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Comparative study of proximate composition, antioxidant vitamins and mineral profile of six local wild fruits consumed in South-eastern, Nigeria

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ABSTRACT: Comparative study of proximate composition, antioxidant vitamin and mineral profile were carried out in six local wild fruits consumed in South East, Nigeria. The wild fruits samples were obtained from Eke Awka market in Awka, Anambra State and were processed for analysis. Proximate compositions, antioxidant vitamins and mineral profile of the samples were determined using standard methods. The result of the study indicated that moisture content of wild mango (31.88 ± 0.02%) was significantly higher ($p<0.05$) compared to other fruits. The protein content of African elemi (14.52 ± 0.02%) was highest followed by African velvet tamarind (8.61 ± 0.12%).Crude fibre (3.50 ± 0.01%) and carbohydrate (51.56 ± 0.02%) were significantly higher in African velvet tamarind compared to other fruits but least in hog plum (0.50 ± 0.01%) and African elemi (25.44 ± 0.02%) respectively. Antioxidant vitamins were present at different concentrations. However, the fruits were generally rich in vitamin C. The mineral profile of the studied fruits showed the presence of macro minerals (Na, Ca, Mg and K) and antioxidant related minerals (Se, Fe, Cu, Zn and Mn). The results obtained from micro minerals indicated that there was a significant difference among the wild fruits while the macro minerals composition of the selected wild fruits did not differ significantly ($p>0.05$) in Ca^{2+}, Mg^{2+}, K^{+} and Na^{+} concentrations among the wild fruits. This study generally showed that wild fruits have appreciable amount of vitamins and minerals therefore should be included in our daily diet.

Keyword: *Sapondiasmombin, Dialiumguineense, Irvingiagabonensis, Phoenix dactylifera, Canariumschweinfurthii, Dennettiatripetala, proximate composition, antioxidants vitamins, mineral profile.*

Introduction

Hog plum (*Spondiasmombin)*: *Spondiasmombin*(Hog plum) (Plate 1.1) which belongs to *Anacardiaceous* family is a tropical fruit tree that grows to about 20 meters tall. It has different local names in Nigeria; in Igbo it is called 'Utu, Ngugulu or Ijikara' while in Yoruba it is called 'Iyeye or Ebo' and in Hausa it is called 'Isada'. The plant has been found to be useful medicinally among many countries of the world where it commonly grows [(1,2)]. The fruit can be consumed raw or processed into jams and jellies. It can be juiced and used to make

ice cream and cold beverages. The green fruits can be pickled in vinegar and eaten with salt and chili, just like olives [3].**African Velvet Tamarind (*Dialiumguineense*):** *Dialiumguineense*, also known as African velvet tamarind (AVT) or lickylicky or black velvet tamarind (Plate 1.2) is a tropical forest fruit tree of the *Leguminosae* family. AVT is known by different names in Nigeria, depending on the locality or tribe. It is known as 'Tsamiyarkurmi' in Hausa, 'Icheku' in Igbo, 'Awin' in Yoruba, and 'Amugen' in Edo. Every part of this wild fruit has its own uses and health benefits. **Wild Mango (*Irvingia gabonensis*):** *Irvingiag abonensis*, also known as wild mango/bush mango or dika nut (Plate 1.3), is a native African fruit tree that produces edible fruits and seeds [4,5,6]. This fruit is locally called differently in Nigeria, in Igbo it is known as 'Ugiri', Yoruba-Oro and Hausa- Goron or Birin.In Cameroon, *I. gabonensis* kernels are widely marketed [7] and form an important diet, providing carbohydrate, oil, and protein to improve health and nutrition andis traded enough in Nigeria.*I. gabonensis* has been used in the treatment of type II diabetics and in the reduction of obesity, either entirely or as a supplement [8,9]. **Date Fruit (*Phoenix dactylifera*):** Dates (*Phoenix dactylifera L.*) (Plate 1.4) is one of the oldest known fruit crops, cultivated for at least 5,000 years in North Africa and the Middle East [10]. It is locally called different names in Nigeria, in Igbo – Nkwuozara, Yoruba – Esoomeka and Hausa – Dabino. They are used in herbal medicine e.g it is eaten by women during pregnancy which helps to strengthen the uterine muscles. Date is also used as a source of food, snack, etc. Date is used for commercial and industrial purpose e.g dates seed oils, which are rich in several fatty acids, are used in soaps and cosmetics [11].**African Elemi (*Canariumschweinfurthii*):** African elemi also known as bush candle, Incense tree, Purple canary tree, or Gum resin tree in English (*Canariumschweinfurthii*) (Plate 1.5) is a big tree with a long and straight bowl of more than 50m. In Nigeria, the tree is known as 'Ube mgba', 'ubeosa', 'ubeokpoko', 'ubeigwe' (Igbo), 'Atili' or 'Atile' (Hausa), or 'Origbo' (Yoruba)[12]. It is reported to be used as a worm expeller and also in teething (in children) and ulcer treatment. It is also locally applied as a lubricant for hairdo and as pomade [13].**Pepper fruit (*Dennettiatripetala*):** *Dennettiatripetala*(Plate 1.6) also have different names in Nigeria which are 'mmimi' in Igbo, 'ataigbere' in Yoruba while 'ako' in Hausa. This fruit is use in traditional medicine as a remedy for cough, fever, toothache, diarrhea, diabetes, and nausea in pregnant women. The wood is used as fuel. This study is aimed at comparing the proximate composition, antioxidant vitamins and mineral profile of these local wild fruits consumed in South-East, Nigeria so as to provide information on alternative and cheaper source of nutrients that can help reduce some nutrient-deficiency diseases.

Materials and Methods

Sample Collection: Hog plum (*Sapondiasmombin*), African velvet tamarind (*Dialiumguineense*), Wild mango (*Irvingiagabonensis)*, Date (*Phoenix dactylifera)*, African elemi (*Canariumschweinfurthii*) and Pepper fruit(*Dennettiatripetala*) were obtained from Eke Awka market in Awka, Anambra State and identified by a taxonomist Dr Gabriel Ogbuozobe, of Botany Department, NnamdiAzikiwe University, Awka, Anambra State, Nigeria.

Sample Preparation: Some of the samples (African velvet tamarind and wild mango) were peeled while the other samples (hog plum, date fruit, African elemi) were de-seeded and sun dried for four days. After sun drying the samples, they were ground using manual grinder and stored in an air tight container prior to use.

Proximate Composition: Proximate analysis of the various samples were determined using the following methods; moisture was determined using the oven dry method, protein was determined using the macro-Kjeldhal method, fibre was determined using the method of hydrolysis, fat was determined using the Soxhlet extraction method, ash was determined using themuffle furnace, Total carbohydrate content of each sample was estimated by 'difference'while the energy value (kcal), was determined using the Atwater value[14,15, 16, 17, 18].

Antioxidant Vitamin Concentration: The concentration of vitamin A, C and E in the fruits extracts were determined using the spectrophotometric method as described by [19].

Mineral Composition: Trace mineral compositions of the various samples were determined by atomic absorption spectrophotometric (AAS) method described by [20].

Statistical Analysis

All data were reported as mean ± standard deviation, where appropriate. One – way analysis of variance (ANOVA) was used to analyze the data results using Statistical Package for Social Science (SPSS) version 20 software. Group mean obtained after each analysis were compared using Ducan multiple comparison test and difference were considered significant at $p<0.05$.

Results and Discussion

Proximate composition

Moisture content of food sample is referred to as the amount of free water and volatile substances that are lost by drying food samples under controlled temperature in an air oven [20]. The result of this study as shown in Table 1, indicate that moisture content of wild mango (31.88 ± 0.02%) was significantly higher ($p<0.05$) compared to other fruits, this result was similar with the study done by [21]. Its high moisture content underscores its high perishability and susceptibility to microbial infections; and this is indicative of low solid matter. It also characterizes the freshness of the fruit since fruits kept for a period of time tend to lose moisture [22]. Crude protein content of food sample is the total nitrogen content multiplied by protein factor [20]. The result also showed that the protein content of African elemi (14.52 ± 0.02%) was highest followed by African velvet tamarind (8.61 ± 0.12%). This result is in agreement with the studies of [23] which showed that the fruit is high in nitrogenous compounds and could be as well useful in animal diets. Crude fat simply signifies the overall estimate of fat present in food. Fat is also known as triglyceride which comprises of ester of three fatty acid chain and a glycerol backbone [20].

Table 1: PROXIMATE COMPOSITION OF SIX SELECTED WILD FRUITS

Composition (%)	African elemi	Wild mango	Hog plum	African Vel. Tamarind	Pepper fruit	Date fruit
Moisture	**26.64 ±0.01^{b}**	**31.88 ± 0.02^{a}**	**20.00 ± 0.01^{d}**	**25.00 ± 0.01^{c}**	**19.00 ± 0.01^{e}**	**8.91 ± 0.01^{f}**
Crude protein	**14.52 ± 0.02^{a}**	**5.84 ± 0.02^{d}**	**3.93 ± 0.01^{e}**	**8.61 ± 0.12^{b}**	**6.20 ± 0.00 ^{c}**	**3.23 ± 0.05^{f}**
Crude fat	**32.04 ± 0.02^{b}**	**28.00 ± 0.01^{c}**	**21.00 ± 0.01^{e}**	**6.33 ± 0.01^{f}**	**23.00 ± 0.02^{d}**	**41.67 ± 0.00^{a}**
Dry ash	**2.56 ± 0.03^{e}**	**0.50 ± 0.01^{f}**	**5.45 ± 0.01^{b}**	**5.00 ± 0.01^{c}**	**8.00 ± 0.01^{a}**	**3.50 ± 0.01^{d}**
Crude fibre	**1.80 ± 0.01^{c}**	**0.50 ± 0.00^{f}**	**1.00 ± 0.00^{e}**	**3.50 ± 0.01^{a}**	**3.00 ± 0.00^{b}**	**1.50 ± 0.03^{d}**
Carbohydrate	**22.44 ± 0.02^{f}**	**33.28 ± 0.02^{e}**	**48.62 ± 0.01^{b}**	**51.56 ± 0.02^{a}**	**40.80 ± 0.01^{c}**	**41.19 ± 0.02^{d}**
Energy value	**436.20 ± 0.02^{b}**	**408.48 ± 0.01^{c}**	**399.20 ± 0.01^{d}**	**297.67 ± 0.01^{f}**	**395.00 ± 0.01^{e}**	**552.69 ± 0.03^{a}**

Values are mean ± standard deviation of triplicate determinations.
Values within the same row bearing the same superscript letters are not significantly different at $P < 0.05$.

The above result (Table 1) signifies that the wild fruits are higher in the following order date fruit > African elemi > wild mango > pepper fruit > hog plum > African velvet tamarind and this result is similar with the study done by [24] the little variation could be due to some kind of environmental changes. Crude ash is the overall estimate of the mineral composition of the food [20]. Ash contents also give an idea about the inorganic content. They are expected to enhance the metabolic processes, growth and development [25]. The result (Table 1) showed that the ash content of pepper fruit (8.00 ± 0.01%) was significantly higher ($p<0.05$) followed by hog plum

(5.45 ± 0.01%) compared to the other fruits while wild mango was the least (0.50 ± 0.01%) among others. This result was slightly lower than the study done by [26] which could indicate that it contains lower quantity of mineral value, especially the micro elements and micro minerals

Crude fiber as shown in Table 1.0, showed that African velvet tamarind (3.50 ± 0.01%) is significantly highest compared to other wild fruits studied while the least were hog plum (1.0 ± 0.01%) and African elemi (1.8 ± 0.01%) this result was lower than that of the previous study done by [27] which indicate that the consumption of the fruits could help in the bowel movement [28]. Fiber also has a biological effect on the absorption and reabsorption of cholesterol and bile acid, respectively [29]. Soluble fiber have health promoting properties as they have been used in lowering plasma and liver cholesterol concentration [30], diarrhea treatment and detoxification of poisonous metals [31].

Carbohydrate was significantly highest in African velvet tamarind (51.56 ± 0.02%) compared to other fruits used respectively, this result was slightly different from the study done by [32]. This implies that fruits are of high calorific value and hence if incorporated into animal feed formulation of man, it could help in the supply of the required energy for daily activates. The result showed that carbohydrate was low in hog plum (48.62 ± 0.02%) and African elemi (22.44 ± 0.02%) which may be due to climatic and geographic differences in places where they were cultivated and also species differences in the samples used. Low carbohydrate value qualifies the fruit as a good fruit snack for the obese and diabetics. The energy value of date fruit (552.69 ± 0.03 kcal/100g) was significantly highest ($p<0.05$) compared to other fruits, this result has little variation with result of the study done by [24] this indicates that the fruits are good alternative for source of energy and could provide more energy when consumed by human. The high energy value found in these fruits may be as a result of high oil content. The wild fruits contain both essential and volatile oils [33].

Antioxidant Vitamin Concentration

Vitamins are one of the vital nutrients needed by organisms in limited amounts. They have varied biochemical functions, some of which (vitamin A, E and C) has antioxidant properties [34]. Vitamin A, a fat-soluble vitamin is essential for normal function of the retina, particularly for visual adaptation to darkness [35]. The vitamin content of the six selected wild fruit consumed in South Eastern State of Nigeria was shown in Table 2. The result showed that there was a statistical significant increase ($p<0.05$) in vitamin A concentration in wild mango compared to other wild fruits while pepper fruit showed a significant increase ($p<0.05$) in vitamin C concentration compared to other fruits. However, African velvet tamarind showed a statistical significant increase in vitamin E concentration ($p<0.05$) compared to other fruits.

TABLE 2: IN *VITRO* ANTIOXIDANT VITAMINS OF SIX SELECTED WILD FRUITS

Composition (Iμ/l)	African elemi	Wild mango	Hog plum	African Vel. Tamarind	Pepper fruit	Date fruit
Vit A	**44.33^{b}**	**137.77^{a}**	**42.44^{c}**	**26.67^{e}**	**30.44^{d}**	**13.55^{f}**
Vit C	**278.95^{c}**	**219.41^{e}**	**170.52^{f}**	**338.95^{b}**	**576.84^{a}**	**274.21^{d}**
Vit E	**34.88^{d}**	**41.47^{b}**	**48.52^{a}**	**41.24^{c}**	**30.51^{e}**	**9.51^{f}**

Values within the same row bearing the same superscript letters are not significantly different at $P < 0.05$.

From the result above Table 2, shows that wild mango had the highest level of vitamin A followed by African elemi and least in date fruit. This result is in agreement with the literature and other studies done by [36] which indicated that all fruits analyzed were rich in β-carotene and vitamin A [37,38,39]. The result also showed that pepper fruit and African velvet tamarind had the highest level of vitamin C and hog plum had the least amount. The high level of vitamin C in pepper fruit and African velvet tamarind was similar to the content in other fruits reported by [40], thereby providing essential source of vitamin C for many in the South-East, Nigeria. The low

level of vitamin C in hog plum may be as a result of variation in environmental condition during production, climate, and soil or specie difference. Vitamin E also known as tocopherol was detected in trace amount. Vitamin E was highest in African velvet tamarind followed by hog plum and least in date fruit. The vitamin E present in this study appears higher than that of [32] which may be due to some environmental conditions or type of specie used for the analysis. The result of this study (Table 2) showed that the fruits have varying concentrations of antioxidant vitamin A, C and E. The presences of these three vitamins in the fruits could be of great importance to human health.

Mineral Composition

Results of micro and macro mineral composition of the six selected wild fruits and their differences are shown in Table 4 and Figure 4. The antioxidant related mineral composition of the six selected wild fruits consumed in South Eastern State of Nigeria is shown in Table 3. The result of the study showed that wild mango was significantly high in copper (0.22 ± 0.01mg/kg) and manganese (0.78 ± 0.01 mg/kg) at $p < 0.05$ compared to other fruits. This is followed by pepper fruit Cu: 0.16 ± 0.01mg/kg and African velvet tamarind Mn: 0.56 ± 0.02mg/kg respectively. Zinc level was also highest in wild mango (0.87 ± 0.01mg/kg) followed by hog plum (0.70 ± 0.02 mg/kg) and the least was pepper fruit (0.42 ± 0.00mg/kg). Date fruit has the highest amount of Fe (16.13 ± 0.03mg/kg) followed by hog plum (11.93 ± 0.02mg/kg) and least was African elemi and difference in mean was significant at $p < 0.05$ in hog plum followed by wild mango (3.48 ± 0.01) and was least in African velvet tamarind (1.94 ± 0.01mg/kg).

TABLE 3: MINERAL COMPOSITION OF SIX SELECTED WILD FRUITS

Composition (mg/kg)	African elemi	Wild mango	Hog plum	African Vel. Tamarind	Pepper fruit	Date fruit
Cu	**0.15^{c}**	**0.22^{a}**	**0.15^{c}**	**0.13^{e}**	**0.16^{b}**	**0.14^{d}**
Mn	**0.44^{c}**	**0.78^{a}**	**0.43^{d}**	**0.56^{b}**	**0.36^{e}**	**0.28^{f}**
Zn	**0.60^{e}**	**0.87^{a}**	**0.70^{b}**	**0.63^{d}**	**0.42^{f}**	**0.67^{c}**
Fe	**5.82^{f}**	**6.64^{e}**	**11.93^{b}**	**7.15^{c}**	**6.82^{d}**	**16.13^{a}**
Se	**2.02^{e}**	**3.48^{b}**	**4.54^{a}**	**1.94^{f}**	**2.16^{d}**	**2.19^{c}**

Values within the same row bearing the same superscript letters are not significantly different at $P < 0.05$.

Table 3, also showed that the six selected wild fruits used in this study were found to contain highest level of iron and selenium. Date fruit (16.13 ± 0.03 mg/kg) was the highest in iron followed by hog plum (11.93 ± 0.02 mg/kg) and least in African elemi at ($p<0.05$), this finding is contrary to the observation made by [41]. The high level of Iron (Fe) in date fruit made it essential in oxygen binding to haemoglobin and also acts as catalyst for many enzymes like cytochromeoxidase[42]. It could be recommended in diets for reducing anemia. The result also showed that hog plum was highest in selenium followed by wild mango and least in African velvet tamarind at ($p<0.05$) which is also contrary to the work done by [43].

Manganese (Mn) acts as the co-factor for the enzymes like arginase, and glycosyltransferase. There are other enzymes like phosphoenol pyruvate carboxykinase and glutamine synthetase which are activated by Mn ions. From the result of this study (Table.1.2), wild mango (0.78 ± 0.01 mg/kg) was significantly ($p < 0.05$) high in manganese compared to other fruits and least in African velvet tamarind (0.56 ± 0.02 mg/kg). Manganese is also essential for hemoglobin formation [44]. Zinc play role in stabilizing micro molecular structure and synthesis. The metal present in DNA and RNA polymerases are zinc dependent enzymes. Table.1.1 showed that wild mango (0.87 ± 0.01 mg/kg) was significantly highest in zinc content followed by hog plum (0.70 ± 0.02 mg/kg)

and least was pepper fruit (0.42 ± 0.00 mg/kg). The result also showed that wild mango was significantly ($p < 0.05$) high in copper (0.22 ± 0.01 mg/kg) compared to other fruits, which is not in agreement with the work of [43,45].

Table 4. showed the macro mineral composition of the selected wild fruits, the result showed that there was no significant difference ($p>0.05$) in Ca^{2+}, Mg^{2+}, K^{+} and Na^{+} concentrations in all the wild fruits. It also showed that date fruit has the highest level of calcium and potassium more than the other six selected wild fruits. The result is in agreement with study done by [46]. Magnesium was the most abundant of all other micro minerals analyzed in this study. Wild mango and African velvet tamarind had the highest amount of Mg and is in agreement with the work of [32]. This was contrary to the observations of some researchers who had reported that potassium is the most abundant mineral in agricultural products [47,48,49]. The result showed that sodium was in appreciable amount in the six selected wild fruit analyzed in this study. Sodium was highest in hog plum followed by African elemi and least in African velvet tamarind. The concentration of Na in hog plum was slightly higher than the one in research done by [50].

TABLE 4: MACRO MINERALS COMPOSITION OF SIX SELECTED WILD FRUITS

Composition (mg/kg)	African elemi	Wild mango	Hog plum	African Vel. Tamarind	Pepper fruit	Date fruit
Ca	**9.16 ± 0.03^{b}**	**7.15 ± 0.42^{f}**	**8.21 ± 0.05^{c}**	**8.02 ± 0.12^{e}**	**8.15 ± 0.26^{d}**	**9.25 ± 0.32^{a}**
Mg	**18.24 ± 0.36^{d}**	**20.18 ± 0.11^{a}**	**18.15 ± 0.11^{e}**	**20.10 ± 1.02^{b}**	**15.66 ± 0.21^{f}**	**18.28 ± 0.48^{c}**
K	**8.27 ± 0.02^{d}**	**9.10 ± 0.21^{b}**	**8.18 ± 0.21^{e}**	**9.81 ± 0.35^{c}**	**7.56 ± 0.02^{f}**	**10.11 ±0.02^{a}**
Na	**8.82 ± 0.12^{b}**	**8.12 ± 0.23^{e}**	**9.10 ± 0.32^{a}**	**7.12 ± 0.44^{f}**	**8.65 ± 0.01^{c}**	**8.21 ± 0.01^{d}**

Values are mean ± standard deviation of triplicate determinations.
Values within the same row bearing the same superscript letters are not significantly different at $P < 0.05$.

Conclusion

This study has shown that the six selected wild fruits grown in South Eastern, Nigeria are rich in nutrients, vitamins and minerals. This showed that the use of these fruits is quite beneficial for healthy living. The world is endowed with a variety of wild fruits which can be exploited independently throughout the year, however the major challenges to their inclusion in the diet remain acceptability and accessibility and in general, lack of interest and neglect by individuals across the world. These challenges can be overcome by educating people on their health benefits through various sources of media with a goal to create an interest in them and eventual inclusion in the daily diet.

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APPENDIX

Plate 1. Hog plum (*Spondiasmombin)*

A. African velvet tamarind with the skin. B. African velvet tamarind without the skin

Plate 2. African Velvet Tamarind (*Dialiumguineense).*

Plate 3. Wild Mango (*Irvingiagabonensis).*

A. Date fruit with the nut. B. Date fruits without the nut.

Plate 4. Date Fruit (*Phoenix dactylifera L.*).

A. African Elemi with the nuts. B. African elemi without the nuts.

Plate 5. African Elemi (*Canariumschweinfurthii*).

Plate 6. Pepper fruit (*Dennettiatripetala). Source:* Maduako (2021).