

**INVESTIGATION OF SOME NUTRITIONAL PROPERTIES OF PLANTAIN
(MUSA PARADISIACA) CULTIVARS IN BAYELSA STATE****Ogidi I.A, Wariboko C. and Alamene A.**Department of Crop and Soil Science, Faculty of Agriculture, Niger Delta University,
Wilberforce Island, Bayelsa State, Nigeria.

ABSTRACT: *The objective of this study is to investigate some nutritional properties of thirteen plantain (Musa paradisiaca) cultivars. Samples collected were subjected to proximate analysis expressed in percentage and mg/100g. The investigation revealed that moisture content in peels ranged from 78.74% Asinberiba to 87.33% Makomuberiba H2, the mean is 83.75%, in food, from 38.78% Okpoisan to 66.03% Ikipiriberiba average in edible portion is 58.05%. Ash in peels from 0.87% Asinberiba to 2.38% Ikipiriberiba, the mean is 1.74% , ash level in food from 0.68% Okpoisan to 1.78% Makomuberiba H1, while the average is 1.27%. Protein in peels from 1.67% Kalabiuberiba to 4.2% Ikipiriberiba and from 2.76% Kalabiuberiba to 6.75% Ikipiriberiba in food and their mean values are 3.04% and 5.04%. Lipid in peels varied from 0.84% Asinberiba to 2.24% Biriyyereberiba and the mean is 1.37%, in food from 0.96% Auberiba to 2.36% Ikipiriberiba with a mean of 1.57%. Fibre in peels from 2.38% Izonberiba to 3.72% Makomuberiba (H1), the mean is 2.91%, in edible portion from 1.88 Auberiba to 3.0% Okpoisan and the average is 2.47%. Dry matter in peels from 12.67% Izuberiba(Biou) to 21.26% Asinberiba, in edible portion from 33.97% Ikipiriberiba to 65.74% Auberiba, the average in peels and in edible portion are 16.28% and 44.26%. Carbohydrate in peels from 88.84% Ikipiriberiba to 92.91% Makomuberiba H2, the mean is 85.47%, in edible portion from 87.22% Ikipiriberiba to 91.67% Kalabiuberiba with an average of 89.66%. Calcium in peels from 19.54mg/100g Izuberiba(Biou) to 28.56mg/100g Ikipiriberiba with a mean value of 23.72mg/100g, in edible portion, from 16.28mg/100g Izuberiba(Biou) to 25.80mg/100g Ikipiriberiba with a mean of 23.72mg/100g. Magnesium in peels varied from 5.53mg/100g Izuberiba(biou) to 9.2mg/100g Asinberiba with a mean of 7.62mg/100g, in edible portion from 4.5mg/100g Auberiba to 5.83mg/100g with an average of 5.04mg/100g. Sodium (Na) in peels from 9.28mg/100g Izuberiba(biou) to 14.72mg/100g and the mean is 12.12mg/100g Ikipiriberiba, in edible portion from 7.73mg/100g Izuberiba (biou) to 13.60mg/100g Ikipiriberiba with a mean of 8.82mg/100g. Potassium(K) in peels from 4.81mg/100g Izuberiba(biou) to 9.52 mg/100g Okpoisan and the mean is 7.16mg/100g, in food from 4.0mg/100g Izuberiba (biou) to 8.55mg/100g Ikipiriberiba with a mean of 8.55mg/100g. Iron (Fe) in peels from 0.57mg/100g Auberiba to 2.23mg/100g Ikipiriberiba with a mean of 1.56mg/100g, in food from 0.63mg/100g Auberiba to 2.54mg/100g Makomuberiba(H2) and the average value of iron is 1.42mg/100g. Manganese(Mn) in peels from 0.12mg/100g Ikipiriberiba to 0.56mg/100g Izonberiba and mean is 0.31mg/100g, in edible portion from 0.05mg/100g Auberiba to 0.57mg/100g Makomuberiba (H2), the average is 0.31mg/100g. Copper (Cu) in peels from 0.02mg/100g Makomuberiba (H2) to 0.22mg/100g Izonberiba, average in peels is 0.08mg/100g, in edible portions from 0.04mg/100g Biriyyereberiba to 0.22mg/100g Makomuberiba (H2) with a mean of 0.13mg/100g. Zinc(Zn) in peels from 0.35mg/100g Auberiba to 1.14mg/100g Makomuberiba (H2) with an average of 0.78mg/100g, in edible portions from 0.21mg/100g Biriyyereberiba to 1.07mg/100g and a mean of 0.64mg/100g. Phosphorus in peels from 0.17mg/100g Izuberiba (Izon) to 0.55mg/100g Makomuberiba (H1)*

and the mean is 0.30mg/100g, in edible portions from 0.13mg/100g Izuberiba (biou) to 0.43mg/100g Makomuberiba(H1) with an average of 0.23mg/100g.

KEYWORDS: Plantain, Musa Paradisiaca, Cultivars, Food, Peels, Beriba.

INTRODUCTION

Plantain (*Musa paradisiaca*) is a large perennial herbaceous plant that originated in Southeast Asia. (IITA-66, 1997). Existing in the world are 68 species and two primary hybrids of plantain (FAO, 2013) In the family of plantain *Musaceae* includes bananas (*Musa sapientum* and *Musa cavendishii*) which has the same growth pattern as plantain but are differentiated from one another by stem and leaf colour, fruit shape and storage of nutritional element of which in the fruit (finger) of plantain it is carbohydrate while in banana it is sugar (Philips, 1976). Evolution of these crops (plantain and banana) are recorded by natural hybridization process between two species of *Musa accuminata* (genome A) and *Musa balbisiana* (genome B). Research record shows that the family *Musaceae* is majorly made up of triploid ($2n=3x = 33$ chromosome plantain and banana are characterized as monocotyledonous plants in the Class- *monocotyledonae*, order- *scitamineae*, family-*Musaceae*, Genus – *Musa*, section- *Eumusa*, species (*M. acuminata* AA, *M. balbisiana*-BB Groups – AAA (dessent and highland beer and cooking banana, AAB (plantains and dessert bananas), ABB (cooking banana) Hugues T. 2005).

Plantain is an important food crop in the humid forest and mid altitude agro-ecological zones of Sub-Saharan Africa and one of the major source of carbohydrate in Asia, Oceania, Africa and Central Americas (Engberger et al.,2006; USDA, 2013). Estimated level of production of plantain worldwide in Africa is little above 50% (FAO, 1990) out of which, West Africa alone produces about 61% (FAO, 2012). More than 70 million people in Africa obtain about 25% of carbohydrate and 10% of calories by consuming plantain (Swennen, 1990; Ortiz et al, 1996). In the Southern part of Nigeria (Izon Tribe), so many assorted types of dishes can be prepared such as keke fiyai (plantain porridge), fufu (alone or with cassava or yam), fuin beriba (roasted plantain), fried (furaiberiba), parboiled (punnberiba), chips and cakes (beribaikpa) can be prepared from plantain.

The edible part of the crop is the fruit (finger) that is formed at maturity of the rhizome. The flower will then develop to a bunch with 3 to 10 hands (Ipe) each holding at least 5 to 10 fingers (fruits). Each fruit can measure about 3 to 12 inches or more in length with coarse external features having prominent edges and flat surfaces(Swennen et al. 1997) depending on the variety.

LITERATURE

Records show that plantain is made up of many mineral nutrients that are in organic nature and are formed naturally. (IFAD, 2011). The elements or mineral nutrients play important roles in the biochemical processes in the process of healthy growth and development of this crop. These elements are obtained from the soil and atmosphere with the help of moisture (water) that dissolve them into solution then taken up through the roots (Lahava E. 1995).

Elements such as As, Ca, Co, Cr, Cu, Cl, F, Fe, I, K, Mg, Mn, Mo, Na, Ni, P, Se, Si, Sn, V and Zn are found in plantain fruits and vegetables which are essential elements and consumed by human and animals which supplies the body with the required minerals. Plantain is considered to which help in the management of high blood pressure and heart diseases. Additional information emphasizes on the low level of toxic and anti-nutrient substance namely cyanogenic glucosides and gluco alkaloides that plays safe for human consumption.

Recent reports on nutrient values and weights of edible portion of plantain [USDA - 2017] connote, the proximates of water/100g = 62.28, 1 cup, sliced 148g = 96.28g and 1 medium 179g = 116.85g. that of Energy 1 value /100g = 122g; 1 cup, sliced of 148g = 1.92k. cal and 1 medium of 179g = 218K. cal. For protein 1 value /100g = 1.30g, 1 cup, sliced 148g = 1.92g 1 medium of 179g = 2.33 k. cal total lipid (fat) 1 value/100g = 0.37g, 1cup, sliced 148g = 1.55g 1 medium of 179g = 0.66. Carbohydrate by difference 1 value /100g = 31.89g, 1 cup, sliced 148g = 47.20g and 1 medium of 179g = 57.08g; fiber total dietary 1 value/100g = 2.3g; 1 cup, sliced 148g = 3.4g and 1 medium 179g = 4.1g; sugar total 1 value/100g = 15.00g; 1 cup sliced 148g = 22.20g and 1 medium 179g = 26.85g. Mineral composition in the same analysis indicates Ca 1value/100g = 3mg, 1cup sliced 148g = 4mg, 1 medium 179g = 5mg; Iron (Fe) 1value/100g = 0.60mg 1 cup, sliced 148g = 0.89mg and 1 medium 179g = 1.07mg. Magnesium (Mg). 1value/100g = 37g = 1cup, sliced 148g = 55mg and 1medium 179g = 66mg; Phosphorus (P) 1 vale/100g = 34mg, 1 cup sliced 148g = 50mg and 1 medium 179g = 62mg; Potassium (K) 1 value/100g = 499mg, 1 cup sliced 148g = 739mg and one medium 179g = 893mg. Sodium (Na) 1 value/100g = 4mg, 1 cup, sliced = 6mg and 1 medium 179g = 7mg; Zinc (Zn) 1 value/100g = 0.14mg, 1 cup, sliced 148g = 0.21mg and 1 medium 179g = 0.25mg. For the mineral composition in this presentation, the value of potassium is the highest i.e. in 1 value/100g = 499mg while the least is Zinc (Zn) i.e. in 1 value/100g = 0.14mg. However, the value of Iron (Fe) as presented is 0.60mg in 1 value/100g and in 1 medium 179g is 1.07mg

From USDA report (2017) vitamin composition in plantain shows that in 1 value/100g vitamin C is 18.4mg, 1 medium 179g is 32.9mg while that of Folate, DFE in 1 value/100g = 22mg and 1 medium 179g is 39mg and that of Vitamin A, RAE in 1 value/100g is 56mg and in 1 medium 179g is 100Ng. The value of Vitamin A, 1 U in 1 value /100g is 1127 1U, whereas zero values Vitamin B – 12 and D (D2 + D3) were recorded in plantain.

Analysis of lipids was highest by 1 value/100g on fatty acids total saturate equals 0.143g and in 1 medium 179g is 0.256g followed by fatty acid, total polyunsaturated in 1 value/100g recorded 0.069g and in 1 medium 179g I 0.124g. The value of fatty acids, total trans and cholesterol were all zero in plantain.

Furthermore, an indept study of nutrients in plantain was carried out by scholars with the following results in nutrient value and percent recommended daily allowances(RDA) ; energy 122kcal, 6%; carbohydrate 31.89g, 24.5%; protein 1.30g, 2%; total fat 0.37g, 2%; cholesterol 0 mg, 0%; dietary fire 2.30g, 6%; folates 22µg, 5.5%; niacin 0.686mg, 4%; pyridoxine 0.299mg, 23%; Riboflavin 0.054mg, 4%; vitamin A 1127 iu, 37.5%; vitamin C 18.4mg, 31%; vitamin E 0.14mg, 1%; vitamin K 0.7 µg, 1%; sodium 4mg, < 1%; potassium 499mg, 10.6%; calcium 3mg, < 0.5%; iron 0.60mg, 7.5%; magnesium 37mg, 9%; phosphorus 34mg, 5% and zinc 0.14mg, 1%.(USDA 2017).

Plantain meal is an important food source and easily digestible with constituents such as water 10.62%, albuminoids 3.35%, fat 1.15%, carbohydrates 81.67% (more than 2/3 starch),

fibre 1.15%, phosphates 0.26% sugar (sucrose) 1.60% high content of vitamin C and potassium (Chung M.J. et al, 2007). Vitamin A (fresh ripe plantain) is an antioxidant that plays valuable role in visual cycle, maintaining healthy mucosa and enhances skin complexion. Vitamin B6 (pyridoxine) in plantain is very important in the treatment of neutritis, anemia and decrease homocysteine (one of the causative factors for coronary artery disease and stroke episodes) in the body. While very high level of vitamin C help to develop resistance against infectious agents and scavenge harmful oxygen-free radicals, but if boiled and cooked the level of this vitamin is drastically reduced (Umesh Rudrappa 2009-17).

MATERIALS AND METHODS

Twelve cultivars of plantain (*Musa paradisiaca*) Ikipiriberiba, Biriyeberberiba, Auberiba, Izuberiba (Izon), Izuberiba (Biou), Izonberiba, Mankomuberiba this cultivar usually form two bunches during fruiting hence H1-(Left bunch) and H2(Right bunch), Kalabiouberiba, Opubiuberiba, Okpoisan, Asinberiba and Maipe (French horn) as control. The cultivars were collected from Okoloba and Sabagreia in Kolokuma/Opokuma Local Government Area, Bayelsa State, Nigeria. They were planted in 2015 and harvested in the year 2016 in the Niger Delta University Teaching and Research farm without the use of synthetic chemicals (fertilizers and pesticides) during cultivation and post-harvest storage period. Harvested fruits (fingers) were randomly collected and subjected to proximate analysis in the Central Laboratory of Niger Delta University Headed by Chief S.Spiff within two weeks. In our analysis, vitamins, caffeine, cholesterol, individual amino acids and lipids were not considered.

Data Analysis

Data collected were subjected to a software composed and developed by Seimokumo S. Angaye Junior. The methods used were Microsoft Excel Quantitative Data Analysis Tool and Visual Basic Programming Language in Integrated Development Environment.

RESULTS AND DISCUSSIONS

The results are presented in charts and in measures of statistical values of both food and peels in which the X- axis is the level of the traits analyzed in mg/100g expressed in percentage of moisture, ash, protein, lipid, fibre, dry matter and carbohydrate, while the rest elements are expressed in mg/100g. In the Y-axis is the plantain cultivars investigated.

Analysis of moisture content (%) in peels and edible portion of plantain cultivars

Fig.1 is a chart showing the percent of moisture content in the peels and food of plantain cultivars. The French horn cultivar was used as the reference (Control) comparison is been made. Results of this characteristics in the chart showed that moisture content in peels range from the least 78.74% (Asinberiba) to the highest 87.33% (Mankomuberiba H2) in mg/100g with a mean value of 83.75% in mg/100g. Whereas, percent moisture content in food varied from 38.78% (Okpoisan) to 66.03% (Ikipiriberiba) in mg/100g and the average moisture content in edible portion is 58.05%. However, the Confidence Levels (95.0%) of peels and

edible portions were 1.51 and 5.39 while the kurtosis were mesokurtic and leptokurtic distributions.

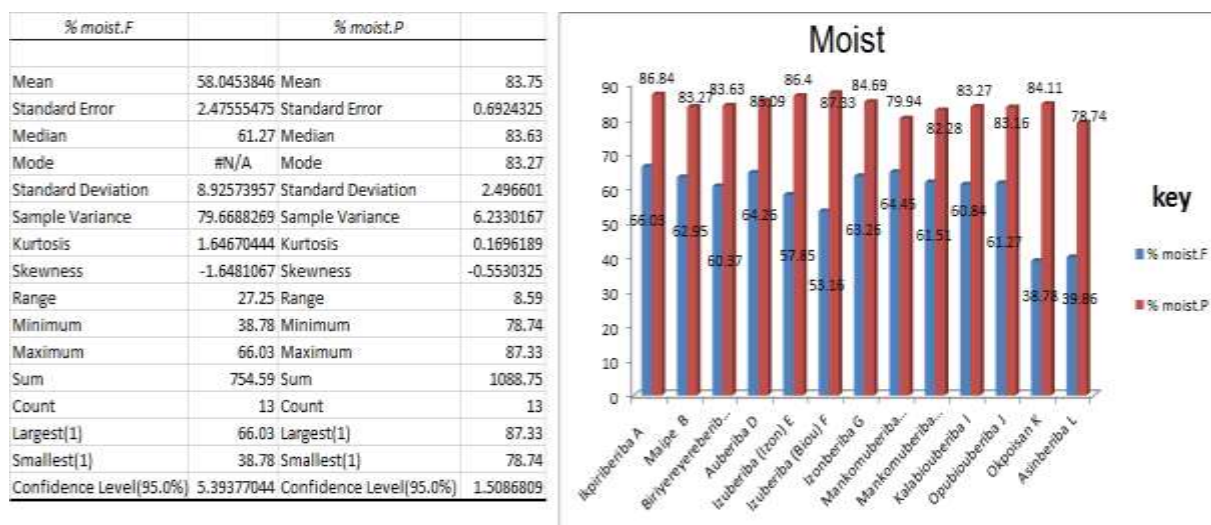


Fig.1 Percent(%) moisture content in food and peels of 12 plantain cultivars (A-L) in 2017

A-Ikpiriberiba, B-Maipe (reference), C-Biriyereyeriberiba, D-Auberiba, E-Izuberiba (Izon), F-Izuberiba (Biou), G- Izonberiba, H-Mankomuberiba (H1), Mankomuberiba (H2), I-Kalabiouberiba, J-Opubiouberiba, K-Okpoisan, L-Asinberiba.

Analysis of ash content (%) in plantain cultivars

Analysis of ash content in peels and food of 13 plantain cultivars (mg/100g) in Fig.2. showed ash content in peels ranged from 2.38% (Ikpiriberiba) to 0.87% (Asinberiba) and a mean value of 1.74% which is expressed in Kurtosis-0.27 (platykurtic distribution) and Skewness -0.13 at Confidence Level (95.0%) of 0.28 whereas, the control recorded 2.54%.

The content of ash in the edible portions of cultivars varied from 1.78% (Mankomuberiba H1) to 0.68% (Okpoisan), while the average value of this trait is 1.27%. The Kurtosis of this evaluation is platykurtic distribution -1.69, and skewness -0.12 at Confidence Level (95.0%) of 0.26.

%ASH.F		%ASH.P	
Mean	1.27384615	Mean	1.758461538
Standard Error	0.11882188	Standard Error	0.129623944
Median	1.25	Median	1.85
Mode	#N/A	Mode	#N/A
Standard Deviation	0.42841838	Standard Deviation	0.467365777
Sample Variance	0.18354231	Sample Variance	0.218430769
Kurtosis	-1.6887071	Kurtosis	-0.27339168
Skewness	-0.1152383	Skewness	-0.12749302
Range	1.16	Range	1.67
Minimum	0.68	Minimum	0.67
Maximum	1.84	Maximum	2.54
Sum	16.56	Sum	22.86
Count	13	Count	13
Largest(1)	1.84	Largest(1)	2.54
Smallest(1)	0.68	Smallest(1)	0.67
Confidence Level(95.0%)	0.25889064	Confidence Level(95.0%)	0.282426312

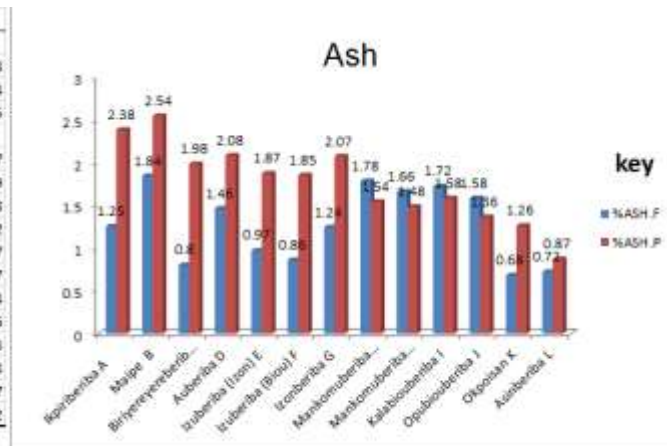


Fig.2. Percent (%) ash content in food and peels of 12 plantain cultivar (A-L) in 2017.

A-Ikpiriberiba, B-Maipe (reference), C-Biriyereyeriberiba, D-Auberiba, E-Izuberiba (Izon), F-Izuberiba (Biou), G- Izonberiba, H-Mankomuberiba (H1), Mankomuberiba (H2), I-Kalabiuberiba, J-Opubiuberiba,K-Okpoisan, L-Asinberiba.

Analysis on protein content (%) in peels and edible portion of plantain cultivars

Results of protein content in peels and edible portions of plantain cultivars in Fig.3.revealed that protein values ranged from 1.67% (Kalabiuberiba) to 4.2% (Ikpiriberiba) in mg/100g of peels and from 2.76% (Kalabiuberiba) to 6.75% (Ikpiriberiba) in mg/100g of food and their mean values were 3.04% in mg/100g of peels and 5.04% in mg/100g of food respectively.

The skewness in peels is -0.001 and in food -0.446 while, the kurtosis in peels and food are all platykurtic distributions at Confidence Levels (95.0%) of 0.46 (peels) and 0.80 (food).

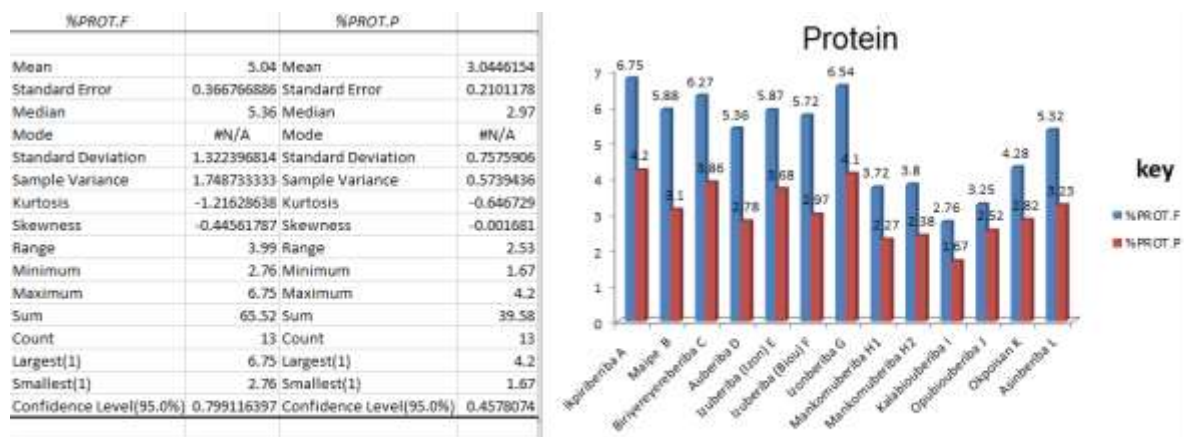


Fig.3 Percent (%) protein content in food and peels of 12 plantain cultivars (A-L) in 2017.

A-Ikpiriberiba, B-Maipe (reference), C-Biriyereyeriberiba, D-Auberiba, E-Izuberiba (Izon), F-Izuberiba (Biou), G- Izonberiba, H-Mankomuberiba (H1), Mankomuberiba (H2), I-Kalabiouberiba, J-Opubiouberiba, K-Okpoisan, L-Asinberiba.

Results on lipid content (%) in peels and edible portion of plantain cultivars

Results of lipid content (%) in peels and edible portions of plantain cultivars are presented in Fig.4. The lipid content (%) in peels of Maipe cultivar (reference) is 1.96% however, this value in Biriyereyeriberiba cultivar is 2.24% which is 0.28% higher than Maipe cultivar. All other cultivars are having values of lipid content lower than Maipe. In peels it varied from 0.84% Asinberiba to 2.24% Biriyereyeriberiba and the mean is 1.37%

The value of lipid content (%) in edible portion of plantain cultivars as presented in Fig.4. showed that Maipe cultivar has the highest level as 2.4%. This characteristic in the rest cultivars are all less than the reference cultivar Maipe. However, in food it swayed from 0.96% Auberiba to 2.36% Ikpiriberiba with a mean value of 1.57%

An important observation seen in the chart is that lipid value in peels of cultivars Biriyereyeriberiba, Auberiba and Izuberiba are higher than in the edible portions but the reverse is the case in the other cultivars. Kurtosis in the peels is platykurtic distribution while in the edible portions is leptokurtic distribution at Confidence Levels (95.0%) of 0.29 and 0.26 respectively.

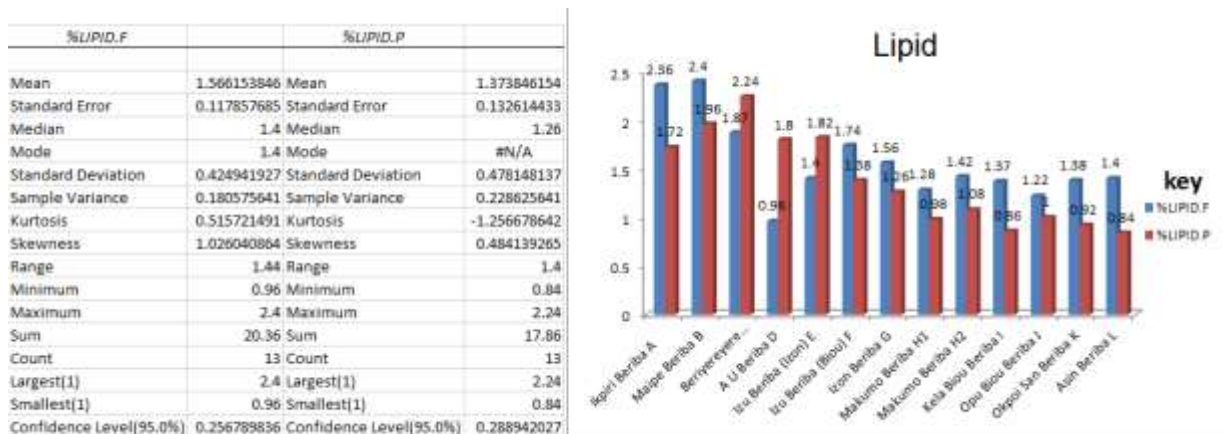


Fig.4 Percent (%) lipid content in food and peels of 12 plantain cultivars (A-L). 2017

A-Ikpiriberiba, B-Maipe (reference), C- Biriwereyereberiba, D- Auberiba, E-Izuberiba (Izon), F-Izuberiba (Biou), G- Izonberiba, H-Mankomuberiba (H1), Mankomuberiba (H2), I-Kalabiouberiba, J-Opubiouberiba, K-Okpoisan, L-Asinberiba.

Results on fibre content (%) in peels and edible portion of plantain cultivars

Fibre content in plantain being an important component of human diet is necessary to be investigated. Our results in Fig.5 showed that the highest level of fibre content in peels is recorded in Mankomuberiba H1 (3.72%) and the least in Izonberiba (2.38%) which is of the same level with Maipe (reference), whereas, the mean is 2.91%.

This trait in the edible portion of cultivars is highest in Okpoisan (3.0%) and smallest in Auberiba (1.88%) and the average level is 2.47%, while the Kurtosis in both peels and edible portions are platykurtic distributions at Confidence Levels (95.0%) are 0.26 and 0.21, respectively.

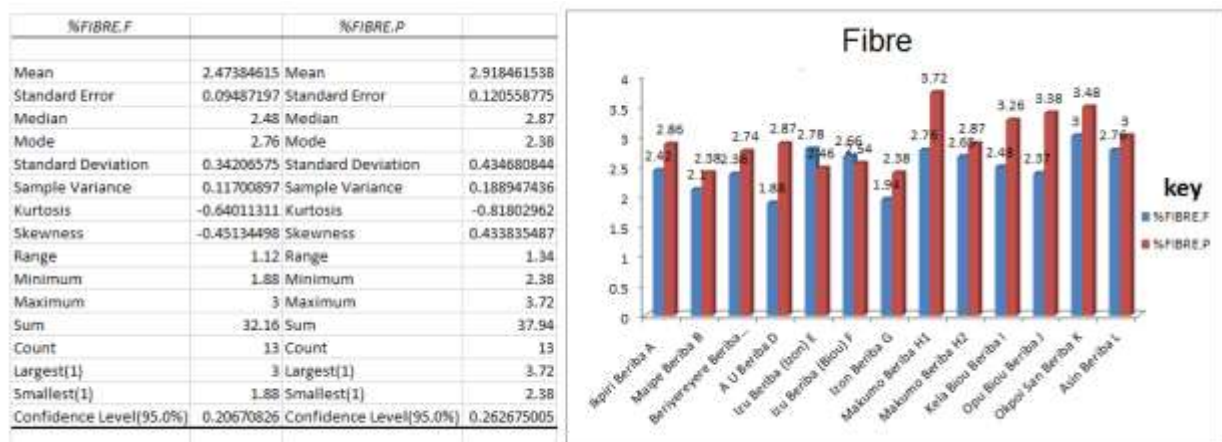


Fig.5 Percent (%) fibre content in food and peels of 12 plantain cultivars (A-L). 2017

A-Ikpiriberiba, B-Maipe (reference), C- Biriyyereberiba, D- Auberiba, E-Izuberiba (Izon), F-Izuberiba (Biou), G- Izonberiba, H-Mankomuberiba (H1), Mankomuberiba (H2), I-Kalabiuberiba, J-Opubiuberiba, K-Okpoisan, L-Asinberiba.

Results of percent (%) dry matter content in peels and edible portion of plantain cultivars

The characteristic of percent (%) dry matter content in peels and edible portion of plantain cultivars is presented in Fig.6. The chart clearly showed that percent (%) dry matter content in peels are less than in the edible portions of all the cultivars investigated. Dry matter content in peels ranged from 12.67 % (Izuberiba - Biou) to 21.26 % (Asinberiba).

The results of this characteristic in edible portion of plantain cultivars varied from 33.97% (Ikpiriberiba) to 65.74% (Auberiba). Kurtosis in peels and edible portions are mesokurtic distribution and platykurtic distribution at Confidence Levels (95.0%) of 1.51 and 6.56. The average values of dry matter in peels and edible portions are 16.28% and 44.26% respectively.

%DM F		%DM P	
Mean	44.26230769	Mean	16.27769231
Standard Error	3.010577752	Standard Error	0.693385557
Median	39.16	Median	16.73
Mode	#N/A	Mode	16.73
Standard Deviation	10.85479245	Standard Deviation	2.500037179
Sample Variance	117.8265192	Sample Variance	6.250185897
Kurtosis	-0.101916798	Kurtosis	0.114340461
Skewness	1.204941606	Skewness	0.512167565
Range	31.77	Range	8.59
Minimum	33.97	Minimum	12.67
Maximum	65.74	Maximum	21.26
Sum	575.41	Sum	211.61
Count	13	Count	13
Largest(1)	65.74	Largest(1)	21.26
Smallest(1)	33.97	Smallest(1)	12.67
Confidence Level(95.0%)	6.559485431	Confidence Level(95.0%)	1.510757347

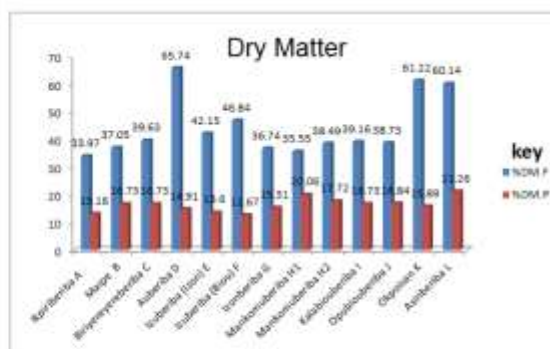


Fig.6.Percent (%) of dry matter (DM) content in food and peels of 12 Plantain Cultivars (A-L).2017

A-Ikpiriberiba, B-Maipe (reference), C- Biriyyereberiba, D- Auberiba, E-Izuberiba (Izon), F-Izuberiba (Biou), G- Izonberiba, Mankomuberiba (H1),Mankomuberiba (H2), I-Kalabiuberiba, J-Opubiuberiba, K-Okpoisan, L-Asinberiba.

Results on percent (%) carbohydrate conten in food and peels of plantain cultivars

Carbohydrate content in peels and edible portons presented in Fig.7.showed that the largest content of this trait is found in the peels compared to the edible portions except in the control (Maipe). The values of carbohydrate content in peels wayed from 88.84% (Ikpiriberiba) to 92.91% (Makomuberiba H2) with a mean of 85.47%.

In edible portions, this trait varied from 87.22% (Ikpiberiba) to 91.67% (Kalabiouberiba) with an average value of 89.66%. Statistic measures of Kurtosis in peels and edible portions are leptokurtic distribution and platykurtic distribution at Confidence Levels (95.0%) of 12.07 and 0.83.

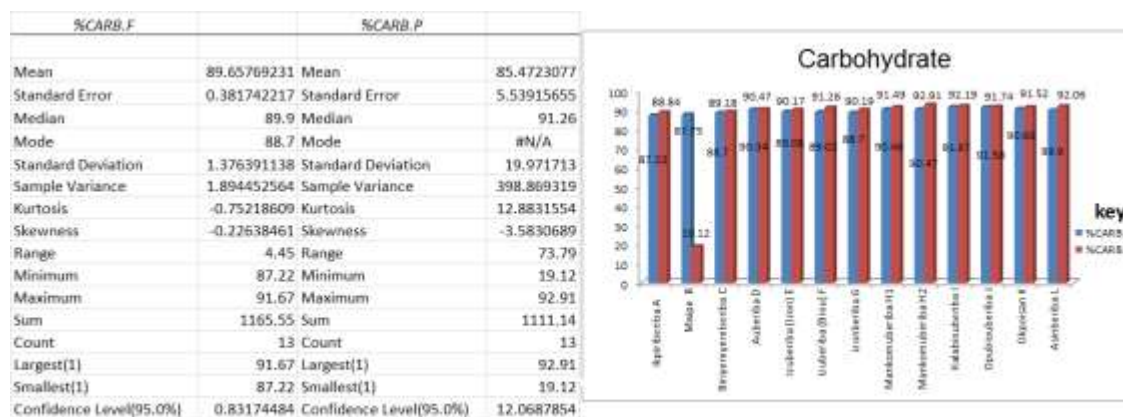


Fig.7 Percent(%) carbohydrate content in food and peels of 12 Plantain Cultivar(A-L),2017

A-Ikpiberiba, B-Maipe (reference), C- Biriyyereberiba, D-Auberiba, E-Izuberiba (Izon), F-Izuberiba (Biou), G- Izonberiba, H-Mankomuberiba (H1), Mankomuberiba (H2), I-Kalabiouberiba, J-Opubiouberiba, K-Okpoisan, L-Asinberiba.

Results of calcium (Ca) content (mg/100g) in peels and edible portion of plantain cultivars

Calcium (Ca) content in peels of plantain cultivars in Fig.8 showed that the values are higher than those values in the edible portions in all the cultivars ranging from 19.54mg/100g (Izuberiba-Biou) to 28.56mg/100g (Ikpiberiba) with a mean value of 23.72mg/100g.

The characteristic of calcium content in edible portions in cultivars varied from 16.78mg/100g (Okpoisan) to 25.80mg/100g (Ikpiberiba) and the average value of this trait in the investigated cultivars is 18.50mg/100g. Kurtosis in both peels and food are platykurtic distribution and leptokurtic distribution at Confidence Level ((95.0%) of 1.90 and 2.55.

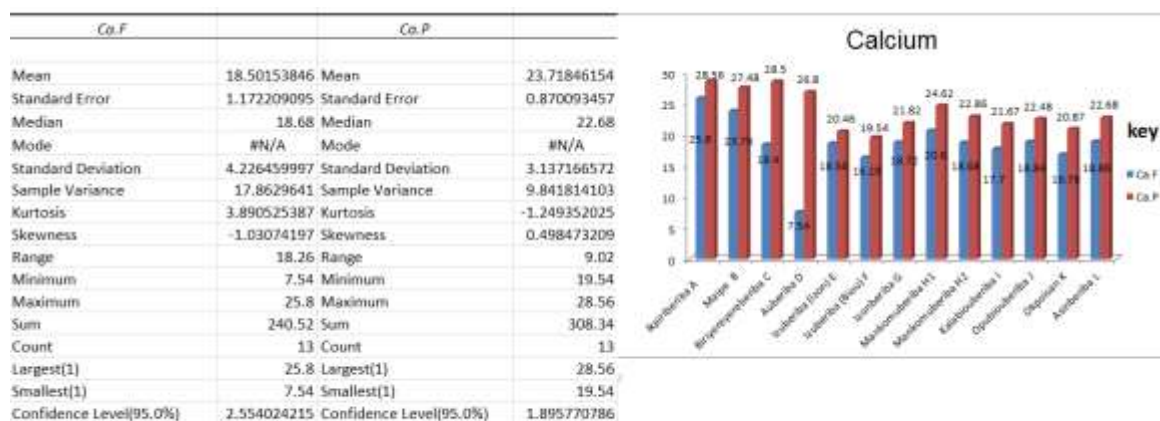


Fig.8.Amount of Calcium(Ca) content in food and peels of 12 plantain cultivars (A-L).2017

A-Ikpiriberiba, B-Maipe (reference), C- Biriyereyeriberiba, D- Auberiba, E-Izuberiba (Izon), F-Izuberiba (Biou), G- Izonberiba, H-Mankomuberiba (H1),Mankomuberiba (H2), I-Kalabiuberiba, J-Opubiuberiba, K-Okpoisan, L-Asinberiba

Results of magnesium(Mg) content (mg/100g) in peels and edible portion of plantain cultivars

Amount of magnesium(Mg) content (mg/100g) in peels is higher than the magnesium content in edible portions in all the cultivars in Fig.9. Cultivars with higher values of this trait than the reference cultivar Maipe are Ikpiriberiba (8.88mg/100), Biriyereyeriberiba (7.48mg/100g), Auberiba (7.59mg/100g), Makomuberiba (H1) (8.32mg/100g), Makomuberiba (H2) (8.92mg/100g), Kalabiuberiba (8.0mg/100g), Opubiuberiba (7.94mg/100g), Okpoisan (8.76mg/100g) and Asinberiba (9.2mg/100g). This trait varied from 5.53mg/100g (Izuberiba -biou) to 9.2mg/100g (Asinberiba) with a mean value of 7.62mg/100g

Magnesium content in edible portions in all the cultivars is less than Maipe (control) except Makomuberiba (H1) (5.83mg/100g) higher than Maipe (control) by 0.43mg/100g. The range of this trait in food is 4.5mg/100g (Auberiba) to 5.83mg/100g (Mankomuberiba-H1) with an average level of Magnesium content 5.04mg/100g while the kurtosis of both peels and food are of platykurtic distributions at Confidence Levels (95.0%) of 0.77 and 0.25.

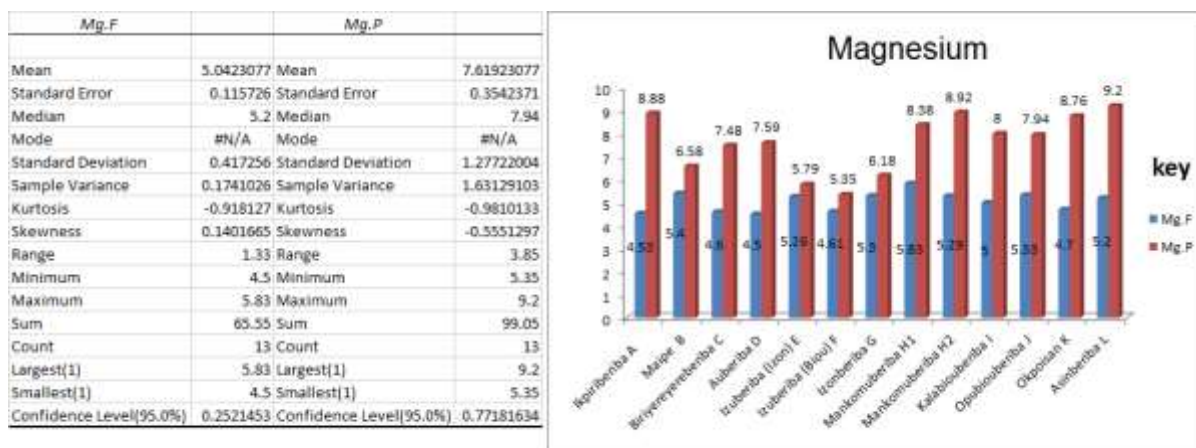


Fig.9.Amount of Magnesium(Mg) content in food and peels of 12 Plantain Cultivars(A-L).2017

A-Ikpiriberiba, B-Maipe (reference), C- Biriyyereberiba, D- Auberiba, E-Izuberiba (Izon), F-Izuberiba(Biou), G- Izon beriba, H-Mankomuberiba (H1), Mankomuberiba(H2), I-Kalabiuberiba, J-Opubiuberiba, K-Okpoiasan, L- Asinberiba.

Results of sodium (Na) content (mg/100g) in peels and edible portion of plantain cultivars

Results of Sodium(Na) content in Fig.10. showed that this trait in peels of all the cultivars are higher than in edible portions of the cultivars investigated. Characteristics of sodium content in peels of Ikpiriberiba (14.72mg/100g) and Biriyyereberiba (14.28mg/100g) are higher than Maipe (control) (13.50mg/100g). Sodium content(Na) peels ranged from 9.28mg/100g (Izuberiba-biou) to 14.72mg/100g and the mean value of this trait in peels is 12.12mg/100g.

The values of sodium (Na) content in edible portions ranged from 7.73mg/100g (Izuberiba - biou) to 13.60mg/100g (Ikpiriberiba) with a mean of 8.82mg/100g. Statistical measure of kurtosis in both peels and food are platykurtic distribution and leptokurtic distribution at Confidence Levels (95.0%) of 0.99 and 1.43 respectively.

No.F		No.P	
Mean	8.820769231	Mean	12.12230769
Standard Error	0.657765703	Standard Error	0.454922019
Median	8.89	Median	12.45
Mode	#N/A	Mode	#N/A
Standard Deviation	2.371607969	Standard Deviation	1.640244666
Sample Variance	5.624524359	Sample Variance	2.690402564
Kurtosis	5.585908865	Kurtosis	-0.504498551
Skewness	-1.10615847	Skewness	-0.254129918
Range	11.16	Range	5.44
Minimum	2.44	Minimum	9.28
Maximum	13.6	Maximum	14.72
Sum	114.67	Sum	157.59
Count	13	Count	13
Largest(1)	13.6	Largest(1)	14.72
Smallest(1)	2.44	Smallest(1)	9.28
Confidence Level(95.0%)	1.433148352	Confidence Level(95.0%)	0.991189932

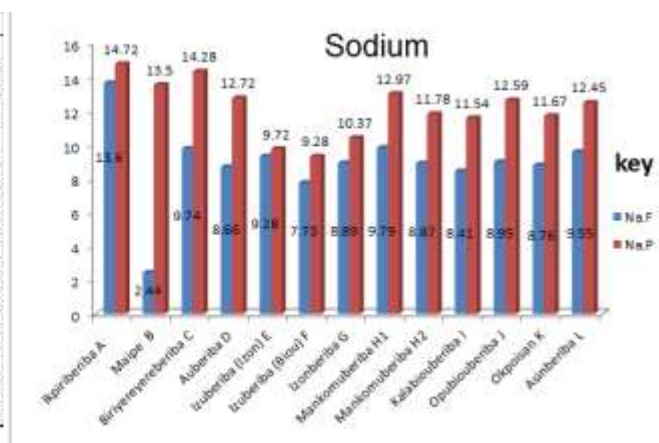


Fig.10.Amount of Sodium (Na) content in food and peels of 12 plantain cultivars(A-L). 2017

A-Ikpiriberiba, B-Maipe (reference), C-Biriyereyeriberiba, D-Auberiba, E-Izuberiba (Izon), F-BiouIzuberiba (Biou), G-Izonberiba, H-Mankomuberiba(H1), Mankomuberiba (H2), I-Kalabiouberiba, J-Opubiuberiba, K-Okpoisan, L-Asinberiba.

Results of potassium (K) content (mg/100g) in peels and edible portion of plantain cultivars

Potassium content in peels of plantain cultivars in Fig.11 reflected that this trait is higher in the edible portions except in Maipe (ref.) (7.56mg/100g). The following cultivars Ikpiriberiba (8.7mg/100g), Biriyereyeriberiba (8.44mg/100g), Opubiuberiba (7.84mg/100g), Okpoisan (9.52mg/100g) and Asinberiba (8.0mg/100g) are with higher values of this quality than Maipe (ref.). Although, this trait in peels ranged from 4.81mg/100g (Izuberiba-biou) to 9.52 mg/100g (Okpoisan) and the mean value of this trait is 7.16mg/100g.

The value of potassium content in edible portion of Ikpiriberiba (8.55mg/100g) is the only cultivar higher than Maipe (7.56mg/100g) while the rest cultivars have values lower than Maipe. The average level this characteristic in edible portion is 5.52mg/100g with kurtosis in peels and edible portions platykurtic distribution and mesokurtic distribution at Confidence Levels (95.0%) of 0.87 and 0.84.

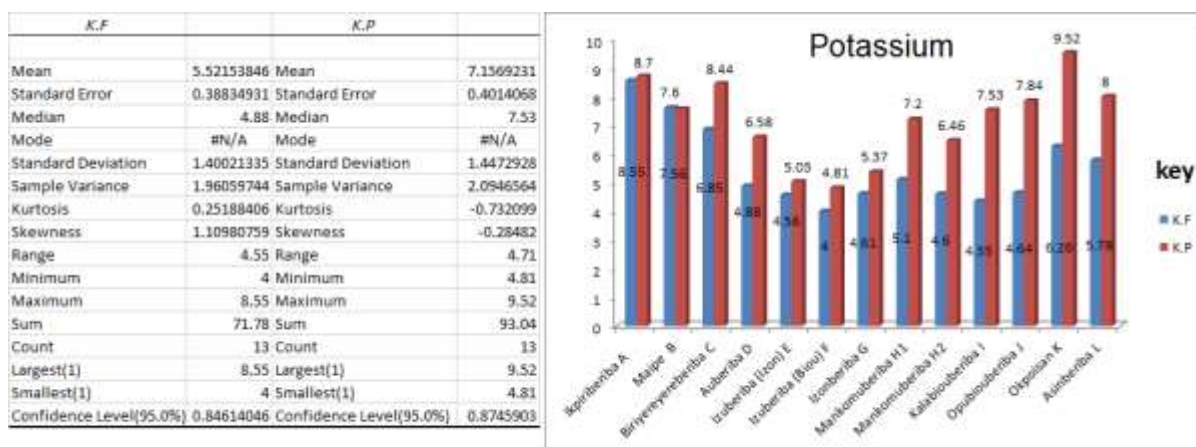


Fig.11.Amount of Potassium(K) content in food and peels of 12 plantain cultivars(A-L).2017

A-Ikpiriberiba, B-Maipe (reference), C-Biriyereyerberiba, D-Auberiba, E-Izuberiba (Izon), F-Izuberiba (Biou), G- Izonberiba, H-Mankomuberiba (H1), Mankomuberiba(H2), I-Kalabiuberiba, J-Opubiuberiba, K-Okpoisan, L-Asinberiba.

Results of iron (Fe) content (mg/100g) in peels and edible portion of plantain cultivars

Evaluation of iron(Fe) content in peels and edible portion of plantain cultivars in Fig.12. showed that iron content in peels of cultivars varied from 0.57mg/100g (Auberiba) to 2.23mg/100g (Ikpiriberiba) with a mean value of 1.56mg/100g.

Higher values of iron (Fe) content in edible portions are recorded in cultivars Biriyereyerberiba (1.267mg/100g), Auberiba (0.625mg/100g), Makomuberiba (H1) (2.46mg/100g), Makomuberiba -H2) (2.54mg/100g), Kalabiuberba (1.76mg/100g), Opubiuberiba (1.73mg/100g) and Okpoisan (0.97mg/100g) while the average value of iron is 1.42mg/100g. Kurtosis on this trait in peels and food are all platykurtic distributions.

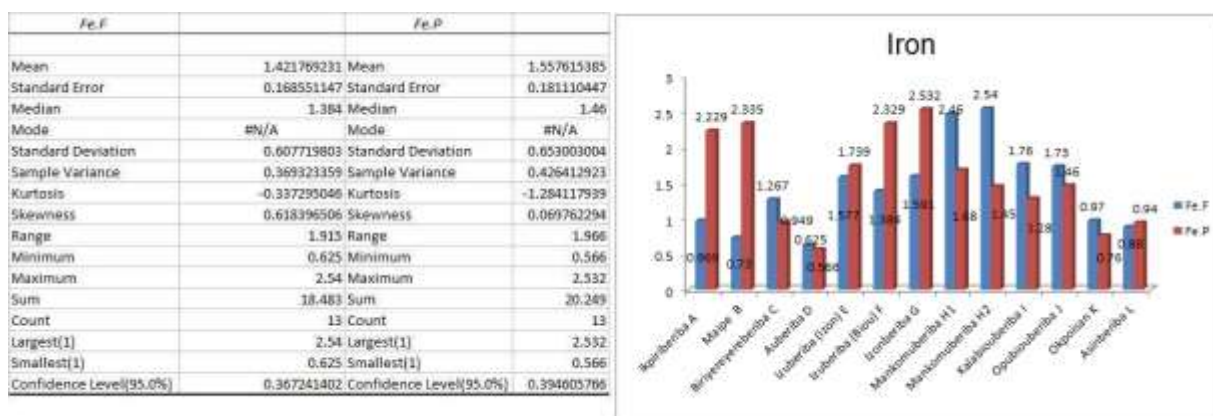


Fig.12. Amount of Iron (Fe) content in food and peels of 12 plantain cultivars (A-L).2017

A-Ikpiriberiba, B-Maipe (reference), C- Biriyeereberiba, D- Auberiba, E-Izuberiba (Izon), F-Izuberiba (Biou), G- Izonberiba, H-Mankomuberiba (H1), Mankomuberiba (H2), I- Kalabiouberiba, J-Opubiouberiba, K-Okpoi san, L-Asinberiba.

results of manganese (Mn) content (mg/100g) in peels and edible portion of plantain cultivars

Results of manganese (Mn) content in peels and edible portions of twelve plantain cultivars in Fig.13. showed that the least value of manganese(Mn) in peels is recorded in Ikpiriberiba (0.12mg/100g), while the highest is recoded in Izonberiba (0.56mg/100g) and mean value of all investigated cultivars is 0.31mg/100g.

Manganese content in edible portion is least in Auberiba (0.05mg/100g) and the highest is recorded in Makomuberiba (H2) (0.57mg/100g) whereas the average level is 0.31mg/100g The Kurtosis of this trait in peels and food are all platykurtic distributions at Confidence levels of 0.09 and 0.07

Mn.F		Mn.P	
Mean	0.32626923	Mean	0.31116923
Standard Error	0.04164727	Standard Error	0.04338541
Median	0.3548	Median	0.296
Mode	#N/A	Mode	#N/A
Standard Deviation	0.15016138	Standard Deviation	0.1564283
Sample Variance	0.02254844	Sample Variance	0.02446981
Kurtosis	-0.2102543	Kurtosis	-1.2005877
Skewness	-0.2181638	Skewness	0.07986416
Range	0.5132	Range	0.449
Minimum	0.0528	Minimum	0.1156
Maximum	0.566	Maximum	0.5646
Sum	4.2415	Sum	4.0452
Count	13	Count	13
Largest(1)	0.566	Largest(1)	0.5646
Smallest(1)	0.0528	Smallest(1)	0.1156
Confidence Level(95.0%)	0.09074161	Confidence Level(95.0%)	0.09452868

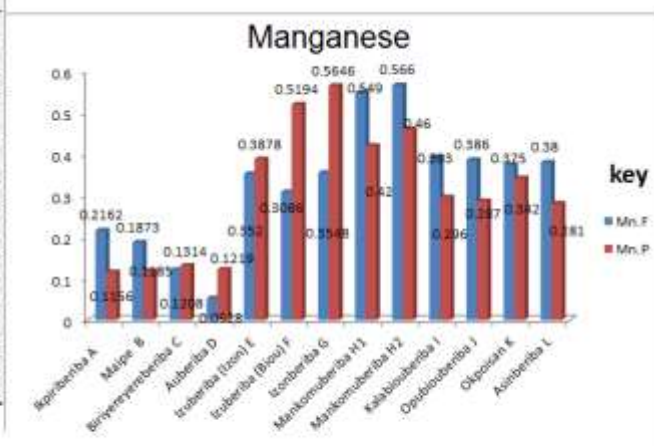


Fig.13.Amount of Manganese(Mn) content in food and peels of 12 plantain cultivars(A-L).2017.

A-Ikpiriberiba, B-Maipe (reference), C-Biriyereberiba, D- Auberiba, E-Izuberiba (Izon), F-Izuberiba(Biou), G-Izonberiba, H-Mankomuberiba (H1), Mankomuberiba (H2), I-Kalabiuberiba, J-Opubiuberiba, K-Okpoisan, L-Asinberiba.

Results of copper (Cu) content (mg/100g) in peels and edible portion of plantain cultivars

Analysis of copper content (mg/100g) in peels and edible portions in plantain cultivars in Fig.14 showed that there is great variation between the constituents of copper content in peels and edible portions. It is clearly shown that copper (Cu) content in peels of plantain cultivars ranged from 0.02mg/100g (Makomuberiba -H2) to 0.22mg/100g (Izonberiba). However, average value of copper content in peels is 0.08mg/100g.

Copper(Cu) content in edible portions of plantain cultivars varied from 0.04mg/100g (Biriyereberiba) to 0.22mg/100g (Makomuberiba -H2) with mean value of 0.13mg/100g.The statistic measure of kurtosis in peels and edible portions are mesokurtic distribution and platykurtic distribution respectively at Confidence Levels (95.0%) of 0.04 and 0.03.

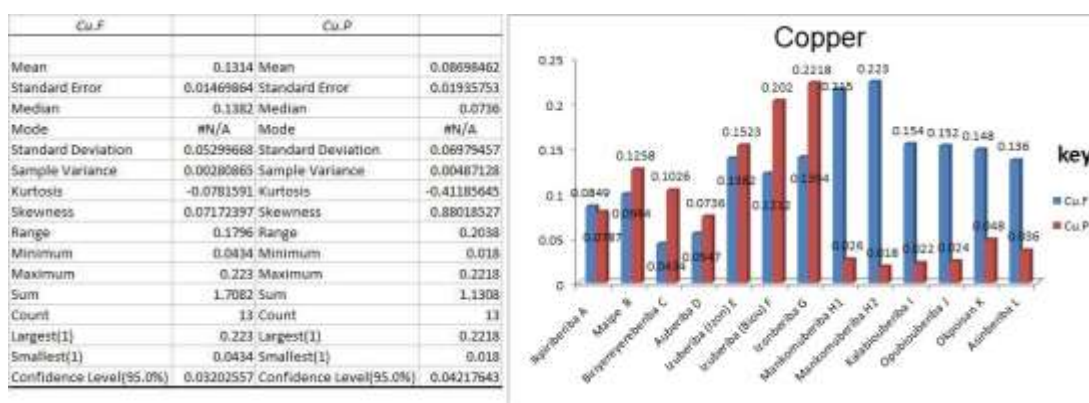


Fig.14.Amount of Copper (Cu) content in food and peels of 12 plantain cultivars(A-L). 2017

A-Ikpiriberiba, B-Maipe (reference), C-Biriyereyereberiba, D-Auberiba, E-Izuberiba (Izon), F-Izuberiba (Biou), G- Izonberiba, H-Mankomuberiba (H1), Mankomuberib(H2), I-Kalabiuberiba, J-Opubiuberiba, K-Okpoisan, L-Asinberiba.

Results of zinc (Zn) content (mg/100g) in peels and edible portion of plantain cultivars

Analysis of zinc content (mg/100g) in peels and edible portions in plantain cultivars in Fig.15 showed that there is great variation between the constituents of zinc content in peels and edible portions. It is clearly shown in Fig.15. that Zinc(Zn) content in peels of plantain cultivars ranged from 0.35mg/100g (Auberiba) to 1.14mg/100g (Makomuberiba -H2) with an average level of zinc 0.78mg/100g.

Zinc(Zn) content in edible portions of plantain cultivars swayed from 0.21mg/100g (Biriyereyereberiba) to 1.07mg/100g and mean value of 0.64mg/100g. Only two cultivars (Biriyereyereberiba and Auberiba) recorded values of zinc lower than the control Maipe. Statistic measure of Kurtosis on peels and food are all of platykurtic distributions at confidence levels (95.0%) of 0.16 and 0.15.

Zn.F		Zn.P	
Mean	0.64176923	Mean	0.78323077
Standard Error	0.07377905	Standard Error	0.07381848
Median	0.668	Median	0.846
Mode	#N/A	Mode	#N/A
Standard Deviation	0.26601415	Standard Deviation	0.26615633
Sample Variance	0.07076353	Sample Variance	0.07083919
Kurtosis	-0.39888704	Kurtosis	-0.9926855
Skewness	-0.15889693	Skewness	-0.319369
Range	0.859	Range	0.785
Minimum	0.208	Minimum	0.353
Maximum	1.067	Maximum	1.138
Sum	8.343	Sum	10.182
Count	13	Count	13
Largest(1)	1.067	Largest(1)	1.138
Smallest(1)	0.208	Smallest(1)	0.353
Confidence Level(95.0%)	0.16075074	Confidence Level(95.0%)	0.16083666

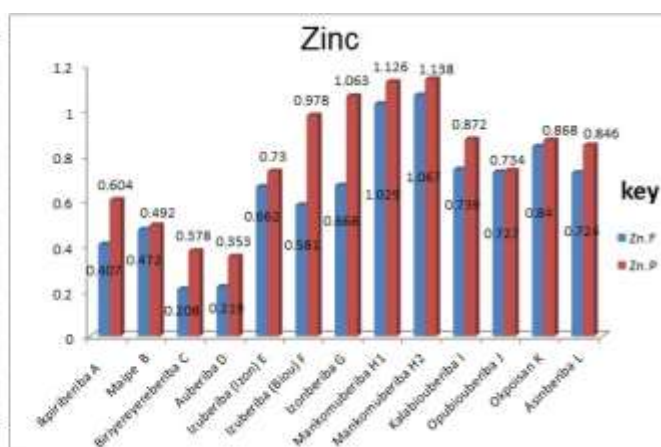


Fig.15. Amount of zinc (Zn) content in food and peels of 12 plantain cultivars (A-L) 2017.

A-Ikpiriberiba, B-Maipe (reference), C- Biriyyereberiba, D- Auberiba, E-Izuberiba (Izon), F-Izuberiba (Biou), G- Izonberiba, H-Mankomuberiba (H1), Mankomuberiba (H2), I-Kalabiuberiba, J-Opubiuberiba, K-Okpoisan, L-Asinberiba.

Results of phosphate (P₀₄) content (mg/100g) in peels and edible portion of plantain cultivars

Amount phosphorus (P) in peels and edible portions of plantain cultivars in Fig.16. showed that only two cultivars (Auberiba and Izonizuberiba) are recorded with lower values of this trait than in Maipe. Phosphorus content in peels of cultivars swayed from 0.17mg/100g (Izuberiba -Izon) to 0.55mg/100g (Makomuberiba-H1) and the mean in peels is 0.30mg/100g.

Results of phosphorus content in edible portions varied greatly among cultivars. The range is from Izuberiba (biou) (0.13mg/100g) to Makomuberiba (0.43mg/100g) with an average level of 0.23mg/100g. Statistic measure of Kurtosis on this trait in cultivars are all leptokurtic distributions at Confidence levels (95.0%) of 0.07 and 0.05 respectively.

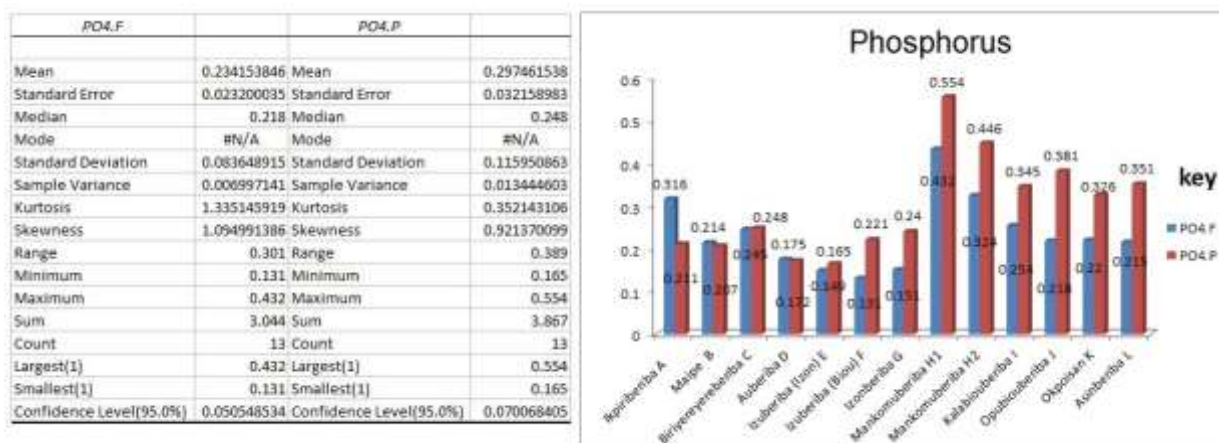


Fig.16.Amount of phosphate(PO₄) content in food and peels of 12 Plantain Cultivars(A-L).2017

A-Ikpiriberiba, B-Maipe(refrence), C-Biriyereyeriberiba, D-Auberiba, E-Izuberiba (Izon), F-Izuberiba (Biou), G-Izonberiba, H-Mannkomuberiba, (H1), Mannkomuberiba(H2) , I-Kalabiouberiba, J-Opubiouberiba, K-Okpoisan, L-Asinberiba.

CONCLUSIONS

1. Results moisture content in peels ranged from the least 78.74% (Asinberiba) to the highest 87.33% (Makomuberiba H2) in mg/100g with a mean value of 83.75% in mg/100g. Whereas, percent moisture content in food varied from 38.78% (Okpoisan) to 66.03% (Ikpiriberiba) in mg/100g while the average moisture content in edible portion is 58.05%.
2. Ash content in peels ranged from 2.38% (Ikpiriberiba) to 0.87% (Asinberiba) and a mean value of 1.74%. The content of ash in the edible portions of cultivars varied from 1.78% Makomuberiba H1 to 0.68% Okpoisan, while the average value of this trait is 1.27%.
3. Protein content in peels and edible portions of plantain cultivars ranged from 1.67% Kalabiouberiba to 4.2% Ikpiriberiba in peels and from 2.76% Kalabiouberiba to 6.75% Ikpiriberiba in food and their mean values are 3.04% of peels and 5.04% of food.
4. Lipid content in peels varied from 0.84% Asinberiba to 2.24% Biriyereyeriberiba and the mean is 1.37%. However, in food it swayed from 0.96% Auberiba to 2.36% Ikpiriberiba with a mean value of 1.57%.
5. Fibre content in peels ranged from 2.38% Izonberiba to 3.72% Makomuberiba (H1) whereas, the mean is 2.91%. This trait in the edible portion of cultivars varied from 1.88% Auberiba to 3.0% Okpoisan and the average value is 2.47%.
6. Dry matter content in peels ranged from 12.67% Izuberiba (Biou) to 21.26% Asinberiba. The results of this characteristic in edible portions varied from 33.97%

Ikpiberiba to 65.74% Auberiba. The average values of dry matter in peels and in edible portions are 16.28% and 44.26% respectively.

7. Carbohydrate content in peels varied from 88.84% Ikpiberiba to 92.91% Makomuberiba H2 with a mean of 85.47%. In edible portions, this trait varied from 87.22% Ikpiberiba to 91.67% Kalabiuberiba with an average value of 89.66%.
8. Calcium content in cultivars ranged from 19.54mg/100g Izuberiba(Biou) to 28.56mg/100g Ikpiberiba with a mean value of 23.72mg/100g. The characteristic of calcium content in edible portions in cultivars varied from 16.78mg/100g Okpoisan to 25.80mg/100g Ikpiberiba and the average value of this trait in the investigated cultivars is 18.50mg/100g.
9. Magnesium content in peels varied from 5.53mg/100g Izuberiba(biou) to 9.2mg/100g Asinberiba with a mean value of 7.62mg/100g. While in edible portions it swayed from 4.5mg/100g Auberiba to 5.83mg/100g with an average level of Magnesium content 5.04mg/100g.
10. Sodium content(Na) peels ranged from 9.28mg/100g Izuberiba(biou) to 14.72mg/100g and the mean is 12.12mg/100g Ikpiberiba, while in edible portions it ranged from 7.73mg/100g Izuberiba (biou) to 13.60mg/100g Ikpiberiba with a mean of 8.82mg/100g.
11. Potassium(K) content in peels swayed from 4.81mg/100g Izuberiba(biou) to 9.52 mg/100g Okpoisan and the mean value of this trait is 7.16mg/100g this trait in food ranged from 4.0mg/100g Izuberiba (biou) to 8.55mg/100g Ikpiberiba with a mean of 8.55mg/100g.
12. Iron (Fe) content in peels of cultivars varied from 0.57mg/100g Auberiba to 2.23mg/100g Ikpiberiba with a mean value of 1.56mg/100g, while in food it ranged from 0.63mg/100g Auberiba to 2.54mg/100g Makomuberiba(H2) and the average value of iron is 1.42mg/100g.
13. Manganese(Mn) in peels varied from 0.12mg/100g Ikpiberiba to 0.56mg/100g Izonberiba and mean value of all investigated cultivars is 0.31mg/100g. Manganese content in edible portion ranged from 0.05mg/100g Auberiba to 0.57mg/100g Makomuberiba (H2) ,whereas the average level is 0.31mg/100g.
14. Copper (Cu) content in peels of plantain cultivars ranges from 0.02mg/100g Makomuberiba (H2) to 0.22mg/100g Izonberiba. However, average value of copper content in peels is 0.08mg/100g, whereas, in edible portions of plantain cultivars it ranged from 0.04mg/100g Biriyeereberiba to 0.22mg/100g Makomuberiba (H2) with a mean value of 0.13mg/100g.
15. Zinc(Zn) content in peels of plantain cultivars ranged from 0.35mg/100g Auberiba to 1.14mg/100g Makomuberiba (H2) with an average level of zinc 0.78mg/100g, while this trait in edible portions of plantain cultivars swayed from 0.21mg/100g Biriyeereberiba to 1.07mg/100g and a mean value of 0.64mg/100g.
16. Phosphorus content in peels of cultivars swayed from 0.17mg/100g Izuberiba (Izon) to 0.55mg/100g Makomuberiba (H1) and the mean in peels is 0.30mg/100g. In edible

portions it varied from 0.13mg/100g Izuberiba (biou) to 0.43mg/100g Makomuberiba(H1)with an average level of 0.23mg/100g.

17. Preferably, consumption of plantain should be whole rather than only the edible portion,since the peels also contain high levels of important nutrients.

REFERENCES

- Chung, M. J.,Woopark, K., Heon K.K., Kim, C.T., Pill, B.J., Bang,K.H., Choi, Y.M., Lee, S.J.(2007). Asian Plantain (*Plantago asitica*). Essential oils suppress 3-hydroxy-3-methyl-glutaryl-co-enzyme A reductase expression in vitro and in vivo and show hypocholesterol anemic properties in mice. *British Journal of Nutrition*,15: 1-9.
- Endlberger, L., Willis, B.H., Blades, B., Duffrey, L., Daniells,J.W. and Coyne, T. (2006). Carotenoid content and flesh colour of selected banana cultivars growing in Australia. *Food and Nutrition Bulletin*,2794), 281-291.
- FAO, 2012: Commodity data, Country rankings.
<http://mongabay.com/commodities/data/category/production/1-crop/489-plantain/51-production+%28tones%29>
- FAO, 2013: Food and Agriculture Organization of the United Nations. Crop yield.
<http://faostat.fao.org/site/567/DesktopDefault.aspx?Page10=567&anchor>
- Food and Agriculture Organisation (FAO, 1990). *Production Yearbook* FAO Rome.
- Hugues Tezenas du Montcel. *Platain Bananas*. *The Tropical Agriculturist*.2005, pp.4-6.
- IITA 2009: International Institute of Tropical Agriculture in Banana and Plantain.
<http://www.iita.org/banana-and-plantain>
- McCormick, D. and H. Schmitz, 2001. *Manual for Value Chain Research on Home Workers in the Garment Industry*. Brighton, Institute of Development Studies.
- International Fund for Agricultural Development (IFAD 2011)
- Lahava,E. 1995. *Banana nutrition*. In *Banana and Plantain*. S. Gowen (ed.). Chapman and Hall, London, pp. 258-316.
- Phillips,T.A. (1976) *An Agricultural Notebook*. Longman, Nigeria LTD, Ikeja,Ibadan, Enugu.pp.125-129.
- Swennen, R. (1995). *Plantain cultivation under West African conditions: A reference manual*. IITA, Ibadan, Nigeria.
- Swennen, R., Ortiz, R. (1997). *Morphology and growth of plantain and banana*. IITA Research Guide 66. (1997). Training Programme, IITA, Ibadan, Nigeria, 32 pages.
- Umesh Rudrappa (2009-17). *Nutrition facts in the food and health benefits*. *Nutrition and you .com* .Web May, 2017.
- USDA (2017). *Indept Analysis of Nutrients in Plantains (Musa species) Nutritive value per 100g*. United States Department of Agriculture Nutritional Nutrient data base. 2017.
- USDA (2017). *United States Department of Agriculture .Food Composition Databases Show Foods –Plantains Raw; Ndb* nal.usda gov. N.P. Web. March 20, 2017.
- USDA, 2012: United States Department of Agriculture. *Nutrient Data Laboratory*.
<http://www.nalusdagov/fnic/foodcamp/data/SR'8/Sr18.html>.