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Research Article

Effects of Deep-Fat Frying using Canola Oil, Soya Oil and Vegetable Oil on the Proximate, Vitamins and Mineral Contents of Unripe Plantain (*Musa x paradisiaca*)

¹Omolola E. Omotosho, ¹Rebecca Garuba, ²Femi Ayoade, ¹Abiodun H. Adebayo, ³Oluwatosin E. Adedipe and ¹Shalom N. Chinedu

¹Department of Biological Sciences, Covenant University, Ota, Nigeria

²Department of Biological Sciences, Redeemer's University, Ede, Osun State, Nigeria

³Department of Biosciences, North Carolina State University, USA

Abstract

Musa x paradisiaca (plantain) is among the major tropical staple foods. This study was designed to determine the proximate, mineral and fat soluble vitamins constituents of unripe plantain fried with three different oils (canola oil, soya oil and vegetable oil) and unripe plantain oven dried sample was used as the control. The vitamins were determined using High Performance Liquid Chromatography (HPLC). The result of the proximate analysis showed that the dried samples had higher levels of protein (25.2%), carbohydrate (50.1%), moisture content (13.3%), ash content (2.02%), crude fibre (7.73%) but low level of crude fat in comparison with the fried samples. Plantain fried with vegetable oil had the lowest levels of protein (20.84%), carbohydrate (26.93%), moisture content (13.1%), ash content (1.72%) and crude fibre (6.57%) but the highest level of crude fat (30.84%). Plantain fried with vegetable oil had the highest level of calcium ($211.80 \pm 0.1 \text{ mg g}^{-1}$) while the dried plantain samples had high level of sodium ($233.80 \pm 0.07 \text{ mg g}^{-1}$). Lead (Pb) was absent in the dried plantain samples. Dried plantain samples gave a higher value of vitamins A ($0.08 \pm 0.01 \text{ mg g}^{-1}$), D ($0.02 \pm 0.01 \text{ mg g}^{-1}$), E ($0.01 \pm 0.00 \text{ mg g}^{-1}$), K ($0.05 \pm 0.00 \text{ mg g}^{-1}$) compared to plantain sample fried with canola oil which gave low level of vitamin D ($0.03 \pm 0.00 \text{ mg g}^{-1}$), E ($0.25 \pm 0.00 \text{ mg g}^{-1}$) and K ($0.03 \pm 0.00 \text{ mg g}^{-1}$). However, there was a very high level in vitamin A ($0.72 \pm 0.02 \text{ mg g}^{-1}$). The result showed that drying in oven retains the nutritional contents of plantain compared to deep-fat frying. Canola oil is recommended for frying although soya oil is also good.

Key words: *Musa x paradisiaca* (plantain), deep-fat frying, canola oil, soya oil, vegetable oil, proximate analysis, vitamins, minerals

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Corresponding Author: Omolola E. Omotosho, Department of Biological Sciences, Covenant University, Ota, Nigeria

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Plantain is among the major tropical staple foods (Dzomeku *et al.*, 2006). It is known that cooking methods or processing techniques of foods often lead to losses of vitamins and other nutrients such as vitamin up to 90% depending of the cooking or processing used (Penelope and Ritu, 2003). In Nigeria, steaming, roasting and frying are the most commonly used cooking methods (Omotosho *et al.*, 2015). The type of oil, oil temperature and time of frying affect the attributes of finished products. Low oil temperature may lead to higher oil uptake into the fried foods (Mba *et al.*, 2015). Cooking of foods leads to the improvement of microbiological and organoleptic qualities, destroy toxins and antinutritional factors increase digestibility and nutrients bioavailability (Erdman and Schneider, 1994), unfortunately these procedures cause the loss of some of the micronutrients in foods (Yang and Gadi, 2008), micronutrients such as the water soluble vitamin and the fat soluble vitamins though thermo sensitive are important in the stimulation of immune system, liver disorder, fight against cancer and cardiovascular diseases (Farvin *et al.*, 2009). In view of their importance in human health, this work was initiated to evaluate the effects of frying in boiling oil bath on the fat soluble vitamins (A, D, E and K) contents of plantains.

MATERIALS AND METHODS

Plant material: Plantain fruits were purchased from Covenant University farm, Ota, Nigeria. The research was conducted in the months of October, 2013 to February, 2014.

Preparation of sample: The picture of unripe plantain (*Musa x paradisiaca*) harvested from the farm is shown in Fig. 1a. The Plantain fruits were peeled as shown in Fig. 1b and washed in distilled water. After which they were cut into thin circular slices just like the locally sold "Plantain" chips. Three different oils: Canola oil; soya oil and vegetable oil were used in the frying of the chips as shown in Fig. 1c. A deep fryer was used for this and the plantain fruits were fried at a temperature of 190°C for 10 min. After cooling, the samples were grinded into powder form using mortar and pestle. After grinding the different plantain fruits powder samples that were fried with the different oils were kept in ziploc bags and labeled accordingly.

Statistical analysis: All the experimental results were the mean (\pm standard deviation) of three parallel measurements. Data were evaluated by using Excel 97 as a tool for the analysis.



Fig. 1(a-c): Picture of unripe plantain (*Musa x paradisiaca*) (a) Unripe plantain fruits from Covenant University farm, (b) Peeled plantain and (c) Fried plantain chips

Proximate analysis: The nutrients in the food were evaluated under 6 parameters: Moisture content, ash content, crude protein, lipid or fat content, crude fiber and carbohydrate content as described previously by Omotosho *et al.* (2015).

Analysis of fat soluble vitamins: This was done using the HPLC method and had been described previously by Omotosho *et al.* (2015).

Mineral analysis: The dried powdered samples were first digested with nitric acid and perchloric acid and then the aliquots were used for the determination the minerals as described previously by Omotosho *et al.* (2015).

RESULTS AND DISCUSSION

Proximate composition: Figure 2 shows the proximate composition of unripe plantain, when it was fried with three different oils which include canola oil, vegetable oil and soya oil. The carbohydrate level was significantly high in the oven dried sample (50.1%), with no significant difference in plantain with canola oil and plantain with soya oil and plantain with vegetable oil was the lowest (26.93%) showing that frying had an effect on carbohydrate. The protein content was significantly higher in oven dried unripe plantain (25.2%), plantain with canola oil, soya oil and vegetable oil had no significant difference showing that the different oils does not have an effect on the protein. Crude fat content was significantly low in oven dried unripe plantain (1.72) and then plantain with vegetable oil was significantly higher (30.84%) which showed that frying had an effect on the crude fat level of plantain with vegetable oil. The moisture content had no significant difference on dried plantain sample, plantain with canola oil, soya oil and vegetable oil. Ash content was relatively low with little or no significant difference showing that ashing does not have effect on frying or the dried sample. The crude fibre level was not significantly influenced by any of the cooking methods. The result agreed with Baiyeri *et al.* (2011) that roasting semi ripe plantain retains most of the nutrients.

Vitamin contents: Figure 3 shows that there are low levels of fat soluble vitamins in the varieties of samples with vitamin A levels in plantain dry sample (0.08) was very low, plantain with canola oil (0.725) has the highest level of vitamin A with plantain with soya oil (0.06), plantain with vegetable oil, (0.064) showing no significant difference. Vitamin D levels in the varieties of samples were relatively low with little or no

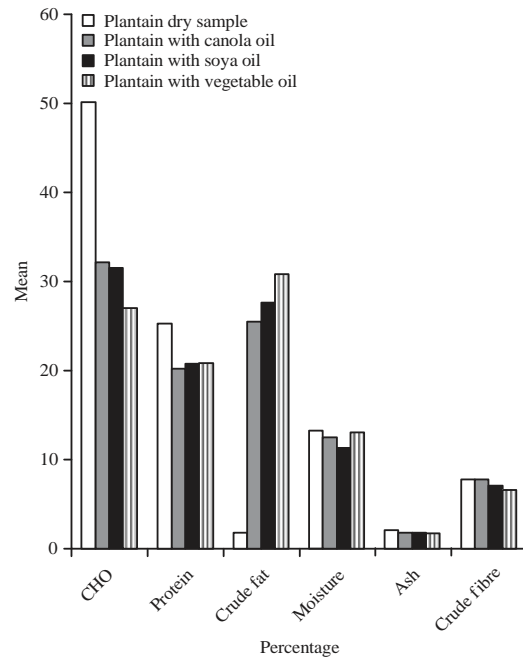


Fig. 2: Graphical representation of the proximate composition of plantain

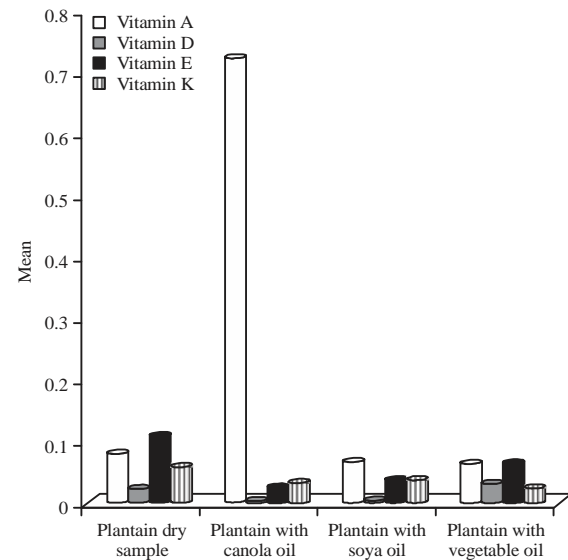


Fig. 3: Graphical representation of vitamin contents of unripe Plantain

significant difference. Vitamin E level on the plantain dry sample was higher (0.11), plantain with canola oil and soya oil were lower with no significant difference. Vitamin k was relatively low with no significant difference although the values were very low vitamin A is more present in any of the cooking methods or techniques, it can also be stated that cooking with canola oil is an ideal way of keeping vitamin A

Table 1: Mineral contents of unripe plantain

	Oven dried plantain	Plantain with canola oil	Plantain with soya oil	Plantain with vegetable oil
Na	233.800±0.07	71.04±0.01	111.62±0.12	73.20±0.14
K	132.150±0.07	124.79±0.01	152.85±0.07	126.65±0.07
Ca	211.130±0.11	235.58±0.07	206.47±0.61	249.82±0.24
Mg	135.750±0.28	50.25±0.14	24.70±0.35	32.15±0.07
Zn	39.170±0.00	21.06±0.04	19.90±0.00	17.33±0.070
Fe	90.200±0.41	71.03±0.01	27.20±0.07	74.85±0.07
Cu	1.770±0.07	1.04±0.00	1.66±0.01	1.36±0.01
Pb	0.060±0.01	0.16±0.01	0.08±0.01	1.36±0.00
N	2.420±0.01	20.16±0.09	5.71±0.01	4.14±0.01
Mn	1.600±0.14	1.15±0.07	1.04±0.01	1.17±0.02

Na: Sodium, K: Potassium, Ca: Calcium, Mg: Magnesium, Zn: Zinc, Fe: Iron, Cu: Copper, Pb: Lead, N: Nitrogen, Mn: Manganese

which is an important vitamin in the body system. Baiyeri *et al.* (2011) reported that steamed fruits had the highest concentration of β -carotene and fruits roasted at the semi-ripe stages had the highest concentration of nutrients. The heat due to roasting seeds prior to pressing does not reduce the amount of tocopherols in the oil (Rekas *et al.*, 2015).

Mineral contents: Table 1 shows the various mineral content in plantain. The three mineral content with no significant value where Cu, Pb and Mn while, N has a very low significance in all of the varieties. Calcium has the highest level of mineral content in all of the cooking procedures of plantain, then K which had a moderate level of significance in the varieties. Sodium only showed a very high level of mineral content in plantain dry sample while others were acceptably adequate. Magnesium had a moderate significance in plantain dry sample while in other varieties they were low. Iron had a less significance in all of the varieties compared to Ca, K, Na and Mg. Baiyeri *et al.* (2011) reported that the mineral constituents were relatively higher at the light green stage of plantain. Fe and K were significantly ($p < 0.05$) higher in the roasted fruits. We had previously established that the oven dried sample of the cocoyam retained most of all the nutrients and that frying reduces most of the parameters investigated except for lipid contents (Omotosho *et al.*, 2015).

CONCLUSION

The results of the study suggest that most nutrients and vitamins are lost during the frying processing of plantain, thereby losing vital constituent that the body needs for daily growth. Vitamin A was present in most of the cooking methods although statistically it can be said that some of its nutrient and other vital vitamins were lost due to the cooking method used and oven drying method retained more nutrient. The mineral contents were greatly affected by the different oil samples calcium which is used by the body for the growth of

human bones and proper structure was retained in all the types of cooking methods used in this study. The proximate analysis showed that the different oil samples increased the overall lipid contents of all the plantain samples with vegetable oil being the highest and canola oil being the lowest which indicates that canola oil is low in fat and that fried foods are rich in fat whereas oven dried samples had lower fat content. The ash content was reduced in all the samples signifying that the potential ability of the plantain to supply essential nutrients has been reduced after frying.

In conclusion, drying in oven retains the nutritional content of plantain compared to deep fat frying. Canola oil is recommended for frying although vegetable oil can also be used.

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