EFFECTS OF THREE RIPENING METHODS ON THE PROXIMATE AND MINERAL COMPOSITION OF PLANTAIN(*Musa paradisiaca*) FRUITS

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ABSTRACT

Ripening of fruit is a natural process in which the fruits go through various physical and chemical changes and gradually become sweet, colored, soft and palatable. This study was carried out to examine the effects of three ripening process which include calcium carbide, wood ash and ripening in the dark on plantain fruit. Freshly harvested green matured plantain bunch were used for the determination of proximate analysis and mineral content [iron(Fe); potassium(K); zinc(Zn), and calcium (Ca)]. Calcium carbide samples had the highest Fe, K and Ca (3.05 mg/100g, 50.0 mg/100g and 3.48 mg/100g) respectively, and also the least content of protein, ash, fibre and fat (3.90%, 1.53%, 0.18% and 0.43%) respectively and significantly different when compared to other ripening methods.

Keywords: Plantain, ripening, proximate, calcium carbide.

INTRODUCTION

One of the most important crops of the tropical and subtropical plants is plantain. It belongs to the *Musaceae* family, genus *Musa* and specie *paradisiaca*(Danlami, Ijoh, & David, 2015). In Africa, it is an important staple food. Worldwide, plantain is the fourth most important commodity after rice, wheat and maize(Oko, Famurewa, & Nwaza, 2015). In Nigeria, the contamination of food through poisons is on the increase. Reports of death as a result of food poisons is alarming(Adewole & Duruji, 2010). The National Agency for Food and Drug Administration and Control issue a public alert on the dangerous practice of sale and consumption of fruits artificially ripened with calcium carbide(NAFDAC, 2018). Fruit ripening is a naturally occurring process(physical and chemical changes) that fruits go through to become, coloured, soft, edible, nutritious and palatable(Brady, 1987). The main reason for artificial ripening is for commercial purposes. Plantain is estimated to provide 60 million people in Africa with more than 200 calories per day(Onwuka & Onwuka, 2005). The many forms in which they are consumed also indicate the long association between man and the crop(Baiyeri, Aba, Otitoju, & Mbah, 2011). Blossoms of plantain are consumed as a vegetable by most people in Nigeria raw, boiled, roasted or fried. The unripe but mature blossoms are sometimes processed into flour for other diets. The over-ripened, are often processed into local wine called 'agangidi'(Onyeka, 2005). As a result of rising population and need to meet the growing demand of the population, different ripening agents are used to initiate the ripening process of the plantain fruits. Ripening is defined as a biological process involving series of physiological changes in colour, flavour, aroma and texture (M. Li, Slaughter, & Thompson, 1997; X. Li et al., 2008; Singh, Bal, Singh, & Mirza, 2018; Sogo-Temi, Idowu, & Idowu, 2014), and fruits gets softened, firmness decreases and starch is converted into sugar(Prabha & Bhagyalakshmi, 1998).

One essential part of fruit business is commercial ripening and this involves the use of ripening agents such as glycol, ethereal, calcium carbide, African bush mango fruit and leaves, palm nut, cassia leaves, yellow pawpaw leaves, torch light battery, calcium carbide, potash, ash, and

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Neubouldia leaves(Adewole & Duruji, 2010; Ajayi & Mbah, 2007; Lewis Sr, 2004; Ojetayo, Bodunde, & Odeyemi, 2018) to fasten the process. Artificial ripening of fruits speeds up the rate of process but the nutritional quality, sensory and safety of the fruits are affected(Hossain, Akhtar, & Anwar, 2015; Nura, Dandago, & Wali, 2018). The use of acetylene as ripening agent is a common practice in some countries but due to high cost many developing(Chowdhury & Alam, 2008) countries including Nigeria, use low cost-calcium carbide. The consumption of calcium carbide ripened fruits is extremely hazardous to health, because it affects the nervous system. The aim of this study is to assess the quality assessment of plantain (*Musa paradisiaca)* as affected by different ripening process (calcium carbide, wood ash and ripening in the dark) commonly adopted.

MATERIALS AND METHODS

Sample Collection and Preparation

The unriped but matured plantain fruits used for this study were purchased from farmer's orchard in Ilaro, Ogun State, Southwestern Nigeria. Plantain bunch purchased contain 35 fingers. The fruits were carefully separated from the bunch, washed with clean water to remove dirts, weighed and subjected to individual ripening method. Preliminary studies on the ripening methods commonly used in the area were carried out, and were found to be use of wood ash, calcium carbide, and ripening in the dark. The control was carried out by storing the plantain fruits without ripening inducers. Three plantain fingers of similar weight were placed in storage sacks of equal size with respective ripening agents except those used as control. Each of three methods of ripening was carried out in triplicates to give a total of 12 replicates of three fruits each. The control samples were kept on the shelf at room temperature until ripened.

Data Collection

Proximate content of plantain were analyzed at full ripe stage according to the method described by standard methods. Protein determination was by micro-Kjeldal method with conversion factor of 6.25. The ash content was carried out by heating the residue in a muffle furnace at 550 ^{o}C for 3 h until a constant weight of ash was obtained. The moisture content were determined by oven-drying at 105 ^{o}C for 3 h (AOAC, 1990). Fat content were determined by extracting 5g sample in a soxhlet apparatus using n-hexane. The carbohydrate content was obtained by deducting the total percentage of moisture, ash, fiber, fat and protein from 100 (Adamu, Ojo, & Oyetunde, 2017). All the analyses were done in triplicates.

Mineral Analyses

Iron, zinc and calcium were analyzed after digestion using Buck Scientific VGP210 Atomic Absorption Spectrophotometer. The potassium determination was achieved with Jenway PFP7 Flame Photometer. A 2-3 g sample was dry-ashed at 550^{o}C to constant weight, the ash was dissolved in volumetric flask with de-ionized water with few drop of conc. HCL (Pearson, 1976). All the analysis were done in triplicates.

Statistical analysis

Descriptive statistics and mean and standard deviation and analysis of variance (ANOVA) were conducted using Excel XP software. Significance was established at $p < 0.05$

RESULTS AND DISCUSSION

In Table 1, the control samples (natural ripening) had the highest carbohydrate, protein, total ash and fibre content, (39.2%, 5.62%, 3.20% and 0.49% respectively). The calcium carbide ripened samples had the lowest protein, ash, fibre and fat content of 3.90%, 1.53 %, 0.18% and 0.43% respectively. There was a significant difference in percent value of protein for all samples at p>0.05. No significant difference was observed in the total ash, moisture content, fat and carbohydrate of the induced plantain fruits and the control Ash content ranged between 1.53-3.20% which was highest in the control and least in the calcium carbide samples. The fibre content ranged between 0.18-0.49% which was highest in the control and least in the calcium carbide samples, however, there was no significant difference in the values. Moisture content values ranged between 51.0-53.7% which was highest in calcium carbide samples and least in the control. The fat content ranged between 0.43-0.72% which was highest in the wood ash samples and least in the calcium carbide sample. The carbohydrate content ranged between 35.5-39.2% which was highest in the control and least in sample kept in the dark. The difference in the values for moisture, fat and carbohydrate for all the samples were insignificant at p>0.05. The higher values of moisture and carbohydrate in all the samples agree with the report by Makanjuola *et al* (2013) and Adamu *et al*(2017), that plantain contain mostly moisture and carbohydrate. Table 1 indicates that protein, ash and fibre content of naturally ripening plantain was gradually reduced as ripening agents were introduced especially the calcium carbide samples. Ripening agent such as calcium carbide has poor nutritional quality(Sogo-Temi et al., 2014).

The ripening days was shortest in the calcium carbide treated samples and longest in the control samples. This result agrees with the results of Adeyemi *et al* 2018 and Sogo-Temi *et al* 2014(Adeyemi M.M., Bawa, M. H., 2018; Sogo-Temi et al., 2014) that calcium carbide treated fruits ripen quicker than the naturally ripened. The samples ripened in the dark attained full ripening on the fifth day, while those treated with wood ash, the sixth day.

In Table 2, the calcium carbide samples had the highest Fe, K and Ca of 3.05 mg/100g, 50.0 mg/100g, and 3.48 mg/100g respectively. The Control had the least Fe (2.68mg/100g) and Ca(1.04 mg/100g) content, while the wood ash treated samples had the least K(20.0 mg/100g) content. The zinc content ranged between 0.07- 2.34mg/100g which was highest in the control and least in calcium carbide treated samples. Significantly different values were obtained for Ca content. The control samples had the lowest Ca (1.04 mg/100g) content while the samples ripened in the dark and calcium carbide recorded the highest and same values of 3.48 mg/kg.

Table 1: Proximate Composition of Samples (%)*

Parameters	Control	Wood ash	Calcium Carbide	In the dark
Crude protein	5.62±0.01 [a]	4.66±0.03 [a]	3.90±0.17[d]	5.38±0.03 [a]
Total ash	3.20±0.32[a]	2.33±0.04 [a]	1.53±0.40 [a]	2.20±0.25 [a]
Crude fibre	0.49±0.17 [a]	0.29±1.30[b]	0.18±0.03[d]	0.25±0.06[c]
Moisture	51.0±1.6 [a]	53.7±0.3 [a]	58.2±0.1 [a]	58.0±0.04 [a]
Fat	0.52±0.09 [a]	0.72±0.08 [a]	0.43±0.33 [a]	0.67±0.07 [a]
Carbohydrate	39.2±0.0 [a]	38.3±0.0 [a]	35.8±0.0 [a]	33.5±0.1[a]
Days of full ripening	8	6	3	5

*Means of three determinations ±SD; means within row with the same letter are not significantly different (p>0.05).

Table 2: Mineral Composition of Samples (mg/100g)*

Parameters	Control	Wood ash	Calcium carbide	In the dark
Fe	2.68± 0.01^{a}	3.00± 0.17^{b}	3.05±0.08^{c}	2.92 ±0.01^{d}
K	30.0±0.01 ^{a}	20.0± 0.10 ^{b}	50.0 ±0.02^{c}	45.0±0.02^{d}
Zn	2.34± 0.07 ^{a}	1.34 ±0.10^{a,b}	0.07±0.03^{b}	1.27±0.11^{c,b}
Ca	1.04±0.01 ^{a}	1.40±.01^{b}	3.48±0.02^{c}	3.48±0.07^{d}

*Means of three determinations ±SD; means within arrow with the same letter are not significantly different (p>0.05).

CONCLUSION

This study has shown the effect of ripening methods on the proximate and mineral composition of ripened plantain. The proximate content of the calcium carbide treated samples were considerably lower than those reported in the literature. The non-calcium carbide induced samples had comparable content of ash, moisture, fat and carbohydrate contents, while the calcium carbide treated fruits has the highest values of Fe, K and Ca. The use of calcium carbide as ripening agent though speeds up ripening period, should be discouraged because of the health hazards associated. Awareness on the dangers of calcium carbide should be a collective responsibility of the Government, traders and the population. Its restriction regarding the procurement and selling of such banned compound in open market should be put in place.

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