a small scale around the homestead gardens either as ornamentals, cosmetics, confectionery or medicinal crop for treatment of malaria, boils or whitlow and cough.

Turmeric is generally known as red ginger in the market but assumes different local names depending on locality. It was sold either fresh for soup preparations in the south or sliced - dry form in the north as dying material. The price of fresh turmeric rhizome ranged between N30 (US$ 0.23) to N50 (US$ 0.39) for a small heap weighing 200g in most markets visited. In some markets in the north (e.g Katsina market), a 50g of powdered turmeric attracted a price of N250 (approx. U$$ 2.0).

Table 1. Turmeric germplasm collection by states and utilization.

State	Frequency of collections	% of total collections	Utilization
Abia	1	1.3	Ornamental
Akwa Ibom	6	7.9	Medicinal/Ornamental
Bayelsa	2	2.6	Soup seasoning
Benue	3	3.9	Medicinal
Cross River	2	2.6	Medicinal/Cosmetics/Rice colorant
Delta	3	3.9	Medicinal
Ebonyi	2	2.6	Medicinal
Edo	9	11.8	Medicinal/ Soup seasoning
Ekiti	12	15.8	Medicinal/ Soup seasoning
Enugu	4	5.3	Medicinal
Kaduna	4	5.3	Medicinal/Dye
Kogi	3	3.9	Medicinal
Kwara	1	1.3	Medicinal
Niger	2	2.6	Dye
Ondo	9	11.8	Medicinal/ Soup seasoning
Osun	5	6.6	Medicinal/ Soup seasoning
Ogun	4	5.3	Medicinal/ Soup seasoning
Oyo	2	2.6	Medicinal/ Soup seasoning
Rivers	2	2.6	Medicinal
TOTAL	**76**	**100.0**	

Hausa Potato: production, utilization and marketing

Hausa potato (*Solenostemon rotundifolius* Poir) was found cultivated relatively on a large scale around Manchok, Kafanchan and Saminaka accounting for 36.8% of the total collection (Table 2). This is followed by

Plateau and Adamawa states with 21.1% each while Nassarawa state accounted for 10.4%, Taraba and Borno states accounted for 5.3% each. Generally, Hausa potato is considered as staple and famine reserve food in most areas where collections were made. In Nassarawa state, Hausa potato is cultivated in areas near the borders with Kaduna or Plateau states by settlers from either of the two states and it was mostly regarded as a famine reserve crop. Cultivation is mainly by women in most of the areas visited and is planted sole or intercropped with yam, cereals, okro and vegetables on ridges or mounds at about 1m x 25cm spacing using seed-tubers. Vine cuttings as means of propagation are rarely used.

Hausa potato is consumed mostly as porridge with peanut or beans. Ware Hausa potato is processed by peeling in the mortar with small pestle, washed, per-boiled and sun dry before storage. The sun-dried stored tubers are usually boiled and prepared as porridge. Seed materials are stored tied in hungry rice haulm or millet, perforated straw bags (for aeration) or earthen pots and kept in a cool dry place without disturbance before planting. A medium size measure, *mudu* (about 1kg) of Hausa potato seed-tubers was sold at N200 (US$1.56) while the ware tuber was sold between N60 (US$0.47) and N70 (US$0.55) in most areas visited.

Table 2. Hausa potato germplasm collection by states and utilization

State	Frequency of collections	% of total collections	Utilization
Adamawa	4	21.1	Food
Borno	1	5.3	Food
Kaduna	7	36.8	Food
Nasarawa	2	10.4	Food
Plateau	4	21.1	Food
Taraba	1	5.3	Food
Total	**19**	**100.0**	

Livingstone Potato/Rizga: production, utilization and marketing

Livingstone potato (*Plecthrantus esculentus*) was found cultivated on a large scale in Plateau and Kaduna states only (Table 3). Collections from Plateau state accounted for 69.2% while the remaining 30.8% was collected from the southern part of Kaduna state. It serves both as staple and famine reserve crop. The old women cultivate it more. It is cultivated sole or intercropped with yams and cereals such as finger millet, sorghum or maize on mounds and ridges at about 1m x 25cm spacing. Women sell Rizga in freshly processed form during the harvest season mostly by the roadside and sometimes in the market during the market days. The medium of measurement known locally as "*mudu*" approximately weighs 1kg. A *mudu* of rizga was sold at a price ranging between N60 (US$0.47) and N70 (US$0.55) in some of the markets visited. Rizga is consumed by boiling and prepared into porridge. The storage takes the same form as Hausa potato by washing the raw fingerlike rhizome in a basket in the running water. The washed tubers are then parboiled, sundry and kept until when needed for food preparations into porridge. The seed materials for planting are usually preserved in the soil *in situ* unharvested.

Table 3. Livingstone potato/rizga germplasm collection by states and utilization.

State	Frequency of collections	% of Total collections	Utilization
Kaduna	4	30.8	Food
Plateau	9	69.2	Food
Total	**13**	**100.0**	

Polynesian arrow root/Amora: production, utilization and marketing

Equal number of Polynesian arrowroot (*Tacca leontopetaloides* Kuntze) was collected from Benue and Oyo states with each state accounting for 19% of the total collection. This was followed by Niger state (14.3%), Plateau (9.5%), Nasarawa (9.5%) and Ogun states (9.5%); while Adamawa, Cross River and Yobe states have the least collection of 4.8% each. Polynesian arrowroot is locally known as '*amora'* or '*gbachie'* in most of the areas visited. It is generally collected in the wild and adapted to the derived savanna and rainforest belts. *Amora* is consumed as food mostly in Niger, Nasarawa, Benue, Yobe and southern part of Plateau states in the form of porridge prepared from the processed starch. Quality starch is produced from the fresh tuber by washing, grating, sieving, dewatering and sun drying. The starch is then milled before use as porridge or soup thickener. It is a delicacy among the *Nupes* and *Tivs* in Benue and Nassarawa states. A *mudu* (measure) of the prepared starch that weighed approximately 1kg was sold between N100 (US$0.78) and N120 (US$0.94).

Table 4. Amora germplasm collection by states and utilization

State	Frequency of collections	% of total collections	Utilization
Adamawa	1	4.8	-
Benue	4	19.0	Food
Cross River	1	4.8	-
Nasarawa	2	9.5	Food
Niger	3	14.3	Food
Taraba	1	4.8	-
Yobe	1	4.8	Food
Oyo	4	19.0	-
Ogun	2	9.5	-
Plateau	2	9.5	Food
TOTAL	**21**	**100.0**	

Chemical Composition of Rizga, Hausa potato, Turmeric and Amora.

The proximate compositions of rizga, Hausa potato, turmeric and amora as determined by AOAC method [AOAC, 1990] are shown in Table 5. The crops are nutritionally carbohydrate foods as indicated by the nitrogen free extract contents (60.23 to 80.40g/100g NFE) but are also rich in protein (7.58 to 14.0g/100g). The NFE is highest in amora (80.4g/100g), followed by rizga (70.4g/100g), turmeric (66.7g/100g) and lastly hausa potato (60.2g/100g) while the mineral contents such as calcium and phosphorus contents are low; 0.27 to 0.45g/100g for Ca and 0.27 to 0.59g/100g for P.

The protein contents as indicated in Table 5 are relatively higher than what is obtainable for cassava (3g/100g), sweet potato (5g/100g), yam (7g/100g) and cocoyam (7g/100g) [Leung, 1968]; thus, the minor root crops rank highest in protein contents relative to major root crops grown in Nigeria. The crude fibre is relatively higher in rizga (14.07%), followed by Hausa potato (11.07%), turmeric (8.63%) and amora (5.69%), while the total ash content was highest in turmeric (6.97%) followed by Hausa potato (6.80%) and amora recording the least (3.01%). Considering the fat contents, the turmeric (3.82%) is relatively higher when compared to Livingstone potato/rizga (0.24) Hausa potato (0.24) and Polynesian arrowroot/amora (0.41). However, there is need to actually ascertain the various oil compositions of turmeric in order to harness its economic values.

Table 5. Average proximate composition of some minor root crops germplasms collected from various locations in Nigeria.

Chemical Composition g/100g dm	Rizga	Hausa potato	Turmeric	Amora
Moisture	7.85	7.76	8.67	8.07
Crude protein	10.52	7.58	14.00	10.53
Crude fibre	14.07	11.07	8.63	5.69
Lipids (fat)	0.24	0.24	3.82	0.41
Total ash	4.77	6.80	6.97	3.01
NFE	70.40	60.23	66.70	80.40
Ca	0.34	0.33	0.45	0.27
P	0.37	0.36	0.59	0.27

CONCLUSION AND RECOMMENDATION

From this study, most of the minor root and tuber crops namely rizga, hausa potato, turmeric and amora are playing significant roles in the food supply system and income generation to the rural households in their respective areas of production. They have good economic potentials as hunger alleviating crops, raw materials for the industries or as foreign exchange earners. A crop like turmeric for instance has a good potential as foreign exchange earner being a base product in curry production and as a functional food due to its health promoting properties. Quality starch can be extracted from high starch content of amora and used in the production of bio-fuel, adhesives, pharmaceuticals and textile industries to cut down on foreign exchange spending. However, for these potentials to be fully harnessed for a diversified economy there is need for more research efforts in the areas of crop improvement, agronomic practices, pests and diseases control, nutritional studies, post-production handling and processing, value addition and market chain development. A policy framework in favour of these crops by the Federal Government will also be necessary to stimulate all the relevant activities pertinent to the development of underutilized root and tuber crops in Nigeria.

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REFERENCES

Asumugha, G.N and O.B. Arene, (1999). Status of production and utilization of other root crops in Nigeria. Preliminary Investigation. NRCRI Annual Report, 1999; (page 149-152).

AACC, (1983). Approved methods of the American Association of Cereal Chemists, St. Paul, Minnesota, USA.

AOAC, (1990). Official Methods of Analysis. Association of Official Analytical Chemists, Washington D.C.

Bainbridge , Z., Tomlins, K., and Westby, A. (1996). Methods of assessing Quality characteristics of Non-Grain starch staples, Part 3. Laboratory Methods, Natural Resources Institute, Chattam, UK. Pp.25-28.

FAO (1996). Report on the state of the World's Plant Genetic Resources for Food and Agriculture, Rome, Italy. 511pp.

International Plant Genetic Research Institute (IPGRI), (2004). Local knowledge, global importance **http://www.ipgri@cgiar.org/newsletter/html.** Consulted March 2005.

Jaenickle, H and Hoschele-Zeledon, I. (2006). Strategic framework for Underutilized Plant species Research and Development, with special reference to Asia and the Pacific, and to Sub-Saharan Africa. International Centre of Underutilized Crops. Colombo, Sri Lanka and Global Facilitation Unit for Underutilized Species. Rome, Italy. 33pp.

Leung, W. (1968). Food Composition Table for Use in Africa. FAO. U.S Department of Health, Education and Welfare, Bethesda, MD

Rehm, S and Espig, G. (1991). The cultivated Plants of the Tropics. Verlag Josef Margraf and CTA. Weikersheim, Germany, 522pp.

Wilson, I.O. (1992). The Diversity of Life, Penguin. London, UK. 423pp.