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Chemical mineral and anti nutrient composition of plantain (musa paradisiacal) during ripening process

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Abstract
Plant foods have played significant roles in maintaining the healthy life for thousand of years. Plantain (musa paradisiacal is a major starchy staple food in Nigeria and many countries of the world. Adequate nutritional analysis is the basis for developing and implementing effective intervention on programmes to improve the nutrition at the population level. This study was carried out to evaluate the chemical, mineral and anti-nutritional composition of plantain during its ripening process. In this study, fruits of plantain in the unripe (UR) semi-rine (SR) and fully ripe (FR) stages were analyzed. The plantain samples were peeled to remove peels, thoroughly washed, cut into small pieces, air dried and grounded into powder. Thereafter, the anti-nutrients, minerals and chemical composition of the fruits were all analyzed. Carbohydrate, crude protein crude fibre, fat, ash and moisture of the fruits ranged from 83.70 – 87.91%, 2.80-3.15%, 41-0.58%, 2.59-3.64%, 2.87-3.05% and 3.14- 6.07 respectively, with the unripe having the highest content of moisture, crude protein and fat. The semi-ripe fruits had high contents of ash and carbohydrate while the fully riped fruit was high in crude fibre. Furthermore, the antinutrients content of the plantain decreased with the ripening stage. It is concluded from this study that to optimize nutrients and decrease the anti-nutrient derived from eating planting fruits, the fruits should be consumed at the riped stage with the exception of the carbohydrate content of the fruit. However, the anti-nutrient decreases to the ripening stage.

Keywords: anti-nutrient chemical, plantain, ripening, fiber

Introduction
Plantain plants are monocxyledons, perennial and important crops in the tropical and sub-tropical regions of the world (Stresses *et al*, 2006) [1] It is cultivated in the tropics and is an important staple food in the sub-saharan Africa, Nigeria inclusive (Awodoyin, 2003) [2] It has been estimated that plantain provides nearly 60 million people in African with more than 200 calories per day (stover and simmonds, 1987) [3] plantain constitute to fourth most important global food commodity after rice, wheat and maize in terms of gross value of production (Asiedu *et al*, 1992); (FAO 2005) [5] and possesses immense health-related benefits. From the nutritional point of view, plantains are among the green vegetables with rich iron content (Adekalu *et al*, 2011) [6] In Nigeria, Cameron, cote d'ivore and other plantain producing countries in Africa, the entire fruit of pulp of plantain either upripe or half ripe are roasted on hot charcoal and eating with other delicacies such as roasted fish and red palm oil and red pepper (Uchun and Ukpebor, 1991) [7] Unripe plantain has been shown to exhibit cholesterol low erring and antidiabetic properties in experimental animals (usha and Visayammal, 1991) [8] There are also indicators that plantain flakes can be used as a safe and cost effective treatment for diarrhea (Emery, *et al*, 1997) [9]

It is of great importance of know the nutrient and toxic substance of locally available plantain during ripening process. Despite the aforementioned health benefits plantain undergoes natural or induced ripening which brings about an inevitable alteration is its chemical and nutritional properties. An important characteristics of ripening in plantain is the rate of respiration known as climatic rise in the process of ripening, the cell well composition and structure of the fruits are reported to change resulting in the softening of the fruit (Ketiku, 1973). Understanding the chemical mineral and anti-nutrient changes associated with ripening of plantain would form a basis for expending the utilization of plantain, hence these study. The study therefore evaluate the chemical, mineral and anti-nutrient composition of plantain during the ripening process.

Materials and Methods
Unriped matured plantain (musa paradisiacal) was purchased from mile one, market in Port Harcourt metropolis, Nigeria. The samples were immediately transported to the laboratory. They were sorted out to remove unhealthy and damaged ones. The samples were kept at room temperature, over the period of six days to monitor the various stage of ripening and were analyzed at the unripe, semi-ripe and fully ripe stages, a daily routine inspection of the plantain was ensured to ascertain when fully riped. The internal between the unripe, semi-riped and fully riped was three days.

Sample Preparation
The ripened, semi-ripened and unripe plantain was peeled and deried. The dried fruit was powered using a blanker and the powered simples kept in the laboratory, for analysis.

Chemical analysis of the samples
The chemicals that were used for the experiment were

obtained from the department of food science and technology, laboratory, Rivers State University.

Moisture Content Determination

A clean flat dish was dried for 15 minutes at 105^0C. It was then allowed to cool in the dedicator for 15 minutes and the weight of sample was taken and 2g of the powered plantain sample was weighed and transferred to the dish and spread out. The disk was the placed in the oven to dry for 2 hours after which they were removed and allowed to cool in the desiccators for 15 minutes. The dishes were weighed and the samples stores for further analysis according to (AOAC, 1990) [1]

$$\% \text{ Moisture content} = \frac{Mositure\ \ loss}{sample\ \ weight} \ x \ \frac{100}{1}$$

Moisture loss = (con weight + Sample before drying) = con weight + sample after drying)

Sample weight – (con weight sample before drying) – con weight.

Ash, content

The dishes were thoroughly washed cleaned and placed in the oven to dry for 30 minutes. They were cooled in the desiccators for 15 minutes and the weight was taken 2g of the powered sample was weighted into the curable after which they were taken to the furnace for ashing at 550^0C for 2 hours. The sample were removed and allowed to cool to room temperature in the desiccators and reweighted according to the (AOAC, 1990) [1].

$$\% \text{ Ash} = \frac{Mositure\ \ ash}{sample\ \ weight} \ x \ \frac{100}{1}$$

Ash – weight of crucible after drying - weight of empty crush

Sample weight – weight of curable + sample – weight of empty crucible

Crude protein determination

Powered plantain sample (2g) was weighted and transferred into a digestion flask. 0.3g. of catalyst (Copper sulphate) was weighted into the flask. 3g of sodium sulphate was also weighted into the flask, 12ml of concentrated H_2SO_4 was added to the flask, the flask was transferred to the digestion rack and taken to the fume cupthoard and also heated for a minimum of 1hr at 300^0C – 420^0C. When a clear solution was formed, water was added and poured into a flat bottom flask. The solution was then made up too 100ml.

Then, 10ml of 2% boric acid was mensured into 100ml conical flask (as receiving flask). 20ml of digest was transferred into a Kjedahl flask and 20ml of 45% NaoH was added into the boric acid indicator until it got to the 50ml mar, $0.05NH_2So_4$ was poured into the burette and titrated against the condensed sample pus on indicator until it slightly turned pink. The reading was taken as the final titre and the percentage Nitrogen and crude protein was calculated, according to the (AOAC, 1990) [1]

$$\% \text{ N} = \frac{\text{Sample tite - blank fitre x Normality of acid x 1.0}}{\text{sample weight in 20ml}}$$

Crude protein content = % Nitrogen x protein factor (6.25).

Fat content determination

A clean dried 500ml round bottom flask was weighted (WI) and 300ml of petroleum ether (40-60^0C) for the extraction was poured into the flask fitted with soxhlet extraction unit. A round bottom flask and a condenser were connected to the soxhlet extractors and cold water circulation was put on. The Wating mantle was switched on and the heating rate adjusted until the solvent was refluxing at a steady rate. Extraction was carried out for six hours. The solvent was recovered and the oil was dried in the oven at 70^0C for one hour. The round bottom flask and oil was cooled then weighed (W2). The lipid content was calculated as follows:

$$\% \text{ crude lipid content} = \frac{W_2 - W_1}{\text{sample weight}} \ x \ \frac{100}{1}$$

Crude fibre determination

The defatted sample was placed in a breaker and 25ml of 1.25% H_2So_4 was added to the sample (AOAC, 1990) [1] The mixture was then heated and allowed boiling for 4-5 minutes in a heating mantle and the beaker covered with a wash glass. A funnel with filter paper was used to filter the boiled sample using boiling water to rinse the remains in the beaker. This process was continued until the sample washing was free from acid. 25ml of NaOH was measured and used to wash the residue back into a beaker and brought to boil. It was then boiled for 4-5 minutes and then allowed to stand for 1 minute. The sample was then filtered through on ashless filter paper that has bee dried and weighed. It was then washed thoroughly using boiling water until the washing was free from the base. The filter paper was then transferred to the oven and allowed to dry for 1 hour at 105^0_C after which it was cooled and weighed. The filter paper was then transferred to an already dried and weighed crucible and then ashed for 2 hours at 550^0C. The weight were taken and the results calculated as follows:

$$\% \text{ crude fibre} = \frac{\text{weight of sample after drying } weight\ of\ \ sample}{\text{sample weight}} \ x \ \frac{100}{1}$$

Carbohydrate determination

Carbohydrate was determined by the calculation of carhydrate = 100 - (protein + moisture + fat + ash)

Mineral Analysis

The content of each mineral on the samples were determined as follows – one hundred grams of each sample was weighed into a 250 ml beaker, according to (AOAC, 1990) [1] 30ml of concentrated metric acid was added to it and evapourated on a steam water bath and thereafter dissolved in 40ml of HCl at a ratio of 1:1 and digeted for two hours on a hot plate with magnetic sturer. 1 ml a dilute HCl was further added to sample and boiled for about 1 hour and thereafter made up to 100ml using distilled water. The minerals, calcium, magnesium, iron, fodium, potassium and phosphours were determined using atomic absorption spectrophotometer.

The calculating were made as follows:

$$\text{Conc. (mg/100g)} = \frac{\text{standard } conc.\ x\ sample\ absorbance}{\text{standard absorbance x weight of sample}} \text{ x } \frac{100}{1}$$

Antinutrient Analysis

The anti-nutrientional factors phyfate tannins, oxalate and saponin were analyzed using AOAC methods (19990). Triplicate samples determination were carried out for each of the analysis.

Statistical analysis

All the analysis was done in triplicate and the result averaged. Results were expressed as mean I.S.D. Significant differences between means were evaluated by the lest significant difference, (LSD) test to determine the level of differences between the sample parameters.

Results

The result of the chemical composition of plantain are presented in Table 1. The moisture content revealed that there was a gradual increase in the moisture content during the repening process. There was also a decrease in the fiber content of the plantain during the repening process. The ash content of the plantain during ripening process increased. There was also gradual increase in protein content of the repining plantain. The carbohydrate content of plantain decreased with time.

The mineral content of plantain increased with the period of ripening (table 2), also the anti-nutrient content of the plantain were reduced during the ripening process, there were no significant difference (P>0.5) between the different ripening stages. Phytate content of the unripe semi-ripe and fully riped plantain fruits wre 0.200%, 0.263% and 0.245% respectively. The tannin, oxalate and saponin content of the plantain reduce during the ripening process. However, the reduction were not significantly different from the unripe, semi riped or riped plantain (table 3)

Table 1: Chemical composition of plantain during ripening process

	Days	% moisture	%Ah	%crude feber	%fat	%protein	% carbohydrate
Unripe	1	41.0±1.38	2.70±0.19	2.51±0.06	2.64±0.50	315±0.07	4.8.0±0.11
Semiripe	3	42.0±1.17	2.90±1.20	1.25±0.08	3.15±0.70	3.65±0.08	47.05±01.8
Fully ripe	6	48.0±1.52	3.14±1.11	1.67±0.71	3.63±0.79	3.90±0.71	39.66±0.50

Values are expressed as mean ±50. n = 3

Table 2: mineral composition of plantain during ripening process

	Days	Calcuium mg/l)	Iron (Mg/L)	Magnesium (mg/L)	Zinc mg/L	Potassium Mg/L	Phosphorus Mg/L
Unripe	1	17.95±0.07	21.04±0.05	24.91±0.07	7.92±0.02	26.59 ±0.03	107.61±0.05
Semi ripe	3	22.16±0.09	27.07±0.14	26.52±0.02	9.52±0.40	27.93±0.07	109.56±0.16
Ripe	6	24.05±0.06	32.29±0.20	28.61±0.04	11,43±0.05	30.25±0.41	111.47±0.07

Values are expressed as mean ±50.m = 3

Table 3: Anti-nutrient components of plantain durng ripening process

Days	Phytate %	Tanin %	Oxalate %	Saponin %
Unripe 1	0.240 ±0.02	0.30 ±0.04	0.55±0.20	1.6 ±0.40
Semi ripe 3	0.220 ±0.03	0.28±0.07	0.49±0.12	1.51±0.30
Ripe 6	0.215 ±0.05	02.5±0.02	0.45±0.4	1.49 ±0.41

Values are expessed as means ± SD

Discussion

The moisture content is very essential for life maintenance. It is one of the most widely used measurement which determine the way the food will be processed and its shelf life. This study reveal the gradual increase in the moisture content of plantain during ripening. The increased moisture content may be due to the break down of some carbohydrate components, due to enzyme activities. The ash content, of food samples is very important in determining mineral contents. There was gradual increase in protein content as well as the fat content of the plantain (Table 1). The finding was in full agreement with the work of Brady (1970) [10] who did similar work with banana.

Protein is needed for normal body growth, repairs and maintenance. Hence, a relatively high amount of protein in plantain during, ripening process is an advantage.

The gradual increase of mineral contents of plantain was consistent with the report of Ahenkora, *et al*, (1997) [11] during repening process. There was also a gradual decrease in the content of the anti-nutritional content of plantain during the ripening process. The reduction in the anti-nutrient content could be to aid in the availability of the minerals as the fruit ripens.

Conclusion

The chemical, minerals and anti-nutrient contents of plantain were studied during the plantain ripening process. The percentage moisture ash, fat and protein all increased as the ripening progressed to day six. However, the anti-nutrient decreased as the repening process progressed. The result show

that plantain is improved in nutrition composition during ripening process.

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