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Food Potentials of Some Indigeneous Wild Fruits in Lowland Rainforest Ecosystem of South West Nigeria

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Abstract: Food potentials of some selected plant species with edible fruits of the lowland rainforest ecosystem of southwest Nigeria were examined in this study. Eight fruits species distributed among seven families were harvested fresh from Ala Forest Reserve located in Ondo State, southwest Nigeria for the analysis. Proximate, mineral and anti-nutritional factors were determined on dry matter basis for the samples. Six of the fruits were analyzed raw while two were roasted and also boiled to bring them to the same level of consumption. It was discovered that the plant species flower and fruit at different period of the year and this made them to be available all year round. The results of the chemical analysis show that all the selected fruits contained adequate level of food nutrients required for normal body functioning and the levels of the anti-nutrients obtained are well below the lethal dose which can make them detrimental for consumption. Their protein values were discovered to be high (above 100 g kg^{-1} DM) except *C. albidum*. All the fruits are potentially good as cheap source of protein and other essential nutrients for the rural sector of the economy that are facing food crisis today. Conservation strategies were recommended for the species to avert the extinction threat on them as a result of increased pressure on this lowland rainforest ecosystem. This will also make them sustainable.

Key words: Forest Reserve, antinutrition, rainforest, extinction, food crisis

Introduction

Food shortage of most African countries is becoming worst today as a result of poverty, unemployment and population growth. Other factors responsible for the shortage of food in the developing countries are competition for agricultural land by other land users, unstable policies on agriculture by the government, lack of agricultural inputs, poor loan facilities and incentives. As a result of these, farmers could only produce what to eat with little or no extra for sale. The diet of many rural dwellers and urban poor are majorly made up of cereal and carbohydrates, as they could not afford the cost animal proteins. Some plant species with edible fruits in lowland rainforest ecosystem of Southwest Nigeria is noted to contain large quantity of protein and vitamins especially vitamins A, B, and C (Okafor, 1979 and Akachuku, 1997). Their consumption therefore is able to augment the diet of this set of people thereby preventing malnutrition, kwashiorkor and marasmus in children. Fruits also have very high percentage of their fresh weight as water and they exhibit relatively high metabolic activity when compared with other plants consumed by man. While some of these fruit species are widely known, most of them still lesser known and therefore underutilized. Their consumption is only popular among the rural dwellers.

One of the main features of the lowland rainforest where these fruits are existing is the outstanding diversity of flora and fauna The main reason for the richness is the existence of favourable climatic condition and availability of fertile soil. Etukudo (2000) noted that there are great varieties of trees in few hectares of the forest than the entire vegetation of Europe. FEPA (1992) recorded 5,018 plant species in Nigeria Rainforest ecosystem of which 205 are endemic and 247 species of mammals. The physiognomy of trees is usually uniform i.e. with straight boles, almost cylindrical.

The tropical rainforest ecological zone generally occurs in the broad inter tropical zone called tropic. It forms a continuous belt around the earth between Latitude 24° S and 24° N and Longitude 10° E and 20° W. The rainforest belt is somewhat bisected unequally by the equator such that more of the forest lies in the northern hemisphere than in the southern hemisphere. In southwestern Nigeria, it is bounded by the freshwater swamp forest in the south and the derived and Guinea savanna vegetation in the north. Beyond the borders of southwestern Nigeria, this ecological zone also extends as a continuous belt to the west (Republic of Benin) and to the east (eastern Nigeria). This ecosystem is under pressure today as a result of shifting cultivation and high dependence on the forest for the supply of indispensable goods and services. The rate of deforestation is increasing daily. This has put edible fruits and other important lowland rainforest species that supply both timber and non-timber forest products under threat of extinction.

The selected fruit species for this study and many other plant species with edible fruits have been identified in lowland rainforests region of S. W Nigeria by Okafor, (1997) and Akachuku, (1999) but in different proportion of abundance. The distribution of the fruit species as reported by Adekunle, (2002) shows that most of them are now endemic. Their relative frequency per hectare is very low. These fruit species flower, fruit and ripe at different time of the year. This made them to be available for consumption at different period of the year. So there is virtually no period of the year this ecosystem is without an edible fruit. Nwoboshi, (1982) noted that fruit development and ripening occur in the tropical rainforest almost all the year round. In West Africa for instance, there are many more trees in fruit during the dry season than in rainy season.

Some of the selected fruit species are big and tall trees that occupy the upper storey of lowland rainforest (height between 30m-40m). Those in this category among them are *C. albidum, A. macrophlla, V. paradoxa* and *T. tetraptera. C. lutea* is a shrub which can also grow into a small tree (height between 10m-15m) and it occupies the lower stratum. *P. guinensis* is an herbaceous plant while *T. conophorum* is a woody climber (lianas). This work is aimed at considering the nutrients and anti-nutrients values of these selected species. This will improve their consumption rate especially the lesser-consumed ones, and conservation effort for sustainable use can therefore be stepped up. Table 1 shows the species selected for this work, their families, type and mode of consumption ,while Table 2 shows the period of flowering and fruiting of the selected fruit species.

Materials and Methods

Samples of all the fruit species were collected from Ala Forest Reserve located on latitude 7°N and 6° 45'N and longitude 5° E and 5° 10'E. The reserve is a typical lowland rainforest ecosystem and is located in Akure North local government area, Ondo state, Nigeria. Before nutrient and anti-nutrient values were determined two of the species (*T. conophorum* and *A. altilis*) were boil and roasted (either of these are usually done before their consumption). Others were analyzed raw. These were done so as to bring all the fruits to their consumption stage. All the analyses were done on dry matter (DM) basis and replicated thrice.

Chemical Analysis: Proximate analysis: The samples were analyzed for proximate composition (crude protein, crude fibre, crude fat and crude ash) by using the standard procedures of the Association of Official Analytical Chemists (AOAC, 1990). But crude protein values were subsequently obtained by using a factor of 6.25. Carbohydrate content (i.e. Nitrogen Free Extracts) of the fruits was determined by subtracting the sum of the weights of crude protein, crude fibre, fat and crude ash from the total dry matter.

Mineral Determination: The level of sodium and potassium in the fruit samples were determined by flame photogrametry (AOAC, 1990). The concentrations of other minerals (Ca, Fe, P and Zn) were determined after wet digestion with a mixture of perchloric and nitric acids using the Atomic Absorption spectrophotometer (AAS, model SP9, Pyechicam, UK).

Table 1: Families, types and mode of consumption of the selected indigenous wild fruits in lowland rainforest ecosystem of SW Nigeria

Species	Family	Types of Fruit	Mode of consumption
Artocarpus altilis	Moraceae	Drupe	Roasted or boiled and chewed
Carpolobia lutea	Polygaceae	Drupe	Licked
Chrysopyllum albidum	Sapotaceae	Drupe	Licked
Anthonotha macrophylla	Leguminosae	Drupe	Soap condiment
Vitallenia paradoxa	Sapotaceae	Drupe	Edible oil
Tetracapidium conophorum	Euphorbiaceae	Nut	Boiled or roasted and chewed
Piper guinensis	Piperaccae	Berry	Soup condiment
Tetrapleura tetraptera	Mimosaceae	Drupe	Licked

Table 2: Flowering and fruiting of the selected indigenous wild fruits in lowland rainforest ecosystem of SW Nigeria

Fruit Species	Flowering	Fruiting
Artocarpus altilis	January-February	September-November
Carpolobia lutea	September-November	February-April
Chrysopyllum albidum	April-June	January-February
Anthonotha macrophylla	October-December	June-September
Vitalleria paradoxa	January-February	May-August
Tetracapidium conophorum	October-December	July-August
Piper guinensis	January-March	August-October
Tetrapleura tetraptera	June-July	November and March

Anti-nutrients Determinations

Phytate: For the estimation of Phytate, phytin-phosphrous in the selected fruits was first estimated by the calorimetric procedure of Reddy *et al.* (1978). This was multiplied by the factor of 3.55 as done by Enuijiugha and Ayodele (2003). 4g of each of the sample was soaked in 100 ml of 2% HCL for 5 hours and filtered. Then, 25 ml of the filtrate was placed in conical flask and 5 ml of 0.3% Ammonium thiocyanate solution was added. This was tiltrated with a standard $FeCl_3$ solution until a brownish-yellow colour persists for 5 minutes.

Tannins: Tannins were obtained by adopting the quantitative method of Markar and Goodchild, (1996). 0.2g of each of the sample was soaked in 10 ml of 70% acetone and placed in ice water bag and soaked for 12 minutes to extract the tannin. This was filtered and 0.5 ml of the distilled water was added to the filtrate. 0.5 ml of lowery reagent and 2.5 ml at 20% Na_3CO were also added. The tube was vortexes and incubated for 40 minutes of room temperature and the result was read at wavelength 700nm on corning colorimeter 253 against the blank. The value obtained was extrapolated from the standard tannic acid curve and then converted to mg TA/100g sample.

Hydrogen Cyanide (HCN): For hydrogen cyanide determination, 4g of each sample was soaked in a mixture containing 40ml of distilled water and 2ml of Othophosphoric acid. The mixture was left overnight to release all bounded hydrocyanic acid. A drop of an anti-foaming agent (paraffin) and anti-buffer (broken chips) were added and the solution was filtered into a flask containing 40ml of water and 0.1g of NaOH pellets. 1.6ml of 5% potassium iodide solution was added to 20 ml of the distillate and 0.4ml of the sample titrated against 0.01ml of silver nitrate. The blank was also titrated until the end point was indicated by a faint but permanent turbidity.

Method of Data Analysis: Data obtained for proximate, minerals and anti-nutrition properties were subjected to one way analysis of variance Steel and Torrie (1960) where significant differences were discovered, mean separation was done by Duncan Multiple Range Test (Duncan, 1955).

Results and Discussion

The results of the proximate analyses of the selected wild indigenous fruits of lowland rainforest ecosystem of SW Nigeria as presented in Table3 show that all the fruits contained appreciable crude protein that can replace animal protein usually absent in the diet of people in developing countries of the world. *Piper guinensis* has the highest value of crude protein (352.95±0.16 g Kg^{-1} DM) on comparative basis. This is followed by wasted *Artocarpus altilis* (304.11±5.64 g Kg^{-1} DM). The least protein content (56.84±0.19 g Kg^{-1} DM) was discovered in *Chrysophyllum albidum*. Out of the 10 samples analysed, 70% of them have their protein value above 200g Kg^{-1}, which has been reported to be required for any food to be rich in protein. A significant difference ($P<0.05$) was discovered to exist in the protein content of the fruits but there is no significant difference, during mean separation, between the boiled and roasted *A. altilis* and *T. conophorum*. A considerable high crude fibre content was detected

Table 3: Proximate Composition (g Kg^{-1} DM) of Selected Indigenous Wild Fruits in Lowland rainforest ecosystem of SW Nigeria

Friut Spp	Crude protein	Crude fat	Ash	Crude fibre	NFE
Carpolobia lutea	121.84±0.15a	95.03±0.01a	21.61±0.40a	282.74±0.01a	478.78±0.13a
Chrysoplhyllum albidum	56.84±0.19b	63.1±0.06a	6.58±0.01b	340.05±0.01a	533.27±1.05a
Artocarpus altilis (boiled)	206.40±0.13c	121.35±0.02b	36.08±0.08a	544.25±0.3b	231.92±0.77b
Altocarpus altilis (roasted)	156.27±1.07a	130.91±0.12b	34.17±0.21a	555.30±0.1b	123.35±0.89c
Anthonotha macrophylla	304.11±5.64d	201.59±1.43c	47.87±1.07c	36.9±0.35c	409.53±1.51a
Tetracapidum canophorum (boiled)	262.47±0.65d	374.88±0.33d	79.91±0.15d	35.53±0.03c	247.21±0.20b
Tetracapadium canophorum (roasted)	284.53±1.56d	343.92±0.41d	67.70±0.15d	25.38±0.05c	278.47±0.40b
Piper guinensis	325.95±0.16d	62.31±0.32b	79.71±0.21d	75.48±0.14d	429.55±0.64a
Tetrapleura tetraptera	273.67±0.49d	93.31±1.8a	58.27±5.2c	80.08±0.02d	578.67±0.67d
Vitallaria paradoxa	308.31±0.84d	140.4±0.2b	71.26±0.26d	57.52±0.16e	422.5±0.31a

All values are mean of three replicates ± standard error

Means followed with the same alphabet vertically is not significantly different ($P < 0.05$)

in four of the fruit samples *i.e.* Roasted *A. altilis* (555.30±0.19 Kg^{-1}), boiled *A. altilis* (544.25±0.3), *C. albidum* (340.05±0.01) and *C. lutea* (282.74±0.01). These fruits could serve as good source of dietary fibre that can improve bowel functioning and reduce plasma cholesterol (Enujiugha and Ayodele 2003). The other species contained relatively low fibre content. Both boiled and roasted *T. conophorum* contained very high value of crude fat (374.88±0.33 boiled and 34.3.92±0.41 roasted). This confirms the high oil content of this fruit species. Therefore, it could be cultivated in large scale and the fat extracted for commercial vegetable oil production. The ash content of the fruits ranges between 6.58±0.01 (as found in *C. albidum*) and 79.91±0.15 g kg^{-1} DM (as detected in boiled *T. canophorum*). The highest NFE was found in *T. tetraptera* (578.67±0.67 g kg^{-1} DM) and the least in roasted *A. altilis*. However, a significant difference occurs in the proximate composition of the fruit samples (P<0.05).

The results of mineral composition of the selected wild indigenous fruits are presented in Table 4. While relative high level of potassium and phosphorus were obtained in the fruits, the values of calcium and sodium were relatively low. The potassium level is between 11.73±1.20 g kg^{-1} DM and 3.22±0.85 g kg^{-1} DM and that of Phosphorous is between 6.38±0.09 g kg^{-1} DM and 2.00±0.03 g kg^{-1} DM. Trace elements (Fe and Zn) were also discovered to exist in all the selected fruits but the levels were relatively low. The value of calcium is between 1.72±0.81 g kg^{-1} DM and 0.72±0.08 g kg^{-1} DM and the value for sodium ranges between 1.25±0.12 g kg^{-1} DM and 0.10±0.08 g kg^{-1} DM. The low values of sodium could be attributed to the general subnormal concentrations of sodium in tropical crops because of the low sodium content of the soils (Balakarishnan and Salunkhe, 1973).

Table 4:Mineral Composition of Some Indigenous wild fruit in lowland rainforest ecosystem

S/N	Ca	K	Na	P	Fe	Zn
Carpolobia intea	0.87±0.09a	7.75±0.00a	0.10±0.08a	6.38±0.09a	1.01±0.01a	0.69±0.01a
Chrysoplhyllum albidum	1.18±0.39a	11.28±0.22b	0.98±0.29b	1.00±0.01b	0.75±0.04a	0.14±0.01b
Altocarpus altilis (Boiled)	1.77±0.18b	8.78±0.27a	0.93±0.13b	5.36±0.10a	0.71±0.07a	0.30±0.02b
Altocarpus altilis (Roasted)	1.53±2.10b	10.89±0.35b	0.63±0.07b	5.14±0.23a	0.82±0.01a	0.78±0.01a
Anthonotha macrophylla	1.70±1.23b	3.73±1.36c	0.88±0.35b	3.22±0.21c	0.07±0.40b	0.28±0.05b
Tetracapidum canophorum (boiled)	1.56±2.23b	6.88±1.36a	0.52±0.26b	4.16±0.08c	0.04 ±0.02b	0.07±0.03b
Tetracapadium canophorum (roasted)	1.72±0.81b	4.29±0.17c	0.84±0.09b	2.87±0.08b	0.59 ± 0 .03a	0.06±0.03b
Piper guinensis	0.72±0.08a	11.73±1.20b	1.25±0.12c	5.81±0.10a	1.44±0.81c	0.72±0. 02a
Tetrapleura tetraptera	1.01±1.08a	3.22±0.85c	1.00±0.08c	2.11±0.03b	0.70±0.01a	0.08±0.01b
Vitallaria paradoxa	1.46±0.03b	5.10±0.85c	0.42±0.02a	2.00±0.03b	0.89±0.02a	0.06±0.01b

All values are mean of three replicates±standard error.
Means followed with the same alphabet vertically is not significantly different (P<0.05)

Table 5: Anti-nutritional level of Selected Indigenous wild fruit in lowland rainforest ecosystem

Fruit Spp	Tannin	Nitrogen chloride	Level of Phytate	Phytin- P
Carpolobia intea	13.02±0.13a	0.84±0.003a	0.17±0.67a	0.048a
Chrysoplhyllum albidum	12.12±.01a	2.03±0.0004b	0.235±0.65a	0.065a
Artocarpus altilis (boiled)	4.15±0.01b	1.69±0.0004b	0.56±0.66a	0.16a
Altocarpus altilis (roasted)	8.28±0.01a	3.21±0.007b	0.65±0.35a	0.18a
Anthonotha macrophylla	6.41±0.02b	7.2±4.59c	0.79±0.56b	0.22b
Tetracapidum canophorum (boiled)	10.22±0.10a	7.2±4.15c	1.57±0.94b	0.4b
Tetracapadium canophorum (roasted)	8.15±0.10a	8.21±4.74c	1.74±0.94b	0.49b
Piper guinensis	2.91±0.667c	26.91±0.214d	2.91± 0.67c	0.82c
Tetrapleura tetraptera	8.27±0.176a	12.00±0.100c	3.27±0.16c	0.92c
Vitallaria paradoxa	1.78±0.37c	12.403±0.124c	1.78±0.31c	0.50c

All values are mean of three replicates ± standard error
Means followed with the same alphabet vertically is not significantly different (P < 0.05)

The zinc level of all the fruits was discovered to be within the range of 0.06±0.01 g kg^{-1} DM and 0.78±0.01 g kg^{-1} DM. So all the fruits were found to be good source of dietary zinc because their values are more than the minimum level of Zn recommended (0.04g Kg^{-1} Dm) for human consumption (Scott, 1985). The highest level of K and P was in *P. guinensis*. This fruit species is also rich in other nutrients hence its importance as soup condiment among the rural communities.

The levels of anti-nutrient factors in the fruits were also significant ($P \leq 0.05$). Highest level of tannin was recorded in *C. lutea* (13.02±0.13 g Kg^{-1} mD) while the least values was in *V. paradoxa* (1.78±0.37 g kg^{-1} DM). Phytate values range between 3.27±0.18 g kg^{-1} DM and 0.17±0.67 g kg^{-1} DM while HCN level was between 12.40±0.12 g kg^{-1} DM and 0.84±0.03 g kg^{-1} DM. *V. paradoxa* has the highest level of HCN while *T. tetraptera* contain the highest amount of Phytate. This is followed by *P. guinensis* with 2.91 ±0.67 g kg^{-1} DM. But there was no significant difference in the values when mean separation was estimated with DMRT. The phytin-P levels followed the same pattern as the phatate levels for all the selected fruits. The anti-nutritional values obtained in this study is similar to those obtained by Agbede and Aletor (2003) in leaf residues of some under-utilized leguminous plants and Enuijiugha and Ayodele (2003) in some lesser-known oilseeds. The levels of HCN obtained for all the selected fruit species were much lower than those reported for cassava and some edible Cowpea varieties (Oke *et al.*, 1995).

Barry, (1985) reported that Phytate could interfere with mineral bioavailability when it is 1% or above of the diet while condensed tannin (20-40g Kg^{-1} Dm) have some beneficial effect in protein metabolism. But (Aletor, 1993) noted that high levels of tannins (76-90 g Kg^{-1} Dm) could be detrimental if consumed. He reported further that certain forage species; root, crops, grains, pulse and fruit contain high levels of cyanide in the form of cyanogenic glycosides. Tewe and Manner, (1980) noted that both inorganic and organic HCN could cause a remarkable change in weight gain and apparent nitrogen digestibility. The levels of anti-nutrients obtained in this present study show that the consumption of the fruits cannot lead to cyanide toxicity or other type of toxicity that usually arises from exposure to sub-lethal dietary dose. This is because the anti-nutritional levels of all the fruits are below the lethal doze for consumption and these levels could further be reduced, especially phytic acid, if further processing is introduced. Since these plant species flower fruit and ripe at different period of the year, they are therefore available throughout the year. Those available during the dry season, especially those that are licked are good for quenching thirst during hot weather. These fruits with adequate food potential are harvested from the forest freely. This makes them to be very cheap and affordable by those who cannot afford the exotic ones like oranges, apples, pear, etc.

Conclusion

This study has evaluated the food value of some selected indigenous fruit in lowland rainforest ecosystem of Southwest Nigeria. All the fruits are rich in nutrient and potentially good for consumption to alleviate hunger in developing countries. The anti-nutritional levels are not detrimental to human health and further processing can still reduce the levels. All the fruit species still exist in the wild and they are been threatened with extinction. This is as a result of increased human activities in the lowland rainforest ecosystem. Prominent among these activities is farming, burning and logging. These are serious set back to insitu method of biodiversity conservation. So, conscious effort should be made to preserve the fruits species in their natural ecosystem (lowland rainforest). Domestication of the fruits is also essential and their cultivation in large scale should be embarked upon. There is also the need to study the phrenology of the species and its importance in flowering and fruiting, as they are ready for harvesting at different period. The consumption of the fruits that is still popular among the rural sector of the economy could be increased through appropriate processing, packaging and marketing. Production of fruit juice, wine and beverages is recommended from the fruits with high percentage of their fresh weight as water and oil production from those with high fat content. This will go a long way in providing employment, increase food supplement and provide affordable drink. The socio-economic life of the rural dwellers could also be improved if the availability of these important fruit species is enhanced. The sales of some of the fruits and its products among them will increase.

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