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Proximate, Phytochemical and Mineral Elements Compositions of Some Edible Fruits Grown in Oil Producing Community of Rivers State, Nigeria.

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Abstract: *Evaluation of Proximate, phytochemical and mineral elements compositions of some edible fruit grown in an oil producing community (Umuetchem) of Rivers State, Nigeria were investigated. The fruits were citrus sinensis (orange), Psidium guajava (guava), Ananas Comosus (Pineapple), Carica Papaya (pawpaw) and Dacryodes edulis (African pear). Proximate analysis on wet weight basis indicated that, both the test and control fruit samples [edible parts] were high in moisture contents. Proximate analysis showed slight variation between samples but not statistically significant ($p<0.05$). Samples were slightly higher in their energy content with values ranging from 37.64±0.70 to 433. 78 ± 0.05, relative to the control which had values in the ranged of 27.04±0.21 to 431.87±0.81. Phytochemical analysis of the fruits showed the presence of alkaloids, tannins, saponins, cyanogenic glycosides, flavonoids and phytates. All samples had very low concentration of cyanogenic glycoside (0.02±0.00) below lethal dose.These values showed no significant difference ($p<0.05$). Phytochemical analysis portrayed all these fruits safe for human consumption as they contained low concentrations of anti-nutrients, below reference toxic standard. The mineral elements analysis indicated that all the samples contained low levels of mineral elements with Potassium as predominant element. with a level as high as 35.10±0.05 in guava and as low as 10.04±0.01 [pineapple] relative to the control samples which had values in the range of 8.39±0.01 to 39.46±0.05, values showed no significant difference ($p<0.05$) All the samples were poor sources of Potassium, Magnesium, Sodium, Zinc and Iron and they showed significant difference ($p<0.05$). The concentrations of Lead (Pb) and nickel in all the samples from the two areas were very low and values showed no significant difference ($p<0.05$). Mercury was not detected in all the samples. The investigated parameters showed that samples were fairly adequate in their nutrients composition but very poor in mineral elements.*

Keywords:*Analysis,Concentration,Fruits, Mineral Elements, Proximate, Phytochemical*

I. Introduction

The contribution of fruits and it constituent to human nutrition cannot be overstated. In Africa, fruits are on high demand. This is because they are complemented with food to ensure balanced diet, and some serve as raw materials to industries. Fruits serve as sources of vitamins and minerals hence, they also become important when the functions of these vitamins and minerals, are being considered in the body [1]. Also, some of these fruits are used in folk medicine to salvage some diseases [2,3,4]. The ability of these fruits to remedy diseases could be as a result of bioactive constituents, which are generally present in plants [3,5,6,7]. However, some of these bioactive substances are also anti-nutrients since they render some of the essential nutrients unavailable for human nutrition [5].

The economy of Nigeria is dependent largely on the petroleum deposit in the Niger Delta Area. However, other human activities including agriculture are carried out in Rivers State. Some of these edible fruits are orange, pineapple, African pear, pawpaw and guava which most times are grown on crude oil impacted environment in Umuetchem, an oil producing community in Rivers State, Nigeria because of inadequate land.Fruits have been part of human diet and food supplement over the years. They are considered as healthy food supplements because they contain high amount of water, carbohydrates, proteins, vitamin A, B_1, B_2, C, D, and E, minerals such as Ca, Mg, Zn and Fe [8] and organic compounds which are required in small amounts, to make the body function properly [9]. Studies on minerals have revealed their function in plants and animals, which include their role in osmotic regulations of the body fluids, enhancing growth, ensuring healthy crops and animals, acting as coenzyme in the formation of chlorophyll. Besides their dietary importance, fruits are also useful as nutrient supplements and recommended internationally as superior to processed foods.

This research was aimed at assessing the proximate, phytochemical and mineral elements composition of selected fruits from Umuetcheman oil producing community in Rivers State in Niger Delta and by extrapolation, assessing the possible impact of the Niger Delta environment, as affected by oil spill and oil exploration activities on the parameters investigated.

II. Materials and Methods

2.1 Reagents

All reagents used in this study were of analytical grades with high purity.

2.2 Sample collection

The samples: *Citrus sinensis* (Orange), *Ananas comosus* (Pineapple), *Dacroyodes edulis* (African Pear), *Carica papaya* (Pawpaw), and *Psidium guajava* (Guava) used for this research work were all bought from farmers at Umuetchem in Rivers State and Gboko in Benue State and identified in the herbarium of the department of plant science, University of Port Harcourt by Dr. Edwin Nwosu.

2.3 Sample preparation

The samples were thoroughly washed with tap water. The outer skin of the oranges, guava, pineapple and pawpaw were scrapped off using a sharp knife. The pawpaw and orange seeds were removed; the hard portion in the middle of the pineapple was also removed and discarded. The inner, fresh, tender and edible portion of each sample was retained and later cut into tiny piece and crushed to homogenize using clean mortar and pestle, the grounded samples were stored in a labeled air tight container and kept in the refrigerator at 40^{o}C and used immediately for subsequent analysis.

2.4 Proximate Composition Determinations

2.4.1Moisture content determination

Two grams (2g) of the fresh sample of each sample was placed in the crucible and heated at 105˚ C until a constant weight was attained. The moisture content of each variety was calculated as loss in weight of the original sample and expressed as percentage moisture content [10].

2.4.2 Determination of crude protein

The crude protein was determined by the Kjeldahl method with slight modification. 0.5 g of the powdery form of each sample was digested with 5 ml of concentrated sulphuric acid in the presence of Kjeldahl catalyst. The nitrogen from the protein in the sample was converted to ammonium sulphate that reacted with 2.5 ml of 2.5 % Brucine reagent, 5 ml of 98 % sulphuric acid to give a coloured derivative and the absorbance read at 470 nm. The percentage nitrogen was calculated and multiplied by 6.25 to obtain the value of the crude protein [11].

2.4.3 Estimation of crude lipid

This estimation was performed using the Soxhlet extraction method. Ten grams (10g) of the powdery form of each sample were weighed and wrapped with a filter paper and placed in a thimble. The thimble was covered with cotton wool and placed in the extraction column that was connected to a condenser. 200 ml of n – Hexane was used to extract the lipid [11].

2.4.4 Determination of crude fiber

The estimation was done using the method of A.O.A.C. [11]. Five grams (5g) of the powdery form of each sample and 200 ml of 1.25 % H2SO4 were heated for 30 min and filtered with a Buchner funnel. The residue was washed with distilled water until it was acid free. 200 ml of 1.25% NaOH was used to boil the residue 30 min, it was filtered and washed several times with distilled water until it was alkaline free. It was then rinsed once with 10% HCl and twice with ethanol. Finally it was rinsed with petroleum ether three times. The residue was put in a crucible and dried at 105^{0} C in an oven overnight. After cooling in a desiccator, it was ignited in a muffle furnace at 550^{0} C for 90 minutes to obtain the weight of the ash.

2.4.5 Determination of ash content

This was done using the method of A.O.A.C [11]. The total ash content of a substance is the percentage of inorganic residue remaining after the organic matter has been ignited. 2 g of the pulverized samples was placed in a crucible and ignited in a muffle furnace at 500^{0}C for 6 hours. It was then cooled in a desiccator and weighed at room temperature to get the weight of the ash.

2.4.6 Carbohydrate determination

The carbohydrate content was determined by subtracting the summed up percentage compositions of moisture, protein, lipid, fiber, and ash contents from 100 [12].

2.5 Phytochemical Content Determination

2.5.1 Determination of phytate

Spectrophotometric method was used in the determination of phytate. 1g of the pulverized samples was dissolved in 25 ml of 0.5 M HNO3 and centrifuged at 4,000rpm for 10 min. 1 ml of 0.03 M Ferric solution was added to the supernatant and left to stand for 15 min in order to allow chelation of the iron molecules by the indigenous plant phytate. At the end of the incubation, it was capped and heated for 20 min, 7.5 ml of distilled water was added to it and vortexed. Thereafter, 0.1 ml of 1.33 M NH4SCN (Ammonium sulphocyanide) solution was added and absorbance read at 465nm. The amount of phytate was extrapolated from a standard calibration curve for calcium phytate.

2.5.2 Determination of oxalate

The titrimetric method of Day &Underwood [13] was used in the determination of oxalate in the samples. 150 ml of 15 N H2SO4 was added to 5 g of the pulverized samples and the solution was carefully stirred intermittently with a magnetic stirrer for 30 minutes and filtered using Whatman No 1 filter paper, after which 25 ml of the filtrate was collected and titrated against 0.1 N KMnO4 solution until a faint pink color appeared that persisted for 30 seconds.

2.5.3 Determination of saponin

Saponin composition was determined using the gravimetric method of Hudson & El-Difrawi [14].Two hundred and twenty millilitres of 20% ethanol was added to 10 g of the pulverized samples and stirred using a magnetic stirrer for 12 hours at 55° C. The solution was filtered using Whatman No 1 filter paper and the extract was reduced to 40 ml under vacuum and 20 ml Diethyl ether was added in a separating funnel and shaken vigorously. The ether layer was discarded while the pH of the aqueous solution was adjusted to 4.5 by adding NaOH. 60 ml of n-butanol was finally used for extraction. The Butanol extract were washed twice with 10ml of 5 % NaCl and evaporated to dryness in a fume cupboard to give a crude saponin which was weighed.

2.5.4 Determination of alkaloid

Alkaloids were determined by gravimetric method of Harborne [15]. Five grams (5g) of the pulverized samples were weighed into a conical flask containing 50 ml of 10 % ammonium hydroxide; the mixture stirred and allowed to stand for 4 hours, before filtering. The filtrate was evaporated to one quarter of its original volume on a hot plate and concentrated ammonium hydroxide solution was added drop-wise to the mixture in order to precipitate the alkaloids. The precipitate was filtered using a weighted filter paper and washed with 10 % ammonium hydroxide solution. The precipitate was dried with the filter paper in an oven at 60 o C for 30 minutes and then re- weighed.

2.5.5 Determination of tannin

Spectrophotometric method of Trease & Evans [16] was used in the determination of tannin in the samples. Five grams (5g) of the powdery form of the samples were extracted with 20ml of warm water and filtered. 0.5ml of the filtrate was added to 0.5 ml of 0.5M ferric solution in an alkaline medium and allowed to stand for 30 minutes for color development. The absorbance was read at 760 nm and the amount of tannin was extrapolated from a standard calibration curve for tannic acid.

2.6 Determination of mineral contents

The method of A.O.A.C [11] was employed for the determination of mineral content. Two gramsof the pulverized samples was placed in a crucible and ignited in a muffle furnace at 550^0C for 6 hours. The resulting ash was dissolved in 10 ml of 10 % HNO3 and heated slowly for 20 minutes. After heating, it was filtered and the filtrate was used for the determination of mineral content. Atomic absorption spectrophotometer (AAS) was used to determine Mg, Fe, Pb, Ni, Cd and Zn, while flame photometer was used for the determination of Na and K in the filtrate.

Statistical analysis

The results are expressed as mean ±standard deviation (SD). One-way analysis of variance (ANOVA) was employed for between and within group comparison while student's t-test was used for paired comparison. 95% level of significance ($p \leq 0.05$) was used for the statistical analysis.

III. Results and Discussion

3.1 Results of Proximate Analyses

Table 3.1: showing theresult of proximate analysis of *Citrussinensis* (orange), *Ananascomosus* (pineapple), *Dacryodesedulis* (African pear), *Caricapapaya* (pawpaw) and *Psidiumguajava* (guava) on wet weight basis from BS – (Benue state) and RS – (Rivers State).

Fruit Samples	% Moisture	% Ash	% Lipid	% Protein	%Carbohydrate	%Fibre
Pineapple (BS)	82.2 ± 007^{b}	0.76 ± 0.04^{a}	2.00 ± 0.10^{b}	0.44 ± 0.08^{a}	7.45 ± 0.06^{c}	7.21 ± 0.10^{c}
Guava (BS)	76.6 ± 0.03^{b}	1.29 ± 0.02^{b}	1.60 ± 0.08^{b}	2.19 ± 0.04^{b}	0.97 ± 0.04^{a}	17.4 ± 0.10^{d}
Orange (BS)	88.8 ± 0.07^{b}	0.63 ± 0.01^{a}	0.65 ± 0.08^{a}	0.44 ± 0.06^{a}	9.30 ± 0.06^{c}	0.18 ± 0.06^{a}
African pea (BS)	44.0 ± 0.05^{a}	1.01 ± 0.04^{b}	42.9 ± 0.04^{c}	7.00 ± 0.09^{c}	4.44 ± 0.08^{c}	0.64 ± 0.04^{a}
Pawpaw (BS)	91.4 ± 0.05^{b}	0.46 ± 0.03^{a}	1.85 ± 0.06^{b}	0.44 ± 0.10^{a}	2.90 ± 0.10^{b}	2.93 ± 0.05^{b}
Pineapple (RS)	86.3 ± 0.06^{b}	0.36 ± 0.03^{a}	3.50 ± 0.09^{b}	0.88 ± 0.10^{a}	6.76 ± 0.09^{c}	2.25 ± 0.07^{b}
Guava (RS)	79.45 ± 0.04^{b}	0.91 ± 0.02^{b}	2.05 ± 0.10^{b}	2.19 ± 0.04^{b}	2.61 ± 0.05^{b}	12.90 ± 0.10^{c}
Orange (RS)	88.9± 0.06^{b}	0.49 ± 0.01^{a}	2.00 ± 0.07^{b}	0.44 ± 0.07^{a}	7.71 ± 0.05^{c}	0.41 ± 0.08^{a}
African pea (RS)	36.9 ± 0.03^{a}	1.52 ± 0.03^{b}	44.60± 0.04^{c}	4.38 ± 0.08^{c}	3.72 ± 0.04^{b}	8.84 ± 0.06^{c}
Pawpaw (RS)	88.3 ± 0.07^{b}	0.62 ± 0.02^{a}	1.10 ± 0.06^{b}	0.88 ± 0.06^{a}	6.66 ± 0.10^{c}	2.47 ± 0.09^{b}

Values are % mean ± SD of triplicate determinations. Values in the same column and having the same superscript letters are not statistically significant at 95% confidence level ($P < 0.05$)

From **table3.1:** the result shows that, the % moisture content was slightly higher in pineapple and guava samples from Umuetchem relative the % moisture content of pineapple and guava from Gboko. Conversely, African pear and pawpaw of test samples showed lower moisture content than the control samples. The observed ash values indicates that test samples had lower ash content than the control samples except African pear that showed a higher ash content relative to the control. The % lipid value was higher in test samples than the % lipid value of the control samples except pawpaw that showed the lower lipid value than the pawpaw from the control.

All the test sample amples except African pear were slightly higher in % protein content than the % protein content of control samples. Also, all the test samples except guava showed lower % carbohydrate composition than the % carbohydrate composition of the control. The % fiber content of test samples was lower than the % fiber content of the control. Conversely, the orange and guava of test samples showed higher % fiber content than the % fiber content of the control sample.

3.3 The energy contents of the fruit samples

Table 3.2: showing the results of calorific value (Energy Content) of *Citrussinensis* (orange), *Ananascomosus* (pineapple), *Dacryodesedulis* (African pear), *Caricapapaya* (pawpaw) and *Psidiumguajava* (guava) from BS – (Benue state) and RS – (Rivers State).

Fruit samples	Energy Content /Kcal/100g
Pineapple (BS)	49.5±0.30^{b}
Guava (BS)	27.0±0.21^{b}
Orange (BS)	44.8 ±0.65^{b}
African Pear (BS)	431± 0.81^{d}
Pawpaw (BS)	30.0± 0.48^{a}
Pineapple (RS)	62.1±0.80^{c}
Guava (RS)	37.6±0.70^{a}
Orange (RS)	50.6 ±0.50^{b}
African pear (RS)	433±0.65^{d}
Pawpaw (RS)	40.0± 0.36^{b}

Values are mean ±SD of triplicate determinations.Values in the same column and having the same superscript letters are not statistically significant at 5% confidence level ($p < 0.05$)

From the above table, the result shows that the energy content of test samples was higher than the energy content of control samples.

3.4 Results of Alkaloid Test

Table 3.4: showingtheresults of Alkaloid test with Mayer and Wagner Reagent

Fruit Samples	Sample +Mayer Reagent	Sample + Wagner Reagent	Results
Pineapple (BS)	Golden yellow ppt.	Silver ppt.	+
Guava (BS)	Golden yellow ppt.	Silver ppt.	+
Orange (BS)	Golden yellow ppt.	Silver ppt.	+
African pear (BS)	Blue black ppt.	Silver ppt.	+
Pawpaw (BS)	Golden yellow ppt.	Silver ppt.	+
Pineapple (RS)	Golden Yellow ppt.	Silver ppt.	+
Guava (RS)	Golden Yellow ppt.	Silver ppt.	+
Orange (RS)	Golden Yellow ppt.	Silver ppt.	+
African pear (RS)	Golden Yellow ppt.	Silver ppt.	+
Pawpaw (RS)	Golden Yellow ppt.	Silver ppt.	+

\+ = presence
ppt = precipitate

3.4.1 Results of Phytochemical Analysis

Table 3.4: showing the results of quantitative Phytochemical Analysis on *Citrussinensis* (orange), *Ananascomosus* (pineapple), *Dacryodesedulis* (African pear), *Caricapapaya* (pawpaw) and *Psidiumguajava* (guava) on wet weight basis from BS – (Benue state) and RS – (Rivers State).

Samples	% Tannins	% Saponins	%Cynogenic Glycosides	% Flavonoids	% Phytates
Pineapple (BS)	$0.20 \pm 0{,}01^{b}$	13.72 ± 0.05^{c}	0.02 ± 0.00^{a}	$6{,}28 \pm 0.03^{c}$	2.50 ± 0.04^{b}
Guava (BS)	$0.\ 49 \pm 0.05^{c}$	1.30 ± 0.01^{a}	0.02 ± 0.00^{a}	0.46 ± 0.02^{a}	$0.73 \pm 0{,}03^{a}$
Orange (BS)	$O.20 \pm 0.02^{b}$	2.15 ± 0.01^{b}	0.20 ± 0.00^{a}	3.98 ± 0.02^{b}	0.55 ± 0.01^{a}
African pea (BS)	0.29 ± 0.04^{b}	1.50 ± 0.02^{b}	0.02 ± 0.00^{a}	2.92 ± 0.01^{b}	1.23 ± 0.03^{b}
Pawpaw (BS)	0.25 ± 0.04^{b}	1.08 ± 0.02^{a}	0.02 ± 0.00^{a}	2.92 ± 0.01^{a}	1.23 ± 0.03^{a}
Pineapple (RS)	0.16 ± 0.03^{b}	13.9 ± 0.05^{c}	0.02 ± 0.00^{a}	14.5 ± 0.05^{d}	0.41 ± 0.01^{a}
Guava (RS)	0.35 ± 0.03^{c}	0.80 ± 0.03^{a}	0.02 ± 0.00^{a}	0.60 ± 0.03^{a}	0.61 ± 0.03^{a}
Orange (RS)	0.19 ± 0.02^{b}	7.20 ± 0.04^{b}	0.02 ± 0.00^{a}	4.90 ± 0.04^{b}	0.34 ± 0.04^{a}
African pea (RS)	0.40 ± 0.05^{c}	3.50 ± 0.03^{b}	0.02 ± 0.00^{a}	$3.\ 88 \pm 0.04^{b}$	1.05 ± 0.05^{b}
Pawpaw (RS)	0.10 ± 0.03^{a}	1.15 ± 0.02^{a}	0.02 ± 0.00^{a}	0.40 ± 0.01^{a}	0.17 ± 0.02^{a}

Values are % mean ± SD of triplicate determinations. Values in the same column and having the same superscript letters are not statistically significant at 95% confidence level ($P < 0.05$)

From table **3.4,** the result shows that, the test samples except African pear had lower % of tannins than samples from the control. It was also observed that, the test samples had higher % saponins concentration than the % saponins concentration of the control samples, except guava of the test samples that showed lower saponins content than guava of the control. All the samples from Umuetchem and Gboko had the same concentration of cyanogenic glycosides. The % flavonoid was higher in the test samples than the % flavonoids of the control, except pawpaw of the test samples that had lower % flavonoids than the control. All the test samples had lower % phytate content than the % phytate of the control samples.

Table 3.5: showing theresult of mineral elements analysis of *Citrussinensis* (orange), *Ananascomosus* (pineapple), *Dacryodesedulis* (African pear), *Caricapapaya* (pawpaw) and *Psidiumguajava* (guava) on wet weight basis from BS – (Benue state) and RS – (Rivers State).

Fruit sample	K (Mg/kg).	Mg (Mg/kg)	Na (Mg/kg)	Zn (Mg/kg)	Pb (Mg/kg)
Pineapple	19.8 ± 0.02^{b}	1.01 ± 0.01^{b}	0.19 ± 0.00^{a}	0.001 ± 0.00^{a}	0.003 ± 0.00^{a}
Guava	39.5 ± 0.05^{d}	0.18 ± 0.00^{b}	0.19 ± 0.00^{a}	0.003 ± 0.00^{a}	0.01 ± 0.00^{a}
Orange	28.9 ± 0.05^{c}	0.43 ± 0.00^{d}	0.21 ± 0.00^{a}	0.02 ± 0.00^{a}	$0.005\ 0.00^{a}$
African pea	8.39 ± 0.01^{a}	0.38 ± 0.00^{c}	0.46 ± 0.00^{b}	0.01 ± 0.00^{b}	0.004 ± 0.00^{a}
Pawpaw	11.3 ± 0.01^{a}	0.11 ± 0.00^{b}	0.22 ± 0.00^{a}	0.02 ± 0.00^{b}	0.003 ± 0.00^{a}
Pineapple	10.0 ± 0.01^{a}	0.60 ± 0.00^{c}	0.22 ± 0.00^{a}	0.02 ± 0.00^{b}	0.002 ± 0.00^{a}
Guava	35.1 ± 0.05^{d}	0.06 ± 0.00^{a}	0.32 ± 0.01^{b}	0.02 ± 0.00^{b}	0.005 ± 0.00^{a}
Orange	31.5 ± 0.02^{c}	0.10 ± 0.00^{b}	0.15 ± 0.00^{a}	0.02 ± 0.00^{b}	0.003 ± 0.00^{a}
African pea	17.7 ± 0.02^{b}	0.20 ± 0.00^{b}	0.17 ± 0.00^{a}	0.02 ± 0.00^{b}	0.002 ± 0.00^{a}
Pawpaw	18.6 ± 0.02^{b}	0.06 ± 0.00^{a}	0.28 ± 0.00^{b}	0.03 ± 0.00^{b}	0.002 ± 0.00^{a}

Values are % mean ± SD of triplicate determinations. Values in the same column and having the same superscript letters are not statistically significant at 95% confidence level (P < 0.05)

Table 3.1: showing theresult of mineral elements analysis of *Citrussinensis* (orange), *Ananascomosus* (pineapple), *Dacryodesedulis* (African pear), *Caricapapaya* (pawpaw) and *Psidiumguajava* (guava) on wet weight basis from BS – (Benue state) and RS – (Rivers State).

Fruit samples	Ni (Mg/kg)	Fe (Mg/kg)	Cd (Mg/kg)	Hg (Mg/kg)
Pineapple	0. 002±0.00 [b]	0.007±0.00[a]	BDL	BDL
Guava	0.001 ±0.00 [b]	0.005±0.00[a]	BDL	BDL
Orange	0.002±0.00 [b]	0.005±0.00[a]	0.001±0.00 [a]	BDL
African pea	0.001 ±0.00[b]	0.005±0.00[a]	BDL	BDL
Pawpaw	0.003±0.00 [b]	0.023±0.00[a]	0.001±0.00 [a]	BDL
Pineapple	0.001 ±0.00 [b]	0.064±0.00[a]	BDL	BDL
Guava	0.002 ±0.00 [b]	0.007±0.00[a]	0.004 ±0.00 [a]	BDL
Orange	0.002±0.00 [b]	0.01±0.00[a]	0.0001±0.00 [a]	BDL
African pea	0.004±0.00 [b]	0.007±0.00[a]	0.0002±0.00 [a]	BDL
Pawpaw	0.003±0.00 [b]	0.006±0.0002[a]	0.01 ±0.00 [a]	BDL

Values are % mean ± SD of triplicate determinations. Values in the same column and having the same superscript letters are not statistically significant at 95% confidence level (P < 0.05). BDL implies below detection limit.

IV. Discussion

The proximate composition of the investigated fruits is given in Table 3.1. The % moisture content varied between samples. The observed high moisture content in both test and control samples are comparable to those reported (72 – 92%) for some fruits, leaves and vegetables [17] and were within reference standard (www.thefruitpages.com) for those fruits. The moisture content of any food is an index of its water activity and it is used as a measure of stability and the susceptibility to microbial contamination. The high moisture content can be responsible for rapid deterioration of these fruits if unprocessed for long after harvesting.

The % Ash value ranged between 0.36 $\pm$ 0.03 to 1.52 $\pm$ 0.03 and 0.46 $\pm$ 0.03 to 1.29 $\pm$ 0.02 for test and control samples respectively. The values were slightly varied between test and control samples but significantly lower than those reported [18] for *Nauclealatifolia* fruits. The % ash content of the test samples fall within reference standardexcept the % ash content of African pear. The control samples showed higher % ash content and were above reference standard except the % ash content of orange that showed conformity with standard. The Ash content is an index of minerals present in a sample [19].

The test fruits samples had their percentage lipid value in the range of 1.10 $\pm$ 0.06 to 44.60 $\pm$ 0.04 and the control samples had values between 0.65$\pm$ 0.08 and 42.90$\pm$ 0.04. Both the test and control samples had higher values than reported [17]for some fruits and seeds (0.41 – 38.40%) and these values were higher than references. Lipid was highly represented in African pear samples from the two geographical areas and values were higher than 38.40% reported [17] for this fruit. The percentage protein ranged between 0.44 $\pm$ 0.07 to 4.38 $\pm$ 0.08 for the test samples and 0.44 $\pm$ 0.06 to 7.00 $\pm$ 0.09 for the control samples. A slight difference was only observed in African pear whose value was lower than the control.

Other samples had values in the same range with the control and showed no significant difference ($p < 0.05$). The observed values in both the test and control samples were lower than between 16.0% and 35.1% recorded in legumes such as *Arachis hypogea* and soyabean respectively and much lower than reference standard, but comparable to reported [20] for Nypa fruit can fruits and seeds. The percentage carbohydrate was between 2.61 $\pm$ 0.05 and 7.71 $\pm$ 0.05, for the test samples and between 0.97 $\pm$ 0.04 and 9.30 $\pm$ 0.06, for control samples.

The test samples showed slight variation ($p<0.05$) with the control. The recorded values for both the test and control samples were relatively low compared to most fruit values (Dike, 2009) and reference standard (www.thefruitpages.com) and much lower than reported values [21] for *pyruscommunis* (pear fruits). The percentage fiber ranged between 0.41 $\pm$ 0.08, 12. 90 $\pm$ 0.10 and 0.18 $\pm$0.06, 17.37 $\pm$0.10., for test and control samples respectively. The values showed significant variation ($p < 0.05$) and were higher than reference standard (www.thefruitpages.com). Food rich in dietary fiber contributes to the prevention of various diseases such as constipation, hemorrhoids, colon cancer, excess cholesterol, diabetes and diverticulosis [19].

Proximate composition of food is the estimation of the nutritive value of human food in chemical form. The percentage moisture content, ash, lipid, crude protein, carbohydrate and fiber showed slight variation between samples and species from the two geographical areas but statistically non-significant ($p<0.05$). The proximate analysis showed a fairly adequate nutrient composition in all the investigated samples. The energy content (calorific values) of the fruit samples are shown in **Table 3.2.** The investigated samples were much

higher in energy content (except guava) relative to values obtained for the control. These values were higher when compared with reference values. The high energy content in African pear (*Dacryodes edulis*) is attributed to its vegetable oil, which can be extracted in commercial quantity

Table 3.3 depicts the phytochemical screening of the fruits investigated. All the samples from the two geographical areas contained alkaloids. Alkaloids are potent bioactive compounds which have been used as CNS stimulant, topical anesthetic in ophthalmology, powerful pain relievers and are known to exert antipuretic action.

The phytochemical quantitative analysis is very useful in the evaluation of some active biological components of some vegetables, fruits and plants. As shown in **table 3.4.,** the percentage (%) Tannin composition of the investigated fruits ranged between 0.10 $\pm$0.03 and 0.40 $\pm$0.05, for the test samples and the control samples ranged between 0.20 $\pm$ 0.01 and 0.49 $\pm$ 0.05. There was no significant difference ($p< 0.05$) in all samples from the two areas. These results when compared with reported values for other plants like pigeon pea (0.1%) and plantain (0.51%) [22] Showed that the fruits were low in tannin content. Tannins are potent astringents. Tannins are capable of lowering available protein by antagonistic competition and can therefore elicit protein deficiency syndrome such as kwashiorkor [23] the low tannin content in not enough to constitute human poison. The lethal value is above 5%.

The saponin concentrations in the fruits ranged from 0.80 $\pm$ 0.03(guava) to 13.85$\pm$0.05 (pineapple), as against the control which had values ranging from 1.08 $\pm$ 0.02 to 13.72 $\pm$ 0.05. The values showed no significant difference ($p < 0.05$) in all samples (from the two areas). These values when compared to the percentage in food plants like pigeon pea (0.51%) and plantain (0.06%) [22] revealed that the fruits were high in saponins. Saponins have been shown to possess both beneficial (lowering of cholesterol) and deleterious properties (cytotoxic; haemolysis and permeabilization of the intestine. High concentration of saponins in the body can reduce uptake of certain nutrients including glucose and cholesterol leading to hypercholesterolemia effect [23]. Saponins also inhibit Na^+ efflux by the lockage of the entrance of Na^+ out of the cell. This leads to higher Na^+ concentration in the cells, activating a Na^+-ca^{2+} antiporter in the cardiac muscle. The increase in ca^{2+} influx through this antiporter strengthens the contractions of heart muscle.

The % flavonoids composition of the test fruit samples ranged from 0.40 $\pm$ 0.01 to 14.54 $\pm$ 0.05, and the control samples values ranged between 0.46 $\pm$ 0.02 and 6.28$\pm$ 0.03. Values were highly varied. These results are not in correlation with the findings of Akindahunsi [24], all samples showed low levels of flavonoids. Flavonoids have much health promoting effects which include anti-allergic, anti-oxidant, anti-inflammatory, anticancer and anti-viral effects. They also potentiate the action of vitamin C, and protect cells from oxidative damage leading to cellular damage [25]. Oxidative stress has been linked to cancer, aging, atherosclerosis, inflammation, ischemic injury and neurodegenerative disease (Parkinson's and Alzheimer's [26].
Flavonoids may help provide protection against these diseases by contributing along with antioxidant vitamins and enzymes, to the total antioxidant defense system of the human body. Epidemiological studies have shown that flavonoids and carotenoids intake is inversely related to mortality from coronary heart disease and to the incidence of heart attacks [27]. Several studies have shown that certain flavonoids can protect LDL from being oxidized [27]. The oxidation of low-density lipoproteins (LDL) has been recognized to play an important role in atherosclerosis, hypertension and excess cholesterol in the blood [28].

The percentage phytates content of the investigated samples ranged from 0.34 $\pm$ 0.04 to 1.05 $\pm$ 0.05 which was relatively low compared with values observed in the control samples which ranged between 0.55 $\pm$ 0.01 and 2.50 $\pm$ 0.04.The knowledge of phytate levels in food is necessary because high concentration can cause complicated effect in human system including indigestion of food and flatulence [29].Phytic acid intake of 4.00–9.00mg/100g, reduces iron absorption by 4–5 folds in humans [30]. But phytate in moderate levels has an anti–oxidant effect and also prevents colon cancers by reducing oxidative stress in the lumen of intestinal tracts [31].All the samples (fruits) from both geographical areas had same concentration of cyanogenic glycoside. The value was very low (0.02 $\pm$ 0.00). This is ideal for the body and much lower than the reported lethal value of 0.07mg/kg [32]. Phytochemical analyses portray these fruits safe for human consumption as they contain appreciable amount of flavonoids, alkaloids, saponins, among others and low levels of toxicants like tannins, phytates and cyanogenic glycoside

The result in **Table 3.5**, showed the concentrations (mg/kg) of selected mineral elements in the investigated fruits. Analysis indicated that all the samples from the two geographical areas contained very low levels of mineral elements with potassium as the predominant elements; with a level as high as 35.10 $\pm$0.05 in guava and as low as 10.04 $\pm$ 0.01 (pineapple), the control samples had values in the range of 8.39$\pm$ 0.01 to 39.46 $\pm$ 0.05. Values were not significantly different ($P < 0.05$).

The concentrations of potassium, magnesium, sodium and zinc showed slight variation between samples from the two geographical areas and were relatively low when compared to recommended dietary allowance. Dike [17] also recorded low concentration of these mineral elements in some fruits.The concentrations (mg/kg) of lead, Nickel and Iron in all the samples from the two areas were less than I mg/g .and

much lower than recommended reference standard. Samples showed no significant difference ($p < 0.05$) in lead, nickel and iron concentrations.Cadmium concentrations in all the samples from the two areas (both investigated and control samples) were below detectable limit of less than 0.001mg/kg. Mercury (Hg) was not detected in all the test samples and the control.

The need for supplementary diet rich in mineral elements is necessary for a singular ratio to avoid mineral deficiency syndromes like rickets and clarification of bones resulting from calcium deficiency.

Distorted enzymatic activity and poor electrolyte balance of blood fluids are related to inadequate Na, k, Mg and Zn as they are most required elements of living cells [33]. Potassium is essential in the maintenance of cellular water balance, PH regulation in the body, and also associated with protein and carbohydrate metabolism [34]. Increased intake of potassium can lower blood pressure up to 3.2mmHg; thereby reducing mortality by 8%, but on the other hand, high consumption of food rich in potassium can cause irregular heartbeat, nausea, or slow pulse, Magnesium is an activator of many enzyme systems and maintains the electrical potential in nerves [34].

The low sodium concentration is nutritionally ideal for hypertensive patients. A high level of sodium is associated with high blood pressure [33]. On the other hand, zinc in trace concentration is important for physiological functions of living tissues and regulates many biochemical processes [33]. Iron is vital in the formation of Hemoglobin and myoglobin, which function in oxygen-transport.It should be noted that prolong consumption of more nutrients from fruits than the body needs can lead to serious disease [33], for example, iron overload can result to liver failure, too much of vitamin A, may have a negative effects particularly in children. Excessive carbohydrate intake is a principal cause of obesity and long term obesity will predispose to illness such as diabetes, heart diseases and cancers [35].

V. Conclusion

The results of the study have shown that, the industrial and polluted environment in Niger Delta (Rivers State) of Nigeria did not impact significantly on the physio-chemical properties of the investigated fruits grown in the locality. For instance, the proximate composition of the investigated samples from the two geographical areas showed slight difference but statistically insignificant ($p<0.05$). It was also noted that all the samples showed no significant difference ($p<0.05$) in their phytochemical compositions. The selected mineral elements analysed showed a significant difference ($p<0.05$) in their concentration. These variations could be attributed to differences in geographical location, availability of these mineral in the soil, soil factor, climatic condition and different rate at which they are taken up from the soil.

In terms of nutritional composition, samples were fairly adequate with low amounts of anti-nutrients. The low level of anti-nutrients showed that they need little or no processing before they are consumed and can therefore contribute, to a large extent, to the nutrition of consumers.

References

[1] J.O. Olusanya, Essentials of food and nutrition. 1st edition, Apex Books limited, Lagos, pp. 36-77, 2008.
[2] I.O. Lawal, N.E. Uzokwe, A.B.I. Igboanugo, A.F. Adio, E.A. Awosan, J.O. Nwogwugwu, B. Faloye, B.P. Olatunji, and A.A. Adesoga, African Journal of Pharmacy and Pharmacology, 4 (1): 004-007, 2010.
[3] D.E. Okwu,Intl.J.Mol.Med.Adv.Sci. 1(4):357–381, 2005.
[4] E. Rukangira, the African herbal industry: constraints and challenges. A paper presented at "the natural products and cosmeceuticals 2001 conference" it was published in erbonsteria Domani "August 2001.
[5] O.I. Ibanga, and D.E. Okon, Journal of Food Science Technology, 7(4)106-110, 2009.
[6] D.E. Okwu, Journal of Sustainable Agriculture and Environment,6:30-34, 2004.
[7] L. Prince and P. Prabakaram, Asian J.Plant Science Research, 2011, 1.1,84, 2011.
[8] A. Wenkam, A., Utilization and processing of fruits. Macmillan. Press, London, 5:388-506, 1990.
[9] R.S. Wills, Post-harvest: An introduction to the physiology of handling fruits, vegetables and ornamental (4th Edn). Publication University of new Wales press Ltd. Vol. 560, 1998.
[10] FAO, Compositional Analysis methods In: Manuals of food quality control. Food analysis, general techniques, additives, contaminants and composition of food and Agricultural organization of the United Nations Pp. 203-232, 1980.
[11] A.O.A.C., Association of Official Analytical Chemists. Official Methods of Analysis of the AOAC, 15th Edn., Washington, D.C. 1990.
[12] G.T.O Otitoju, Effect of dry and wet milling processing techniques on the nutrient composition and organoleptic attributes of fermented yellow maize (Zea mays) African Journal of Food Sciences, 3: 113-116, 2009.
[13] J.R.A. Day, andA.L. Underwood, Quantitative Analysis 5th Ed., Prentice-Hall publications, London. p701, 1986.
[14] B.J.F. Hudson, andE.A. El-Difrawi, The sapogenins of the seeds of four Lupin species. Journal of Plant Foods, 3:181-186, 1979.
[15] J.B. Harborne, Phytochemical Methods. Chapman and Hall Ltd, London. Pp. 149-188, 1973.
[16] G.E. Trease and W.C. Evans, Pharmacognosy, 13th. Braillière Tindall, London p.290, 1989.
[17] M.C Dike, Proximate, Phytochemcial and Nutrient compositions of some fruits, seeds and leaves of some plant species at Umudike, Nigeria, 2009.
[18] I.O. Amoo and L. Lajide., Chemical Composition and Nutritional Significance of the fruit of Nauclea latifolia RIV Ltd. Sostanze Grasse, 76:331-332, 1999.
[19] L.G. Hassan, B.B. Usman, A.S. Kamba, S.W. Hassan, Nutritional compositions of vegetable spaghetti. Nigeria food journal, vol. 27, No.2, 2009.

[20] V.N. Osabor, G.E. Egbung and P.C. Okafor, Chemical profiles of Nypa fruitican from Cross River Estuary., South-Eastern Nigeria. Pak. J. Nutr. 7:146-150, 2008.
[21] M.G. Mahammad, A.S. Kamba, L. Abubakar and E.A. Bagna, Nutritional composition of pear fruits (Pyrus communis). African journal of food science and Technology vol. 3, pp.76-81, 2010.
[22] A.U. Osagie, M. Muzquiz, C.O. Burbano, C. Cuadado, G. Ayet and A. Castano, Some antinutritional constituents in ten staple food items grown in Nigeria-Tropical Sci. (UK). 36.109-115, 1995.
[23] K.R. Price, I.I. Johnson and G.K. Fenwick. The chemical and Biological significance of saponin in foods and feeding stuffs. CRC-Critical Reviews in Food Science and Nutrition 26, 27-135, 1987.
[24] A.A. kindahunsi, Phytochemical screening, nutrient and anti-nutrient composition of selected tropical green leafy vegetables, African J. Biotechnol. 4:54-60, 2005.
[25] G.W. Burlon and K.U. Ingold, B-Carotene, an unusual type of lipid antioxidant. J. Sci, 224:573, 1984.
[26] P. Paloza,Pro-oxidant actions of carotenoids in biological systems. Nutr. Rev. 56:257-266, 1998.
[27] R.B. Donald and M. Cristobal, Antioxidant activities of flavonoids. J. Agric. 52:125-757, 2006.
[28] E. Middleton and C. Kandaswami, The impact of plant flavonoids on mammalian cells. Implications for immunity, inflammation and cancer. Chapman and Hall, London, 619-652, 1993.
[29] E.N. Nwoko and B.B. Bragg, Influence of Phytic acid and crude fibre on the availability of minerals from protein supplements in growing chicks. J. animal Sci. 57:475-477, 1977.
[30] R.F. Hurrell, Influence of vegetable protein sources on trace element and mineral bioavailability. The journal of nutrition 133(9): 2973s-7s, 2003.
[31] N.R. Reddy and K. Shridhar,Food phytates. Boca Raton. CRC, 2001.
[32] Environmental Protection Agency. A handbook on site treatment of hazardous waste-contaminated soils. EPA/540/2-90-002 (NT.S. PB90155607), 1998.
[33] T.N. Berry, The role of condensed tannins in the nutritional value. Br J. Nutri. 51:493-504, 1998.
[34] M.E. Shils, Magnesium in modern nutrition, in wealth and Disease. Hart R.S and M.E. Shils (Eds), Ch.6, Sect, B. Philadelphia, 1973.
[35] Anonymous, Obesity: What is the solution? watch tower Bible and tract society of Nigeria 8:3-11, 2004.