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Enumeration of Microbial Density in Plantain (*Musa Paradisiaca*) Chips Sold in Yenagoa Metropolis, Nigeria

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Abstract: *This study evaluated the microbial load of plantain chips sold in Yenagoa metropolis, Bayelsa state, Nigeria. Triplicate sample of plantain chips were purchased from market area in Akenfa, Agudama-Epie, Etegwe junction, Igbogene, Kpansia and Opolo. The microbial population was enumerated using pour plate method. Results of the total heterotrophic bacteria, bacteria of the* Enterobacteriaceae *family and total fungi ranged from 3.99 - 4.73 Log cfu/g, 2.46 – 2.84 Log cfu/g and 2.90 – 3.38 Log cfu/g, respectively. Analysis of variance revealed no significant variation (P>0.05) among the different locations. The populations were within tolerable limit for ready to eat food as specified by Food and Agricultural Organization, Food Quality Check Programme and International Commission on Microbiological Specifications for Foods. Based on the density of the bacteria of the* Enterobacteriaceae *family there is the need to improve handling processes.*

Keywords: *Food contamination, Microorganisms, Plantain, Public Health.*

1. INTRODUCTION

Food is among the fundamental necessities needed for human existence. Authors have variously reported that food is required for the effective functioning of the different parts of human body as well as growth and development (Izah *et al*., 2017, 2016a,b, 2015a,b). This is probably due to the fact that foods contain essential nutrients and vitamins for healthy wellbeing (Izah *et al*., 2015a). Food resources are mainly from vegetation, animals and to lesser extent microorganisms. Different plants that bear edible fruit are consumed in different ways.

In many tropical countries in Central and South America, Africa and Southeast Asia, plantain is cultivated as a staple food. Fajinmi *et al*. (2011) reported that plantain is a perennials and herbaceous plants that belong to *Musaceae* family. According to Oriola *et al*. (2017), Olagoke *et al*. (2018), plantain is among the essential staple food that is consumed by millions of people in many developed and developing countries. Plantain cultivation is not capital intensive due to low labour requirement when compared to other staple food crops such as yam, cassava, rice etc.

Plantain is a major source of carbohydrates, vitamins and minerals. In addition, plantain has health benefits including antioxidant, easy digestibility and excess body weight control. In Nigeria plantain is cultivated in both seasons (wet and dry) of the year. Nigeria produces over 2.11 million metric tons of plantains per year (Akinsanmi *et al*., 2015). As such it's a major diet in many families in Nigeria.

Plantain is prepared into different forms for easy availability and consumption. Some of the plantain products are means of preservation to avoid spoilage. In Nigeria, preparation of chips from plantain is very common. This typically involves the frying of the sliced plantain (unripe or semi-ripe) with vegetable oil from groundnut. In many regions, plantain chips are packaged in nylon bags.

The handling and processing of plantain chips typically lack quality control measures. As such, they could be contaminated by microbial flora in the processing/ packaging materials. Food borne diseases cause gastrointestinal tract disorder and are transmitted through consumption of contaminated food (Izah *et al*., 2015a). Previous studies have indicated that *Staphylococcus aureus*, *Bacillus subtilis*,

Pseudomonas aeruginosa and *Klebsiella pneumonia* as microbes associated with over ripe plantain (Olagoke *et al*., 2018). Fajinmi *et al*. (2011) reported that ripening enhance the microbial density of banana, and are characterized by the presence of *Staphylococcus aureus, Lactobacillus* and *Bacillus* species (bacteria), *Aspergillus flavus, Aspergillus niger, Fusarium, Saccharomyces* and *Penicillium* species (fungi). Some of these fungi such as *Aspergillus*, *Fusarium* and *Penicillium* have the ability to produce aflatoxins (Izah*et al*., 2015a; Ineyougha *et al*., 2015; Orutugu*et al*., 2015). Some of the microbes such as *S.aureus* is a pathogenic microorganism of public health concern (Iyoha and Agoreyo, 2015). As such there is the need to assess the density of microbes found in some common ready to eat food. To these effect, studies on some common ready to eat food in Bayelsa state have been reported including pineapple, paw-paw, water melon (Izah *et al*., 2015a), meat pie (Kigigha *et al*., 2017), groundnut (Kigigha *et al*., 2016), zobo drink (Kigigha *et al*., 2018), kunu (Orutugu *et al*., 2015). But information about the microbial quality of plantain chips is scanty in literature. Therefore this study aimed at assessing the microbial density in plantain chips sold in Yenagoa metropolis, Nigeria.

2. MATERIALS AND METHODS

2.1. Field Sampling

Triplicate samples of plantain chips were purchased from six marketing environment (viz: Akenfa, Agudama-Epie, Etegwe junction, Igbogene, Opolo and Kpansia) in Yenagoa metropolis. As such, a total of eighteen samples were purchased, three being from each location. The plantain samples were transported to the laboratory for analysis.

2.2. Sample Preparation

The samples were macerated using blender (BLG-450, Binatone, Nigeria). Then after, about 20g of the sample were blended into 180 ml of sterile water. The blender was washed and rinsed with sterile water after each maceration.

2.3. Enumeration Microbial Counts

The microbial density was enumerated following the pour plate method previously described by Pepper and Gerba (2005), Benson (2002). 1.0 ml of the blended samples was serial diluted. Then1.0 ml was aseptically transferred into the petri dish labeled according to the media. Nutrient Agar (meant for total heterotrophic bacteria), potato esdextrose agar (meant for total fungi), macconkey agar (meant for bacteria of the *Enterobacteriaceae* family) and Salmonella-Shigella Agar (meant for Samonella and Shigella counts) were prepared according to the manufacturer's instruction. The prepared agar were allowed to cool in a water bath at 45-50 ^{o}C before pouring into the petri dish containing the serial diluted samples. The plates were stirred and allowed to solidify before incubating inverted at 37°C for 24-48 hours for total heterotrophic bacteria, bacteria of the *Enterobacteriaceae* family and Samonella-Shigella counts, and 30°C for 3-5 days for fungi. The resultant colonies that grew on the different media were counted and expressed as colony forming units (cfu)/g.

2.4. Statistical Analysis

Statistical Package for Social Sciences software version 20 was used for the statistical analysis of the log transformed microbial counts. Data were expressed as mean and standard deviation. One-way analysis of variance was carried out at P = 0.05 to show significant difference, and Waller Duncan test was used to show the source of the variation.

3. RESULTS AND DISCUSSION

The microbial density in some plantain chips sold in Yenagoa metropolis, Bayelsa state, Nigeria is presented in Table 1. The total heterotrophic bacteria, bacteria of the *Enterobacteriaceae* family and total fungi of the plantain chips ranged from 3.99 - 4.73 Log cfu/g, 2.46 – 2.84 Log cfu/g and 2.90 – 3.38 Log cfu/g, respectively. Basically, there was no significant variation (P>0.05) among the various locations. Furthermore, there was no Salmonella and Shigella in the plantain chips.

Table1. *Microbial population of plantain chips sold in Yenagoa metropolis, Nigeria*

Locations	Total Heterotrophic Bacteria, Log cfu/g	Total bacteria of the *Enterobacteria-ceae* family, Log cfu/g	Total Fungi, Log cfu/g	Samonella-Shigella, cfu/g
Akenfa	4.09±0.85a	2.47±0.37a	3.38±0.39a	0.00±0.00
Agudama-Epie	4.33±0.44a	2.62±0.41a	3.25±0.37a	0.00±0.00
Etegwe Junction	4.73±0.56a	2.84±0.80a	3.18±0.54a	0.00±0.00
Igbogene	4.36±0.92a	2.46±0.76a	2.90±0.76a	0.00±0.00
Opolo	4.52±0.81a	2.57±0.42a	3.26±0.63a	0.00±0.00
Kpansia	3.99±0.54a	2.72±0.09a	3.12±0.29a	0.00±0.00

Each value is expressed as mean ± standard deviation (n = 3); The same alphabet along the column is no significant difference (P>0.05) according to the Waller Duncan Statistics;

The absence of significant difference in the microbial density could be associated to the level of hygiene practice by processors and vendors (Izah et al., 2015a). It could also be due to the fact that the same person processed and packaged the plantain chips which was bought in wholesale by the vendors and then sold in bits to the final consumers. Instances of fruit vendor marketing products in different markets in Yenagoa metropolis have been reported by Izah et al. (2015a).

The microbial density in the plantain chips were within the tolerable limits (10**4** – 10**5**) recommended for ready- to-eat food (ICMSF, 1996 cited in Olopade et al., 2014; Izah et al., 2016b; Kigigha et al., 2015a,b, 2018). It was also lower than the limit (10**5**) recommended by Food and Agricultural Organization (FAO, 1979 Cited in Bukar et al., 2010), and (10**6**) stipulated by Food Quality Check Programme limits (Food Quality Check Programme, 2011 cited in Anagu et al., 2015; Kigigha et al., 2018). However, most bacteria of the *Enterobacteriaceae* family are of public health concern. Therefore there is the need for improved handling processes.

4. CONCLUSION

This study evaluated the microbial density of plantain chips sold in Yenagoa metropolis, Nigeria. The study found that the density is with tolerable limit for ready to eat food as stipulated by Food and Agricultural Organization, Food Quality Check Programme limits and International Commission on Microbiological Specifications for Foods. However, there is the need for improve handling processes because of the density of bacteria of the *Enterobacteriaceae* family in the plantain chips.

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