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#### **RESEARCH ARTICLE**

# REVIEW ON THE NUTRITIONAL VALUE, CULTIVATION AND UTILIZATION POTENTIAL OF SOME MINOR AND UNDER-UTILIZED INDIGENOUS ROOT AND TUBER CROPS IN NIGERIA.

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#### Abstract

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..... A review is presented on the nutritional value, cultivation and utilization potentials of some minor indigenous root and tuber crops found in Nigeria, namely; Livingstone potato (Plectranthus esculentus N.E BR), Coleus potato (Solenostemon rotundifolius (Poir) J.K. Morton), Arrowroot (Tacca leontopetaloides) and amora (Curcuma longa). Nigeria has a large population (over 150 million) and most people depend so much on root and tuber crops as their major source of food and income. However, due to population explosion and over dependence on some few edible crop species, there is the need to explore and grow other root and tuber crops which are minor and under-utilized. This paper examines the nutritional and utilization potentials of the minor indigenous root and tuber crops as supplement to the major root and tuber crops (Yam, cassava, sweet potato etc.) because of their high calorific content and essential micronutrients. They also have great medicinal and industrial usage as raw materials and have various socioeconomic benefits as they can be used as feed for livestock and are an important source of income for the rural families. The crops are tolerant to poor soils and draught stress and hence require low input in terms of cultivation.

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#### **Introduction:-**

Global food security has become increasingly on only a handful of crops. Over 50% of the global requirement for proteins and calories are met by just three crops; maize, wheat and rice. Only 150 crop species are commercialized on a significant global scale yet, humankind has, overtime used more than 7,000 edible species (IPGRI, 2000). The narrowing base of global food security is limiting livelihood options for the rural poor, particularly in marginal areas. Addressing their needs requires that the focus of research and development is broadened to include a much wider range of crop species. Many of these species occupy important niches, adapted to the risky and fragile conditions of rural communities. They have a comparative advantage in marginal lands where they have been selected to withstand stress conditions and contribute to sustainable production with low-cost inputs. They also contribute to the diversity-richness and hence the ability of agro-ecosystems (IPGRI, 2000).

Ethno-botanic surveys indicate that hundreds of such species are still to be found in most countries, representing an enormous wealth of agro-biodiversity with potential to contribute to improved incomes, food security and nutrition, combating "hidden hunger" caused by micronutrients (vitamin and mineral) deficiencies (IPGRI, 2000). However, these locally important species are frequently neglected by science. Lack of attention by research and development has meant that their potential value is underexploited. This neglect places them in danger of continuing genetic erosion further restricting development options for the rural poor.

Many people in the developing world especially Sub-Saharan Africa (SSA) are highly dependent on root and tuber crops as contributory if not the principal source of their food and nutrition. In Sub-Saharan Africa, root and tuber

crops play a major part in daily diet, accounting for over 50% of the total staple. In West Africa 33% of the total food energy and 15% of the protein intake are provided by root crops (Afuakwa, 1996). Since food and nutrition security is an issue of great concern especially in many Sub-Saharan Africa countries, basic food and nutritional needs of people may be met with the use of indigenous food crops such as Coleus potato, Plectranthus, Turmeric, Arrowroot and host of other minor crops that are traditionally known to be palatable and desirable while providing dietary supplements to the staple foods (Kana *et al.*, 2012).

### Root and tuber crops:-

Root crops are edible, energy-rich underground plant structures developed from modified roots while tuber crops are those crops in which the edible carbohydrate-rich storage organs develop wholly or partly from underground stems (Okigbo, 1989). The Major root and tuber crops grown in Nigeria are Cassava (*Manihot esculernta*), Yam (*Dioscorea spp*), Sweet potato (*Ipomoea batatas*) and Irish potato (*Solanum tuberosum*) (Quin, 2001). In addition to the major root and tuber crops, there are many types of tuberous and rhizomatous minor root crops which are grown and used in different parts of Nigeria. The word 'minor' or 'lesser' as applied to root and tuber crops has often been used to describe the root and tuber crops whose economic usage has been overtaken by the exotic or improved ones. Although they may be considered as minor, neglected or under-utilized, these crops have been found adapted to marginal areas where edaphic and climatic conditions may not be favourable to the exotic or improved materials (Olojede *et al.*, 2005).

Many of the minor root and tuber crops serve as important components of subsistence farming system in their native areas and have played significant, if not crucial roles in household food security and income generation of the rural areas. 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). These include Coleus potato (*Solenostemon rotundifolius*), Livingstone potato (*Plectranthus esculentus*), Amora (*Tacca leontopetaloides*), Turmeric (*Curcuma longa*), Aerial Yam (*Discorea bulbifera*), Cocoyam (*Colocasia esculenta*) etc.

#### Minor and under-utilized root and tuber crops and nutrition:-

Food and nutrition security is always achieved when adequate food (quantity, nutritional quality, safety, sociocultural acceptability) is available and accessible for and satisfactorily used and utilized by all individuals at all times to live a healthy and active life (WHO, 2009).

The Focus of most agricultural research has always been on increasing crop yields to ensure adequate calories for people who would otherwise have gone hungry. However, less attention was given to nutritional quality – providing a sufficient quantity of food trumped providing nutritious food. As a result, diets deficient in essential vitamins and micro-nutrients still persist in many parts of the world especially Sub-Saharan Africa (Padulosi *et al.*, 2013). Of the world's estimated 7 billion people, 500 million still suffer from protein-energy malnutrition, but over 1.6 billion suffer from Iron deficiency, over 200 million from vitamin A insufficiency (WHO 2009) and it has been estimated that over 400,000 children die each year from effects directly related to Zinc deficiency (Harvest plus 2011; Padulosi *et al.*, 2013). Minor and under-utilized crops provide essential micro-nutrients and thus complement staple foods.

It is increasingly realized according to Indusigie and Olayide (1975), that inadequacy of food calories in diets as well as protein deficiency contributes to malnutrition in Nigeria. Minor or lesser root crops can contribute to food and nutrition security being high in calorific values and other essential nutrients (Kana *et al.*, 2012). They play a very significant role in providing the dietary and energy requirements of the local people during lean periods. They are rich in major and minor nutrients and all the nutrients are essential for proper functioning of the body (Kana *et al.*, 2012). According to Alleman (2002) the content of 14% protein in Coleus potato on dry matter basis for instance compares well with Irish and sweet potatoes as well as other tuber crops. The principal amino acids present in the protein of these lesser root and tuber crops are arginine, aspartic and glutamic acids. The tubers are also a rich source of dietary energy and 100 g of the tubers provides 392 – 394 KJ of metabolisable energy (Schoeninger *et al.*, 2011). A standard serving dish of these crops is reported to provide in addition, a large proportion of the daily dietary requirements of Calcium, Vitamin C and Iron. Inadequate quantity of food (those deficient in calories) and not merely protein deficiency is reported as the cause of widespread protein calorie malnutrition, since with

insufficient calories, protein in diets is used to supply energy instead of fulfilling its body building roles (Indusigie and Olayide, 1975).

The comparative yield of nutrients and minerals of major tuber staples and minor root and tubers are presented in Table I. The minor root and tuber crops hold potentials as seen in the table to meet the calorific needs of an average Nigerian.

Component/100g	Yam	Cassava	Sweet	Coleus	Livingstone	Turmeric	Amora
Portion			potato	potato	potato		
Energy (KJ)	494	670	360	394	400	1481	392.5
Protein (g)	1.50	1.4	1.6	1.3	7.71	7.8	1.50
Fat (g)	0.17	0.28	0.05	0.2	0.12	9.9	0.08
Carbohydrate (g)	28	38	20	21.9	29.32	64.9	96.42
Fibre (g)	4.1	1.8	3.0	1.1	14.12	21.1	0.28
Calcium (mg)	17	16	30	17.0	0.34	183	*
Vitamin C (mg)	17.4	20.6	24	1.0	*	29.5	43.2
Iron (mg)	0.54	0.85	0.61	6.0	100	41.4	1.38
Magnesium (mg)	0.40	0.38	0.26	*	15.5	193	1.52
Potassium (mg)	816	271	337	*	1225	*	36.45
Phosphorus (mg)	55	27	47	*	*	268	6.67
Zinc (mg)	0.24	0.34	0.30	*	*	4.4	1.60

Table I: Comparison	of nutrient contents	of major tuber s	taple foods with	n minor tuber	crops in Nigeria.
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Source:Kyesmu and Akueshi, 1989; Rethinam et al., 1994; Schoeninger et al., 2000; Ukpabi et al., 2009, Enyiukwu et al., 2014.

Key: \* = not determined

# Cultivation and agronomic practices:-

There are considerable differences in the agro-climatic conditions suitable for the cultivation of the different minor or lesser root and tuber crops. Farmers usually grow these crops around homesteads, long farm boundaries and marginal lands with little agronomic attention paid to them. They also follow indigenous crop husbandry methods which culminate ultimately to low yields. Reasons behind the low yields are traceable to farmers' non-adoption of improved crop production techniques and lack of improved and high yielding varieties of the crop as well as lack of capital for acquiring improved inputs (Dung *et al.*, 2010).

The minor root and tuber crops under review are popularly propagated vegetatively using the edible part, mainly the tubers (in Coleus potato and Livingstone potato) or tuberous rhizomes (in Amora and Turmeric) which can be planted as sprouted or un-sprouted on raised beds or ridges (Burkill, 1995; Alleman, 1996). These crops have been found adapted to marginal areas where the edaphic and climatic conditions may not be favourable to the exotic or improved materials, they are also tolerant to poor soils and draught stress. However, they grow very well on well-drained, loose and friable fertile loam or clay loam, with good organic matter.

These crops are reportedly very hardy, but the optimal conditions for growth are temperatures of  $15 - 28^{\circ}$ C, annual rainfall of 700 – 1,100 mm and a soil pH of 6.5 to 7.0 (for livingstone potato). A temperature of  $18 - 35^{\circ}$ C, annual rainfall of 1000 – 2000 mm and a soil pH of 5 – 7.5 has been reported by Dahal and Idris (1999) to be the optimal growth conditions for Curcuma longa. In Coleus potato, tuberous rhizomes or seed tubers are normally planted at a depth of 5 cm on ridges or raised beds and are spaced at 15 – 20 cm while in Amora, they are planted at about 15 cm deep and a distance of 30 - 40 cm (Codd, 1985).

The maturity time of these minor and under-utilized root and tuber crops is relatively favourable when compared with that of the major root and tuber crops as shown in table II. This has indicated that these crops have the potential to mature earlier with improved agronomic and cultural practices. It has been reported that harvesting of Livingstone potato and Coleus potato is done between 6 to 7 months after planting (Alleman and Hammes, 2006). While the tubers of Amora and Turmeric is ready for harvest at approximately 8 to 10 months after planting (Annamalai, 1994; Ukpabi *et al.*, 2009).

Table II: Comparative maturity period of major tuber staples and minor root and tuber crops in Nigeria.

	Yam	Cassava	Sweet	Coleus	Livingstone	Turmeric	Amora
			potato	potato	potato		
Average harvest	8 - 10	8-15	4 - 5	5-6	6-7	7 - 10	7 - 8
period (months)							

Source: Idusigie and Olayide, 1975; Alleman and Hammes, 2006; Ukpabi et al., 2009

# Utilization and potential:-

Minor or lesser root and tuber crops are mainly used as food in the rural areas, food additives for flavouring and marinating beef, chicken, masking strong smells associated with goat, sheep and spicing tomato-rich dishes. They also serve as dry season fodder for domestic animals like cattle, camel, sheep (Enyiukwu *et al.*, 2014).

In addition, these crops are frequently used as medicines and are used to treat a range of ailments especially those relating to digestion, stomach ailment such as dysentery and diarrhoea are treated by coleus potato and arrowroot (Lukhoba et al., 2006). Semwal et al., (1997) reported that curcuma is medically efficacious in the treatment of circulatory problems, liver diseases, dermatological disorders and blood purification. The use of livingstone potato in ethnopharmacology in the treatment of digestive problems, stomach ache and pains has been very effective as reported by Burkill (1995). Furthermore, Eleazu et al., (2014), revealed in their study on the effect of livingstone potato on diabetes and its complications on streptozotocin induced diabetes in rats that it has anti-diabetic potentials. Since most of these minor and under-utilized crops have medicinal potentials, they can play important role in the lives of rural people, particularly those in the remote parts of the developing countries that have limited access to adequate health facilities. In addition, the effectiveness, limited side effects and relatively low costs of these potentially medicinal minor crops make them to be widely prescribed even when their biologically active compounds are unknown (Schippers, 2000; Eleazu et al., 2014). These minor and under-utilized crops can also be used as raw materials for industries, for instance coleus potato tubers are made into alcoholic drinks (Abapol, 1997). Industrially, the starch obtained from arrowroot tubers is used to stiffen fabrics as revealed by Brand-miller et al., (1993). Green (1995) reported that Curcuma longa is used as a natural colouring agent in food industries and confectionery, or as a dye to colour products such as tanned leather, cotton, thread and palm fibres as golden yellow.

Minor root and tuber crops have great economic and utilization potential, they hold potential to serve as source of food, raw materials, animal feed, medicines and industrial raw materials for Nigeria (Kana *et al.*, 2012). Besides their nutritional attributes these crops hold strong economic potential and could be financially rewarding to the farm economy. As reported by Olojede (2013), the crops hold strong potential to becoming commodity crops for food and nutrition security, poverty alleviation and economic growth in Nigeria. They have good potential in increasing the range of tuber crops available for human consumption.

# **Conclusion:-**

There is an urgent need to broaden the food basket of the Sub-Saharan Africa by supporting the development of traditional crops neglected and marginalized by current research and agricultural policies. These crops, with their greater adaptability to extreme climatic conditions and their resilience to biotic and abiotic stresses, can be effective instruments for curbing food insecurity and malnutrition. Although they are characterized by lower yields, minor root and tuber crops will also produce harvestable yields where major crops may fail. They are also valuable in fighting hidden hunger and are particularly useful in improving diets that are too rich in refined carbohydrates and fats. In addition, agricultural production focused on agro-biodiversity can contribute to harnessing and safeguarding centuries-old traditions and is a powerful instrument for keeping alive the cultural identity of farmers and indigenous communities.

These minor and under-utilized root and tuber crops have great untapped potential to support smallholder farmers and food and nutrition security while also sustaining the resources needed to address present and future environmental challenges. Making full use of these crops, however, will involve making them more commercially competitive with improved 'modern' varieties. Part of this poor competitive value is because poor rural areas often have little capacity to negotiate with the private sector, thus excluding the possibility of access to new technologies and markets that could increase the potential of these locally used crops.

Interventions to support improved cultivation practices, better yield and marketability of these minor and underutilized root and tuber crops are numerous and not limited to the following:

- 1. The Development of better yielding varieties by research.
- 2. Improving cultivation and traditional agronomic practices.
- 3. Enhancing value addition technologies.
- 4. Better access of producers (rural farmers) to markets.
- 5. Promoting Value chains of the crops.
- 6. Validation and promotion of nutritional, medicinal and industrial benefits of the crops.
- 7. More effective maintenance of genetic and cultural diversity of farm .

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