

NUTRITIONAL AND SENSORY QUALITIES OF UNRIPE PLANTAIN COOKED USING DIFFERENT METHODS

¹Onwudiwe, O. E. and ²Obue, A

¹Department of Agricultural Education, Federal College of Education (T), Asaba, Delta State
nikejahp@gmail.com; 08062908052

²Department of Agricultural Education, College of Education, Warri, Delta State
08037095361

ABSTRACT

The study was designed to determine the nutritional and sensory evaluation of different processed forms of unripe plantain as fresh, boiled, fried and roasted. Two research questions were formulated for the study. Twenty (20) member panel were asked to rate the colour, texture, taste and overall acceptability of the blends using a 9-point scale. Proximate analyses of the samples were carried out. It was therefore observed that the different forms of processing unripe plantain altered the nutritive value of the substrate. Boiled plantain was higher in protein, ash and moisture content than other forms. Fried unripe plantain was richer in carbohydrate. Fried unripe plantain was preferred in taste, colour and aroma. The panelist preferred the physical properties (texture) of fried plantain when compared to other forms. It was recommended that amongst individuals who want to get reasonable protein content from unripe plantain should boil it. Individuals who want to get reasonable carbohydrate content from unripe plantain should fry it.

Keywords: *Nutritional evaluation, sensory qualities, unripe plantain, cooking methods*

INTRODUCTION

Plantain belongs to the family *Musaceae* and the genus *Musa*, tree like perennial, 2 – 9 inch tall, with an underground rhizome. They can be differentiated by the number of fingers in the bunch, a characteristics used in naming the fruit in many parts of southern part of Nigeria (Makanjuola, Ajayi, Mathew & Makanjuola, 2013). Raw green plantains can only be eaten after cooking, each fruit measures about 3 to 10 inches or more in length depending upon the cultivar type. They tend to have coarser external features with prominent edges and flat surface. *Musa paradisiacal* (plantain) is a major starchy staples in the sub-Saharan Africa both for rural and urban populace, providing more than 25% of the carbohydrate and 10% of the daily calorie intake for more than 70 million people in the continent (Kayode, et al., 2013). Over 2.11 million metric tons of plantains are produced in Nigeria annually which contributes substantially to the nutritional status of subtropical local population (Akinsanmi, 2015). Plantain is a source of food, beverages, fermentable sugars, medicines, flavouring, cooked foods, silage, fragrance, rope, cordage, garlands, shelter, clothing, smoking material and numerous ceremonial and religious uses (Nelson, 2006). Plantain flowers, ripe fruit, unripe fruit, leaves and stem extract and its active

constituents have been used for the treatment of a large number of human ailments (Auta & Kumurya, 2015).

The main pharmacological (medicinal) effects of this plant especially the unripe plantain are: hepatoprotive, diuretic, analgesic, anti-ulcer, wound healing, hair – growth promoter and haemostatic activity (Kumar, 2012). Unripe plantain is usually processed into plantain flour by slicing the plantain and sun drying for some days (Ngalani, 1989) and cooked into sticky paste delicacy “*Amala ogede*” (Yoruba), and “*Ebue*” (Ogonis) served with vegetable soup. Unripe plantain is also boiled, fried, processed into chips (Onyejegbu & Olorunda, 1995), or boiled and pounded to plantain pastry and eaten with soups, sauce or vegetables (Tchango, Bikoï, Achard, Escalant & Ngalani, 1999). It can also be processed to food/foodstuffs such as breakfast cereals, baby complementary foods (Folayan & Bifarin, 2011). The International Institute for Tropical Agriculture (IITA) (2005) reported that post-harvest loss of plantain is one of the major threats to the availability of the fruit that is a staple to many Nigerian families. Ihekoronye and Ngoddy (1985) reported that processing may impart new colour, flavour, taste, and texture to food products, as well as enhancing the nutritive value and extending the shelf-life of the fermented products.

Unripe or ripe plantain is processed in a number of ways that may alter the content and its nutritional quality. Boiling, cooking and frying of plantain may result in alteration of physical properties through gelatinization and retrogradation of the carbohydrate content. Altering the physical form of a complex carbohydrate changes the postprandial glucose and insulin response to it (O’dea, Snow & Nestel, 1993). The effect of moist and dry heat on *in vivo* and *in vitro* starch digestibility showed that boiling and pressure cooking resulted in faster rate of digestion than roasting (Thorne, Thompson & Jenkins, 1983). The type and time of cooking may influence the *in-vivo* and *in-vitro* digestibility of carbohydrate foods. According to Booher, Behan and McNeans (2011), the conditions which increase the digestibility of starches include those modifications that produce obvious hydration of the granules distinct from changes in chemical nature, or disruption of the organized structure.

The current trend in nutrition in meeting consumers’ daily dietary needs is promotion of dietary diversification through locally available foods. However, little is known about the nutrient composition and nutrient retention of processed unripe plantain products. It is therefore the purpose of this study to provide information on the nutritional and sensory evaluation of different processed forms of unripe plantain as fresh, boiled, fried and roasted.

OBJECTIVE OF THE STUDY

The purpose of the study is to assess the nutrient and sensory properties of unripe plantain for improved family condition. Specifically, the study:

1. assessed the nutritional characteristics of fresh, boiled, fried and roasted unripe plantain
2. evaluate the sensory properties of boiled, fried and roasted unripe plantain

RESEARCH QUESTIONS

The following research questions guided the study:

1. What are the nutritional characteristics of fresh, boiled, fried and roasted unripe plantain?
2. What are the sensory properties of fresh, boiled, fried and roasted unripe plantain?

MATERIALS AND METHODOLOGY

Population and sample of the study

The population of the study comprised of 20 staff of School of Vocational Education, Department of Home Economics, Federal College of Education (Technical), Asaba Delta State.

Instrumentation

Score sheet for sensory evaluation was used for data collection in this study. The sensory attributes of the processed forms of the unripe plantain [Fresh (T0) Boiled (T1); Fried (T2); Roasted (T3)] were evaluated by the 20 member panel were asked to rate the colour, texture, taste and overall acceptability of the different forms using a hedonic 9-point scale

Sample preparation

The method for sample preparation applied by Oboh & Erema (2010) was used. Unripe fresh plantain fingers were obtained from the local market. These fingers were washed, peeled and cut into sizes with a sharp stainless steel knife. Three plantain processing methods were applied. This included boiling, frying and roasting. Some slices were boiled in water heated to about 100⁰C for 10 mins. Frying was achieved by deep frying in pre-heated groundnut oil for 7 minutes. An electric roasting method was used to roast the plantain with frequent turning over and over for about 15 mins.

Analytic procedures

After the sample preparation and processing, samples were each tied in a polythene bag and taken to the lab for laboratory analysis. Each sample was analyzed for moisture content, crude protein, crude fibre, dry matter, ash, ether extract and nitrogen free extract according to the AOAC (2012) methods.

Sensory evaluation

In carrying out the sensory evaluation, the sample was served after preparation to the twenty panelists who were familiar with plantain. The sensory attributes of the product tested included colour, taste, aroma, texture and general acceptability. A 9-point hedonic scale was used with 1 representing the least score (meaning dislike extremely) and 9 representing the highest score (meaning like extremely) (Kiin-Kabari & Eke-Ejiofor, 2013).

Statistical analysis

Statistical analysis was done using SPSS 16 statistical programme. The data was subjected to analysis of variance (ANOVA). The Mean (X) and Standard deviation were separated with the use of Duncan's multiple range test at 0.05 significant level.

RESULTS AND DISCUSSION OF FINDINGS

Research question one: What are the nutritional characteristics of fresh, boiled, fried and roasted unripe plantain?

Table I: Nutritional Properties of different processed form of unripe Plantain

Form of Processing	Crude Protein	Moisture Content	Dry Matter	Ether Extract	Ash	Crude Fibre	Carbohydrate
Fresh	2.3 ^a	63.5 ^{ab}	36.5 ^a	0.3 ^a	4.0 ^d	0.1 ^a	29.9 ^b
Boiled	3.5 ^c	67.0 ^{ab}	33.0 ^a	0.5 ^{ab}	4.2 ^c	0.2 ^a	24.6 ^b
Fried	2.4 ^a	6.5 ^a	93.6 ^c	14.0 ^c	3.8 ^b	1.0 ^a	72.4 ^a
Roasted	3.2 ^b	20.3 ^a	79.7 ^b	0.5 ^{ab}	2.5 ^a	1.0 ^a	72.5 ^a

Means followed by the same letter in the same column are not significantly different ($P < 0.05$) from each other

Table I shows the results of the nutritional properties of unripe plantain fresh and processed with four different methods. The results revealed that boiled plantain significantly ($P < 0.05$) had the highest crude protein when compared with other forms of processed plantain. The higher moisture content of the boiled plantain might be responsible for the higher crude protein content when compared with other. Water is said to help to release nutrient content in food items especially in soluble form (Ebuehi, 2005). In terms of moisture content, boiled and fresh plantain's composition were significantly ($P < 0.05$) the same but were higher than fried and roasted. The findings are in line with Akinsanmi et al., (2015) who found that peeled and boiled plantain gained moisture content as a result of moisture gained from atmosphere and water used to boil it respectively. The result in dry matter indicated that fried plantain was significantly ($P < 0.05$) higher than other forms of processed plantain. Fried and roasted could have higher dry matter because their form of processing reduces moisture in a food item than others. Ether extract or crude fat was significantly ($P < 0.05$) higher in fried plantain than other forms of processed unripe plantain. This observed increase in crude lipid content might be due to the effect of oil used to fry the plantain. Vegetable oil is said to contain a reasonable amount of fat at room temperature. Part of the crude lipid might have burnt off during roasting of the plantain, hence the observed reduction in value (Adepoju, Sunday & Folaranmi, 2012). Ash content was significantly ($P < 0.05$) higher in fresh plantain than other existing forms. The finding negates the finding of Adepoju *et al.* (2012) who found that drying, boiling and roasting brought significant improvement in ash and crude fibre content of samples of plantain. There was no significant ($P < 0.05$) difference between the forms of plantain on crude fibre. Roasted and fried plantain significantly ($P < 0.05$) had higher carbohydrate content when compared to fresh and boiled. The reduction in value of carbohydrate in boiled was believed to be due to additional boiling water absorbed by the sample, as well as loss through leaching of soluble carbohydrates into the boiling water. Processing has been reported to improve carbohydrate availability in a more digestible form (Paradez-Lopez & Harry, 1989)

hence, this explained the significant increase observed in the carbohydrate content of roasted and fried.

Research question two: What are the sensory properties of fresh, boiled, fried and roasted unripe plantain?

Table II: Sensory Evaluation of Plantain

Processing Method	Taste Mean \pm SD	Aroma Mean \pm SD	Texture Mean \pm SD	Colour Mean \pm SD	General Acceptability Mean \pm SD
Boiled	7.5 \pm 1.23 ^a	7.1 \pm 1.32 ^a	7.6 \pm 1.57 ^a	7.1 \pm 1.62 ^a	7.4 \pm 1.31 ^a
Fried	8.4 \pm 0.88 ^b	8.4 \pm 0.68 ^b	8.4 \pm 0.88 ^b	8.1 \pm 0.72 ^b	8.4 \pm 0.80 ^b
Roasted	7.8 \pm 1.33 ^a	7.7 \pm 0.73 ^c	7.7 \pm 1.04 ^a	7.5 \pm 1.19 ^a	7.9 \pm 0.93 ^a

Note: Values with the same superscript in the same column are not statistically different i.e. ($p < 0.05$).

Table II shows a summary of the values of mean and standard deviation computed from data obtained from panel's scores. Response on taste, fried plantain was significantly ($P < 0.05$) higher than roasted and boiled plantain. Preference for plantain fried might be because of taste enhanced from other condiments such as oil, salt and other spices added. For aroma, the result shows significant difference in the panelists assessment of the results from the three processing methods considered. The aroma of fried plantain is most liked, followed by that from roasted and then comes boiled. The aroma or flavor preference in fried plantain may be traced to the onion and oil used to prepare the fried plantain. The preference fried unripe plantain for colour, texture and general acceptability was significantly ($P < 0.05$) higher than boiled and roasted. Frying is one of the major value addition processes for plantain which results in products with a unique flavour-texture combination (Mellema, 2003; Pedreschi, 2012). The primary reason for the popularity of fried foods may be the characteristics like soft, juicy interior as well as thick and crispy outer crust (Garcia, Ferrero, Bertola, Martino & Zaritzky, 2002). Texture, colour and oil content are the main quality parameters of fried products (Hindra & Baik, 2006).

CONCLUSION

Besides being an energy food, unripe plantain as one of the major staple foods in most parts of the world has the potential to provide modest amounts of various food nutrients. It was observed that the different forms of processing unripe plantain altered the nutritive value of the substrate. Boiled plantain was higher in protein, ash and moisture content than other forms. Fried unripe plantain was richer in carbohydrate. Fried unripe plantain was preferred in taste, colour, texture and Aroma.

RECOMMENDATIONS

1. Individuals who want to get reasonable protein content from unripe plantain should boil it

2. Individuals who want to get reasonable carbohydrate content from unripe plantain should fry it
3. Unripe plantain is best enjoyed when fried
4. Diabetic patients should go for boiled plantain as it has less carbohydrate and sugar content

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