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Proximate and Mineral Content of Some Medicinal Food Plants Commonly Consumed in North-Eastern Part of Nigeria

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Abstract: Study of the proximate and mineral content of the leaf part of Spinous amarantthus (SM), Senna aceidental (SA) Phyllanthus niruri (PN), Hisbiscus-sabdariff (HS), Lebtadenia hastata (LH); fruit part of Azanza garkena (AG), Balanite agyptiaca (BA) Deuterium senegalense (DS), Ziziphus spini Christi (ZS), cucurbita spp squash gaurd (CS) and seed part of Pakia biglobasa (PB), Citrullus vulgaris (CV), Moringa oleifera (MO), Phaseolus vulgaris (PV) and Spondius purpure (SP) collected from North-eastern parts of Nigeria were carried out. The proximate content (Ash, moisture, fats, fiber, protein and carbohydrate) were analyzed using methods of Association of Official Analytical Chemists (AOAC), while the mineral contents (Fe, K. Mg, Zn and Pb) were analyzed using Atomic Absorption Spectrometric method. The results revealed the range of proximate and mineral content of leafs, fruits and the seeds as 6.71 - 10.95% (Moisture), 10.62 - 19.17% (Ash), 3.35 - 8.05% (Fiber), 2.96 - 6.54% (Fats), 1.76 - 2.88% (Protein) 56.42 - 70.32% (Carbohydrate) and 26.25-436.15 µg/g (Fe), ND - 8321.1 µg/g (K), ND - 3.65 µg/g (Mg), ND - 11.55 µg/g (Zn) and 13.50-166.55 µg/g (Pb); 7.65 - 11.45% (Moisture), 2.67 - 6.29% (Ash), 1.17 - 8.48% (Fiber), 3.91 - 6.37% (Fats), 0.64 - 1.20% (Protein), 17.68 - 79.69% (Carbohydrate) and ND-639.455 µg/g (Fe), ND µg/g (K), ND - 0.55 µg/g (Mg), ND µg/g (Zn) and ND-12.60 µg/g (Pb) and 3.64 - 10.77% (Moisture), 3.27 - 4.79% (Ash), 1.17 - 8.23% (Fiber), 5.04 - 45.07% (Fats), 1.08 - 3.36% (Protein), 40.49 - 84.05% (Carbohydrate) and ND-387.45 µg/g (Fe), ND µg/g (K), ND - 2.30 µg/g (Mg), ND µg/g (Zn) and 5.00-157.50 µg/g (Pb) respectively. The outcome of this study indicated that the medicinal food plants commonly used in the north-eastern part of Nigeria are nutritive and also contained mineral contents which includes toxic one such a lead to be beyond WHO maximum limits.

Keywords: Proximate, Minerals, Food Plants, AOAC and AAS

1. Introduction

The use of traditional food in healing has been part of health care system in many cultures since time memorial. Food and diets are usually being consumed for the purpose of mental, physical and emotional balance for disease prevention. Hippocrates, the father of modern medicine advised more than 2,500 years ago that, “Let food be thy medicine and medicine be thy food” [1]. The effort, to control, improve health and reduce risk of disease using natural methods by consumers has kept the advice running its course with vigor. The attention of researchers to investigate traditional foods for their medicinal values in order to complement existing ways of healing or as alternatives to

drugs has therefore been drawn towards medicinal foods plants. History have documented that traditional dietary healing takes into account the individual's personality, age and metabolism, along with seasonal issues, to achieve optimum health using significant tools such as ingredients, cooking techniques and meal presentation [2]. Plants rich in alkaloids, amino acids, betalin, catechuic tannins, carotenoids, flavonoids, glycosides, phenolic acids, b-sitosterol, steroids, terpenoids, lipids, saponin, linoleic acids, stigmasterol and rutin has been reported to posses medicinal values for diuretic purposes, peptic ulcer and management of anemia [3], [4] and other disease conditions such as burning sensation, leucorrhoea, leprosy, abdominal pain, chicken pox, dysentery, dysurea, fever, hysteria, malaria, mania, tonsillitis and piles [5].

According to World Health Organization [6], "medicinal plants are plants that contain properties or compounds that can be used for therapeutic purposes or those that synthesize metabolites to produce useful drugs". The term "herbal drug" determines the part of a plant used for preparing medicines (for example leaves, flowers, seeds, roots, barks, stems, etc) which usually contains biologically active chemical substances which have curative properties [7]. Medicinal plants which are used as food play significant role in providing nutrients as well as pharmacologically importance to primary health care services of the rural populace, it has been reported that, about 80% of the marginal communities around the world uses plants for such purposes [8], [9]. Bioactive compounds content of plants naturally work with nutrients and dietary fiber to protect against diseases. The nutrients, minerals and biochemical like carbohydrates, fats and proteins, iron, zinc, potassium and magnesium play important roles in satisfying human health needs [10]. The worth of medicinal food plant species can therefore be determined by its proximate and mineral content values [11]. Research evidence has indicated that, high consumptions of fruit, vegetables and other plants' parts rich in phenolic substances enrich the body with anti-carcinogens; this is due to the anti-oxidative and anti-inflammatory properties, which appear to contribute to their chemopreventive or chemoprotective activity [12].

The growing interest towards the use of natural plants products as medicine or food for physiological and nutritional purposes deserve more attention than ever before, this is due to the facts that the chemical composition of such plants could determine its safety in achieving the purpose of its use or harm to the body. The study was aimed at determining the proximate and mineral content of leafs, fruits and seeds of some plants commonly used as food and medicine in North-eastern part of Nigeria in order to ascertain their nutritional and safety level.

2. Methodology

2.1. Apparatus and Reagents Used

All the equipments used were calibrated; Moisture balance (Model: MB200, England OHAUS), Analytical weighing balance (OHAUS Analytical plus, England), Atomic Absorption Spectroscopy (GBC Aranta Version 2.0, Switzerland), Micro-kjedahl apparatus (S. W. Germany), Muffle furnace (Korl-kolb, Germany). All the reagents used were of analar grades purity; glass-wares of appropriate sizes were properly washed using appropriate solvents and rinsed with deionised water.

2.2. Sample Collection and Preparation

The samples were collected from North-eastern Nigeria packaged, coded and taxonomically authenticated by Botanist. The samples were sorted-out from foreign matter, shade-dried and powdered using mortar and pestle and packaged in labelled air-tight plastic containers for further analysis.

2.3. Proximate Analysis

The methods established by Association of Official Analytical Chemists (AOAC, 1990) for determination of moisture, ash, crude fiber, crude lipid and crude protein content were used for the proximate analysis of all the samples. The moisture content of the samples were determined by weighing one (1.0g) gram of each sample in porcelain crucible, dried in an oven (Gallenkamp, UK) at 105°C for 24 hours, cooled in a desiccator and re-weighed until constant weight was obtained. The percentage loss in weight was calculated and expressed as percentage moisture content. Ash content was determined by the incineration of one (1.0g) gram of each sample in a muffle furnace thermostat at 550°C for 3 hours until the samples turned whitish-carbon free. The percentage residue obtained was weighed and expressed as ash content. The crude protein content was determined by estimating the nitrogen content where 1.0g of the samples was digested and titrated using micro-Kjeldahl method based on the assumption that plant proteins contain 16% nitrogen, the protein content of each sample was calculated using the formula, $Protein = percentage\ nitrogen \times 6.25$. The samples were analyzed for crude lipid by weighing one (1.0g) grams of each sample into thimble and extracted for 3 hours with petroleum using soxhlet apparatus. Crude fiber was determined by acid and alkaline digestion methods using 1.25% H_2SO_4 (W/V) and 1.25% NaOH (W/V) solutions. The carbohydrates content were obtained by difference where the percentage moisture, ash, crude protein, crude lipid and crude fiber obtained were added and subtracted from 100% moisture free samples [13].

2.4. Sample Preparation for Mineral Analysis

The ash samples were digested with a mixture of concentrated nitric acid (S. G. 1.4 at 20°C; 70% W/V) and hydrochloric acid (S. G 1.18; 37% W/V) in the ratio of 1:10, filtered through Whatman filter paper (No 1, size 11mm) into 50 mL volumetric flask and made-up to mark with deionised water and transferred to plastic sample bottle and capped prior to analysis.

2.5. Analytical Procedure for Mineral Determination

The mineral content of the prepared samples were determined using GBC Avanta version 2.0 Model of Atomic Absorption Spectrophotometer which was equipped with hallow-cathode lamps of the metals of interest and flame-type sample atomizer after it was optimized and calibrated with standard solutions of suitable concentrations. The reagent blank and the samples were analyzed and the concentrations estimated using the relation: $Metal\ (\mu\frac{g}{g}) = \frac{C \times V \times d.f}{W}$, where C is the concentration of the sample solution in µg/mL; V is the volume of the prepared sample solutions in mL; W is the weight of the samples in grams and d.f is the dilution factor, if used [14], [15].

3. Results and Discussion

The results of proximate and mineral content of leafs of *Spinous amarantthus (SM), Senna aceidental (SA), Phyllanthus niruri, Hisbiscusc sabdariff (RS) and Lebtadenia hastata* (LH); fruits of *Azanza garkena* (AG)*, Balanite agyptiaca* (BA) *Deuterium senegalense* (DS)*, Ziziphus spini Christi* (ZS) *and cucurbita spp squash gaurd* (CS) and seeds of *Pakia biglobasa (PB), Citrullus vulgaris (CV), Moringa oleifera (MO), Phaseolus vulgaris (PV) and Spondius purpure* are presented in Table 1 to 6.

Table 1. *Proximate Composition of the leafs part of Spinous amarantthus (SM), Senna aceidental (SA), Phyllanthus niruri (PN), Hisbiscus-sabdariff (HS) and Lebtadenia hastata (LH) (% dry matter, DM).*

Samples Name	Moisture (%)	Ash (%)	Protein (%)	Lipid (%)	Fiber (%)	Carbohydrate (%)
SM	11.64±1.01	19.17±2.12	2.88±0.28	5.34±0.13	4.55±0.02	56.42±4.01
SA	10.18±0.41	11.43±1.85	1.76±0.06	2.96±0.06	3.35±0.09	70.32±3.34
PN	6.71±0.74	14.55±0.79	2.42±0.09	6.54±0.52	3.52±0.01	66.26±8.11
HS	10.95±0.91	10.62±0.01	2.46±0.03	5.79±0.71	4.58±0.82	65.60±3.62
LH	8.57±0.01	11.49±0.11	1.80±0.01	4.84±0.69	8.05±0.88	65.25±5.15

Table 2. *Proximate Composition of the fruit part of Azanza garkena (AG), Balanite agyptiaca (BA) Deuterium senegalense (DS), Ziziphus spini Christi (ZS) and cucurbita spp squash gaurd (CS) (% dry matter, DM).*

Samples Name	Moisture (%)	Ash (%)	Protein (%)	Lipid (%)	Fiber (%)	Carbohydrate (%)
AG	11.45±2.05	4.19±0.04	0.96±0.002	57.24±6.59	8.48±1.05	17.68±0.73
BA	9.77±1.58	2.67±0.02	1.2±0.016	6.37±0.08	6.17±0.03	73.82±6.48
DS	9.02±0.92	4.10±0.08	0.64±0.001	5.54±0.27	4.17±0.09	76.53±9.37
ZS	9.97±0.63	3.27±0.01	0.82±0.007	5.08±0.54	1.17±0.07	79.69±5.13
CS	7.65±0.08	6.29±0.52	0.77±0.001	3.91±0.42	3.67±0.15	77.71±7.21

Table 3. *Proximate Composition of the seed part of Pakia biglobasa (PB), Citrullus vulgaris (CV), Moringa oleifera (MO), Phaseolus vulgaris (PV) and Spondius purpure (SP) (% dry matter, DM).*

Samples Name	Moisture (%)	Ash (%)	Protein (%)	Lipid (%)	Fiber (%)	Carbohydrate (%)
PB	10.77±0.44	4.43±0.33	3.26±0.03	9.83±0.01	8.23±2.66	63.48±2.43
CV	4.05±0.34	3.27±0.08	1.68±0.21	45.07±3.09	5.44±0.91	40.49±2.85
MO	4.66±0.78	4.79±0.03	3.36±0.13	27.04±1.94	6.51±0.59	53.64±3.01
PV	9.54±1.31	3.51±0.22	2.59±0.36	24.02±0.84	1.17±0.17	59.17±4.18
SP	3.64±0.11	3.87±0.31	1.08±0.07	5.04±1.01	2.32±0.08	84.05±1.95

Table 4. *Mineral Content of the leafs of Spinous amarantthus (SM, Senna aceidental (SA), Phyllanthus niruri (PN), Hisbiscus-sabdariff (HS) and Lebtadenia hastate (LH).*

Samples Codes	Fe (µg/g)	K (µg/g)	Mg (µg/g)	Zn (µg/g)	Pb (µg/g)
SM	300.00	3,385.65	3.65	ND	13.50
SA	26.25	8,321.10	ND	ND	15.35
PN	436.15	6,408.35	3.05	11.55	55.50
HS	359.30	6,638.60	2.45	0.35	166.55
LH	158.15	ND	2.70	ND	123.90

Table 5. *Mineral Content of the fruits of Azanza garkena (AG), Balanite agyptiaca (BA), Deuterium senegalense (DS), Ziziphus spini Christi (ZS) and cucurbita spp squash gaurd (CS).*

Samples Codes	Fe (µg/g)	K (µg/g)	Mg (µg/g)	Zn (µg/g)	Pb (µg/g)
AG	41.25	ND	ND	ND	1.45
BA	185.10	ND	ND	ND	ND
DS	639.45	ND	0.55	ND	5.65
ZS	4.90	ND	ND	ND	12.60
CS	ND	ND	ND	ND	6.75

Table 6. *Mineral Content of the seeds of Pakia biglobasa (PB), Citrullus vulgaris (CV), Moringa oleifera (MO), Phaseolus vulgaris (PV) and Spondius purpure (SP).*

Samples Codes	Fe (µg/g)	K (µg/g)	Mg (µg/g)	Zn (µg/g)	Pb (µg/g)
PB	387.45	ND	2.30	ND	83.05
CV	ND	ND	ND	ND	5.00
MO	ND	ND	2.10	ND	10.55
PV	ND	ND	ND	ND	157.5
SP	122.55	ND	ND	ND	84.45

3.1. Proximate Composition

Table 1 to 3 show the results of proximate content (moisture, ash, fiber, protein and lipids and carbohydrate) of leafs samples of *Spinous amarantthus* (SM*), Senna aceidental (SA), Phyllanthus niruri, Hisbiscus-sabdariff (HS) and Lebtadenia hastata* (LH); fruits samples of *Azanza garkena* (AG)*, Balanite agyptiaca* (BA) *Deuterium senegalense* (DS)*, Ziziphus spini Christi* (ZS) *and cucurbita spp squash gaurd* (CS) and seeds samples of *Pakia biglobasa (PB), Citrullus vulgaris (CV), Moringa oleifera (MO), Phaseolus vulgaris (PV) and Spondius purpure (SP).*

Measurement of moisture is one of the important requirements in food processing, preservation and storage industries (Onwuka, 2005). In this study, the ranges of the moisture content obtained in the leafs, fruits and the seeds samples were 6.71 - 10.95%, 7.65 - 11.45% and 3.64 - 10.77% respectively (Table 1, 2 and 3). The sample with high moisture retention capacity are AG (11.45±2.05%) fruits, SM (11.64±1.01%) leafs and PN (10.77±0.44%) seeds. The moisture level of all samples analyzed were below the WHO maximum permissible limit of moisture (<15%) for food, this therefore indicated that, the samples are less susceptible to microbial growth [13] which guarantees longer shelf-life of the samples.

Ash content is a measure of the total amount of minerals present within a food, whereas the ‘’mineral content” is a measure of the amount of specific inorganic components usually, carbonates, phosphates, silicates and silica present within a sample. It is an important parameter in setting standard for crude drugs [16].

The percentage ash content determined in the leafs, fruits and the seeds samples ranges from 10.62 - 19.17%, 2.67 - 6.29% and 3.27 - 4.79% respectively. The leaf samples indicated higher level of ash with sample SM (19.17±2.12%) followed by the fruits CS (6.29±0.52%) and the seeds MO (4.79±0.03%) samples as shown in Table 1, Table 2 and Table 3. The ash content obtained in all the leaf samples and fruits sample CS were above the specified limit of ash for edible plants which is 5.00-8.70% [17].

The health benefits of fiber rich food cannot be over-emphasized, this is due to the facts that links fiber with epidemiological conditions; fiber enhances the intestinal absorption of nutrient, prevent colon cancer, reduce the incidence of heart disease, lowers inflammation, diabetes, blood pressure, glucose and cholesterol levels and enhances digestion and wastes elimination [18], [19] and reduces the incidence of CNS disorders [20]. The results obtained from this study (Table 1 to Table 3), indicated the of fiber content of the leafs, fruits and the seeds samples analyzed which ranges 3.35 - 8.05%, 1.17 - 8.48% and 1.17 - 8.23% respectively. Most of the seeds samples were richer in fiber content with sample PB indicated the highest (8.23±2.66%) follow by the fruits with sample AG indicating the highest (8.48±1.05%) and the leaf LH sample shows the highest (8.05±0.88%) as shown in Table 1, Table 2 and Table 3. The moderate level of fiber in all the samples is appropriate, because at lower level it aids absorption of glucose and fat and at high level can cause intestinal irritation, lower digestibility and decreased nutrient usage [21], [22].

Proteins are required in diet in order to provide essential amino acids that cannot be synthesized by the body. *In this study, the ranges of the percentage protein content of the leafs (*1.76 - 2.88%*), the fruits (*0.64 - 1.20%*) and the seeds (*1.08 - 3.36%*) obtained indicated that, the seeds samples were richer in protein with MO (*3.36±0.13*) having the highest values follows by the leafs which shows the highest protein in the SM (*2.88±0.28*) and the and the fruits with the highest being obtained in BA (*1.2±0.016*) samples.* The low protein content of these samples indicates that they cannot be depended upon solely as a source of protein required by the body. The recommended dietary allowance (RDA) of protein for individual adults weighing 70kg and 50kg are 56g and 46g, while children may consume 2kg/day [23]. The protein content of these samples is lower than the protein content of *P. Africana and X. aethiopica* (12.45%) reported by Hassan and Umar [24].

The percentage crude lipid content of the leafs, fruits and seeds samples analyzed ranges from 2.96 - 6.54%, 3.91 - 57.24% and 5.04 - 45.07%. The seeds samples were richer in lipids content, the highest value was obtained in CV (45.07±3.09) sample, followed by the fruits samples which the highest values was obtained in sample AG (57.24±6.59) and the leafs sample of the highest lipid content was PN (6.54±0.52). The crude lipid content obtained for most of the samples analyzed in this study were lower than similar study reported by [19]. Lipid provides very good sources of energy and aids in transport of fat soluble vitamins, insulates and protects internal tissues and contributes to important cell processes [25], therefore consumption of lipid rich diet because many body functions utilizes lipids.

The results obtained for the percentage carbohydrate content of the leafs, fruits and the seeds samples presented in Table 1, Table 2 and Table 3 shows that the fruits samples were richer in carbohydrate, followed by the seeds and the leafs. The ranges of the carbohydrate content of the leafs,

fruits and the seeds samples were 56.42 - 70.32%, 17.68 - 79.69% and 40.49 - 84.05% respectively. The highest carbohydrate content of the seed, fruits and the leaf's samples was obtained in sample SP (84.05±1.95%), ZS (79.69±5.13%) and SA (70.32±3.34%) plant is a moderate source of carbohydrate when compared with the Recommended Dietary Allowance (RDA) of 130g [25].

3.2. Mineral Content

The result of mineral content of the leafs samples of *Spinous amarantthus* (SM*), Senna aceidental (SA), Phyllanthus niruri, Hisbiscus-sabdariff (HS) and Lebtadenia hastata* (LH); fruits samples of *Azanza garkena* (AG), *Balanite agyptiaca* (BA) *Deuterium senegalense* (DS), *Ziziphus spini Christi* (ZS) *and cucurbita spp squash gaurd* (CS) and seeds samples of *Pakia biglobasa (PB), Citrullus vulgaris (CV), Moringa oleifera (MO), Phaseolus vulgaris (PV) and Spondius purpure (SP)* are presented in Table 4, 5 and 6 respectively. The leaf samples indicated high concentration of K followed by Fe, Pb, Mg and Zn. The Pb level of all the leaf samples was above the WHO limits specified for herbal material/products [6]. Fe content of the leafs, the fruits and the seeds samples ranges from 26.25 to 436.15 µg/g (Table 4), 4.90 to 639.45 µg/g (Table 5) and 122.55 to 387.45 µg/g (Table 6) for samples SM, SA, PN, HS LH; AG, BA, DS, ZS and PB, SP respectively. The role of iron in the body is clearly associated with haemoglobin and the transfer of oxygen from lungs to the tissue cells. The dietary limit of Fe in the food is 10-60mg/day. Low Fe content causes gastrointestinal infection, nose bleeding and myocardial infarction. Iron deficiency is the most prevalent nutritional deficiency in humans and is commonly caused by insufficient dietary intake, excessive menstrual flow or multiple births [26].

K and Mg are electrolyte which serves as electric charge carriers for the maintenance of heart, nerves and the muscles. However, their excess consumption can lead to other factors such as heart and hormonal disorders [27]. In this study, high level of potassium (K) in the leaf samples indicated that they can be good for relieving anxiety, stress and stabilizing blood pressure, however, excess consumption can result to dehydration and hyperaemia, while the deficiency of K in the fruits and the seeds samples can leads to muscle paralysis [28] if they are depended upon as source of K. The potassium content of the leafs which ranges from 3,385.65 - 8,321.10 µg/g were above the Recommended Dietary Allowance (1875-5625mg/kg) for adults by National Research Council. Magnesium also helps to build bones and boost immune system, but its excess consumption can result to low blood pressure, depression and lethargy [29]. The Mg content of the leaf and the fruits samples ranges from 2.45 to 3.65 µg/g and 0.55 µg/g (DS) only. The Zn content of the leaf samples ranges from 0.35 to 11.55 µg/g in sample PN and HS only, no Zn was detected in the fruits and the seeds samples. The presence of zinc in the samples enhances support for the activities of over 300 enzymes include dehydrogenase, alkaline phosphates and carboxypeptidase which are usually associated to proteins and genetic materials. Zinc also boost immune system and improve sexual functions but its excess consumption can lead to digestive upset, diabetes, anaemia and its deficiency in the body can lead to dermatitis [30], [22].

Several cases of human health disorder such as organ malformation and malfunction have been linked to lead toxicities. Lead exposure has been shown to cause severe anaemia, permanent brain damage neurological disorder, reproductive problems and a host of other diseases. According to the Agency for toxic substances and diseases of the US public health services, the major expose of lead to the general population in food, is through fruits, vegetables and grains. The relative high level of lead might have resulted from accumulation of Pb through air pollution, inclusion or absorption from some pesticides such as lead Arsenates, applied during cultivation.

3.3. Conclusion

Finally it can be concluded that some leafs, fruits and seed medicinal food samples commonly consumed in the North-eastern part of Nigeria were investigated for proximate and mineral content. The outcome of the study revealed that the seed samples were richer in proximate content while the leaf samples were richer in the mineral content. This indicated that both the leaf and the fruit samples are good source of nutritional food contents useful for managing different disease conditions.

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