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Influence of Different Processing Methods on the Nutritional and Phytochemical Properties of Unripe Plantain (Musa Paradisca) and Dward Unripe Banana (Musa acuminata)

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Abstract:

Objectives; *The study ascertains the influence of different processing methods on the nutrients and phytochemical contents of unripe plantain and dwarf bananas.*

Materials: *The samples used in the study include raw unripe plantain fingers and dwarf unripe banana fingers. Methods; The samples were subjected to different processing methods of roasting and frying. They were saperately oven dried, grounded into fine flour, sieved, packaged and preserved in clean nylon for further analysis.*

Results: *The result showed that, roasted unripe dwarf banana had higher protein content (1.76g) than the roasted unripe plantain (1.68g). The Cho content of the roasted unripe plantain was higher (81.9g) in relation to the roasted unripe dwarf bananas (79.21g). Mineral result showed that phosphorus, Zinc, iron potassium, magnesium and calcium content were higher in the fried unripe dwarf banana (8.72, 1.91, 2.93, 10.64, 8.58 and 18.75) in respect to the fried unripe plantain (7.44, 1.62, 2.02. 9.48, 7.16 and 16.46) but highest in the raw unripe dwarf banana. Analysis showed higher oxalate content in both the raw dwarf unripe banana (0.18) and the raw unripe plantain (0.19), than was found in the other processed samples. Fried and roasted raw banana had (0.02 and 0.03) oxalate in relation to fried and roasted unripe plantain (0.03 and 0.03 respectively).*

Conclusion: *Processed (fried and roasted) samples had lower phytochemical contents in relation to the raw samples. Minerals were lower in the processed samples in relation to the raw unripe dwarf banana. This could be attributed to the loss encountered during processing. we therefore recommend proper processing of food before consumption, so that utilization of minerals will be maximized. Conclusive evidence has shown that unripe dwarf banana has higher nutritional qualities than the unripe plantain even after processing.*

Keywords: *Processing methods, Nutritional, phythochemical and properties*

1. INTRODUCTION

Food processing is the transformation of raw ingredients by physical or chemical means into food or of food into other forms. There are many processing method which include, cooking such as boiling, frying, roasting, grilling, baking and etc. These activities results in the manufacturing of ready to-cook or pre-cooked foods like chips, cakes, pies, sauces and many others.

Processing reduces the nutritional and phytochemical content value of some root crops as a result of losses and changes in major nutrients including protein, carbohydrate, minerals and vitamins (1). The first step in processing any food is by peeling which removes some nutrients if it is not done carefully, nutrients may still be lost during roasting and frying. Vitamins are susceptible to both process. Fried and roasted food tend to loose more nutrients than boiled food and are energy dense food. They are not recommended for people who are overweight or have heart diseases. The benefits of the processing methods are to help in toxin removal, increase food consistency and help in the presentation of the food. Processing methods can also reduce the incidence of food borne diseases in raw meats that could harbour pathogenic micro-organisms (e.g. Salmonella) which are capable of causing serious illness also, boiling method can help reduce the micro organisms (2).

Plants play important role in the cycle of nature. This is because life on earth basically depends on them, plants provide man with all his needs as regards food, shelter, clothing, fragrance as well as medicine. They are naturally occurring substances that produce almost all the food that animals as well as human eat. They have potentials to make their own food through photosynthesis. All foods that people eat naturally

come directly or indirectly from plants. It is basic for averting hunger from every human being.

Phytochemicals are chemical compounds that occur naturally in plants. Some are responsible for colour and other organoleptic properties such as the smell of garlic. The term is generally used to refer to those chemicals that may have biological significance, for example flavonoids but are not established as essential nutrients. There are many phytochemicals that have potentials to affect diseases like cancer, metabolic syndrome (3).

The phytochemical profile (cartenoids, flavonoids, phenolic, saponins) are reduced by different processing methods.

Plantains are members of the banana family, native to India and are grown most widely in tropical climates. They are starchy, low in sugar. It is used in many ways like savory dishes, like potatoes would be used and is very popular in western Africa and the Caribbean countries it is usually fried or baked. Plantains are sometimes referred to as the pasta and potatoes of the Caribbean (4).

The plantain averages about 65% moisture content and the banana averages about 83% moisture. Hydrolysis, the process by which starches are converted to sugar, acts faster in fruit and in banana with high moisture content, it converts starches to sugar faster in bananas than it does in plantains (5). Plantains are often firmer than dessert banana; they also have less sugar.

Unripe plantain (Musa Paradisca) is the common name for plant species in the genius Musa. It is a perennial crop that takes the appearance of a tree as it matures, diverse cultivars are grown (6). It is very similar to the unripe desert banana outwardly in appearance and is longer in length, have thicker skin and contain more starch than banana (7). Different species of unripe plantain also have different phytochemcial content. Their species include, Giant french plantain, medium french plantain, true horn plantain and false horn plantain.

Bananas have been traced through history back to 327BC, primarily in India. It was not until 1834, however that the mass production of the banana (Musa acuminata) began. Banana trees are not technically trees that grow from a rhizome. Gardeners in cooler climates can grow the dwarf banana (musa acuminata) in containers and bring it indoor during cold weather. The smaller banana plant is the same as for its larger cousin, unless it is grown in a container. In that case, it requires more attention and a diluted fertilizer.

The dwarf cavendish banana is a widely grown and commercially imported Cutivar. The name dwarf Carvendish is in reference to the height of the pseudostem, not the fruit (8). It is one of the most commonly planted banana varieties from the lavendish group and the main source of commercial carvendish banana along with grand Nain (9).

Carvendish were named after witham carvendish, 6th Duke of Devonshire though not the first known banana specie in Europe around 1834. The plants were botanically describe by Paxton as musa cavendishis after the Duke. (10). Dwarf cavendish plants grow up to a height of only 6-8ft (1.8-2.4m).

Plantains are important component of many dishes in Western Africa and Caribbean countries. In addition, the leave of musa species can be used as a source of fiber for thread cloth string, thread or can be used as thatch and roofing the plants are grown also as an effective source of shade for other crops (11). The psythum in plantain has been used as GI therapy to treat hyperlipidemia, for anticancer effects and for respiration treatment (12). In human studies, plantain has been effective remedy for chronic bronchi's, Asthma, cough and cold. Chemical studies show that psythium seed is useful as a bulk laxative. Plantains contributes to a healthy and balanced diet, providing a rich source of vitamins and minerals to help fuel the body (13). The most abundant nutrient in plantain is carbohydrate. Each medium size plantain contains approximately 57 grams of total carbohydrates, with almost 27 grams coming from sugar. Each medium plantain also contain 4.1 grams of dietary fiber, a nutrient that helps control blood sugar and cholesterol levels, as well as prevent constipation. The fiber in plantains contributes significantly to daily intake requirements (14). One medium plantain provides about 20% of daily diet or 14% in a 2000 calorie diet, according to Colorado State University.

Potassium: Bananas and plantains provide a source of potassium- almost 20% of daily recommended intake, according to the linus pauching Institute. The body uses this potassium to support the nervous system; As a result, eating plantains and help prevent the muscle weakness, intestinal paralysis and irregular heart-beats that can occur due to potassium deficiency (15). **Vitamin A**: Eating a medium plantain provides the body with 2017 international units (IU) of vitamin A,

corresponding to 86% of the recommended intake for women and 67% of the intake for men according to the pauhing Institute. **Phytochemical composition of plantain.** Plantain contains many biologically active compounds. The plantain fruit stimulates gastric mucus secretion and growth of the gastric mucosal cells. The lectins in plantain seem to bind some mannose oligosaccharides that are on some bacteria which help them attach to the gastric and intestinal linings. the tannin (astringent) allantion (promotes wound healing, speeds up cell regrowth inflammatory flavoniod) aucubin (a glycoside a powerful anti-toxin, increases uric acid excretion by the kidneys), baicalein, linolenic acid, Oleanolic acid, sorbitol indiod glycosides in plantains are considered the major factors in making it a mild anti-inflammatory, as well as an antimicrobial and anti haemorrhagic. It acts as a sedative, anaesthetic, alternative, antiseptic, anti-viral, anti-toxic, anti-histamin, anti-inflamatory, anti-rheumatic, anti-tumor, anti- cancer, anti-carcinogonic, a diuretic an expects rane, a hypotensive and organoleptic. Plantain also contain Silla which makes plantain high in Calcium this herb is high in mualage especially the seeds. Also, active in plantains are monsterpene alkaloids triterpenes, phenols, sugars and flavoniods, lutein, scutellarin, baicacakin, nepetin, hispidulin, plantagoside and acteoside plantamajoside. Plantain also contains other plant acids such as chlorogenic, citric, ferutic, neochlorogenic, fumaric, hydroxyl-cinnamic, salicyctic, ursolic and benzoic acids. Cetalpol stimulates the production of advance gland androgens, has an anti-inflamatory ability, seems to help in wound healing and increase the production of sex hormones, (16). **Dwarf Bananas.** Dwarf Bananas are among the most widely consumed fruits on the planets and according to the U.S department of Agriculture Americans favorite fresh fruit (17). The curry yellow fruits are high in potassium and protein, a form of fiber". They can also be a good way to get magnesium and vitamin c and B6. Dwarf banana are high in anti oxide which can provide protection from free radicals which we come in contact with everyday, from the sunlight is the lotion one puts on the skin. Bananas are good for the heart. They are packed with potassium, a mineral electrolyte that keeps heart beating. Bananas has high potassium and low sodium content may also help protect the cardiovascular system against high blood pressure. Banana can be helpful in overcoming depression "due to high level of tryptophan, which the body converts serotonin, the mood elevating brain neurotransmitter (18) Bananas are high in fiber, which can help keep one on regular shape. One banana can help protect against type two diabetes and also in weight loss; (19) in general, bananas are a great weight loss food because they taste sweet and are filling, which helps curb craving. They also help sustain blood sugar levels during work outs. Carrots may get all the glory for helping the eyes, but banana do their share as well. The fruits contain a small but significant amount of vitamin A, which is essential for protecting the eyes, maintaining normal vision and improving vision at night according to national institute of health. Vitamin A contains compounds that preserve the membranes around the eyes and are an element in the proteins that bring high to the corneas. Like other fruit, bananas can help prevent macular degeneration, an incurable condition which blurs central vision. Bananas may not be overflowing with calcium but they are still helpful in keeping bones strong. According to a 2009 article in the journal of physiology and Biochemistry, bananas contains a number of frutoligosaccharides there are no digestive carbohydrates that encourage digestive – friendly probotics and enhance the body's ability to absorb calcium. **Nutritional Content of Dwarf Bananas.** Dwarf Bananas are very low in saturated fat, cholesterol and sodium and are a good source of dietary fiber, vitamin c and B-6 and minerals potassium and manganese. They are great sources of energy that can be eaten in many ways, including mixed with other fruits to make a fruit salad, sliced on cereal or yoghurt, combined in a sandwich with peanut butter or blended into a smoothie. A Banana makes a convenient snack for those on the go.-all wrapped up in its very own package. **Calorie Information.** A medium-sized banana has about 105 calories. Of those calories, 97.4% come from carbohydrate, 3.3% come from fat and 4.3% come from protein (Bates, 2013). A banana contains 27 gram representing fiber 6.3 grams starch and 14.4gnaturally represents sugars. A banana has only 0.4grams of fat in a single serving with almost twice as much omega-6 fatty acid compared to omega-3 fatty acids. **Vitamin and Mineral Content.** A single banana contains 75.5 Iu% vitamin A, 10.3grams of vitamin C, 611.0 milligrams choline and trace amounts of vitamin E, vitamin k, riboflavin, niacin, vitamin B6, folate, pantothenic acid and betaine. Additionally, a medium–seized banana contains 5miligrams of magnesium, 422 milligrams of potassium and trace amounts of sodium, zinc, iron, copper and Selerium (20). **Health Benefits.** Because they have potassium it is an important mineral in the regulation of blood pressure, organ health and muscular integrity. Potassium deficiency symptoms can

range from cramped and tired muscle to high blood pressure and headaches. Banana help maintain cellular function, electrolyte balance and a healthy cardiovascular system. They also offer a quick, convenient and bioavailable source of immediate and long term energy (21).

2. MATERIALS AND METHODS.

The unripe plantain and dwarf banana were purchased from Ahia Eke Market in Umuahia Abia State, Nigeria.

2.1 Sample Preparation:

2.1.1. Roasting; Four fingers each of unripe plantain and dwarf banana were washed and peeled. The samples were sliced and placed on a grill rack, very close to the grill. The samples were subjected to a temperature of 150°c -200°c for oven drying and even browning for 15-20minutes. The samples were grinded into fine flour, sieved and packaged in a clean nylon for further analysis.

2.1.2. Frying; Four fingers each of unripe plantain and dwarf bananas were washed and peeled. They were placed in a bowl and sliced into equal proportions. good quantity of vegetable oil was poured into a frying pan and allowed to heat. The samples were poured into the oil until it turns golden brown. The samples were removed from the frying pan and poured into a sieve to drain oil and to cool. The samples were grinded into fine flour, sieved and was stored in a clean nylon for further analysis.

Chemical Analysis; Proximate analysis was conducted on the unripe plantain flour and dwarf banana flour using standard assay method of AOAC (22). **Determination of Minerals;** The mineral content of the test samples were determined by the dry ash extraction method following which specific mineral element. 2.0g of the sample was burnt to ashes in a muffle (as in ash determination) the resulting ash was dissolved in 100ml of dilute hydropchloric acid (lm HCL) and diluted to 100ml in a volumetric flask using distilled water. The digest so obtained was used for the various analysis.

Determination of saponins. The saponin content of the samples were determined by double extraction gravimetric method (23). 5g of the powered sample was mixed with 50 ml of 20% aqueous ethanol solution in a flask. The mixture was heated with periodic agitation in water bath for 90 minutes at 55°C; it was then filtered through a filter paper. The residue was extracted with 50 ml of 20% ethanol and both extract were pored together and the combined extracted was reduced to about 40 ml at 90°C and transferred to a separating funnel where 40 ml of diethyl either was added and shaken vigorously. Separation was by partition during which the ether layer was discarded and the aqueous layer reserved. Re extraction by partitioning was done repeatedly until the aqueous layer become clear in colour. The sapinions were extracted, with 60 ml of normal butanol. The combined extracts were washed with 5% aqueous sodium chloride (Na CI) solution and evaporated to dryness in a reweighted evaporation dish. It was dried at 60"C in the oven and reweighted after cooling in a desicator. The process was repeated two more times to get an average. Saponin content was determined by difference and calculated as a percentage of the original sample thus;

$$\% \text{ Saponin} = \frac{W_2 - W_1}{\text{Wt of sample}} \times 10$$

Where : W_1 =weight of evaporating dish

W_2 =weight of dish + sample

Determination of Alkaloids. This was done by the alkaline precipitation gravimetric method described by (24). A measured weight of the sample was dispersed in 10% acetic acid solution in ethanol to form a ratio of 1.10 (10%). The mixture was allowed to stand for 4h at 28°C. It was later filtered via what man No 42 grade of filter paper. The filtrate was concentrated to one quarter of its original volume by evaporation and treated with drop wise addition of cone aqueous NH_4OH until the alkaloid was precipitated. The alkaloid precipitated was received in a weighted filter paper, washed with 1% ammonia solution dried in the oven at 80°C. Alkaloid content was calculated and expressed as a percentage of the weight of sample analyzed.

Determination of Tannins: The method of (25) was used for the determination of tannin contents of the differently processed samples. 0.2g of finely ground sample was measured into a 50 ml beaker. 20 ml of 50% methanol was added and covered with parafin and placed in a water bath 77-80°C for 1h and stirred with a glass rod to prevent lumping. The extract was quantitatively filtered methanol to rinse. This was made up to mark with distilled water and thoroughly mixed. 1 ml of sample extract was pipette into 50ml volumetric flask, 20ml distilled water, 2.5 ml Folin-Denis reagent and 10 ml of 17% Na_2C0_3 were added and mixed properly. The mixture was made up to mark distilled water, mixed well and allowed to stand for 20

min when a bluish – green colouration developed. Standard Tannic Acid solutions of range 0-10 ppm were treated similarly as 1 ml of sample above. The absorbances of the Tannic Acid Standard solutions as well as samples were read after colour development on a Spectrnic 21D Spectrophotometer at a wavelength of 760 mm. Percentage tannin was calculated using the formula:

Tannin (%) = Absorbance of sample x Average gradient x Dilution factor.

Statistical Analysis;

Data collected were analyzed using the statistical package for social sciences, version 15.0 software. The differences in the nutrient and phyotochemical component/content of each of the sample were compared with that of their control using the students T-test.

Table 1: *Proximate composition of food samples*

Treatment	Moisture content	Dry matter	ASH	Crude fibre	E.E	Protein	CHO
Raw (unripe)	59.46±0.01^{b}	40.49±0.03^{e}	1.83±0.01^{c}	0.63±0.01^{f}	0.54±0.02^{d}	1.81±0.01^{b}	35.75±0.05^{d}
Fried Unripe plantain	9.52±0.03^{f}	90.48±0.06^{a}	1.80±0.07^{d}	0.78±0.01^{d}	8.50±0.02^{b}	1.74±0.02^{d}	77.63±0.02^{b}
Roasted unripe plantain	13.82±0.02^{d}	86.14±0.02^{c}	1.75±0.01^{e}	0.92±0.02^{b}	0.61±0.02^{c}	1.68±0.01^{e}	81.19±0.02^{a}
Dwarf (Raw) banana	61.20±0.02^{a}	38.67±0.04^{f}	2.18±0.02^{a}	0.67±0.02^{e}	0.630±0.01^{c}	1.83±0.01^{a}	33.40±0.04^{e}
Fried	12.42±0.06^{e}	87.55±0.02^{b}	1.85±0.01^{b}	0.84±0.03^{c}	9.15±0.05^{a}	1.63±0.01^{f}	74.11±0.02^{c}
Roasted	15.68±^{c}	84.32±0.01^{d}	1.78±0.02^{e}	0.96±0.02^{a}	0.620±0.10^{c}	1.76±0.03^{c}	79.21±0.03^{b}

Mean ± Standard deviation of duplicate analysis

Mean values with different superscripts down the column are significantly different (P.

Table 2: *Mineral content of the food samples*

Treatment	calcium	Magnesium	Potassium	Iron	Zinc	Phosphorus
Raw (unripe)	19.48±0.02^{b}	9.55±0.03^{b}	10.55±0.06^{b}	2.92±0.02^{b}	1.81±0.06^{b}	8.46±0.02^{c}
Fried	16.46±0.01^{f}	7.16±0.03^{f}	9.48±0.10^{e}	2.02±0.01^{e}	1.62±0.02^{d}	7.44±0.03^{e}
Roasted	17.45±0.03^{e}	7.52±0.02^{e}	9.85±0.04^{d}	2.63±0.01^{d}	1.77±0.03^{c}	8.24±0.04^{d}
Dwarf (Raw) banana	21.64±0.01^{b}	10.28±0.01^{a}	11.31±0.02^{a}	3.46±0.01^{a}	1.90±0.02^{a}	9.50±0.01^{a}
Fried	18.75±0.02^{d}	8.58±0.02^{d}	10.64±0.02^{b}	2.93±0.05^{b}	1.91±0.01^{a}	8.72±0.02^{b}
Roasted	17.45±0.02^{e}	7.52±0.01^{e}	9.85±0.04^{d}	2.63±0.01^{d}	1.77±0.04^{c}	8.24±0.01^{d}

Mean ± Standard deviation of duplicate analysis

Mean values with different superscripts down the column are significantly different (P.

Table 3: *Phytochemical contents of food samples*

Treatment	Alkaloid	Phenol	Saponin	Phylate	Tannin	Oxalate	flavonoid
Dwarf banana (raw)	0.13^{c}±0.01	0.06^{a}±0.00	0.12^{b}±0.00	0.11^{a}±0.00	0.08^{b}±0.00	0.18^{a}±0.00	0.09^{ab}±0.00
Fried	0.02^{f}±0.01	0.01^{d}±0.00	0.02^{f}±0.00	0.02^{a}±0.00	0.04^{f}±0.00	0.02^{b}±0.00	0.02^{c}±0.00
Roasted	0.04^{d}±0.00	0.05^{b}±0.00	0.04^{c}±0.00	0.03^{a}±0.00	0.07^{c}±0.00	0.03^{b}±0.00	0.04^{bc}±0.00
(Raw) plantain	0.24^{a}±0.01	0.02^{c}±0.00	0.16^{a}±0.00	0.13^{a}±0.01	0.09^{a}±0.00	0.19^{a}±0.00	0.12^{a}±0.00
Fried	0.04^{e}±0.02	0.05^{b}±0.01	0.03^{d}±0.00	0.03^{a}±0.02	0.04^{e}±0.00	0.03^{b}±0.00	0.03^{bc}±0.00
Roasted	0.05^{b}±0.00	0.05^{b}±0.00	0.04^{c}±0.01	0.03^{a}±0.03	0.07^{c}±0.00	0.03^{b}±0.00	0.04^{bc}±0.00

3. CONCLUSION

The study has provided baseline information on the influence of processing methods on the nutrient and phytochemical profile of roasted and fried Unripe plantain and dwarf Unripe banana. It is therefore recommended that proper care should be applied when processing the food products in other to reduce loss of nutrients. Also, use of adequate processing methods should be encouraged, that will reduce the presence of antinutrients to a safe level.

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