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Proximate and Mineral Analysis of Some Edible Wild Seeds and Stem in Makurdi, Benue State, Nigeria

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Abstract

Benue State is endowed with numerous varieties of useful plants whose fruits, seeds, roots, stems and leaves serve important roles in nutrition but unfortunately many of these plants have not been put to maximum use. The neglect of these forest food plants is attributed to inadequate information on their nutritional potential to serve as food. The broad objective of the study was to examine the nutritional composition of *Vitellaria paradoxa* fruits, *Cissus populnea* stem, *Afzelia africana* seeds, *Parkia biglobosa* seeds and *Prosopis africana* seeds. Carbohudrate content was found to be the most abundant nutrient in all the plant species studied when compared with other nutrients. The highest carbohydrate content (58.22±0.2%) was found in *Cissus populnea* stem followed by carbohydrate content in Afzelia africana seeds (51.36±0.01%). The least carbohydrate content of 35.68±0.06% was found in the fruits of *Vitellaria paradoxa*. There were significant variations in the concentrations of nutrients screened from the 5 selected plants at p>0.05 level. Proximate analysis showed that *Vitellaria paradoxa* fruits, *Cissus populnea* stem, *Afzelia africana* seeds, *Parkia biglobosa* seeds and *Prosopis africana* seeds were good sources of minerals such as Calcium,Magnesium, Potassium, iron and Chlorine. Potassium had the highest concentration in all the plant species when compared with other nutrients. The highest Potassium content (32.92±0.59%) was found in *Vitellaria paradoxa* fruits followed by Potassium content of 25.15±0.07% in *Afzelia africana* seeds. However, Potassium content between Prosopis africana seeds (15.77±0.81%) and Cissus populnea stem (15.77±0.61%) were not significantly different. The least concentration of Potassium was found in *Parkia biglobosa* seeds (8.03±0.11%). The mean quantities of minerals found in the plant species that were screened differ significantly at P<0.05 level. It was concluded that *Vitellaria paradoxa* fruits, *Cissus populnea* stem, *Afzelia africana* seeds, *Parkia biglobosa* seeds and *Prosopis africana* seeds were good sources of nutrients and major minerals like calcium, magnesium, potassium, iron and chlorine. Diabetic persons need to be careful about the consumption of these plant species. It was recommended that efforts should be made to conserve and protect these plant species through domestication as they are rich sources of nutrients.

Keywords: Proximate; Minerals; Analysis; Edible; Wild seeds; and Stem.

1. Introduction

Feeding the world's ever growing population is one of the most serious problems facing humanity in the 21st Century. According to Food and Agricultural Organization of the United Nation FAO [1], 925 million people in the world are food insecure. In developing countries like Nigeria where there are much nutritional problems, there is need for increased nutritional research with the view to discovering new food supplements. In order to meet the demand for nutritionally balanced food for the world's increasing population and relieve the intense pressure on land use and natural resources, plants used as food must be explored [2]. Forest trees are a direct source of food for more than a billion of the world's poorest people. Forest trees provide staple food and supplemental foods such as fruits, edible leaves and nuts. The most direct way in which forest trees contribute to food security is through contributions to diets and nutrition. Trees found in forests provide important nutrient–rich foods for rural people. They add variety to diets and improve taste and palatability of food. In some societies that traditionally inhabit areas with significant forest cover, trees from forests have been used for generations as nutrient rich food sources [3]. It has been reported that over 4000 plant species have the potential of providing food for millions of urban and rural dwellers [4]. According to Food and Agricultural Organization of the United Nation FAO [1], more than 50 million people in India alone depend directly on forests for subsistence. It has been estimated that between 48% and 68% of the population in Africa suffer from some form of malnutrition [3]. Undoubtedly, forest trees have played an important role in offsetting starvation among rural people. According to Ickowitz, *et al.* [5], children from communities surrounded by forests in 21 African countries have more nutritious diets than children from households in areas with fewer local forest resources. Natural tree products constitute an important part of human diets and are also an important source of income [6]. They are excellent source of minerals and vitamins. In Africa these natural tree products constitute the most affordable and dietary sources of vitamins, trace elements and other bioactive compounds. They form common ingredients in a variety of traditional native dishes for the rural population in developing countries [7]. Studies have identified some food tree species and initiated studies of their nutritional potential [6]. In many developing countries, rural populations derive a significant part of their food and energy requirements from trees which also improve the quality of life. Greater knowledge of the potential of these species and their capacity to improve man's way of life will add weight to efforts to conserve these forest trees.

2. Statement of the Problem

Food shortages in most African countries are becoming worse today as a result of poverty, population growth, scarcity of farmland, and competition for agricultural land and poor agricultural policies. As a result, it is very difficult for a Nigerian farmer to produce enough food to feed his large family. Over 40% of households across all agro-ecological zones in Nigeria face the problem of severe food insecurity [8]. Many forest fruits like *Vitellaria paradoxa* fruits, *Parkia biglobosa* seeds and *Cissus populnea* stem are consumed by the rural people. They consume these forest foods mainly to offset their hunger with little or no understanding of their nutritional composition. The nutritional potentials of most of these indigenous fruit species are lesser known. Previous literatures reveal that many forest tree species are rich sources of vitamins, minerals, proteins, fats and other nutrients. But for many other tree species, such information is lacking. Some of these plants are under threat of being lost due to poor harvesting methods such as uprooting or harvesting which involves destroying the entire plant. Nutritional value information about edible forest plants is needed for aiding decision making on the choice of species for domestication.

3. Objectives of the Study

The broad objective of the study was to examine the nutrienal composition of *Vitellaria paradoxa* fruits, *Afzelia africana* seeds, *Parkia biglobosa* seeds, *Prosopis africana* seeds and *Cissus populnea* stem.

3.1. Specific Objectives

1. To determine the nutritional values of some edible forest trees.
2. To determine the presence of minerals such as calcium, magnesium, Potassium, iron and chlorine.

4. Materials and Methods

4.1. Methodology

The seeds of *Vitellaria paradoxa*, *Afzelia africana*, *Parkia biglobosa*, *Prosopis africana* and stem of *Cissus populnea* were purchased from Wurukum Market in Makurdi. The seeds and stem were taken to the Department of Forest Production and Products, Federal University of Agriculture, Makurdi for proper identification. The seeds were crushed to powder form using mortar and pestle. The powder powdered seeds were then used for proximate analysis.

Determination of Ash: Ash content was determined according to AOAC [9]. 10g of each sample were weighed in a crucible. The crucible was heated in a muffle furnace for about 3-5 hours at 600^{o}C. It was then cooled in a desiccator and weighed to completion of ashing. To ensure completion of ashing, it was heated again in the furnace for 30minutes, cooled and weighed. This was repeated till the ash became white or grayish white. The ash content was calculated using the following formula below;

Determination of crude protein: The crude protein was determined using micro Kjeldahl method as describe in AOAC [9]. 2g of each sample material were taken in a Kjeldahl flask and 30ml concentrated sulfuric acid (H_2SO_4) was added followed by the addition of 10g potassium sulphate and 1g copper sulphate. The mixture was heated first gently and then strongly once the frothing had ceased. When the solution became colourless or clear, it was heated for another 1hour, allowed to cool, diluted with distilled water (washing the digestion flask) and transferred to 800ml Kjeldahl flask. Three or four pieces of granulated zinc and 100ml of 40% caustic soda were added and the flask was connected with the splash heads of the distillation apparatus. Next 25ml of 0.1N sulphuric acid was taken in the receiving flask and distilled. When two-thirds of the liquid had been distilled, it was tested for completion of reaction. The flask was removed and titrated against 0.1 N caustic soda solution using methyl red indicator for determination of Kjeldahl nitrogen, which in turn gave the protein content. The nitrogen percent was calculated using the following formula.

Protein content was estimated by conversion of nitrogen percentage (N%) to protein.

Protein % = N% x Conversion factor (6.25)

Where conversion factor = 100/N (N% in fruit products).

Determination of crude fat: Crude fat content was determined gravimetrically after extraction with diethyle ether (ethoxyethane) and petroleum ether from an ammonia alcoholic solution of the sample. 10g of each sample was taken into a Mojonnier tube. 10ml of ethanol was mixed well and cooled. Added 25ml diethyl ether, stopper the tube, shaked vigorously and then added 25ml petroleum ether and the tube was left to stand for 1hour. The extraction was repeated three times using a mixture of 5ml ethanol, 25ml diethyl ether and 25ml petroleum ether and adding the extraction to the distillation flask. The solvents were distilled off, the flask was dried for 1hour at 100^{o}C and reweighed. The percentage fat content of the sample was calculated by the following formula which gave the difference in the weights or the original flask and the flask plus extracted fat represent the weight of fat present in the original sample.

Where W_1 = Weight of empty flask (g), W_2 = Weight of flask + fat (g) and W_3 = Weight of sample taken (g).

Determination of crude fibre: 2g of each sample was treated with 200 ml of 1.25% H_2SO_4. After filtration with wattman paper No. 4 and washing, the residue were treated with 1.25% NaOH. It was filtered, washed with hot water and then 1% HNO_3 and again with hot water. The residue were ignited and the ash weighed. Loss in weight gave the weight of crude fiber

Where; a = weight of sample; b = weight of crucible; c = initial weight of crucible containing sample before ignition and d = final weight of crucible containing ash after ignition.

Determination of Carbohydrate: The carbohydrate content will be calculated using following:

Available carbohydrate (%), = 100 – [protein (%) + Moisture (%) + Ash (%) + Fibre (%) +

Fat (%)] as was used by Folake, *et al.* [10].

Determination of minerals: Calcium, magnesium, potassium, iron, and Chlorine.

Determination of Calcium and Magnesium: Calcium and Magnesium were determined according the method by George, *et al.* [11]. 2 g of the dry ash sample was dissolved in 5 ml of warm 1:4 hydrochloric acid. This solution was made up to 50 ml with distilled water in a volumetric flask. The solution was transferred in to 15 ml conical centrifuge tube and 2 drops of methyl orange was added. Drop by drop, hydrochloric acid was added. The solution changed to red colour. Then 1 ml of 5% ammonium phosphate was slowly added with shaking. 2 ml of ammonium hydroxide was added and the solution was left to stand for I hour. The mixture was centrifuged and decanted. The precipitate was washed three times with 5 ml of alcohol. 2 ml of supernatant was then used for phosphate determination. 5 ml of the dissolved precipitate was taken and 1 ml of 2.5% oxalic acid was added as well as a drop of methyl orange. Sodium acetate solution was then added slowly until PH was approximately 4.0 until the indicator turned from red to orange. The mixture was then allowed to stand for 4 hours for complete precipitation of the calcium oxalate. The precipitate of calcium oxalate was then centrifuged and washed twice with 3 ml of 2% ammonium hydroxide. The supernatant and the washings were saved for Calcium and Magnesium determination. Calcium and Magnesium were then calculated as shown below;

Calcium (Mg/kg) = Mg of Phosphorus × factor 1.62

Magnesium (Mg/kg) =Mg of Phosphorus × factor 1.62

Determination of Potassium: 10 g of dry ash sample was digested with nitric acid and the absorbance was read on photo electric colorimeter using a wavelength of 450 nm [9].

Potassium (Mg/kg) ×100

Determination of Iron: 10 g of the powder sample was poured slowly into 250 ml volumetric flask containing 10 ml of acetone. The flask was properly covered and left in the refrigerator for I hour. The supernatant was separated into two centrifuge tubes. The supernatants were then transferred to a 100 ml volumetric flask. 100 ml of deionized water was added. 10 ml of the solution was pipetted into 25 ml volumetric flask. 5 ml of acetate buffer and 4 ml of 1, 10 Phenanthroline was added. It was well mixed and colour change was observed. The mixture was left to stand for 30 minutes and then 25 ml of deionized water was added. The spectrophotometer was turned on and left to warm for 15 minutes. The absorbance of the solution was read at the wavelength of 450 nm (MMDM, 2010). The absorbance was recorded and concentration of iron (Fe) was calculated as shown below

Iron (Mg/Kg) = ×100. Where W = 10 g of the sample.

Determination of Chlorine: Chlorine was determined by dry ashing the powder sample at 55^{o}C and dissolving it in 10% hydrochloric acid (25 ml) and 5% lanthanum chloride (2 ml). The solution was boiled and filtered using whatman filter paper N0. 42. Deionized water was added. The absorbance of the solution was read on Digital Jenway flame photometer [12].

Data Analysis: Data obtained from proximate parameters of nutrients and minerals were expressed as means±standard deviation. Means were subjected to one-way analysis of variance (ANOVA) to test for differences between means using statistical package for social science (SPSS) software version 20.

5. Results

Table1 shows the Nutrient composition of *Vitellaria paradoxa* fruits, *Afzelia africana Parkia biglobosa, Prosopis africana* seeds and *Cissus populnea* stem. Carbohydrate was found to be high (35.68±0.06 to 58.22±0.02) in all the plant species that were selected for the study. In *Vitellaria paradoxa* fruits, lipids were found to be higher (39.24±0.01) followed carbohydrate (35.68±0.06) with Ash content (2.65±0.02) as the least. In *Afzelia africana* seeds, carbohydrate was higher (51.36±0.01) followed by protein (17.47±0.02). Proximate analysis of *Parkia biglobosa* seeds showed that carbohydrate was higher (35.95±0.02) followed by protein (22.35±0.04) with Ash as the least (5.40±0.02). However, in *Prosopis africana* seeds, carbohydrate was found to be higher (46.99±0.04) followed by protein (22.31±0.01) and Ash as the least (4.68±0.02). The highest quantity of carbohydrate (58.22±0.02) was found in *Cissus populnea* stem when compared with other plants.

Table-1. Proximate Analysis of Nutrients found in *Vitellaria paradoxa* Seeds, *Afzelia africana*, *Parkia biglobosa*, *Prosopis africana* Seeds and *Cissus populnea* Stem

Plant species	Nutrients					
	Moisture	Ash	Lipid	Fibre	Protein	Carbohydrate
Vitellaria paradoxa	5.40±0.2	2.65±0.02	39.24±0.01	9.69±0.03	7.36±0.02	35.68±0.06
Afzelia africana	6.17±0.01	3.35±0.01	17.12±0.01	4.54±0.03	17.47±0.02	51.36±0.01
Parkia biglobosa	8.44±0.02	5.06±0.01	19.77±0.02	8.44±0.01	22.35±0.04	35.95±0.02
Prosopis africana	7.89±0.01	4.68±0.02	8.22±0.01	9.91±0.02	22.31±0.01	46.99±0.04
Cissus populnea	7.54±0.01	5.12±0.01	1.12±0.01	2.88±0.01	25.13±0.02	58.22±0.02

Mean±Standard deviation

Analysis of variance (ANOVA) showed that there were significant variations in concentrations of nutrients screened from the five (5) selected plants at 0.05 level of significance since the F calculated (19.37) was greater than the F tabulated value (2.62) (Table 2)

Table-2. Analysis of Variance for Concentration of Nutrients

	df	SS	MS	F-cal	F-tab
Between Groups	5	5921.370	1184.274	19.37	2.62
Within Groups	24	1467.042	61.127		

df = degree freedom, SS = Sum of Squares, MS = Mean Square, F-cal = calculated value, F-tab = tabulated value.

Table 3 showed the proximate analysis of mineral composition of the five (5) plant species selected for the study. The analysis showed that the five (5) selected plant species contained calcium, magnesium, potassium, iron and chlorine. In *Vitellaria paradoxa*, among all the nutrients screened, potassium had the highest content when compared with other minerals found in *Vitellaria paradoxa* fruits and also had the highest potassium content when compared with other plant species. Chlorine had the least content of 0.29±0.01% in *Vitellaria paradoxa* fruits. In *Afzelia africana*, potassium was found to have the highest content (25.15±0.07%) followed by calcium with 2.78+0.04% and chlorine with 0.13+0.04% as the least quantity. In Parkia biglobosa, calcium had the highest quantity of 10.35±0.80% and iron had the least quantity of 0.61±0.03%. The highest quantity of calcium (32.50+0.56%) was found in *Prosopis africana* when compared with other plant species. Among all the minerals found in *Cissus populnea*, potassium had the highest quantity of 15.77±0.61%.

Table-3. Mineral Composition of *Vitellaria paradoxa* Seed, *Afzelia africana*, *Parkia biglobosa*, *Prosopis africana* Seeds and *Cissus populnea* Stem

Plant species	Minerals				
	Calcium	Magnesium	Potassium	Iron	Chlorine
Vitellaria paradoxa	1.48±0.28	8.53±0.11	32.92±0.59	0.52±0.11	0.29±0.01
Afzelia africana	2.78±0.04	1.37±0.02	25.15±0.07	1.27±0.05	0.13±0.04
Parkia biglobosa	10.35±0.80	5.88±0.04	8.03±0.11	0.61±0.03	4.91±0.50
Prosopis africana	32.50±0.56	0.14±0.02	15.77±0.81	0.58±0.04	0.12±0.01
Cissus populnea	0.53±0.03	0.29±0.09	15.77±0.61	1.24±0.06	0.14±0.01

Mean±Standard deviation

Table 4 showed the analysis of variance for mineral composition of the selected plant species. The analysis of variance (ANOVA) showed that the mean quantities of minerals found in the plant species that were screened differ significantly at 0.05 level of significance since the F calculated value was greater than the F tabulated value.

Table-4. ANOVA for Mineral Composition of the Selected Plant species

	df	SS	MS	F-cal	F-tabα=0.05
Between Groups	4	1249.244	312.311	5.355	2.87
Within Groups	20	1166.384	58.319		

df = degree freedom, SS = Sum of Squares, MS = Mean Square, Fcal = calculated value, F-tab = tabulated value.

6. Discussion

The result of this study has indicated that *Vitellaria paradoxa* friuts, *Afzelia africana*, *Parkia biglobosa*, *Prosopis africana* seeds and *Cissus populnea* stem were good sources of nutrients and minerals. Appreciable quantities of carbohydrate were found in all the plant species studied. The highest carbohydrate content (58.22±0.02%) was found in *Cissus populnea* stem. This is contrary to the findings of Onojah, *et al.* [13] who stated that a lower quantity of carbohydrate (16.68%) present in *Cissus populnea* stem. But this result agrees with the findings of Adebowale, *et al.* [14] who stated that *Cissus populnea* stem contain high concentration of carbohydrate (43.7±2.5%). *Afzelia africana* contained 51.36±0.01% carbohydrate. In *Prosopis africana* seeds, carbohydrate content was 46.99±0.04%. This result is similar to the report by Olorunmaiye, *et al.* [15] who stated that *Afzelia* *africana* seeds contained high contration of carbohydrate (53.94%) and *Prosopis africana* seeds contained 72.72% carbohydrate. Carbohydrate contents in *Parkia biglobosa* seeds and *Vitellaria paradoxa* were not significantly different and were the least carbohydrate contents when compared. In *Parkia biglobosa* seeds, carbohydrate content was 35.95±0.02% while in *Vitellaria paradoxa* fruits, carbohydrate content was 35.68±0.06%. This agrees with the report by Alabi, *et al.* [16]; Maanikuu and Peker [17]. The high presence of carbohydrate content in these plant species is an indication that they can be used as energy giving foods.

Considerable concentrations of protein were found in *Afzelia africana* seeds, *Parkia biglobosa* seeds, *Prosopis africana* and *Cissus populnea*. The highest concentration of protein (25.13±0.02) was found in *Cissus populnea*. This is in agreement with Onojah, *et al.* [13] who reported that the highest nutrient found in Cissus populnea stem was protein. In *Parkia biglobosa* seeds, protein content was 22.35±0.04%. In *Prosopis africana*, protein content was 22.31±0.01%. In *Afzelia africana* seeds, protein content was 17.47±0.02. This agrees with the findings by Nzekwe, *et al.* [18] who reported that *Afzelia africana* contain moderate concentration of protein. The least concentration of protein (7.36±0.02%) was found in *Vitellaria paradoxa* fruits. Low fibre contents were found in all the plant species. The highest fibre content (9.91±0.02) was found in *Prosopis africana* seeds. This result agrees with the report of Onah and Okore [19] who also reported low content fibre content in *Prosopis africana* seeds. The content of fibre in *Vitellaria paradoxa* was 9.69±0.03. This is similar to the findings of Akoma, *et al.* [20] who reported fibre content of 9.06+0.67%. In *Parkia biglobosa* seeds, the fibre content was 8.44+0.01%. In *Afzelia africana* seeds, fibre content was 4.54+0.03%. This result is agrees with Adebayo and Ojo [21] who also reported low fibre content in *Afzelia africana* seeds. The least fibre content was found in *Cissus populnea*. High content of lipid was found in 39.24±0.01% was found in *Vitellaria paradoxa* fruits. This result agrees with the findings Enaberue, *et al.* [22] who reported a high lipid content in *Vitellaria paradoxa* in the Guinea Savana area of Nigeria. In *Afzelia africana* seeds, lipid content was 17.12+0.1%. In *Parkia biglobosa* seeds, lipid content of 19.77+0.02% was found while in *Prosopis africana* seeds, lipid content was 8.22±0.01%. The least concentration of lipid (1.12±0.01%) was found in *Cissus populnea* stem.

Low concentrations of ash were found in all the five (5) plant species selected for the study. The highest concentration of ash (5.12±0.01%) was found in *Cissu populnea* stem. This result is similar to the findings by Olorunmaiye, *et al.* [15]. This was followed by ash content of 5.06±0.01% in *Parkia biglobosa* seeds. This is similar to the findings of Olowokere et al (2018) who reported ash content of 6.71±0.06% in *Parkia biglobosa* seeds. The least content of ash (2.65±0.02%) was found in *Vitellaria paradoxa* fruits. This is contrary to submission by Agbo, *et al.* [23]; Akoma, *et al.* [20] who reported high ash content in *Vitellaria paradoxa* fruits. But the result agrees with Adebayo and Ojo [21] who stated low ash content in *Afzelia africana* seeds. In *Afzelia africana* seeds, ash content of 3.35±0.01% was found. This was similar to the report by Olorunmaiye, *et al.* [15] who stated that *Afzelia africana* seeds contained 3.62% ash. Low moisture content was recorded in all the plant species. The highest moisture content of 8.44±0.02% was found in *Parkia biglobosa* seeds. This disagrees with Alabi, *et al.* [16] who reported high moisture content in *Parkia biglobosa* seeds. Moisture content of 7.89±0.01% was found in *Prosopis africana* seeds. This agrees with Olorunmaiye, *et al.* [15]. Moisture content of 7.54±0.01% was found in *Cissus populnea* stem. This result is contrary to the findings of Onojah, *et al.* [13] who reported low moisture content in the stem of *Cissus populnea*. In *Afzelia africana* seeds, moisture content of 6.17±0.01% was recorded. This result was within the range of 7.45±0.02% as was reported by Adebayo and Ojo [21]. The least moisture content (5.40±0.21) was found in *Vitellaria paradoxa* fruits.

Appreciable concentrations of major minerals like calcium, magnesium, potassium, Iron and chlorine were also found in the selected plant species studied. The highest concentration of calcium (32.50±0.56%) was recorded in *Prosopis africana* seeds when compared with other plant species. In *Parkia biglobosa* seeds, calcium content was 10.35±0.80%. In *Afzelia africana* seeds, the concentration of calcium was 2.78±0.04%. In *Vitellaria paradox* fruits, calcium was 1.48±0.28%. The least concentration of calcium was found in *Cissus populnea*. The occurrence of calcium in these plant species is an indication that upon consumption, they will help to build and maintain strong bones. The highest concentration of magnesium (8.53±0.11%) was found in *Vitellaria paradoxa* fruits followed by 5.88±0.04% magnesium in *Parkia biglobosa* seeds. In *Afzelia africana* seeds, magnesium content was 1.37±0.02%. In *Cissus populnea* stem, magnesium was 0.29±0.09%. This is similar to the submission of Onojah et al (2013) who also reported low magnesium content of 0.10% in *Cissus populnea* stem. The least concentration of magnesium (0.14±0.02%) was found in *Prosopis africana* seeds. The highest concentration of potassium (32.92±0.59%) was found in *Vitellaria paradoxa* fruits. This is contrary to the findings of Akoma, *et al.* [20] who reported low potassium content of 1.97±0.01% in *Vitellaria paradoxa* fruits. In *Afzelia African* seeds, potassium content was 25.15±0.07%. This is contrary to the findings of Nzekwe et al (2016) who reported low potassium content of 0.39% in *Afzelia africana* seeds. Means of the experimentally determined values of potassium for *Prosopis africana* (15.77±0.81%) seeds and *Cissus populnea* stem (15.77±0.61%) were not significantly different. The least concentration of potassium (8.03±0.11%) was found in *Parkia biglobosa* seeds. Low concentrations of iron and chlorine were found in all the plant species investigated. Low concentrations of iron (Fe) which range from 0.52±0.11% – 1.29±0.06% were found across the five selected plant species studied. The content of chlorine which ranged from 0.12±0.01% to 4.91±0.50% was recorded across the plant species studied.

7. Conclusion

The outcome of this study showed that *Vitellaria paradoxa* fruits, *Afzelia africana*, *Parkia biglobosa*, *Prosopis africana* seeds and *Cissus populnea* stem are good sources of nutrients and major minerals like calcium, magnesium, potassium, iron and chlorine. They are quality foods with major minerals. High levels of carbohydrates were found in all the plant species. Diabetic persons need to be careful about the consumption of these plant species. Low levels of iron and chlorine were recorded from all the plant species.

Recommendations

1. Efforts should be made to conserve and protect these plant species through domestication as they are rich sources of nutrients. Plant species like *Afzelia africana* is on the verge of extinction and if no efforts are made to conserve or domesticate it, it may become completely extinct.

2. More research should be carried out on these plant species to determine the presence of vitamins and phytochemical properties which are important to human health.

Conflict of Interest: None

References

[1] Food and Agricultural Organization of the United Nation FAO, 2011. "FAOSTAT." Available: http://faostat.fao.org/default.aspx

[2] Hughes, J., 2009. "Just famine foods. What contribution can underutilized plants make to food security?" *Acta Horticulture,* vol. 806, pp. 39-47.

[3] Vinceti, B., Termote, C., Ickowitz, A., Powell, B., Katja, K., and Hunters, D., 2013. "The contributions of forests and trees to sustainable diets." *Sustainability,* vol. 5, p. 4797–4824. Available: www.mdpi.com/journal/sustainability

[4] Rubaihayo, E. B., 2002. "The contribution of indigenious vegetable to household food security. IK Notes. 44:1-4. In: Ndamitso, M. M. ; Mathew J. T.; Shaba, E. Y.; Salihu A.B. and Ogunmiloro, O. J. (2012). Comparative Nutritional Compositions of Irvingia gabonensis (Wild Bush Mango) Seeds and Abelmoschus esculentus (Okra) Pods." *Nigerian Journal of Chemical Research,* vol. 17, p. 50–58.

[5] Ickowitz, A., Powell, B., Salim, M. A., and Sunderland, T. C. H., 2014. "Dietary quality and tree cover in Africa." *Global Environmental Change,* vol. 24, p. 287–294.

[6] Lamien, N., Lingani-Coulibaly, P., and Traore-Gue, J., 2009. "Importance of local fruits consumption in diet balance in Burkina Faso, west Africa." *Acta Hort. (ISHS),* vol. 806, pp. 203-208. Available: http://www.actahort.org/books/806/806_24htm

[7] Edwige, T. D. N., Parkouda, C., Lamien, N., Aminata, S., Castr-Euler, A. M., and Boussim, I. J., 2014. "Nutritional composition of five food trees species products used in human diet during food shortage period in Burkina Faso." *African Journal of Biotechnology,* vol. 13, p. 1807–1812.

[8] Otu, W. I., Idiong, C., Idiong, I. N., Itoro, N. B., Iniobong, E. O., and Uwemedimo, E. O., 2014. "Analysis of food insecurity status of urban food crop farming households in cross river state, nigeria: A usda approach." *Journal of Agricultural Science,* vol. 6, p. 132–141.

[9] AOAC, 2000. *Official methods of official analytical chemists*. Arlington Virginia, USA: Association of Official Agricultural Chemists.

[10] Folake, G. O., Mutiu, A. A., Rita, M. S., Temitope, O., Ekundayo, T. S., Taiwo, A. O., and Odiaka, S. C., 2013. "Proximate composition of whole seeds and pulp of african black velvet tamarind (dialium guineense)." *IOSR Journal of Agriculture and Veterinary Science Volume,* vol. 5, p. 49–52.

[11] George, D. M., Anderson, C. T., Sheldon, M., and Kinshell, L. W., 1949. "A method for the colorimetric determination of calcium and magnesium in small amounts of urine, stool and food." *Journal of Biology and Chemistry,* vol. 180, p. 175–180.

[12] Adepoju, O. T. and Adeniji, P. O., 2012. "Nutrient Composition and Micro nutrient potential of three wildly grown varieties of African star apple (Chrysophyllum albidum) from Nigeria." *African Journal of Food Science,* pp. 345-351.

[13] Onojah, P. K., Salawu, O. W., and Uma, S., 2013. "Proximate and Phytochemical Screening of Cissus populnea." *The International Journal: Research Journal of Science and IT Management,* vol. 2, p. 1–4.

[14] Adebowale, K. O., Nwokocha, L. M., and Agaje, W. B., 2013. "Composition of cissuspopulnea stem." *Journal of Food Composition and Analysis,* vol. 30, p. 41–46.

[15] Olorunmaiye, K. S., Apeh, L. E., Madandola, H. A., and Oguntoye, M. O., 2019. "Proximate and phytochemical composition of African mahogany (afzelia africana) seeds and African mesquite (prosopis Africana) pod." *Journal of of Applied Science and Environmental Management,* vol. 23, p. 249–252.

[16] Alabi, D. A., Akinsulire, O. R., and Sanyolu, M. A., 2005. "Qualitative determination of chemical and nutritional composition of parkia biglobosa (JACQ) benth." *African Journal of Biotechnology,* vol. 4, p. 812–815.

[17] Maanikuu, P. M. and Peker, K., 2017. "Medicinal and nutritional benefits from the shea tree (vitellaria paradoxa)." *Journal of Biology, Agriculture, and Health Care,* vol. 7, p. 51–57.

[18] Nzekwe, U., Ajuziogu, G. C., Njoku, E. U., Okafor, G. I., Sani, M. B., Onyeke, C. C., Onyeonagu, C. C., Ohaneje, A. A., and Eze, C. S., 2016. "Nutritional food content of seed and eaffects of five different growing media on the seed germination and seedling growth of afzelia africana sm caesalpinaceae." *African Journal of Biotechnology,* vol. 15, p. 384–391.

[19] Onah, A. I. and Okore, V. C., 2017. "Effects of methods of hydrolysis of the composition of prosopis africana seed hydrolysates." *IOSR Journal of Pharmacy and Biological Sciences,* vol. 12, p. 17–20.

[20] Akoma, O. A., Nma, N. A., Musa, S. A., and Salihu, A. B., 2018. "Nutritionl and phytochemical composition of vitellaria paradoxa (shea fruit pulp)." *International Journal of Biotechnology Research and Review,* vol. 22, p. 1–7.

[21] Adebayo, S. F. and Ojo, O. C., 2013. "Nutritient composition and functional properties of afzelia africana seeds." *IOSR Jornal of Environmental Science, Toxicology and Food Technology,* vol. 6, p. 01–03.

[22] Enaberue, L. O., Obisesan, I. O., Okolo, E. C., and Ojo, A., 2014. "Proximate and chemical composition of shea (vitellaria paradoxa C.f GAETN) fruit pulp in the guinea savana of Nigeria." *World Journal of Agricultural Sciences,* vol. 2, p. 078–083.

[23] Agbo, N. W., Agee Pong, M. Y., and Owusu, B. G., 2014. "Nutritional Composition of shea nut (Vitellaria paradoxa) by-products and their digestibility by Nile Tilapia (Oreochromis niloticus) juvenile." *Journal of Science and Technology,* vol. 34, pp. 7-16.