



# **Proximate and Microbiological Quality of Roasted Plantain, Its Sauce, Fish and Side Vegetable Sold in Rivers State University and Its Environment**

**Obinna-Echem, Patience Chisa<sup>1\*</sup> and Eze, Simeon Christian<sup>1</sup>**

<sup>1</sup>*Department of Food Science and Technology, Rivers State University, Nkpolu-Oroworukwo, Port Harcourt, Rivers State, Nigeria.*

## **Authors' contributions**

*This work was carried out in collaboration between both authors. Author OEPC designed the study, performed the statistical analysis, wrote the protocol, managed part of the literature searches and wrote the first draft of the manuscript. Author ESC managed the analyses of the study and part of the literature searches. Both authors read and approved the final manuscript.*

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## **ABSTRACT**

The proximate composition and microbiological quality of roasted plantain, its sauce, fish and side vegetable sold in River State University and its environment were investigated. The samples were purchased from four different locations namely staff club (SCL), shopping complex (SHC), back-gate (BGT) and maingate (MGT). Using standard methods, the samples were analyzed for proximate and microbiological quality. The values for moisture, ash, crude protein, crude fibre, fat and carbohydrate were 53.30 - 57.22 %, 2.94 - 3.73 %, 9.26 - 10.13 %, 2.34 - 3.67 %, 11.62 - 13.41 %, and 15.42-20.07 % respectively. The energy varied from 206.76-229.93 kcal/100g. For all the samples from all locations, aerobic count varied from 5.31 - 7.98 Log<sub>10</sub>CFU/g for plantain and fish. *Escherichia coli*, *Salmonella* and *Staphylococcus* ranged from 4.06 - 7.42, 5.48 - 7.41 and 5.31 -7.90 Log<sub>10</sub>CFU/g respectively, while Coliform and fungi count varied respectively from 5.01 - 7.57 and 5.01 - 7.33 Log<sub>10</sub>CFU/g. The leave had significantly ( $P \leq 0.05$ ) the highest microbial load. The microbial load exceeded the acceptable limits for ready to eat foods and can be attributed to poor hygiene practices. Some samples except the leave had no detectable levels of the pathogens

\*Corresponding author: Email: [patience.obinna-echem@ust.edu.ng](mailto:patience.obinna-echem@ust.edu.ng), [chisanupat@yahoo.com](mailto:chisanupat@yahoo.com);

and fungi. The presence of pathogens indicates potential hazard to the health of consumers, hence the need awareness on proper handling and hygiene practices among street food vendors.

**Keywords:** Roasted plantain; sauce; fish; side vegetable; proximate; microbiological qualities.

## 1. INTRODUCTION

Plantain (*Musa sapientum* Var *Paradisiacal* Linn) is one of the extensively consumed staple food in West Africa sub-region, Northern African, Mexico and Caribbean [1]. All stages of the plantain fruit from immature to over ripe is useful. Immature fruits are peeled, sliced, dried and made into powder and consumed as plantain "fufu". The mature fruits (ripe or unripe) are consumed boiled, steamed, pounded, roasted, or sliced and fried into chips, while overripe ones can be processed into beer or used in the preparation of some cereal and legume pudding. Industrially, plantain fruits serve as composite in the making of baby food, bread, biscuit and others [2,3]. Plantain when boiled is eaten with palm oil, vegetable soup or assorted stew, the fried riped ones (*dodo*) are consumed with cereal gruels and when roasted it is consumption with palm oil sauce, roasted fish and side vegetables. The preparation and consumption in roasted form is called *bole*. It is a popular food consumed across the multi-ethnic group and the various socio-economic classes in Nigeria [1].

Fish and fishery products constitute an important food component for a large section of world population, more so in developing countries, where fish forms a cheap source of protein [4]. Atlantic horse mackerel (*Trachurus trachurus*) locally called shiny is the common fish that is barbecued and eaten alongside with the roasted plantain. Also eaten alongside with the roasted plantain is *Gongronema latifolium*. It is a leafy vegetable, herbivorous, non-woody plant from the family of *Asclepiadaceae* that has been accepted as a dietary constituent and medicinal plant among peasants in Nigeria and it is more popular in the South-Eastern States and South-Western Nigeria, where it is called "utazi" and "arokeke" respectively [5,6]. It is used in many different ways in different places, as spices and vegetable for preparation of delicacies in homes. It can be consumed fresh, cooked or dried and applied as powdery spices [7,8]. Other side vegetables eaten with roasted plantain include onions rings and fresh tomatoes.

Roasted plantain is a ready-to-eat food prepared on the street and sold along the street by

vendors and hawkers or prepared at home, transported from home and consumed on the street without further processing. The popular method of preparation of the roasted plantain is by placing the peeled plantain on a wired gauze over burning charcoal. The barbecued fish (*Trachurus trachurus*) in a similar manner, after washing, salting and marinating in some mixture of spices is arranged on the smoking gauze and smoked over the burning charcoal used in roasting the plantain. The roasted plantain and the barbecued fish are held at the corner of the roasting gauze where the charcoals are not blazing. At the point of sales, they are quickly rewarmed, and the sauce added with the side vegetables.

The sauce is made of palm oil, onions, fresh red pepper, salt and other spices for flavor and taste. Street foods like roasted plantain is well patronized in Nigeria since it is easily accessible and also serves as an important source of income. However, roasted plantain being a ready-to-eat food largely do not meet proper hygiene standards and is mostly involved in foodborne diseases [9]. Foodborne diseases result from the ingestion of bacteria and their toxins produced in the food and constitute major health problem [10].

Roasted plantain implication in food borne diseases is attributable to microbial contamination at different stages of handling during preparation and processing [11]. Researchers have investigated the microbiological quality of some street vended foods and identified some foodborne pathogens such as *Escherichia coli*, *salmonella sp.*, *Staphylococcus aureus* and *Listeria monocytogenes*. Contamination occur due to poor hygiene practices, improper handling, inappropriate holding temperatures, and exposure to flies [12,13,14,15].

Consumption of roasted plantain is inevitable because millions of people depend on it as a source of nutrients, available and ready-to-eat food. Information on the microbiological quality of roasted plantain, and the components it is consumed with: the sauce, fish and the side

vegetables is needed as millions of people get ill and many die each year, from consuming unsafe food [16,17]. This study was therefore aimed at evaluation of the proximate composition and microbiological quality of roasted plantain, its sauce, fish and side vegetables sold in Rivers State University and its environment.

## 2. MATERIALS AND METHODS

### 2.1 Roasted Plantain Samples

Roasted plantain, its Sauce, fish and side vegetable were purchased separately from four (4) different locations in Rivers State University and its environment namely; staff club, shopping complex, back gate and main gate. The samples purchased in the packaging materials used by the sellers, were collected into well labelled Ziploc bags and transported immediately to the laboratory for proximate and microbiological analyses.

### 2.2 Sample Standardization for Proximate Analysis

There were variations in sizes of the plantains and the portions of the different components consumed alongside with it. In order to have a 100% portion for proximate analysis, the samples were standardized by dividing the weight of each component with the total weight of served portion and multiplying by 100. The values used for analysis are shown in Table 1.

### 2.3 Proximate Analysis of Roasted Plantain, Its Sauce, Fish and Side Vegetables from Rivers State University and Its Environment

The moisture, ash, crude protein, crude fibre and fat contents of the samples were analyzed according AOAC method [18]. Briefly, moisture was determined by drying the samples in a hot air oven (DHG 9140A) at 130°C until a constant weight was obtained. The crude protein content was determined by kjeldahl method and a nitrogen conversion factor of 6.25 was used. The lipid content was determined by soxhlet extraction method with ethyl ether. The ash content was determined gravimetrically after the incineration of the samples in a muffle Furnace (Model SXL) at 550°C for 2 hours. Enzymatic-gravimetric method was utilized in the determination of crude fibre. The carbohydrate was calculated by difference {100 - (Crude

protein + crude fibre + ash + fat)}. Energy values were obtained using Atwater factor of 4 Kcal/g for protein and carbohydrate and 9 Kcal/g for fat.

### 2.4 Microbiological Enumeration of Roasted Plantain, Its Sauce, Fish and Side Vegetables from Rivers State University and Its Environment

The microbiological quality of the roasted plantain, its sauce, fish and side vegetable was evaluated by using conventional microbiological methods as described by Harrigan, [19]. Twenty-five (25 g) of each of the samples (Roasted plantain, its sauce, fish and side vegetable) were stomacher homogenized in 225ml of sterile peptone water and serially diluted to 10<sup>6</sup> using same diluent. The dilutions (0.1 ml) were spread, plated on appropriate media for the microorganisms. Coliform was enumerated on MacConkey Agar (MCA) incubated at 30°C for 24-48 h. *Salmonella*, *Staphylococcus aureus*, aerobic count and *Escherichia coli* were respectively, plated on Salmonella-Shegilla Agar (SSA), Mannitol Salt Agar (MSA), Nutrient Agar (NA) and Eosin Methylene Blue (EMB) incubated at 37°C for 24 – 48 h. Potato Dextrose Agar (PDA) incubated at 25°C for 72 h was used for mould and yeast count.

### 2.5 Statistical Analysis

Data obtained was subjected to analysis using Minitab (Release 18.0) Statistical Software (Minitab Ltd., Coventry, UK). Statistic differences were obtained using analysis of variance (ANOVA) under the general linear model and Fisher pairwise comparison at 95% confidence level.

## 3. RESULTS

### 3.1 Proximate Composition of Roasted Plantain, Its Sauce, Fish and Side Vegetable from Rivers State University and Its Environment

There was significantly ( $P \leq 0.05$ ) variations in the proximate composition of samples as shown in Table 2. Moisture, Protein, fat, ash and crude fibre varied from 53.30 - 57.22 %, 9.26 - 10.13 %, 11.57 - 13.41 %, 2.94 - 3.73 % and 2.34 - 3.67 % respectively. The carbohydrate and Energy value respectively, ranged from 15.42 - 20.64 % and 206.76 and 229.93 Kcal/100g.

### 3.2 Microbiological Quality of Roasted Plantain, Its Sauce, Fish and Side Vegetables from Rivers State University and Its Environment

The microbial count of the samples from Rivers State University staff club are shown in Fig. 1. Aerobic count, *Salmonella* and *Staphylococcus* counts varied from  $5.31 \pm 0.01$  -  $6.74 \pm 0.65$ ,  $5.77 \pm 0.01$  -  $6.41 \pm 0.01$  and  $5.80 \pm 0.00$  -  $6.70 \pm 0.70$   $\text{Log}_{10}\text{CFU/g}$  respectively and the *G. latifolium* leaf which was the side vegetable had significantly ( $P \leq 0.05$ ) the highest counts. *Coliform* and *E. coli* counts were  $5.78 \pm 0.01$  -  $6.78 \pm 0.03$  and  $5.20 \pm 0.00$  -  $6.71 \pm 0.10$   $\text{Log}_{10}\text{CFU/g}$  respectively with the sauce having significantly ( $P \leq 0.05$ ) the highest count and the fish least. The sauce had no detectable levels of *Salmonella* and *Staphylococcus*. Fungi count varied from  $6.04 \pm 0.01$  -  $7.28 \pm 0.61$   $\text{Log}_{10}\text{CFU/g}$  for the sauce and the leave.

Fig. 2 showed that the microbial count of samples from Rivers State University shopping complex were: Aerobic, *Coliform* and *E. coli* count respectively, which ranged from  $6.00 \pm 0.00$  -  $6.67 \pm 0.62$   $\text{Log}_{10}\text{CFU/g}$ ,  $5.60 \pm 0.01$  -  $7.45 \pm 0.58$  and  $5.60 \pm 0.01$  -  $6.95 \pm 0.01$   $\text{Log}_{10}\text{CFU/g}$ . The leave had significantly ( $P \leq 0.05$ ) the highest *Coliform* and *E. coli* count and the fish had significantly ( $P \leq 0.05$ ) the least count. There was no detectable level of *E. coli* in the fish and sauce sample. *Salmonella* varied from  $6.89 \pm 0.81$  -  $7.09 \pm 0.57$   $\text{Log}_{10}\text{CFU/g}$  for the sauce and the fish respectively. *Staphylococcus* varied from  $5.96 \pm 0.01$  -  $7.25 \pm 0.30$   $\text{Log}_{10}\text{CFU/g}$  for the sauce

and the leave respectively. Fungi varied from  $5.01 \pm 0.01$  -  $6.39 \pm 0.55$   $\text{Log}_{10}\text{CFU/g}$  with significantly ( $P \leq 0.05$ ) highest count in the vegetable.

Microbial count of samples from the University's back gate are shown in Fig. 3. Aerobic count, *Coliform* and *E. coli* varied respectively from  $7.35 \pm 0.65$  -  $7.98 \pm 0.71$ ,  $6.06 \pm 0.08$  -  $7.57 \pm 0.54$  and  $5.89 \pm 0.16$  -  $7.42 \pm 0.59$   $\text{Log}_{10}\text{CFU/g}$  while *Salmonella* and *Staphylococcus* varied from  $5.48 \pm 0.00$  -  $7.41 \pm 0.52$  and  $5.31 \pm 0.01$  -  $7.90 \pm 0.63$   $\text{Log}_{10}\text{CFU/g}$  respectively. Fungi varied from  $5.60 \pm 0.00$  -  $7.33 \pm 0.57$   $\text{Log}_{10}\text{CFU/g}$ . The leave had significantly ( $P \leq 0.05$ ) the highest *Coliform*, *E. coli*, *Salmonella*, *Staphylococcus* and fungi counts while plantain had the least of *E. coli*. The sauce, plantain and fish respectively, had no detectable level of *Coliform*, *Salmonella* and *Staphylococcus*.

Fig. 4 showed the microbial count of samples collected from the University's main gate. Aerobic count, *Coliform* and *E. coli* in the samples varied from  $6.10 \pm 0.28$  -  $7.19 \pm 0.58$ ,  $5.01 \pm 0.01$  -  $6.61 \pm 0.02$  and  $6.14 \pm 0.62$  -  $7.06 \pm 0.42$   $\text{Log}_{10}\text{CFU/g}$  respectively. Only the leave had *Staphylococcus* count of  $7.54 \pm 0.71$   $\text{Log}_{10}\text{CFU/g}$ . The plantain and the fish had no detectable levels of *Salmonella* and *Fungi*, their levels in the sauce and leave were  $6.10 \pm 0.14$  -  $6.81 \pm 0.36$  and  $6.34 \pm 0.06$  -  $6.45 \pm 0.57$   $\text{Log}_{10}\text{CFU/g}$ . The leave samples from all location had all the enumerated microorganisms (100% occurrence), while plantain had 75% occurrence of the microorganisms as shown in Table 3.

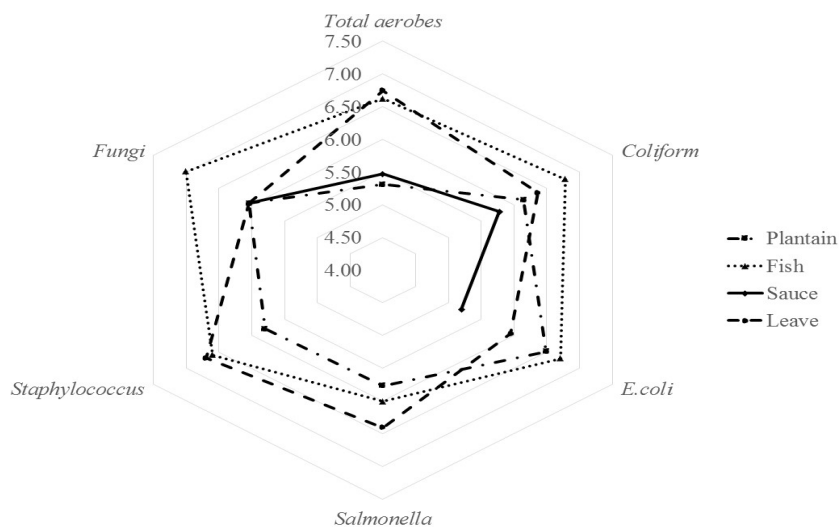


Fig. 1. The Microbial count ( $\text{Log}_{10}\text{CFU/g}$ ) of roasted plantain, sauce, fish and side vegetable from the University's staff club

**Table 1. The Standardization of roasted plantain, sauce, fish and side vegetable for proximate composition**

Location	Sample weight (g)				Total
	Plantain	Fish	Sauce	Vegetable	
Staff club	49.29	31.35	16.34	3.02	100
Shopping complex	53.78	27.63	14.85	3.83	100
Backgate	52.12	30.02	14.18	3.62	100
Maingate	53.86	30.01	12.63	3.49	100

**Table 2. Proximate composition (%) and energy content (Kcal/100g) of roasted plantain mixed with sauce, fish and side vegetable**

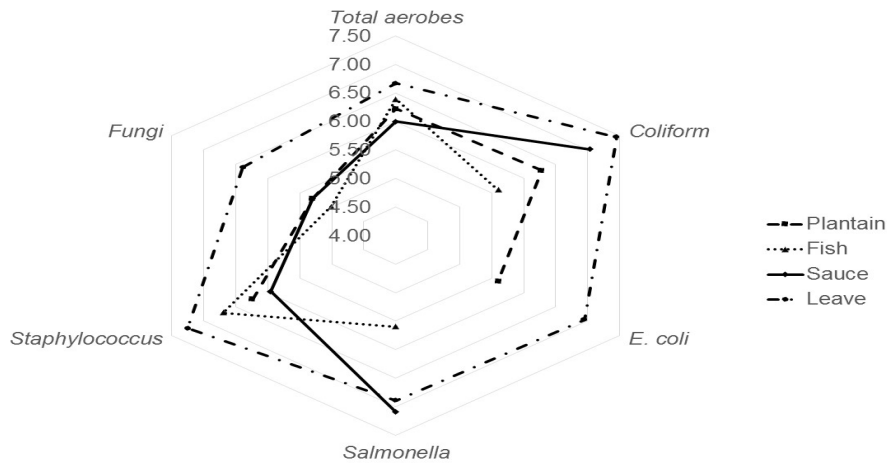
Locations	Moisture	Ash	Crude Protein	Crude fibre	Fat	Carbohydrate	Energy
Backgate	52.30±0.03 <sup>c</sup>	2.94±0.06 <sup>c</sup>	9.70±0.03 <sup>b</sup>	2.37±0.28 <sup>b</sup>	12.07±0.02 <sup>b</sup>	20.64±0.43 <sup>a</sup>	229.93±1.65 <sup>a</sup>
Maingate	55.23±0.28 <sup>b</sup>	3.73±0.07 <sup>a</sup>	9.26±0.00 <sup>c</sup>	3.19±0.29 <sup>ab</sup>	11.57±0.26 <sup>c</sup>	17.04±0.23 <sup>b</sup>	209.27±3.29 <sup>c</sup>
Shopping complex	54.60±0.65 <sup>b</sup>	3.13±0.07 <sup>bc</sup>	9.71±0.11 <sup>b</sup>	3.67±0.14 <sup>a</sup>	13.41±0.12 <sup>a</sup>	15.49±0.14 <sup>c</sup>	221.43±1.22 <sup>b</sup>
Staff club	57.22±0.23 <sup>a</sup>	3.28±0.00 <sup>b</sup>	10.13±0.00 <sup>a</sup>	2.34±0.34 <sup>b</sup>	11.62±0.17 <sup>bc</sup>	15.42±0.28 <sup>c</sup>	206.76±0.29 <sup>c</sup>

*Values are mean ± standard deviation of duplicate samples*

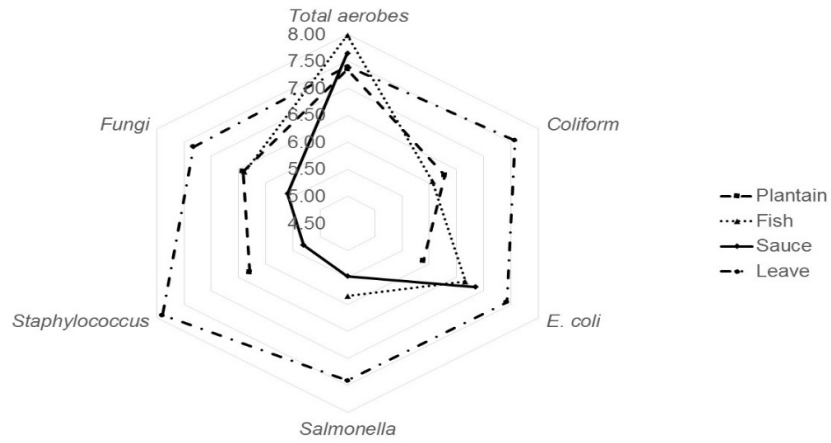
*Means with the same superscripts within the same column and are not significantly ( $P \geq 0.05$ ) different*

**Table 3. Occurrence of the microorganisms in the samples**

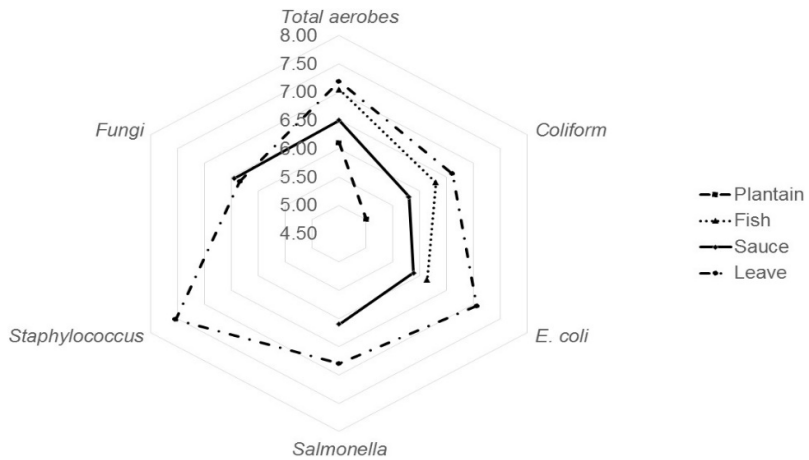
Microorganisms	Sample/percentage of occurrence				Average (%)
	Plantain	Fish	Sauce	Leave	
Total aerobes	8(100.0)	8(100.0)	8(100.0)	8(100.0)	100.0
<i>Coliform</i>	8(100.0)	8(100.0)	8(75.0)	8(100.0)	93.8
<i>E. coli</i>	8(75.0)	8(75.0)	8(75.0)	8(100.0)	81.3
<i>Salmonella</i>	8(25.0)	8(75.0)	8(75.0)	8(100.0)	68.8
<i>Staphylococcus</i>	8(75.0)	8(50.0)	8(50.0)	8(100.0)	68.8
Fungi	8(75.0)	8(75.0)	8(100.0)	8(100.0)	87.5
Average (%)	75.0	79.2	79.2	100.0	



**Fig. 2. The Microbial Count ( $\text{Log}_{10}\text{CFU/g}$ ) of roasted plantain, sauce, fish and side vegetable from the University's Shopping Complex**



**Fig. 3. Microbial Count ( $\text{Log}_{10}\text{CFU/g}$ ) of roasted plantain, sauce, fish and side vegetable from the University's back gate**



**Fig. 4. Microbial Count ( $\text{Log}_{10}\text{CFU/g}$ ) of roasted plantain, sauce, fish and side vegetable from the University's main gate**

## 4. DISCUSSION

### 4.1 Proximate Composition of Roasted Plantain, Its Sauce, Fish and Side Vegetable from Rivers State University and Its Environment

Moisture plays significant role in the growth of microorganisms and usually has positive correction with microbial growth and affects the storage stability of the food. The moisture content of the samples was higher than that reported by Adetunde et al. [20] for roasted unripened (15.3%) and ripened plantain (39.59%). The increase in moisture can be attributed to the other components of the roasted plantain (the sauce, fish and side vegetable) usually consumed with it. The high moisture content of the plantain will encourage microbial growth.

The protein values were higher than the range for roasted plantain (3.15 - 5.25) alone [20]. The addition of fish and the side vegetable may be responsible for the increase in protein as atlantic mackerel has been reported to contain 17.46% protein [21] and the fresh leave of *Gongronema latifolium* vegetable Utazi contains about 33.60 - 66.60 % protein [22,23]. Protein is essential for cellular functions and the body does not have reserves to be used in times of need as with carbohydrate and fat. The protein content of the roasted plantain meal will meet more than 23% of the recommended dietary reference (DRI) intake for an adult 19-30 years with body weight of 60 kg given that the DRI is 0.66 g/Kg/d [24].

Fat is applicable to triacylglycerols whether they are solid or liquid at ambient temperatures [25]. Fat plays significant role in the flavour and aroma of the food. It is a very important source of energy and performs basic role in the structure and function of biological membranes [24]. The fat content of the samples was higher than values of 1.76% reported by Pikuda and Illelaboye [26] and 4.23% reported by Adetunde et al., [20] for unripened roasted plantain but lower than 19.56% for roasted ripened plantain. The sauce which is more of palm oil and the fish may have contributed to the increase in lipid content of the unripened roasted plantain analyzed in this present study.

Ash is the inorganic residue that remains after incineration or complete oxidation of organic component of food and a representation of the total mineral content in food [27], while crude fibre is important in normal bowel function among

other health benefits. The high ash content of the samples is an indication of good source of minerals.

The carbohydrate ( $\leq 20.64$  %) and energy ( $\leq 229.93$  Kcal/100g) values of the samples were lower than 61.58% and 278.50 Kcal reported by Pikuda and Illelaboye [26]. The difference can be attributed to the higher moisture content. The energy requirement for an adult male between 30 - 59 years of age is 212 and 266 KJ/kg body weight respectively for those involved in moderate and heavy activities [28]. The consumption of 100g of the roasted plantain with the sauce, fish and vegetable for an adult male weighing about 40 kg will meet 102 -113 % and 81 -90 % of the recommended energy requirement for moderate and heavy activity respectively. This read-to-eat roasted plantain with the sauce, fish and vegetable is therefore an important source of nutrient and energy.

### 4.2 Microbiological Quality of Roasted Plantain, Its Sauce, Fish and Side Vegetables from Rivers State University and Its Environment

The microbiological analysis revealed unsatisfactory levels of contamination of the roasted plantain, its sauce, fish and side vegetable that can pose the risk of food poisoning. In general, the leave had significantly ( $P \leq 0.05$ ) the highest microbial load. The chopped leaves are stored in covered plastic containers at ambient temperature from where they are served. Storing food at ambient temperatures for a long time before consumption have been implicated in the occurrence of food poisoning [11].

Fish ought not to carry those organisms typical of mammalian microflora such as *E. coli* and faecal coliform. Their presence is a clear indication of contamination from a terrigenous source [29]. It would have been expected that the plantain, fish and the sauce that had passed through heat processing should be free or have satisfactory levels of the enumerated microorganisms. However, the presence of these microorganisms irrespective of the hot holding can be attributed to several factors. The abuse of temperature condition as temperature during such holding are within the danger zone for the proliferation of microorganism or production of their toxins; unhygienic conditions related to the location of the food stalls, especially in dirty roadside locations (as with the main and back gate,

although the chopping complex and the staff club stands are within a clean confined space with adequate water supplies) and they are displayed uncovered and exposed to the environment; use of unclean hands to package the ready-to-eat roasted plantain: the same hand used in handling raw materials, money and any other item including touching of their apron and the body; and opening of the polythene bags by wetting the fingers with saliva from the tip of the tongue and subsequently blowing air into the bags. These are in agreement with reports in literature [30,31,32,10] on the factors associated with contamination of ready-to-eat street foods.

Aerobic count is the total number of bacteria able to grow in an aerobic environment in moderate temperature, an indicator of quality highlighting the potential problems of storage and handling. Aerobic counts in the samples were unsatisfactory as they exceeded the guideline of  $<10^3$  CFU/g (3  $\text{Log}_{10}$  CFU/g) for ready-to-eat foods [33].

Coliforms are nonpathogenic gram-negative asporogeneous rods that ferment lactose within 48 hours and produce dark colonies with a metallic sheen on Endo-type agar. They are represented by four genera of the family *Enterobacteriaceae*: *Citrobacter*, *Enterobacter*, *Escherichia*, and *Klebsiella* [34]. The coliform count in foods indicates inadequate processing, contamination due to cross-contamination with raw materials and dirty equipment/utensils as well as improper storage temperature. Although coliforms are nonpathogenic, there could be the presence of pathogens which when ingested followed by growth and multiplication in the host including tissue invasion/release of toxins become a health risk [35].

*E. coli* is a natural component of human gut flora, its presence in the roasted plantain, its sauce, fish and side vegetable exceeded the recommended standard of  $<20$  CFU/g (1.30  $\text{Log}_{10}$ CFU/g) [33]. The unsatisfactory levels in the food implies contamination of faecal origin attributable to poor hygiene practices by the food vendors. Its presence may also pose food safety problems as other enteric pathogens may also be present and some strains are enterotoxigenic and cause gastroenteritis [36].

*Salmonella* are gram-negative non-sporing enteric bacteria rods that cause foodborne gastroenteritis They are prevalent in many foods and are important food safety hazard [34]. *Salmonella*, was present in only 25% of the

plantain samples, but was present in 75% of the sauce and the fish and 100% of the leave samples. According to the guideline by Centre for Food Safety [33], the presence of *Salmonella* is not expected in ready-to-eat foods. Although, the plantain samples from the shopping complex, back and main gates had no count of *Salmonella*, its presence in the sauce, fish and the side vegetable render the food unsafe for consumption.

*Staphylococcus aureus* is a gram-positive coccus and a natural flora of human body especially the orifices. The levels of *S. aureus* in the plantain, sauce, fish and side vegetables exceeded the guideline of  $<20$  CFU/g [33]. Its presence in food points to excessive human handling [37]. Amusan et al., [4] suggested the use of latex gloves to reduce excessive human hand contact, if such gloves are worn all through the processing without regular changing after handling other materials or are used to also touch the body the problem may be unsolved without adequate food safety and hygiene awareness. The presence of fungi in the samples are worrisome as some fungi are associated with the production of mycotoxins known to be hazardous to health.

## 5. CONCLUSION

The proximate composition revealed that the roasted plantain, its sauce, fish and vegetable is a good source of nutrient and will provide energy to meet daily requirements. The microbiological analysis however, revealed a high level of contamination in the leave, fish, sauce and the plantain samples. The microbial load exceeded the guideline for ready-to-eat foods and can be attributed to poor handling and poor hygiene practices. The presence of pathogens indicates potential hazard to the health of consumers. There is the need for the appropriate health and Food authorities to create the awareness on proper handling and hygiene practices among street food vendors.

## DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by



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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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