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EFFECTS OF WRAPPING MATERIALS ON THE MICROBIAL POPULATION OF STEAM BEAN PUDDING (*MOIMOI*)

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ABSTRACT

The effects of wrapping materials on the microbial population of Moimoi were assessed. A total of thirty samples of wrapped Moimoi of plastic, waterproof and aluminum foil was collected from food vending sites located in Choba. The samples were taken to the laboratory and analyzed using standard microbiological methods. The total prevalence of bacteria that occurred from foil Moimoi were *Micrococus* (35%), *Bacillus* (25%) , *Staphylococcus* (20%) and *Proteus* (20%). The total prevalence of bacteria obtained on plastic Moimoi were *Staphylococcus* (27%), *Bacillus subtilis* (23%) *Proteus sp* (23%), *Micrococcus sp* (13%) and *Bacillus cereus* (14%). Total prevalence obtained from nylon Moimoi were *Staphylococcus* (27%), *Bacillus cereus* (23%), *Proteus* (18%), *Micrococcus* (18%) and *Bacillus subtilis* (14%). The mean total bacteria count, Staphylococcus count and coliform count obtained ranged from 9.8 x10^3 - 1.35 x10^3 cfu/g. The result of the study further shows that most of the gram-positive isolates such as *Staphylococcus sp*, *Micrococcus sp*, *Bacillus subtilis* and *Bacillus cereus* were resistant to antibiotics of ceftriaxone, cloxacillin, Augmentin, ceftazidime and cefuroxime while the gram-negative bacteria isolated Proteus sp was resistance to Augmentin and cefuroxime but susceptible to gentamycin, erythromycin and cefuroxime. Contamination of these wrapped Moimoi samples is due to poor personal hygiene and sanitation among food handlers. To prevent outbreak of food poisoning, users of this wrapping materials should wash wrapping materials with clean water before using and food in these wrapping materials should be consumed immediately to reduce multiplication of microorganisms.

Contribution/Originality: The study revealed that the wrapping materials used for packaging of RTE Moimoi have great impact on the microbial quality of RTE Moimoi as those packaged with Nylon bags were highly contaminated with microorganisms when compared to other packaging materials in the study.

1. INTRODUCTION

Food according to Idodo-Umeh (2014) is any substance which when taken into the body cells yield energy and materials for growth, repairs of damaged tissues and regulation of processes without causing harm to the consumer. Food borne illness has been linked to consumption of pathogens present in foods majorly due to improper handling, processing and packaging of these food. Foodborne pathogens are known to be responsible for over millions of cases of infections coupled with health problems (Arun & Elum, 2008). Moimoi has been regarded as a very popular ready to eat steamed gel food produced from cowpea paste in Nigeria and West Africa at large (Olapada, 2002; Uzuegbu & Eke, 2000). Moimoi is a food produced mostly in West Africa by mixing wet milled dehulled beans or cowpea flour with water, vegetable oil and seasonings into a homogenous slurry or paste, wrapped or packaged in

leaf pouches or other packaging materials like aluminum containers and tin can then steamed. During steaming, the aforementioned food paste solidifies into an irreversible gel between basically due to hydration of complex carbohydrate, protein gelation (Okechukwu, 1992; Osuji, 2012) and also due to curdling of complex carbohydrate (Urbanski, 1982). Uzuegbu and Eke (2000) however, posited that bean variety affects how the yield and phase separation of Moimoi could turn out to be. Moimoi as a food can be consume as breakfast snack with pap alone, and with other cereal foods like rice in most Nigerian homes (Nwosu, 2011). The aforementioned food is an excellent source of nutrient and can be consumed anytime of the day (Akusu & Kiin-Kabari, 2012). Food packaging entails the act of wrapping or enclosure of food in materials. Materials such as papers, leaves, polyethylene, glasses, aluminum foil and has been recognized as most used materials for food packaging due to their ability to preserve and shield food from outside influences and damage while providing consumers with the nutrients required. Wrapping/packaging materials like plastic, waterproof and aluminum foil are used in packaging quick consumed food products like Moimoi (Ajala, 2011; Onwuka, 2014).

Due to scarcity in urban areas where they are highly demanded, Moimoi is mostly packaged in tin containers and flexible plastics like polyethylene film bags, aluminum foils and plates (Onwuka, 2014) to meet higher demands in this area due to change in lifestyle of people. However, it has been discovered that these aforementioned packaging materials leaves desirable imparts or undesirable flavour component into food products which can either enhances product acceptably unlike undesirable one (Kabuo, 2013). Acceptability of Moimoi depends on appearance colour, taste, aroma and texture which are the major parameters that determine product quality (Kabuo, 2013). The use of wrapping materials such as aluminum foil, tin can etc. has experienced a high rate of usage recently for packaging of Moimoi mostly due to their barrier properties such as grease proof, non-absorption coupled with odorless, tasteless, opaque to light, bright in appearance and non-toxic properties. These wrapping materials also has low tear strength, susceptible to strong acid and alkali.

Aluminum cans and plates naturally coated with aluminum oxide are another most widely used materials for cooking *Moimoi* with higher effective barrier to temperature, moisture, high resistant to most forms of corrosion and chemical attack (Marsh & Bugusu, 2007). These aforementioned food materials have been regarded to be better than leaves in cooking and packaging of Moimo*i* (Koleosho, 2013). According to Komolafe (2005) food packaging or wrapping materials provides proper environmental conditions for long shelf life and protects food products against microbiological, chemical or physical deterioration.

Moimoi which is a processed food of cowpea can be preserved for extended periods by a combination of aseptic packaging to exclude microbes and oxygen as well as to maintain a moderate temperature (VanGarde & Margy, 1994). Wasiu, Maziya-Dixon, and Menkir (2013) opined that packaging materials have been known to be possible source of microbial contamination of food. Mensah, Yeboah-Manu, Owusu-Darko, and Ablordey (2002); Idowu (2006) in their studies has all isolated the likes *of S. aureus*, *E. coli*, *Klebsiella spp*, *Proteus spp*, *Aspergillus niger*, *Aspergillus fumigatus*, *Mucor spp* and *Penicillium* spp in ready-to-eat food of Moimoi. Mbaeyi and Iroegbu (2013) reported *Escherichia coli* and *Klebsiella pneumonia* on beans, Yam, garri, pears, cassava, foo-foo, abacha, okpa and Moimoi as the microorganism found on them as a result of wrapping materials.

No work has been documented on the effect of plastic which is a wrapping materials on the microbial population of Moimoi but there has been report on effects of plastic as a wrapping or packaging materials on food. With the increase in the use of wrapping materials on Moimoi, there is a need for a thorough scientific evaluation to ascertain their effects on microbial population of Moimoi.

It is in the light of these that this research seeks to bring to the fore the effects of wrapping materials on microbial population of Moimoi with the aim to isolate and characterize and compare microbial loads of each wrapping materials of Moimoi (Steam bean pudding).

2. MATERIALS AND METHODS

2.1. Location of the Market

Chobe market is located 1km from University of Port Harcourt. It is situated near a poorly drained site. **Purposive** sampling was used during the course of this study and this was based on the availability of food vendors within the study area.

2.2. Sample Collection

A total of 30 samples of wrapped oi Moimoi of plastic (10), waterproof (10) and aluminum foil (10) were collected randomly major food vending sites in University of Port Harcourt, Abuja and Choba Campus. The samples were collected over a two weeks' period. Samples were purchased when freshly prepared and were then collected into a sterile Ziploc bag, and was then taken under aseptic condition to the laboratory for microbiological analysis within a specific hour of collection. Fresh samples of not more than a day old (as indicated by the sellers) were obtained for analysis.

2.3. Microbial analysis of Moimoi Samples

25g of each of the samples (non-homogenized) were weighed and placed into 250ml of sterile peptone water in a conical flask. The Moimoi was stirred gently using a sterile glass rod for about 5minutes. From the stock solution, a tenfold serial dilution was carried by transferring 1ml of the solution into 9ml of sterile diluent in the test tube to obtain a dilution factor of 10^2, 1ml of the solution was transferred from the first test tube to the second to obtain a dilution factor of 10^3. These processes continued to a dilution factor of 10^6 was obtained. While culturing on the media, 0.1ml of the solution gotten from the test tubes with a dilution factor of 10^4 and 10^6 were dispensed on the plate agar in duplicates. 0.1ml of the solutions with dilution factor of 10^{-2} and 10^{-3} were dispensed on the selective media from bacteria isolation. After sub-culturing of the isolates on nutrient agar, media agar slants were prepared in bijou bottles by dispensing 10ml of nutrient agar solution into bijou bottles. The medium was sterilized by autoclaving at 121^0C for 15minmutes at 15psi. the bottles were slanted and allowed to solidify, isolates from the pure cultures were inoculated on the surface of the agar slant and this was incubated at 37^0C for 24hours.

Bacterial Isolates were identified based on colonial morphology and cultural characteristics on growth media which include: colony size, color, opacity, consistency, colony pigmentation elevation, odour, swarming, identification materials, reagents and protocols were according to Cheesbrough (2005). Identification of Fungi was done by colonial morphology (colour, size and texture) and the cell morphology (mycelium, hyphae) of the fungi using lactophenol blue. A piece of mycelium from the petri-dishes was mounted on a clean grease-free slide using a sterile wire loop and was cove red with a cover slip/ a drip of lactophenol cotton blue was added and allowed for few minutes before examining under the microscope.

2.4. Antibiogram

This was done against eight antibiotics using disc diffusion assay on Mueller-Hinton agar , by agar well diffusion assay. They included Gentamicin(10 mcg) Erythromycin (15mcg) Ofloxacin (10mcg) Ceftazidime (30mcg) Ceftriaxone (30mcg) Cloxacillin (5mcg) Augmentin (30mcg) Cefuroxime (15mcg) (Okekeaji, Okore, Ibezim, Martins, & Odoh, 2018).

2.5. Statistical Analysis

The data extracted for the mean total aerobic plate count, of the Moimoi wrapped in Nylon, Aluminum, foil, and plastic plates were analyzed using the IBM SPSS software version 25. All statistical analyses were carried out using analysis of variance (ANOVA). Significance of the differences was ascribed at the 0.05 level for ANOVA.

3. RESULT

Packaging is an integral part of food processing; it provides the proper environmental conditions for long shelf life. This was in evidence from the results obtained from effects of wrapping materials (foil, plastic and nylon) on the microbial population of Moimoi (steam bean pudding).

The result of the study revealed total bacterial count obtained from wrapping materials of Moimoi from foil, plastic and nylon. From the result, it was observed that the wrapping materials had different range of bacteria count observed on them. Figure 1- 3 presents the total heterotrophic bacteria counts of moi moi sample wrapped with different wrapping materials The total heterotrophic bacteria count recorded in all the aforementioned wrapping materials for Moimoi under study ranged from 9.7 $x10^4$ -1.04 $x10^6$ cfu/g. Foil Moimoi total bacteria count ranging from 9.7 $x10^4$ - 1.47 $x10^6$, while plastic Moimoi had total bacteria count ranging from 6.55 $x10^6$ - 1.17 $x10^6$ and nylon moi moi had a total bacteria count ranging from 8.2 $x10^4$ - 1.04 $x10^6$ cfu/g. The values obtained are higher than the World Health Organization directives on microbial limits which made it known that total heterotrophic bacterial count should not exceed the limit of 5.0 x 10^5 colonies per gram of sample. The finding of this study tallies with the result recorded from the study of Monday, Francis, and Mohammad (2016). The result of the study also aligned with that of Oranusi, Oguoma, and Agusi (2013) on Moimoi coupled with the result of Adegunloye, Agarry, Adebolu, and Adetuyi (2006) whose bacteria count obtained in their study falls in line with this present study. Significant difference ($p<0.05$) was observed in the levels of the aerobic bacteria counts of the different Moimoi samples.

Figure 5-7 shows the total staphylococcus counts from moimoi wrapped with different wrapping materials. The result obtained for total Staphylococcus count of different Moimoi samples; the result showed that the total Staphylococcus count obtained ranged from of 9.8 $x10^3$ - 2.09 $x10^5$. *Staphylococcus sp.* have previously been reported by Owhe-Ureghe, Ekundayo, Agboniahor, Oboh, and Orhue (1993) to be associated with steamed bean pudding (Moimoi) and maize pap. The materials used for Moimoi in terms of plastic recorded the highest *Staphylococcus* count. while the same plastic also had the lowest *Staphylococcus* count amongst all the samples used on Moimoi. However, there was no growth of *Staphylococcus* count on some of the sample for foil, plastic and nylon Moimoi with plastic and foil exhibiting the lowest occurrence of no coliform growth. However, there was statistically significant difference ($p<0.05$) between the microbial loads in the different Moimoi samples. The total Staphylococcus count obtained from this study is higher than the standard set by Food Drug Agency (FDA) limit for *Staphylococcus* in food is which is placed at $<10^3$ CFU/g.

The isolation of *Staphylococcus* from this study correlates with the findings of Oranusi et al. (2013); Taulo, Wetlesen, Abrahamsen, Mkakosya, and Kululanga (2008) in which this organism was implicated in ready-to-eat foods. The presence of *Staphylococcus* is largely as a result of human contact and this suggest poor hygiene practices since the organism is a normal flora of the skin and nasal passage (Cogen, Nizet, & Gallo, 2008). However, the result of Adebola, Muhammed, Bello, and Abdulyekeen (2016) obtained no *Staphylococcus* count on ready to eat food in their study wrapped with both nylon and plastic which quite disagree with this present study.

Figure 9-11 presents the total coliform count for moimoi wrapped with different materials. The total coliform count obtained; the result showed that total coliform values obtained ranged between 4.7 $x10^3$ to 1.35 $x10^3$ cfu/g. Furthermore, to the total coliform counts observed, plastic Moimoi recorded the highest value (4.7 $x10^3$) while foil recorded Moimoi the lowest value (1.35 $x10^3$) of coliform count. However, coliform counts were not observed from some of the samples for foil, plastic and nylon. There was statistically significant difference ($p<0.05$) between the microbial loads in the different Moimoi samples. The values obtained from this study are in alignment with World Health Organization directives on microbial limits of total coliform counts of not exceeding 5.0 x 10^3 per gram of the sample. The value of coliform count obtained in this study does not conform to that of Oranusi et al. (2013) which was observed for Moimoi as the value recorded in their study was higher than the present study.

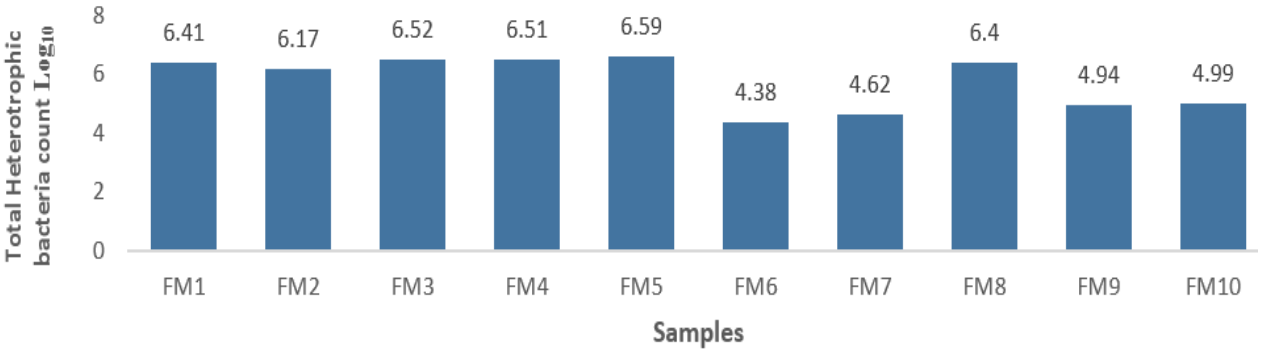

Figure 1. Total heterotrophic bacteria counts of Foil Moimoi samples.

Note: FM= Foil Moimoi.

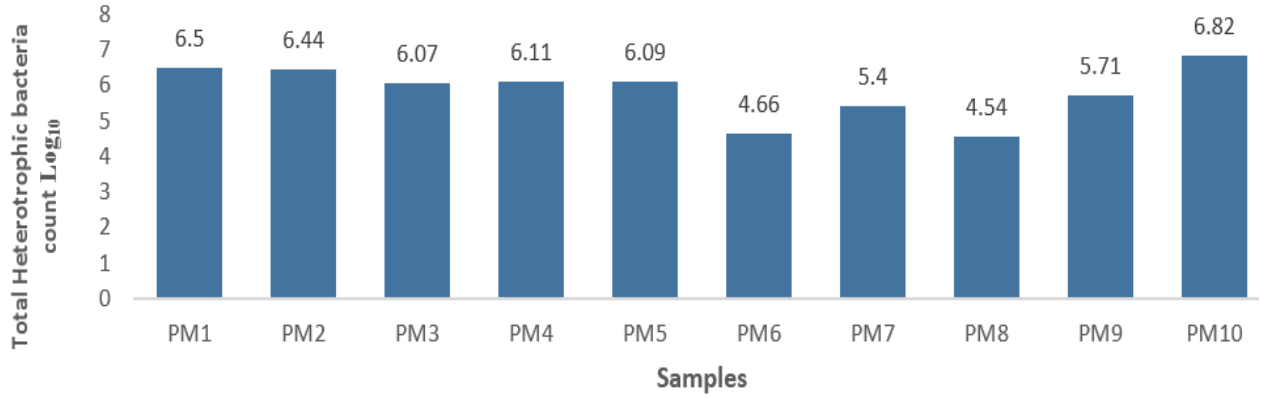

Figure 2. Total heterotrophic bacteria counts of plastic Moimoi samples.

Note: PM= Plastic Moimoi.

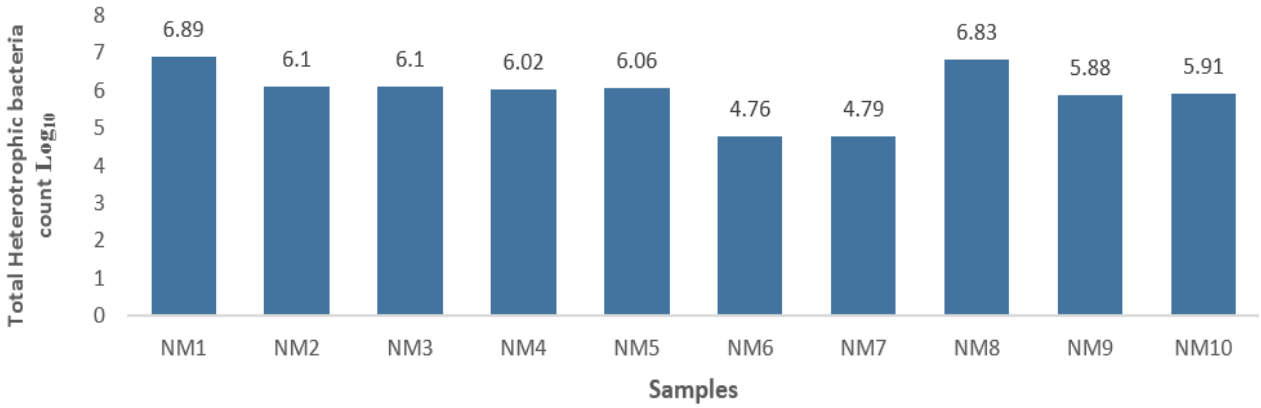

Figure 3. Total heterotrophic bacteria counts of Nylon Moimoi sample.

Note: NM= Nylon Moimoi

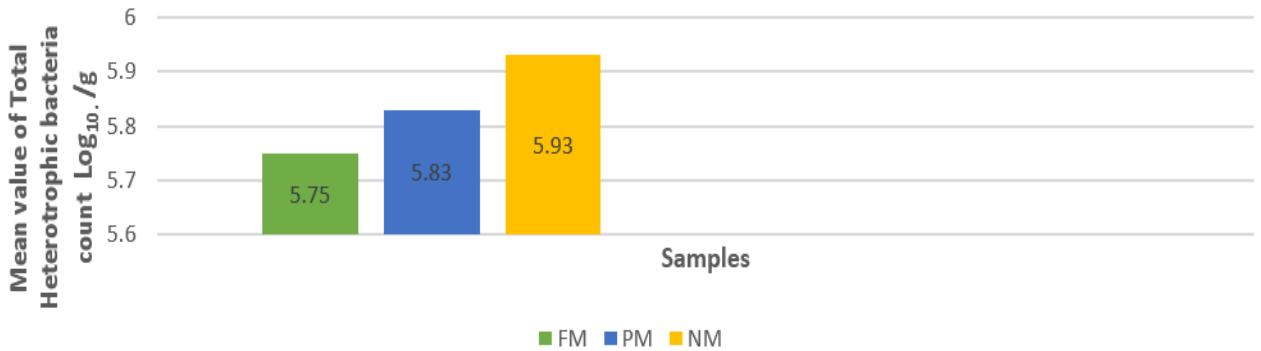

Figure 4. Total mean of total heterotrophic bacteria counts of the different Moimoi samples.

Note: FM= Foil Moimoi (Green) PM= Plastic Moimoi(Blue NM= Nylon Moi-Moi(yellow).

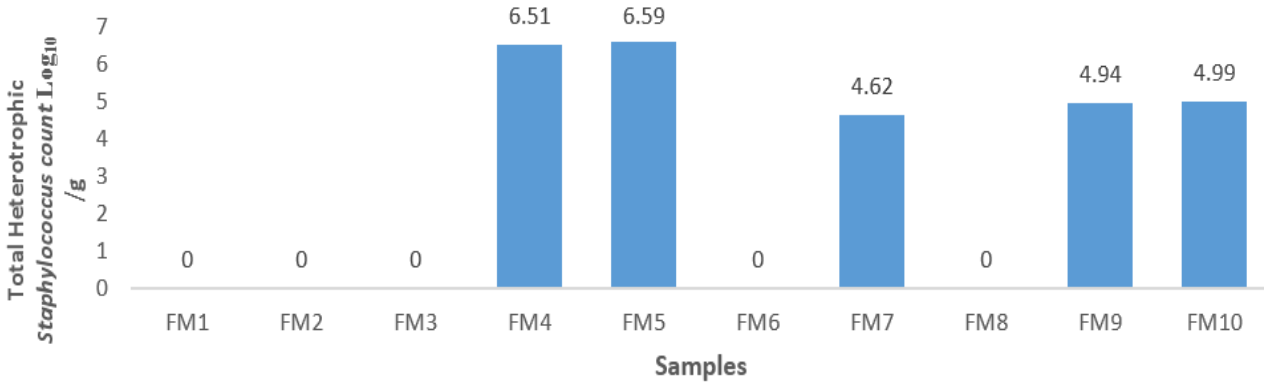

Figure 5. Total heterotrophic *Staphylococcus* count of foil Moimoi samples.

Note: FM= Foil Moimoi.

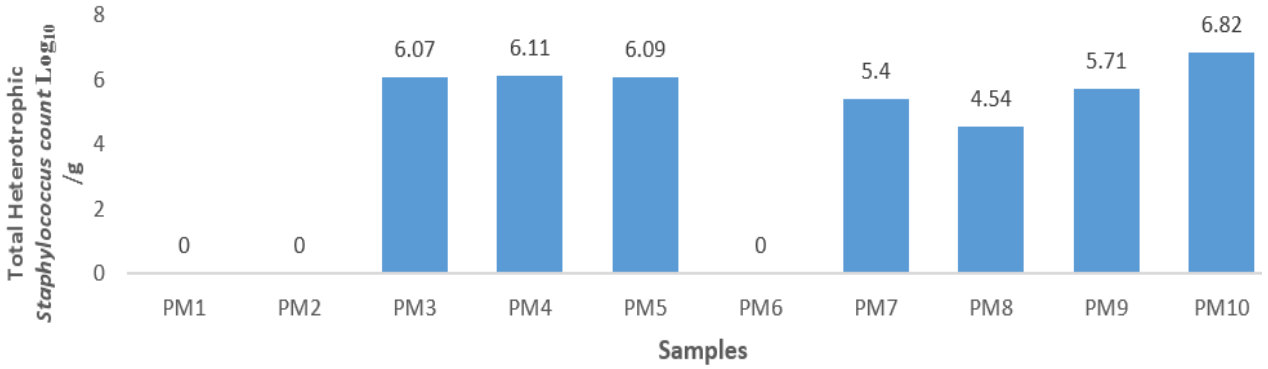

Figure 6. Total heterotrophic *Staphylococcus* count of plastic Moimoi samples.

Note: PM= Plastic Moimoi.

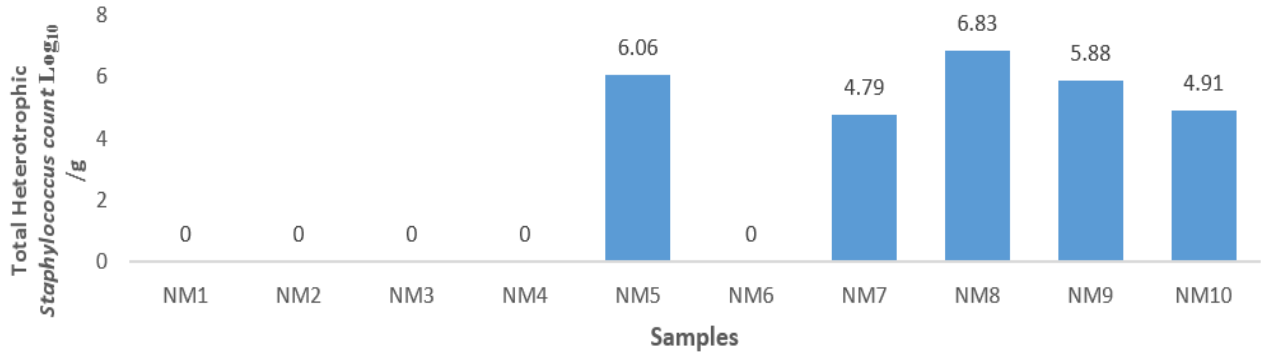

Figure 7. Total heterotrophic *Staphylococcus* count of Nylon Moimoi samples.

Note: NM= Nylon Moi-moi.

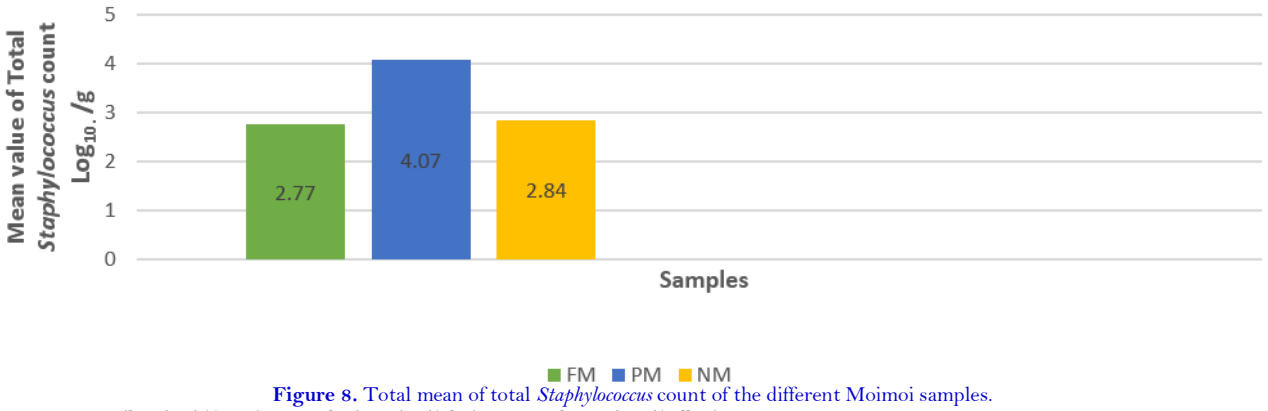

Figure 8. Total mean of total *Staphylococcus* count of the different Moimoi samples.

Note: FM= Foil Moimoi (Green) PM= Plastic Moimoi(Blue) NM= Nylon Moi-Moi(yellow).

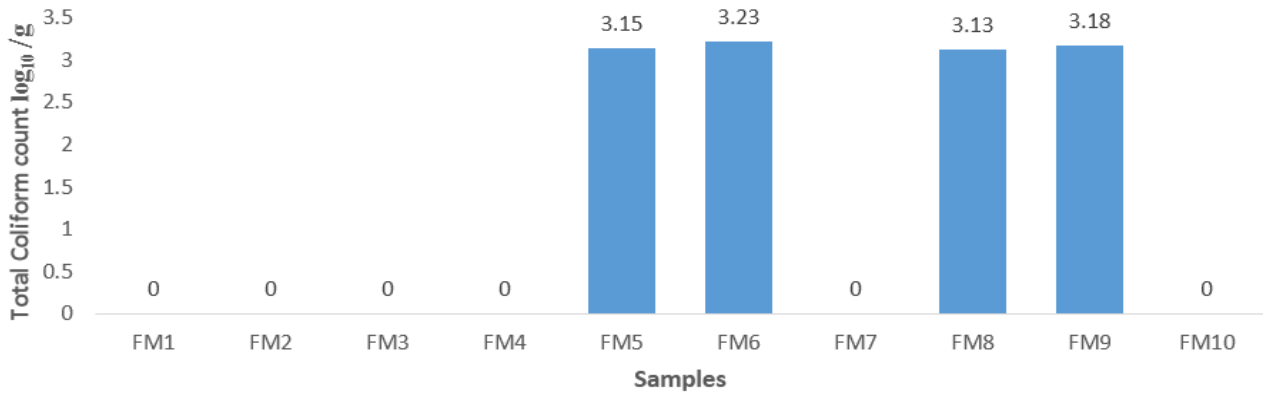

Figure 9. Total coliform counts of foil Moimoi.

Note: FM= Foil Moi-moi.

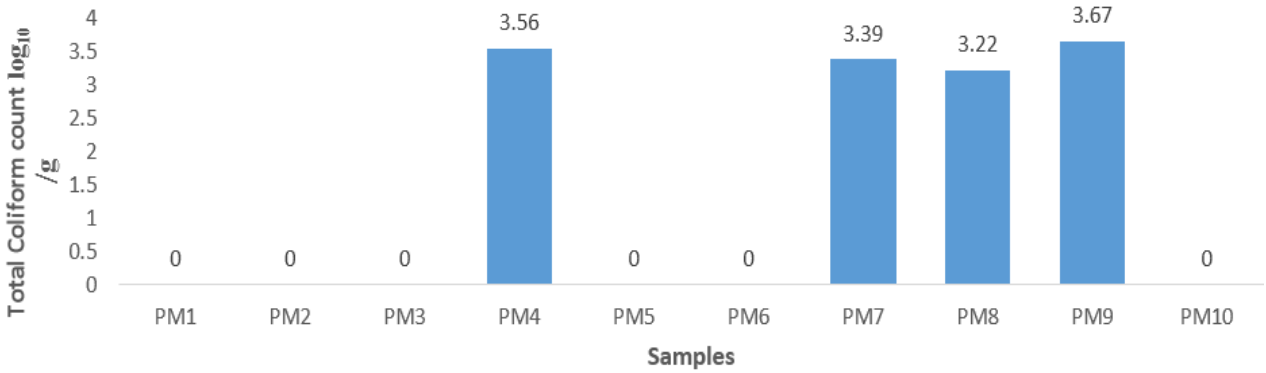

Figure 10. Total coliform counts of plastic Moimoi.

Note: PM= Plastic Moi-moi.

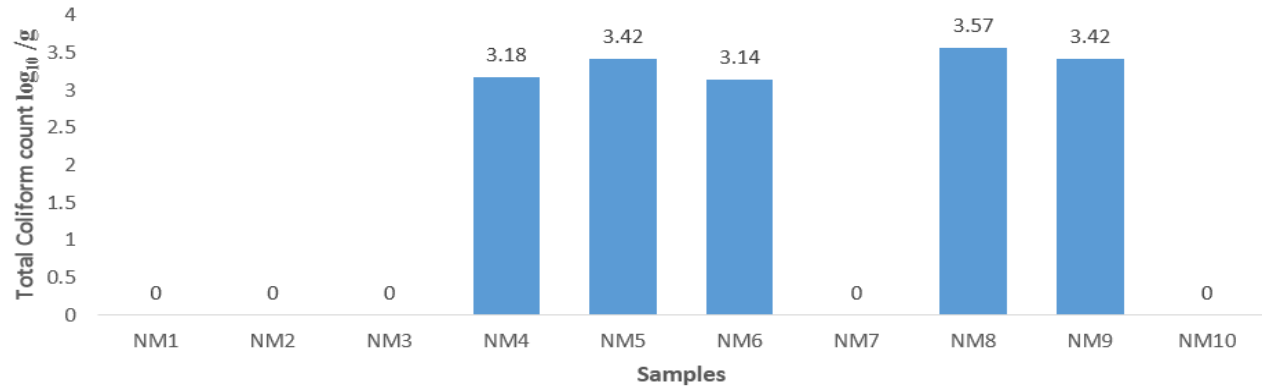

Figure 11. Total coliform count of Nylon Moimoi.

Note: NM= Nylon Moimoi.

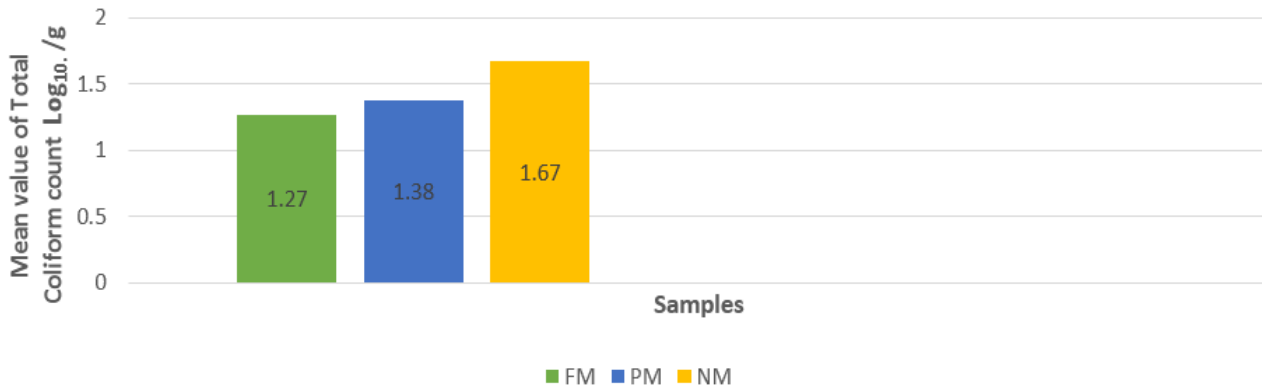

Figure 12. Total mean of total coliform count of the different Moi-Moi samples.

Note: FM= Foil Moimoi (Green) PM= Plastic Moimoi(Blue) NM= Nylon Moi-Moi(yellow).

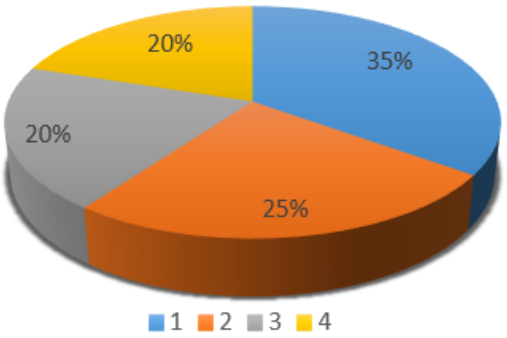

Figure 13. Percentage frequency of bacteria isolated from Foil MoiMoi.

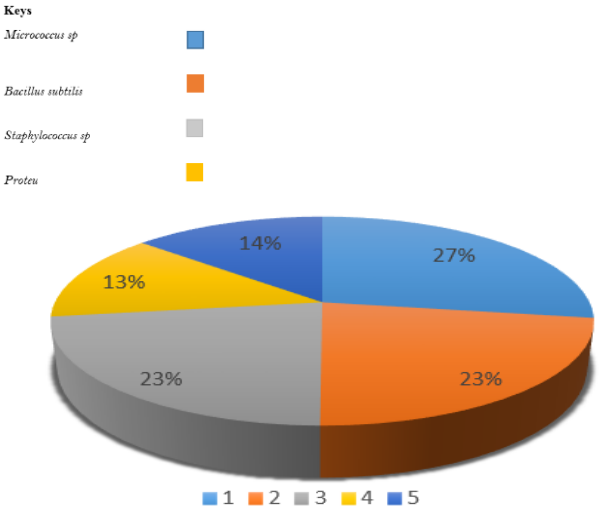

Figure 14. Percentage frequency of bacteria isolated from Plastic Moimoi.

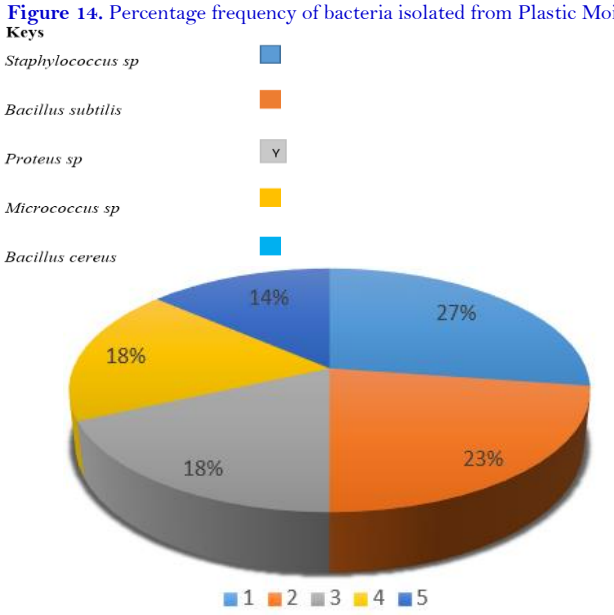

Figure 15. Percentage frequency of bacteria isolated from Nylon Moimoi.

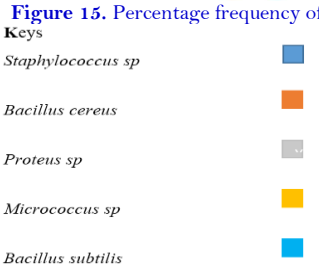

Table 1. Anti-biotic susceptibility test for bacteria isolated from foil Moimoi samples.

Isolate code	GEN	CTR	ERY	CXC	OFL	AUG	CAZ	CRX	Gram rxn	
F1	19mm	-	14mm	-	23mm	-	-	-	+ve Rod	*Bacillus subtilis*
F2	21mm	-	25mm	6mm	19mm	-	-	-	+ve Cocci	*Micrococcus sp*
F3	20mm	-	16mm	-	14mm	-	-	-	+ve Cocci	*Staphylococcus sp*
F4	17mm	0.4mm	15mm	-	18mm	-	-	6mm	-ve Rod	*Proteus sp*
F5	22mm	0.6mm	19mm	-	15mm	-	-	9mm	-ve Rod	*Proteus sp*
F6	22mm	-	19mm	-	24mm	-	-	-	+ve Rod	*Bacillus subtilis*
F7	19mm	-	17mm	-	14mm	-	-	-	+ve Cocci	*Staphylococcus sp*
F8	23mm	-	22mm	6mm	19mm	-	-	-	+ve Cocci	*Micrococcus sp*
F9	17mm	-	16mm	-	16mm	-	-	-	+ve Cocci	*Staphylococcus sp*
F10	25mm	-	21mm	-	18mm	-	-	-	+ve Rod	*Bacillus subtilis*
F11	19mm	-	24mm	5mm	19mm	-	-	-	+ve Cocci	*Micrococcus sp*
F12	21mm	-	25mm	7mm	21mm	-	-	-	+ve Cocci	*Micrococcus sp*
F13	23mm	-	16mm	-	12mm	-	-	-	+ve Cocci	*Staphylococcus sp*
F14	23mm	-	12mm	-	23mm	-	-	-	+ve Rod	*Bacillus subtilis*
F15	22mm	0.4mm	19mm	-	15mm	-	-		-ve Rod	*Proteus sp*
F16	21mm	-	20mm	6mm	19mm	-	-	-	+ve Cocci	*Micrococcus sp*
F17	17mm	0.4mm	17mm	-	18mm	-	-	6mm	-ve Rod	*Proteus sp*
F18	19mm	-	24mm	6mm	19mm	-	-	-	+ve Cocci	*Micrococcus sp*
F19	21mm	-	14mm	-	21mm	-	-	-	+ve Rod	*Bacillus subtilis*
F20	21mm	-	23mm	6mm	17mm	-	-	-	+ve Cocci	*Micrococcus sp*

Note: GEN- Gentamicin ERY- Erythromycin OFL- Ofloxacin CAZ- Ceftazidime CTR- Ceftriaxone CXC- Cloxacillin AUG- Augmentin CRX- Cefuroxime.

Table 2. Anti-biotic susceptibility test for bacteria isolated from plastic Moimoi samples.

Isolate code	GEN	CTR	ERY	CXC	OFL	AUG	CAZ	CRX	Gram rxn	
P1	21mm	-	16mm	-	23mm	-	-	-	+ve Rod	Bacillus subtilis
P2	19mm	-	23mm	6mm	19mm	-	-	-	+ve Cocci	Micrococcus sp
P3	23mm	-	16mm	-	12mm	-	-	-	+ve Cocci	Staphylococcus sp
P4	20mm	-	16mm	-	22mm	-	-	-	+ve Rod	Bacillus subtilis
P5	17mm	0.5mm	15mm	-	18mm	-	-	6mm	-ve Rod	Proteus sp
P6	20mm	-	16mm	-	19mm	-	-	-	+ve Cocci	Staphylococcus sp
P7	19mm	-	23mm	6mm	19mm	-	-	-	+ve Cocci	Micrococcus sp
P8	18mm	-	15mm	-	18mm	-	8mm	-	+ve Rod	Bacillus cereus
P9	22mm	-	17mm	-	13mm	-	-	-	+ve Cocci	Staphylococcus sp
P10	20mm	-	17mm	-	15mm	-	-	-	+ve Cocci	Staphylococcus sp
P11	20mm	0.5mm	19mm	-	15mm	-	-	-	-ve Rod	Proteus sp
P12	19mm	-	14mm	-	17mm	-	10mm	-	+ve Rod	Bacillus cereus
P13	19mm	-	14mm	-	21mm	-	-	-	+ve Rod	Bacillus subtilis
P14	19mm	-	21mm	-	14mm	-	-	-	+ve Cocci	Staphylococcus sp
P15	23mm	-	14mm	-	16mm	-	-	-	+ve Cocci	Staphylococcus sp
P16	20mm	0.5mm	17mm	-	18mm	-	-	6mm	-ve Rod	Proteus sp
P17	19mm	-	14mm	-	17mm	-	-	-	+ve Rod	Bacillus subtilis
P18	21mm	-	21mm	7mm	25mm	-	-	-	+ve Cocci	Micrococcus sp
P19	17mm	0.3mm	15mm	-	18mm	-	-	6mm	-ve Rod	Proteus sp
P20	25mm	-	20mm	-	19mm	-	-	-	+ve Rod	Bacillus subtilis
P21	22mm	0.6mm	19mm	-	15mm	-	-	9mm	-ve Rod	Proteus sp
P22	20mm	-	14mm	-	21mm	-	11mm	-	+ve Rod	Bacillus cereus

Note: GEN- Gentamicin ERY- Erythromycin OFL- Ofloxacin CAZ- Ceftazidime CTR- Ceftraixone CXC- Cloxacillin AUG- Augmentin CRX- Cefuroxime.

Table 3. Anti-biotic susceptibility test for bacteria isolated from nylon Moimoi samples.

Isolate code	GEN	CTR	ERY	CXC	OFL	AUG	CAZ	CRX	Gram rxn	
N1	18mm	0.4mm	15mm	-	18mm	-	-	5mm	-ve Rod	Proteus sp
N2	25mm	-	21mm	-	20mm	-	-	-	+ve Rod	Bacillus subtilis
N3	20mm	-	16mm	-	18mm	-	-	-	+ve Cocci	Staphylococcus sp
N4	25mm	-	21mm	6mm	19mm	-	-	-	+ve Cocci	Micrococcus sp
N5	18mm	-	15mm	-	20mm	-	9mm	-	+ve Rod	Bacillus cereus
N6	21mm	-	17mm	-	15mm	-	-	-	+ve Cocci	Staphylococcus sp
N7	20mm	-	14mm	-	18mm	-	10mm	-	+ve Rod	Bacillus cereus
N8	24mm	-	24mm	6mm	19mm	-	-	-	+ve Cocci	Micrococcus sp
N9	22mm	-	14mm	-	19mm	-	11mm	-	+ve Rod	Bacillus cereus
N10	24mm	-	20mm	-	19mm	-	13mm	-	+ve Rod	Bacillus subtilis
N11	22mm	-	22mm	-	15mm	-	-	-	+ve Cocci	Staphylococcus sp
N12	17mm	0.3mm	19mm	-	19mm	-	-	7mm	-ve Rod	Proteus sp
N13	18mm	-	21mm	5mm	25mm	-	-	-	+ve Cocci	Micrococcus sp
N14	20mm	-	16mm	-	19mm	-	-	-	+ve Cocci	Staphylococcus sp
N15	20mm	0.3mm	17mm	-	20mm	-	-	5mm	-ve Rod	Proteus sp
N16	19mm	-	21mm	-	14mm	-	-	-	+ve Cocci	Staphylococcus sp
N17	19mm	-	14mm	-	23mm	-	-	-	+ve Rod	Bacillus subtilis
N18	18mm	-	15mm	-	18mm	-	7mm	-	+ve Rod	Bacillus cereus
N19	22mm	0.6mm	19mm	-	15mm	-	-	9mm	-ve Rod	Proteus sp
N20	25mm	-	20mm	-	22mm	-	-	-	+ve Rod	Bacillus subtilis
N21	21mm	-	24mm	4mm	19mm	-	-	-	+ve Cocci	Micrococcus sp
N22	20mm	-	17mm	-	17mm	-	-	-	+ve Cocci	Staphylococcus sp

Note: GEN- Gentamicin ERY- Erythromycin OFL- Ofloxacin CAZ- Ceftazidime CTR- Ceftriaxone CXC- Cloxacillin AUG- Augmentin CRX- Cefuroxim.

Figure 13-15 illustrates the percentage occurrence of the organism isolated from different moimoi wrapped with different wrapping materials. The total prevalence of bacteria that occurred from foil Moimoi ranged from 20% to 35% where *Micrococcus* was placed at 35%, *Bacillus* (25%) *Staphylococcus* (20%) and *Proteus* (20%). However, it was recorded that *Micrococcus* has the highest prevalence compared to other bacteria on foil Moimoi the rate of bacteria occurrences conforms to the study of Adegunloye et al. (2006).

The total prevalence of bacteria obtained on plastic Moimoi in this present study ranged from 13% to 27%. *Staphylococcus* had a prevalence occurrence of 27%, *Bacillus subtilis* (23%) *Proteus sp* (23%), *Micrococcus sp* (13%) and *Bacillus cereus* (14%). *Staphylococcus* has the highest prevalence value on plastic Moimoi.

Total prevalence obtained from nylon was ranged from 14% to 27%. The highest prevalence value recorded was from *Staphylococcus* (27%) compared to other bacteria isolated from this study. *Bacillus cereus* (23%), *Proteus* (18%), *Micrococcus* (18%) and *Bacillus subtilis* (14%).

The prevalence of *Staphylococcus* was the highest in all the aforementioned wrapping materials on Moimoi compared to other wrapping materials their percentage occurrence. This rate of prevalence is in alignment with that of Oranusi et al. (2013) and Adegunloye et al. (2006). The isolation of *Staphylococcus* from this Moimoi shows that human origin, intrinsic factors from the environment are the main cause of this. The isolation of *Micrococcus* and *Proteus sp* from the moimoi sample could be associated to poor unhygienic practices during the preparation.

The occurrence of *Bacillus spp* in the food could be due to the fact that they are spore formers. This heat-resistant spore may have survived processing Contamination of foods could have resulted from inappropriate processing, incomplete heating, or secondary contamination via contact with contaminated equipment's and utensils. *Bacillus spp. Staphylococcus* are mainly as a result of environmental contaminants so is thus their higher percentage prevalence is therefore not out of order (Aboloma, 2008; Hazariwala et al., 2002).

The isolation of *Bacillus cereus, Bacillus* subtilis and *Proteus* spp, corroborate the findings of Mensah et al. (2002); Idowu (2006); Taulo et al. (2008) in which these organisms was implicated in ready- to- eat- the present study do not agree with the study result of Frank-Peterside, Dosumu, and Njoku (2001) who in their study were able to isolate fungal pathogens that was not obtained in this study. The result obtained from the report of Frank-Peterside et al. (2001) on Moimoi just like this present recorded no fungi growth. The study of Frank-Peterside et al. (2001)

posited this non-isolation of fungi not obtained in their study to be due to the fact that freshly prepared moi moi undergo heat treatment (steaming) which are always employed in the processing of the dish therefore making the heat kill most of the vegetative cells. This aforementioned reason justify why isolation of fungi was not recorded in this findings (Frank-Peterside et al., 2001). It was observed that moimoi wrapped in nylon had high counts in total bacteria and coliform count this is similar to the study of Ojesola, Afolabi, and Oloyede (2021) on Ready to eat rice wrapped in different packaging materials. The results from this study indicate that packaging materials have significant effects on the microbial quality of moimoi ($P<0.05$).

Figure 4 show the mean total heterotrophic bacteria counts of the different Moimoi samples in which moimoi wrapped in Nylon had the highest bacteria count when compared to other packaging material.

Figure 8 presents the Mean total *Staphylococcus* count of the different Moimoi samples, moimoi in plastic had the highest staphylococcus count when compared to other packaging material.

Figure 12 illustrates **the** mean total coliform count of the different Moi-Moi samples in which moimoi wrapped in Nylon had the highest coliform count when compared to other packaging material.

Table 1 presents the Anti-biotic susceptibility test for bacteria isolated from foil Moimoi samples it was observed that all the organism isolated from Foil moimoi samples were resistant to Ceftazidime and Augmentin and sensitive to Gentamicin, Erythromycin, Ofloxacin, Table 2 and 3. Shows the Anti-biotic susceptibility test for bacteria isolated from plastic and nylon Moimoi samples indicating that all the organism isolated from plastic and nylon moimoi samples were resistant to Augmentin and sensitive to Gentamicin, Erythromycin, Ofloxacin. this may be due to the fact that these antibiotics are broad spectrum drugs which has an antimicrobial spectrum which includes some gram-positive and some gram-negative organisms, as well as certain rickettsiae, larger viruses, protozoa, and pleuropneumonia-like organisms.

The result obtained from the antibiotic susceptibility test shows that gram-negative isolate (*Proteus sp*) was resistant to ceftriaxone, cloxacillin, Augmentin, ceftazidime, erythromycin and cefuroxime, while the gram-positive (*Staphylococcus sp*, *Micrococcus sp*, *Bacillus subtilis a*nd *Bacillus cereus*) were sensitive to the antibiotics of gentamycin, erythromycin and ofloxacin. The isolated organism sensitive conforms to Stanley, Ifeanyi, Ejiofor, and Nwosu (2014) who isolated gram-positive bacteria of the likes of *Bacillus subtilis*, *Staphylococcus sp* sensitive to gentamycin in his findings. The presence of these multi-drug resistant strains of the isolated organism in moi moi could act as a vehicle to disseminate antibiotic resistance to other bacteria. Resistance to multiple antibiotics can lead to occurrence of newly emerging resistant bacteria which may be transmitted to consumers causing infection that are difficult to treat. Frank-Peterside et al. (2001) result study is also in alignment with this present study on Moimoi where it was discovered that majority of the gram-negative isolates (*Proteus* sp, *Escherichia coli and Pseudomonas aeruginosa*) were resistant to antibiotics of erythromycin Augmentin, and Ampicillin while the gram positive bacteria (*Staphylococcus sp* and *Bacillus sp*) obtained in the study were sensitive to gentamycin and erythromycin.

4. CONCLUSION

This research work revealed that all the packaging material had different impart on the moi-moi. It is mandatory that foods must be free from contaminations as much as possible. The presence of *Staphylococcus sp Bacillus subtilis*, *Proteus sp*, *Micrococcus sp* and *Bacillus cereus* demonstrates a potential health risk as these organisms are pathogenic and have been implicated in food borne diseases (Granum, 2005; Wagner, 2009).

5. RECOMMENDATIONS

The following recommendations are hereby made from his study;

- Education on food safety practices and a close and stringent supervision of ready-to-eat foods should be carried out by relevant authorities to prevent food-borne illness.

- Users of this wrapping materials should wash wrapping materials with clean water before using and food in these wrapping materials should be consumed as soon as possible to reduce multiplication of microorganisms.

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