Proximate analysis and utility indices of some common vegetables of South East Nigeria

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ABSTRACT

Analysis of proximate Composition and utility indices of some common vegetables of South East Nigeria was carried on between 2017 and 2018. The aim was to ascertain the core nutritional capacity of our vegetables and their wholistic Economic relevances. Proximate methods after (AOAC, 1984) which included Differential method (Carbohydrates), Soxhlet fat extraction method (fat), sample digestion using concentrated sulphuric acid in the presence of a metallic catalyst (protein) oven drying methods for (moisture content) etcetera were employed. One hundred and fifty questionnaires with reliability and validity established were distributed amongst staff and students of COOU (Uli and Igbariam), NAU (Awka) Oko and Nsugbe at 30 per institution. At the end of the analysis, it was ascertained that Pterocarpus soyaxica (oha) had the highest carbohydrate (68.35) and fat content (11.65); Talinum triangulare (Gbolodi) had the highest ash content (26.75); Gongronema latifolium (utazi) had the highest protein content (8.23); Murraya koenigii (curry) had the highest fibre content while Amaranthus hybridus (Green amaranth) had the highest moisture content (29.15). The woody vegetable species (perennials-like Pterocarpus soyaxica and Pterocarpus santalinoides (nturukpa) had the highest utility indices (+7) as opposed to the herbaceous species (mostly annuals and biennials (+4) that had the greater numerical superiority. A major challenge we have apart from devegetation, is devising a scientific means of preservation of our vegetables so they can be safely available all the year round (all seasons availability).

Keywords: Proximate, utility, vegetables, analysis, South East Nigeria.

1. INTRODUCTION

1.1 Background of Study

Food is an indispensable requirement of all peoples and cultures. The case of South East Nigeria is not different. To ensure good health, productivity and longevity, a balanced diet regimen must be pursued to a large extent. For food to be said to be balanced, the following classes of food must be adequately represented: Carbohydrates, proteins, fats and oils, water, vitamins and minerals, and Roughage. From the proximate analysis we carried out, it is evident that vegetables are sources of all these classes of food to varying degrees. Different vegetables contain different concentrations of these food substances, little wonder those who are strictly vegetarians can live out their entire life span on vegetables alone.

1.2 Statement of the Problem

Over the years the problems that have been encountered with the ready availability of our vegetables in terms of quality and quantity have included, but not restricted to: their paucity/unavailability in the dry season; land use conflicts; deforestation and desertification; erosion and flooding; Environmental degradation, incessant bush fires, grazing pressures, and other negative anthropogenic influences. It is important to note that vegetables are so attuned to rainfall that the more months of rainfall, the more vegetables are obtainable; some farmers use irrigation to perpetuate vegetable availability but this brings to the fore another problem-most vegetables are not hardy plant species therefore they are susceptible to infectious and non-infectious plant diseases.

1.3 Significance of the Problem

According to Okeke et al. (2008), Agriculture is a heritage occupation of the Igbo people. (Subsistence of course, emphasis mine). Notwithstanding, stunting and micronutrient deficiency (Vitamin A, Iron, Iodine and Zinc) are prevalent. More recently, there has been an increased incidence of non communicable diseases among the Nigerian population. The long-term malnutrition problem of the poor nations cannot be solved by food aid or food trade with the affluent countries but rather by the adequate utilization of indigenous plant foods (Ihekoronye and Ngoddy 1985). This is because traditional food resources can make substantial contribution in meeting the nutritional needs of the population, especially the low income group and particularly in times of seasonal scarcity (Okigbo, 1986; FAO, 1987; Okeke et al; 1993).

1.4 Scope of Study

The emphasis of this study is strictly on proximate analysis of South East vegetables and establishment of the wholistic utility indices of identified species.

1.5 Aim of the Study

To ascertain the nutritional composition of common vegetables of South East, Nigeria and ascertain their all round economic relevances.

1.6 Objectives of the Study

1. Determination of moisture, carbohydrate, Ash, Crude-Fibre, Crude Fat and Crude Protein concentration of the vegetables and 2. Identification of the Economic Relevance of the vegetables in terms of: Food value, income, medicinal significance, Industrial relevance, Animal fodder, Fuel wood, and others.

2. LITERATURE REVIEW

In a comprehensive research work done on Igbo foods, Okeke et al. (2008), encountered about a hundred and sixteen vegetables which reflected most commonly consumed vegetables in the Igbo culture area. However, some areas savour particular vegetables more than the others. For example, *Gnetum africanum* and

Pennisetum purpureum are typical of Igbos from Imo and Abia States, while bitterleaf (*Vernonia amygdalina*) is most popular in Anambra State. A further list of uncommon, minimally used vegetables were found to be consumed among Delta Igbos. Some of the vegetables even grow as weeds. Most are ground and used in making soups and are said to have a variety of medicinal values. Okafor (2015) made the following contribution, 'A number of food products from Forest/Farm species that have significant commercial potential have been described by Okafor (1991), Okafor and Lamb (1994). Okafor et al; (1996), and Ejiofor and Okafor (1997). The products include jams, jellies and fruit juice from *Irvingia gabonensis*, *Chrysophyllum albidum*; non alcoholic beverages from the powdered fruits of *Treculia africana,* health drinks from seeds of Garcinia kola and calyx of *Hibiscus sabdariffa* and seasoning from seeds of *Piper guineenses, Monodora myristica*, *Xylopia spp* etc. Medicinal preparations from plant parts include balm for arthritis using leaves of *Cassia tora*, and an anti-malaria tea using *Morinda lucida, Azadirachta indica, Carica papaya* and *Cymbopogon citrattus*. Medicated herbal soups can be made with leaves of various species such as *Aloe vera*, *Cassia alata*, *Azadirachta indica* and *Lonchocarpus cyanescens*. The commercial exploitation of these species result in increased revenues and healthcare benefits. The value of these products have implications for both development potential and the need for large-scale conservation of the species on which they are based. According to Sarumi et *al*. (1996), Edible wild plants which could be used as leafy vegetables etc include the following: *Boerhavia diffusa; Portulaca oleracea, Ceiba pentandra, Cyrtosperma senegalensis, Argostasia, Emilia sonchifolia* and *Moringa pterygosperma.* They also listed some underutilized vegetable species for Research in Nigeria to include: *Corchorus olitorius, Vernonia amygdalina, Pterocarpus spp., Solanum spp., Gnetum spp., Musa spp., Bambusa spp.*, and *Amaranthus spp.* Uno et al (2001) stated that, "The leaves of plants (vegetables) such as Cabbage, Lettuce, Spinach, Chard, Grape, Celery, Parsley, and bay laurel have long been parts of our diets and favourite items in our salads and stews. The spices thyme, oregano, peppermint, spearmint, wintergreen basil and sage are all derived from leaves. Similarly, tea is extracted from leaves of a relative of the garden Camellia, and Agave leaves are used to make tequila and mescal. Fibres from the leaves of palms and their relatives are used to make Panama hats, clothing, brooms, and thatched huts in the tropics. Fibers from manila hemp are used to make cords and ropes. Many leaves contain poisons that, when administered in small amounts, are useful drugs e.g digitoxin and digitalis from the foxglove plant - *Digitalis purpurea*. Many leaves (vegetables) are economically important sources of food, spices, drinks, dyes, fibers, fuel and drugs.

3. Materials and Methods

3.1 150 questionnaires were distributed. 30 each for staff and students of Uli and Igbariam Campuses of COOU, and then NAU Awka, Oko Polytechnic and Nsugbe (NOCEN). Test validity was established by the team of Botany lecturers of COOU Uli, while reliability was established using test retest method.

3.2 Proximate Analysis

Moisture Content

Procedure

A Petri-dish was washed and dried in the oven

- Approximately 1-2g of the sample was weighed into Petri dish
- The weight of the Petri dish and sample was noted before drying
- The petridish and sample were put in the oven and heated at 105^0c for 2hr the result noted and heated another 1hr until a steady result is obtained and the weight was noted
- The drying procedure was continued until a constant weight was obtained

% moisture content = $\frac{w1 - w2}{\text{Weight of sample}}$ 100

Where W1 = weight of petridish and sample before drying

W2 weigh pf petridish and sample after drying.

Carbohydrate Determination

(Differential method)

100 – (% Protein + % Moisture + % Ash + % Fat + % Fibre)

Ash content

(AOAC, 1984)

Principle: The ash of foodstuff is the inorganic residue remaining after the organic matter has been burnt away. It should be noted, however, that the ash obtained is not necessarily of the composition as there may be some from volatilization.

Procedures

- Empty platinum crucible was washed, dried and the weight was noted.
- Approximately 1-2g of sample was weighed into the platinum crucible and placed in a muffle furnace at 550^0c for 3 hours.
- The sample was cooled in a dessicator after burning and weighed.
- Calculations

% Ash content =

$$\frac{W3 - W1}{W2 - W1} \times \frac{100}{1}$$

Where

W1 = weight of empty platinum crucible

W2 = weight of platinum crucible ad sample before burning

W3 = weight of platinum and ash.

Crude Fibre

Procedure:

1. Defat about 2g material with petroleum either (if the fat content if more than 10%).
2. Boil under reflux for 30 minutes with 200ml of a solution containing 1.25g of H_2SO_4 per 100ml of solution
3. Filter the solution through linen
4. Wash with boiling water until the washings are no longer acid.
5. Transfer the residue to a beaker and boil for 30 minutes with 200ml of a solution containing 1.25g of carbonate free NaOH per 100ml
6. Filter the final residue through a thin but close pad of washed and ignited asbestos in a Gooch crucible.
7. Dry in an electric oven and weigh
8. Incinerate, cool and weigh

The loss in weight after incineration x 100 is the percentage of crude fibre.

$$\% \text{ crude fibre} = \frac{\text{Weight of fibre}}{\text{Weight of sample}} \times 100$$

Crude fat

Soxhlet Fat Extraction Method

This method is carried out by continuously extracting a food with non-polar organic solvent such as petroleum either about 1 hour or more.

Procedure:

1. Dry 250ml clean boiling flasks in over at 105-110^{0}c for about 30 minutes.
2. Transfer into a dessicator and allow to cool
3. Weigh correspondingly labeled, cooled boiling flasks.
4. Fill the boiling flasks with about 300ml of petroleum either (boiling point 40-60^{0}c).
5. Plug the extraction thimble lightly with cotton wool
6. Assemble the soxhlet apparatus and allow to reflux for about 6 hours
7. Remove thimble with care and collect petroleum either in the top container of the set-up and drain into a container for re-use.
8. When flask is almost free of petroleum either, remove and dry at 105^{0}c-110^{0}c for 1 hour.

9. Transfer from the oven into a dessicator and allow to cool; then weigh.

$$\% \text{ fat} = \frac{\text{wt of flask + oil} - \text{wt of flask}}{\text{Wt of sample}} \times 100$$

Crude Proteins

(AOAC, 1984)

Principle: The method is the digestion of sample with hot concentrated sulphuric acid in the presence of a metallic catalyst. Organic nitrogen in the sample is reduced to ammonia. This is retained in the solution as ammonium sulphate. The solution is made alkaline, and then distilled to release the ammonia. The ammonia is trapped in dilute acid and then titrated.

Procedures

- Exactly 0.5g of sample was weighed into a 30ml kjehdal flask (gently to prevent the sample from touching the walls of the side of each and then the flasks were stoppered and shaken. Then 0.5g of the kjedahl catalyst mixture was added. The mixture was heated cautiously in a digestion rack under fire until a clear solution appeared.
- The clear solution was then allowed to stand for 30 minutes and allowed to cool. After cooling was made up to 100ml with distilled water was added to avoid caking and then 5ml was transferred to the kjedahldstillation apparatus, followed by 5ml of 40% sodium hydroxide.
- A 100ml receiver flask containing 5ml of 2% boric acid and indicator mixture containing 5 drops of Bromocresol blue and 1 drop of methelene blue was placed added under a condenser of the distillation apparatus so that the tap was about 20cm inside the solution and distillation commenced immediately until 50 drops gets into the receiver flask, after which it was titrated to pink colour using 0.01N hydrochloric acid.

Calculations

% Nitrogen = Titre value x 0.01 x 14 x 4

% Protein = % Nitrogen x 6.25

4. RESULTS

Table 1. Proximate Analysis of some important vegetables common to South East Nigeria

S/N	Scientific Name	Local Name	Common Name	Ash %	Protein %	Carbohydrate %	Fat %	Fibre %	Moisture %
1	Murraya koenigii		Curry	10.10	5.60	37.79	9.16	29.25	8.10
2	Telfeiria occidentalis	Ugu		9.10	3.85	63.15	5.50	13.10	5.30
3	Vernonia amygdalina	Onugbu	Bitterleaf	12.35	6.65	49.45	5.60	16.25	9.70
4	Pterocarpus Soyaxica	Oha		11.75	7.35	68.35	11.65	5.05	5.30
5	Gongronema latifolium	Utazi		18.44	8.23	18.32	7.62	20.60	26.80
6	Ocimum gratissimum	Nchuanwu	Scent leaf	16.70	3.50	50.00	2.20	8.10	19.50
7	Amaranthus hybridus	Green	Green Amaranth	9.73	6.90	29.07	1.80	23.35	29.15
8	Piper guineense	Uziza	Hot leaf	15.95	3.15	29.25	7.62	25.90	15.25
9	Solanum Anara melongena	Anara		16.20	7.84	57.14	8.51	1.56	8.75
10	Corchorus olitorius	Keren -keren		1.85	6.83	55.60	8.28	7.10	20.35
11	Pterocarpus santalinoides	Nturukpa		13.02	6.96	36.42	8.70	27.90	7.00
12	Talinum triangulare	Gbolodi	Water leaf	26.75	3.19	27.30	2.01	13.55	21.05
				161.94	70.05	521.84	78.65	191.71	176.25

From table 1 above, 12 vegetable species were analyzed scientifically through proximate analysis to ascertain the concentrations of the following vital macromolecules/nutrients- protein, carbohydrate, fat, ash, moisture and fibre content. The macromolecule that occurred in the highest concentration were in the following order: Carbohydrate (521.84), Fibre (191.71), Moisture (176.21), Ash (161.94), Fat and Protein (70.05). Coming to individual vegetable species; *Talinum triangulare* had the highest ash content (26.75), while *Cochorus olitorius* had the least (1.85); *Gongronema latifolia* had the highest protein content (8.23); while *Piper guineense* had the least (3.15); *Pterocarpus soyaxica* had the highest carbohydrate content (68.35), while *Gongronema latifolium* had the least (18.32), *Pterocarpus soyaxica* had the highest fat content (11.65), while *Amaranthus viridis* had the least (1.80); *Murraya koenigii* had the highest fibre content (29.25), while *Solanum melongena* had the least (1.56); *Amaranthus viridis* had the highest moisture content (29.15), while *Telfeiria occidentalis* and *Pterocarpus soyaxica* had the least value (5.30) jointly.

Table 2. Utility indices of some common vegetables of South East Nigeria

S/N	Botanical Name	Family	Food	Income	Animal Fodder	Medicinal plant	Industrial raw material	Fuel wood	Others	Total
1	Amaranthus viridis	Amaranthaceae	X	X	X	X				4
2	Amaranthus hydridus	Amaranthaceae	X	X	X	X				4
3	Gongronema latifolium	Asclepiadaceae	X	X		X				3
4	Asclepsias Lineolata	Asclepiadaceae	X	X		X				3
5	Vernonia amygdalina	Asteraceae	X	X	X	X		X		5
6	Telfeiria occidentalis	Cucurbitaceae	X	X	X	X				4
7	Cucumis pepo	Cucurbitaceae	X	X		X				3
8	Pterocarpus soyaxica	Fabaceae	X	X	X	X	X	X		6
9	Ocimum gratissimum	Lamiaceae	X	X		X		X	X	5
10	Abelmoschus esculentum	Malvaceae	X	X		X				3
11	Piper guineense	Piperaceae	X	X		X			X	4
12	Talinum triangulare	Portulacaceae	X	X	X					3
13	Solanum lycopersicum	Solanaceae	X	X		X	X			4
14	Solanum melongena	Solanaceae	X	X	X	X		X		5
15	Capsicum annuum	Solanaceae	X	X					X	3
16	Cochorus olitorius	Tiliaceae	X	X	X					3
17	Pterocarpus santalinoides	Fabaceae	X	X	X	X	X	X		6
18	Gnetum africanum	Gnetaceae	X	X		X				3
19	Murraya Koenigii	Rutaceae	X	X		X				3
20	Pennisetum purpureum	Poaceae	X	X	X	X				3
	TOTAL		20	20	9	15	3	5	3	

From table 2 above, plant vegetable species under consideration were twenty while indices of utility were seven. All the twenty vegetable species were useful as both food and source of income. Fifteen had medicinal relevance; nine were relevant as animal fodder (crops); three as industrial raw materials; five as fuel wood, while three species were relevant in other utility areas like: Erosion control, Organic manure, Phytoremediation et cetera.

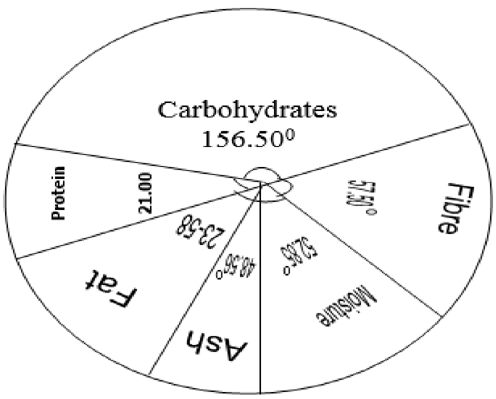

Fig. 1. Pie Chart depicting overall concentrations of the six classes of food encountered in common vegetables of South East Nigeria through proximate analysis.

5. DISCUSSION AND CONCLUSION

5.1 DISCUSSION

From table 1 the nutritional macromolecule that recorded the highest concentration in our common vegetables was carbohydrates (521.84) followed by: fibre (191.71); moisture (176.25); Ash (161.94); Fat (78.65) and Protein (70.05) in this order. The Pie Chart in fig 1 told the story explicitly. It may therefore be reasonable to assume that regular consumers of our common vegetables are assured of minimal daily requirements of carbohydrates, fibre, water, minerals and vitamins and may need supplemental feeding for only proteins and fats, and possibly additional carbohydrates just for energy purposes. From table 2, the most prevalent family was Solanaceae (3), the Genus with the highest relevance was Pterocarpus (6); individual species that were particularly important besides the Pterocarps, in terms of only food, income, medicinal, animal fodder and industrial raw material or fuel wood included: *Vernonia amygdalina*, *Solanum lycopersicon, Telfeiria occidentalis*, *Solanum melongena* and Amaranthus species. In thinking loudly, I have often imagined how a soup/source comprising a mixture of all the species with the highest concentration of each food class (combined) will look like: *Pterocarpus soyaxica* plus *Talinum triangulare* plus *Gongronema latifolium* plus *Murraya koenigii* plus *Amaranthus hybridus.*

5.2 CONCLUSION

Common vegetables of South East Nigeria are rich in the following food macromolecules in order of decreasing concentration as follows: Carbohydrates, fibre, moisture, Ash, fat and protein. Most are herbaceous annual species; therefore in terms of Economic Relevance the woody perennial Pterocarpus Genera is the most useful. Holistically though, they are important sources of food, income, medicine, animal fodder, fuel wood and industrial raw materials. In terms of their sustainability - forest conservation /protection, soil protection/husbandry, environmental protection (cleansing) and modern methods of farm irrigation will go a long way.

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