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Research Article

COMPARATIVE STUDY OF THE CONSTITUENTS OF NUTRITIONAL INTEREST OF FALSE HORN PLANTAIN (*MUSA PARADISIACA* L.) IN TWO OF THE RECIPES CONSUMED IN THE DEMOCRATIC REPUBLIC OF CONGO

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Abstract

In DR Congo, plantain bananas are often eaten in the form of recipes, some of which include lituma, plantain pulp prepared in boiling water or steam and crushed. This study was conducted in order to compare the contents of the energetic constituents as well as those of the mineral compounds of the False Horn plantain in the green / ripen state compared to the same uncooked banana in order to highlight which mode of cooking better preserves these nutritional elements. The results obtained show that the cooked False Corn plantain absorbs water. Boiled bananas lose total ash, fat and carbohydrates, their water-soluble energy components. Likewise, the losses of mineral elements (Ca, Mg, P, K and Na) are much greater in boiled bananas than in bananas cooked in steam. Thus, the cooking method which preserves the energetic constituents and the mineral elements of the False Horn plantain is cooking in steam.

Keywords: D R Congo, False Horn plantain, Cooking, Energy components, Minerals elements

INTRODUCTION

The plantain banana, still called cooking banana or simply plantain by its scientific name, *Musa paradisiaca* is the fruit of the plantain banana tree, a plant of the musaceae family. It is a cross between the two species: Musa acuminata and Musa balbisiana. Their cultivars give several types of diets in which the fingers (fruits) compete. The apical fingers being larger than those born at the base. Based on the number of fruits in a bunch, the presence/absence of the male bud, the number of flowering stages bearing female flowers (number of hands) as well as the number of differentiated female flowers per hand (number of fingers), a typology of bunches has been established. Due to the absence of the male bud and the reduced competition of the fingers within a bunch, True Horn Plantain will have larger fingers than False Horn Plantain (bc). Similarly the latter will have larger fingers than the French type (bf) (Mbarga, 2013; Dhed'ADjailo *et al.,* 2011). Plantain bananas are produced in large quantities throughout the world. The D.R. Congo, with its 4,159,932 tonnes in 2014 (Serge BokumaOnsiti *et al.,* 2015), was one of the major African producers. In nutritional terms, the plantain banana is the fourth most important staple food in the tropical zone (Lassois, 2009) after cassava, maize and rice (Odah, 2013). It is also one of the fruits that are essential for the diet of the populations since it provides them with energy constituents: proteins, lipids, carbohydrates and fibres, vitamins including A, B6, C and D, and mineral elements including potassium (K), calcium (Ca), magnesium (Mg), phosphorus (P), which are essential for the proper functioning of the organism (G. NgohNewilaha, 2005; Juan-Alfredo, 2007).

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Plantain also has medicinal virtues; in fact, regular consumption of plantains prevents the risk of kidney and colorectal cancers, protects the stomach lining against ulcers, reduces the symptoms of chronic diarrhoea in children, prevents cardiovascular diseases, has a beneficial effect against type 2 diabetes (Sampath Kumar, 2012). Around the world, some of its standardized processing products are: crisps, infant foods, cossettes, unsweetened/sweetened flours from green/ripe pulps, French fries, dried/frozen ripe pulps; reconstitution products for local dishes (ntouba, foutou, etc.); and products to reconstitute local dishes (ntouba, foutou, etc.) (Sampath Kumar, 2012).), pancakes, bread, cakes, doughnuts and others from plantain flour (Kwa, 2019), (S. Le Berre, 1969; Guillaume Hensel Fongang Fouepe). In D.R. Congo, plantains are also eaten alone or in combination with other foods. In either case, plantains are prepared in the form of culinary recipes including: lituma, prepared and crushed plantain pulp, plantain Faux Horn in the green/wall state cooked in steam or boiled in water. This study is being conducted to determine which of the last two cited culinary recipes of the Faux Horn plantain banana better conserves the energy constituents and mineral elements.

MATERIALS AND METHODS

Materials

Plant material: The plant material of the study includes two hands of plantain plantains False Horns in the green/wall state. This plant material was purchased in Kinshasa in the market of Matete.

Equipment: The equipment used in this study of certain constituents of nutritional interest in the recipe samples of

False Horn plantains in the green/wall state includes: kitchen knife: 1; kitchen basin: 2; Kern emb 500-1 analytical balance, accuracy 0.1 g: 1; precision analytical balance (Mettler AE100, accuracy 0.001g; packet of tissue paper: 1; vine rack (thickness: 2. 5 cm diameter: 25 cm): 2; stainless steel kettle of height h = (22.5 ± 0.1) cm and diameter d = (26.0 ± 0.1) cm: 1; stainless steel kettle of height h = (24.0 ± 0.1) cm and diameter d = (28.0 ± 0.1) cm: 1; stainless steel kettle of height h = (24.0 ± 0.1) cm and diameter d = (28.0 ± 0.1) cm: 1; stainless steel kettle of height h = (24.0 ± 0.1) cm and diameter d = (28.0 ± 0.1) cm: 1. 5 ± 0.1) cm: 1; packet of plastic bag No. 8: 1; gas stove brand Coete-gaz with gas cylinder: 1; distilled water: 25 L; muffle oven brand Heraeus R. F. A: 1; Soxhlet apparatus: 1; Concentrated H2SO4; Atomic absorption spectrophotometer brand (Variantechtron AA6, Japan): 1; Aluminium capsule:1; Desiccator containing silica gel:1; Oven (Heraeus):1; Spatula:1; Hot plate brand Luxell: 1; Porcelain crucible:1; Fat extractor brand: Velp Scientific : 1; Beaker:1; Rotavapor (IKA Janke &KUnkel):1; 100 mL volumetric flask:1; Nitrogen distiller:1; Pipettes; Magnetic rod:1; Mineraliser (brand: Buchhi, Velp Scientific):1; Reflux assembly (according to Soxhlet):1; Filter paper (Whatman n01); 250 mL ground-necked flask:1; pH meter (brand: Hanna Instruments and Mettler Toledo):1.

Methods

In this work, the recipe samples of the green/white plantain False Horn plantains offered for consumption after cooking retained are boiling water and steam. Figure 1 below shows the steps leading to these consumable recipes. Each preparation step has a sample coding. In the diagram below, the samples of green/wall plantain False Horn bananas cooked in boiling water/steam and cooled (E1bcr and E1vcr) were analysed.

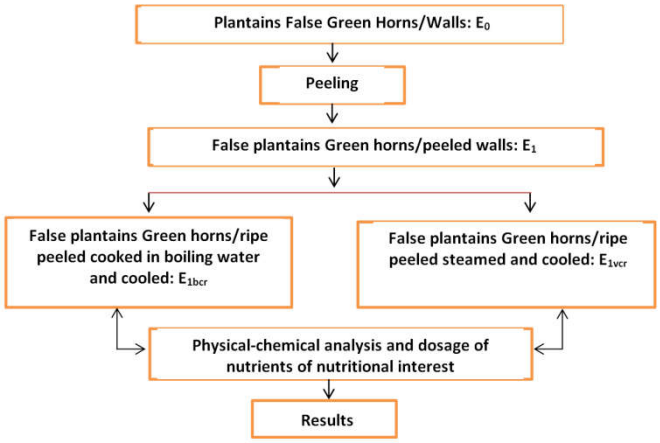

Figure 1. Steps in the preparation of Plantain False Horn bananas according to two cooking methods: boiling water and steaming

Preparation of recipe samples.

For the Faux Horn plantain banana recipe:

In boiling water.
Clean three plantain plantains with distilled water, peel them, wipe them with tissue paper and weigh them, these are the recipe samples E1bcr

Place the E1 samples in two pots each containing 2.5 litres of distilled water; the first with the green bananas and the second with the ripe bananas, light the two-plate gas stove, cook them for one hour, cool them to room temperature and weigh them.

In the steam.
Clean the horny plantain bananas in green/maroon state with distilled water, peel them, wipe them with tissue paper and weigh them. These are the E1vcr recipe samples

Place a 7 cm high stainless steel washer at the bottom of each pot on which the liana rack rests as shown in Figure 1 below, pour 2.5 L of water so that the rack is not flooded, place the E1vcr recipe samples in the two pots, the green bananas in the first pot and the ripe ones in the second, light the gas stove, cook them for one hour, cool them to room temperature and weigh them.

Table 1 groups the average masses with the standard deviation of three trials for each recipe as an error.

Figure 2 shows the kettles containing the liana racks while Figure 3 shows the peeled recipe samples.

Figure 2. Kettles containing liana racks

Figure 3. Kettles containing peeled recipe samples.

Determination of constituents of nutritional interest in recipe samples: In this work, the constituents of nutritional interest in the recipe samples of plantain False Horns in the green/wall state determined are: the contents: water, ash, crude protein, lipids, total carbohydrates, celluloses. The same applies to the following mineral elements: Ca, K, Mg, Fe, P and Na, they will be determined by classical methods (J. Didier de Sant Amand, 1966) in general and in particular;

The water content, H (%) of the samples received was determined using the method of dehydration of the samples to constant weight described by Vervack (1982), and then calculated by the relation :

H (%)=(P_2-P_3)/P_e x 100 (1)

With:

H (%): water content of the sample
P1 (g): weight of empty capsule ;
P2 (g): weight of capsule with fresh sample;
P3 (g): weight of capsule with sample after drying;
Pe (g): test sample.

The total ash content was determined by charring followed by incineration Vervack (1982). The total ash content was calculated with the relation:

CT (%)=(C_3-C_2)/〖C_2-C_1〗_ x 100 (2)

With:
TC (%): total ash content of the sample
C1 (g): weight of empty crucible ;
C2 (g): weight of crucible with fresh sample;
P3 (g): weight of crucible with sample after incineration;

The fat content of the samples was determined by the Soxhlet method as described by Vervack (1982). The following expression is used to determine the fat content :

MG (%) = (P_f-P_v)/P_e x 100 (3)

Fat content (%): fat content of the sample
Pf (g): weight of the capsule with fat after evaporation of the solvent ;
Pv (g): weight of the empty capsule;
Pe (g): test sample.

The protein content was deduced from the determination of total crude nitrogen using the Kjedahl method described by Vervack (1982). It was then calculated using the expression :

PR (%) = ((V_a-V_b)x1.4f_c)/P_e x 100 (4)

With:
PR (%): protein content of the sample
Va (g): Titratable volume of acid ;
Vb (g): Volume of base used (10 mL);
fc (g): Conversion factor used (6.25) based on the fact that most pure proteins contain approximately 16% nitrogen.
Pe (g): test sample.

The crude fibre content was determined by Kurschner's method based on the attack of organic matter by a mixture of nitric acid and acetic acid described by Vervack (1982). It was then calculated by the relationship :

FB (%)=((P_2-P_1)-(C_2-C_1)/P_e x 100 (5)

With:
FB (%): crude fibre content of the sample
C1 (g): weight of empty crucible ;
C2 (g): weight of the crucible after incineration;
Pe (g): weight of filter paper;
P2(g): weight of filter paper with dried and cooled filtrate;
P2(g): weight of filter paper with dried and cooled filtrate

Determination of trace elements in recipe samples. The trace elements in the recipe samples whose contents have been determined are Ca, Mg, Fe, Na, K and (PO4)3-. For this purpose, mineralized solutions were first prepared for each recipe sample. The total ash obtained was solubilized in a 100 mL Erlenmeyer flask containing a boiling solution.

RESULTS

Tables 1, 2 and 3 report the results of the analyses of the constituents of nutritional interest of plantain False Horn in the green/wall state. Each result is a mean of three samples with the standard deviation as the error

Table 1. Average masses of the samples of plantain bananas False Horn green/ripe recipe samples

	E_0	E_1	E_{1bcr}	E_{ep}	E_{wa}
Cooked in water					
<m> (g)	283,5±4,2	214,97±4,23	197,52±3,10	86,00±7,28	17,47±7,85
<m> (g)	238,7±13,4	171,43±3,42	167,9±10,5	70,80±1,13	3,53±1,41
	E_0	E_2	E_{2vcr}	E_{ep}	E_{wa}
Cooked in water vapour					
<m> (g)	274,97±48,43	183,37±43,43	191,27±43,15	91,60±5,05	7,90±1,93
< m > (g)	441,30±3,82	315,77±35,38	318,07±35,21	125,53±31,94	2,30±0,46

Table 2. Teneurs des constituants énergétiques de la banane plantain Faux Corne verte /mure

	H(%)	CT (%)	MG (%)	P B (%)	H C (%)	F B (%)
Uncooked						
<bpFCv>	59,60±5,55	1,10±0,01	0,27±0,03	2,23±0,01	36,79±5,52	0,67±0,01
<bpFCm>	58,87±0,38	1,14±0,04	0,32±0,02	2,27±0,02	37,41±0,41	0,67±0,01
Cooked in water						
<bpFCv>	67,07±0,14	0,63±0,02	0,00±0,01	2,25±0,02	30,04±0,16	0,67±0,01
<bpFCm>	67,93±0,16	0,70±0,16	0,01±0,01	2,33±0,01	29,03±0,10	0,67±0,01
Cooked in water vapour						
<bpFCv>	60,02±0,51	1,02±0,09	0,21±0,01	2,45±0,02	36,30±0,41	0,67±0,01
<bpFCm>	60,25±0,79	1,13±0,03	0,01±0,01	2,56±0,01	36,05±0,79	0,58±0,01

Table 3. Mineral Content of Plantain False Horn Green/ripe

	Fe^{2+}(%)	Mg^{2+}(%)	Ca^{2+}(%)	Na^{+}(%)	K^{+}(%)	$(PO_4)^{3-}$ (%)
Uncooked						
<bpFCv>	0,30±0,01	0,51±0,06	0,70±0,00	2,22±0,01	34,61±2,30	11,26±0,01
<bpFCm>	0,21±0,00	0,41±0,00	0,70±0,00	1,70±0,11	35,61±2,08	12,05±0,28
Cooked in water						
<bpFCv>	0,10±0,00	0,41±0,00	0,50±0,1	1,31±0,12	21,32±2,25	9,01±0,14
<bpFCm>	0,10±0,00	0,40±0,01	0,50±0,1	1,21±0,00	22,92±3,38	9,10±0,13
Cooked in water vapour						
<bpFCv>	0,30±0,01	0,49±0,02	0,60±0,00	1,50±0,28	32,60±2,77	9,10±0,13
<bpFCm>	0,10±0,00	0,45±0,04	0,50±0,1	1,41±0,01	35,30±1,70	10,51±1,50

DISCUSSION

Figure 4 below is the histogram of the water masses absorbed by the samples of cooked and cooled False Green Horn/woody plantain samples (E1bcr and E1vcr). In green, the boiled samples and in yellow those prepared in water vapour. Samples whose masses are : (17.47±7.85 g /7.90±1.93 g) are False Horn plantains in the green state and those whose masses are (3.53±1.41 g/ 2.30±0.46 g) are False Horn plantains in the ripe state.

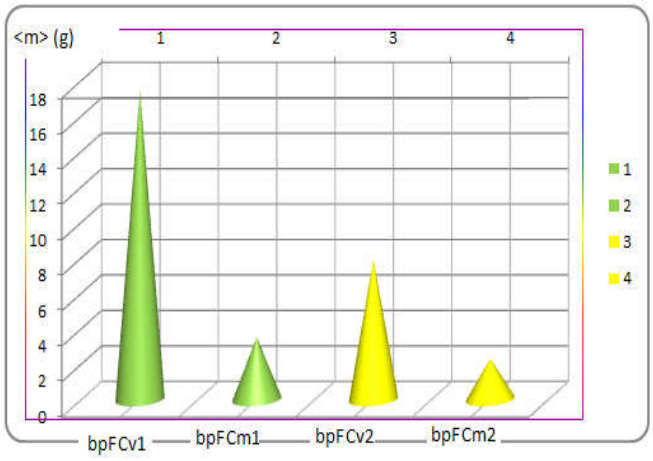

Figure 4. Histogram of water uptake by green plantain/ baked banana in water (green)/in water vapour (yellow)

From this histogram, the following observations can be made:

- The plantain Faux Horn plantain in the green/cooked wall state absorbs water independently of the cooking method.
- Plantain False Horn in the cooked green state absorbs a lot of water, which the banana ripens regardless of the cooking method.

This absorbed water has several functions in the cooked fruit, which consist in modifying the contents of certain energy constituents as well as those of the mineral elements as listed in Tables 2 and 3. For example, this water increases the water content (67.07±0.14 % and 67.93±0.16 %) for Faux Horn plantain bananas in the boiled and cooled green/wall state. On the other hand, for plantain banana False Horn in green/wall state boiled in water vapour and cooled: (60.02±0.51% and 60.25±0.79%). Table 2 groups the results for the energy constituents while Table 3 is the results for the mineral elements. These grades are in accordance with data from the literature (Augustin K. Yao, 2014; Andrés Giraldo Toro, 2015; Augustin K. Yao, 2014; Cas, 1966). Looking at the fat contents in Table 2, the absorbed water dissolves almost completely in the boiled green Faux Horn banana and partially in the ripe Faux Horn banana. The same is true for total ash and carbohydrates, which are partially dissolved. The same absorbed water also contributes to the loss of a proportion of the minerals. The loss of potassium (K) in Faux Green Horn plantain is approximately (38.4%/5.8%) and (35.6%/0.8%) in ripe bananas. For phosphorus (P), the loss is about (20%/19%) in green banana and (24.5%/12.8%) in ripe banana. It would be as if this water would partially destroy the fixation sites of these minerals and the structures of the water-soluble nutrient constituents which are then extracted.

Conclusion

The study showed that the plantain false Horn plantain in its green/wall boiled or baked in water vapour absorbs water. This absorbed water increases the moisture content of the cooked product. In the boiled green banana, this absorbed water dissolves the water-soluble nutrient constituents and extracts the mineral elements in greater proportions than in the boiled green banana in steam. Therefore, the most suitable cooking method, as it leads to less loss of nutrients and minerals, is steam cooking.

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