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# EVALUATION OF MICROBIAL HAZARDS ON CONTACT SURFACES IN ANIMAL PROCESSING ENVIRONMENTS IN RIVERS STATE, NIGERIA

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***Abstract:***
*This study conducted bacteriological screening of environmental contamination sources in abattoirs and retail outlets across Rivers State local markets. A total of 100 swab samples from various contact surfaces were collected and analyzed for total viable counts (TVC) and the presence of Listeria and Salmonella species. TVC ranged from Log10 3.33 to 7.90 cfu/cm² in markets and Log10 3.53 to 6.94 cfu/cm² in retail outlets, with significantly higher counts in markets ($p < 0.05$). The isolated bacteria included Escherichia coli (27.6%), Klebsiella spp. (13.9%), Staphylococcus spp. (12.7%), Streptococcus spp. (4.3%), Bacillus spp. (14.9%), Pseudomonas spp. (21.2%), and Micrococcus spp. (5.3%). Listeria spp. (10%) and Salmonella spp. (40%) were detected in refrigerators at retail stores. Salmonella was also isolated from cutting boards, weighing balances, knives, and butchers' hands, while Listeria was found on all except butchers' hands. Wooden tables and cutting boards in retail outlets, and wash water and tables in markets had the highest bacterial loads. These findings highlight significant public health risks associated with meat handling surfaces, emphasizing the need for stringent cleaning and sanitization protocols to prevent cross-contamination and ensure food safety in Rivers State.*

***Keywords:*** *Environmental contamination, Abattoir, Retail outlets, Food safety*

## Introduction

The presence of bacterial pathogens in poultry -processing equipment and associated surfaces may contribute to the contamination of meat. It is generally accepted that microbial loads on surfaces and equipment vary in different poultry plants and abattior depending on the microbial quality of the meat (Evans et al., 2004).

It is already known that most bacteria form biofilm on hydrated surfaces (Costerton *et al.,* 1999). Most of these bacteria have the ability of producing a matrix of biofilms which protect them from external harm and enables them to adhere strongly to contact surfaces making it necessary to go an extra mile during cleaning. Typical contact surfaces in Nigerian retail outlet and abattoir may include handler's hands and outer garments, wooden tables, cutting knives, weighing scales, carton papers, cleaning sponges/brushes, aprons and water-holding utensils such as metal buckets or plastic containers. These meat handling equipment should therefore be maintained and stored in a way that will minimise the chance of meat becoming contaminated as their contamination can contribute to cross-contamination of noncontaminated poultry meat. Microorganisms, once in the interior of the wood, may persist in the inner structure. Improperly washed weighing scales and cutting knives may also have biofilms with bacteria within their matrix. Unless such equipment are thoroughly sanitized, they may continue to contaminate foodstuff as noted (Costerton *et al*., 1999; Hassan et. al., 2010). Hence, uncontaminated poultry meat will become contaminated by the time it comes in contact with such surface. On the other hand, contaminated meat is able also to disseminate food-borne pathogens to clean contact-surfaces Contamination of Pathogenic bacteria in poultry processing such as *Salmonella* (Foley *et al.,*2008) , *Listeria Monocytogenes (Lawrence and Gilmore 1994)* have been studied extensively and is been associated with poultry processing, poultry products, or both. In the processing of birds, microbial contamination

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can occur from processes such as bird-to-bird contact, handling of the carcasses by employees, contact with processing equipment or tools etc.
Cleaning of equipment is important to remove these contaminants and prevent the development of extra polymeric biofilms, which protect bacteria and allow them to multiply on equipment surfaces unless removed by a combination of chemical and mechanical treatments (CarpentierandCerf1993.)Enumeration of microbial populations on surfaces of poultry processing equipment has been considered an important means of monitoring sanitation system effectiveness before and during operations because cross contamination can occur from equipment that touches poultry products. The objective of this study is to determine the incidence of *Salmonella and Listeria sp on contact surfaces in* poultry abattoirs and retail outlets and to determine the sanitary condition of local poultry abattoirs and poultry retail shops using total viable count (TVC)
Swab samples were collected from 10 retail outlets and 10 abattior (market) within Port Harcourt metropolis covering 10cm of every contact surface using peptone water dabbed sterile cotton wool swabs and transferred to previously sterilize screw-capped test tubes holding 10 ml of sterile medium of 0.85% NaCl and 0.1% peptone. Wash water knives, weighing balance, cutting board, butcher hands were also sampled. All samples were transported in ice for immediate analysis.

**Bacteriological Analysis**

**Total Viable Counts of the Swab Samples**

Method is as described by Bhadare *et al.* (2009. Swab sample tubes were vortexed for 30 seconds, serially diluted up to $10^{-6}$ using sterile normal saline and plated for total viable count (TVC) using $10^{-4}$ and $10^{-5}$ concentrations. Incubation was for 24-48 hours at 37° C in duplicates.

**Isolation of *Salmonella Spp* from Swab Samples**

Prepared swab samples as described above were transferred into 225ml buffered peptone water for pre-enrichment at 37°C for 24-48 hours. After which a ml of culture was transferred to 10 ml of selenite F broth and incubated at 37°C for 18 hours before plating on Salmonella shigella agar and incubation at 37°C for 24 hours (Bhadare *et al.*, 2009).

**Isolation of *Listeria Spp* from Swab Samples**

Prepared swab samples as described above were transferred into 225ml half fraser enrichment at 30°C for 24. After which 1 ml of culture was transferred to 10 ml of Full fraser broth and incubated at 37°C for 24-48 hours before plating onto PALCAM agar and supplemented with PALCAM Selective Supplement and incubated at 37°C for 24–48 hrs.

**Results**

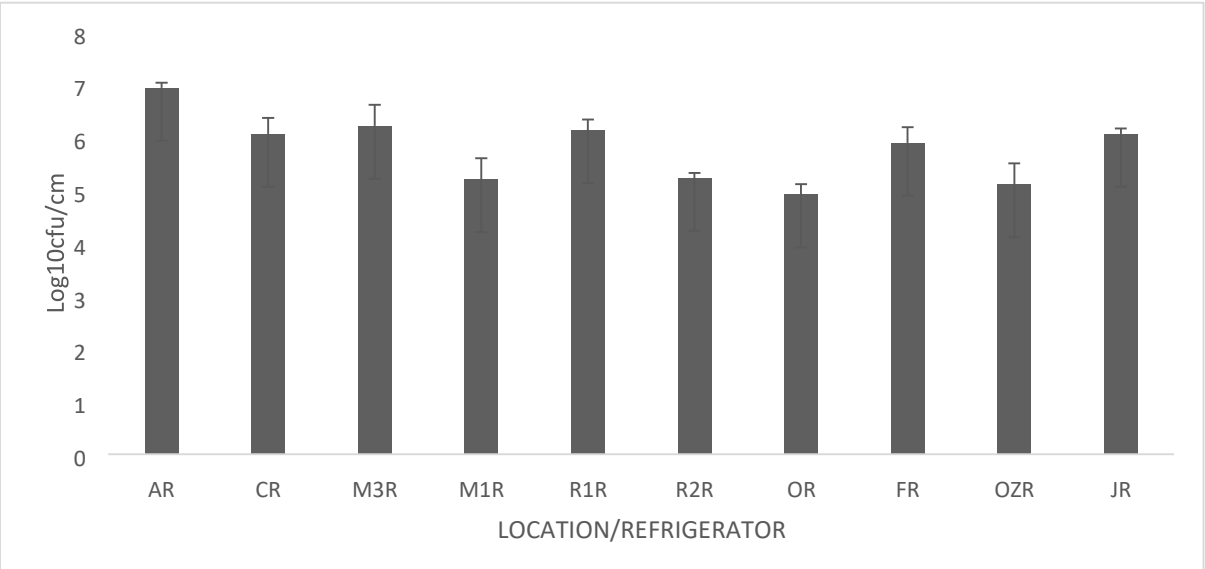


**Fig 1;** Total Bacterial counts of the Refrigerators used in the different Retail outletsA-Aluu,C Choba,M3-Mile 3,M1-Mile 1,R1 -Rumuosi,R2-Rumuokoro,OZ-Ozouba,F-Fruitmarket,O-

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**Fig2;** Total Bacterial counts of the weighing balance used in the different Retail outlets Oillmill,J-Junction
A-Aluu, C-Choba,M3-Mile 3, M1-Mile 1, R1-Rumuosi,R2-Rumuokoro,OZ-Ozouba,F-Fruitmarket,O-Oillmill,J-Junction

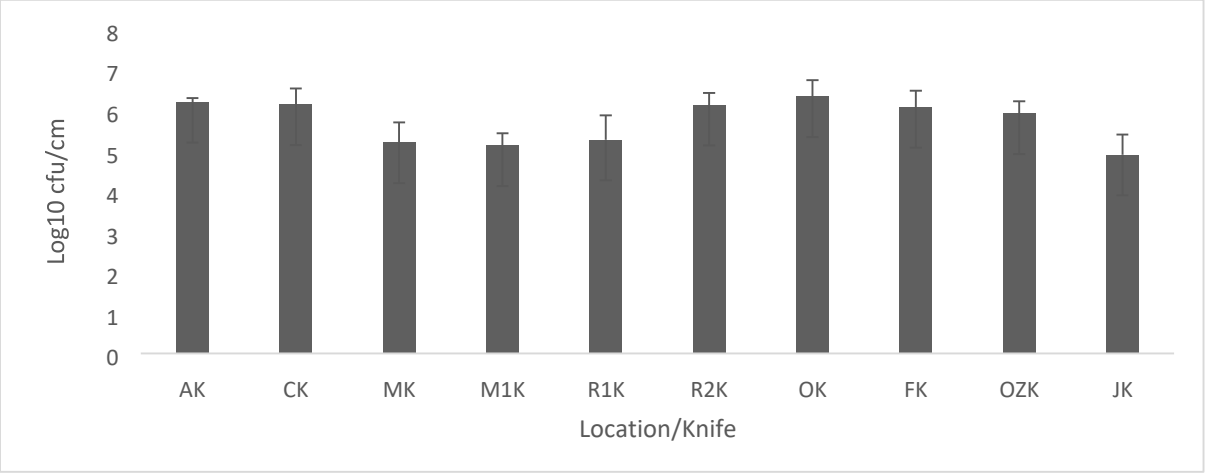


**Fig3;** Total Bacterial counts of the knife used in the different Retail outlets
A-Aluu, C-Choba, M3-Mile 3, M1-Mile 1, R1 -Rumuosi, R2-Rumuokoro, OZ-Ozouba, FFruitmarket, O-Oillmill,J-Junction

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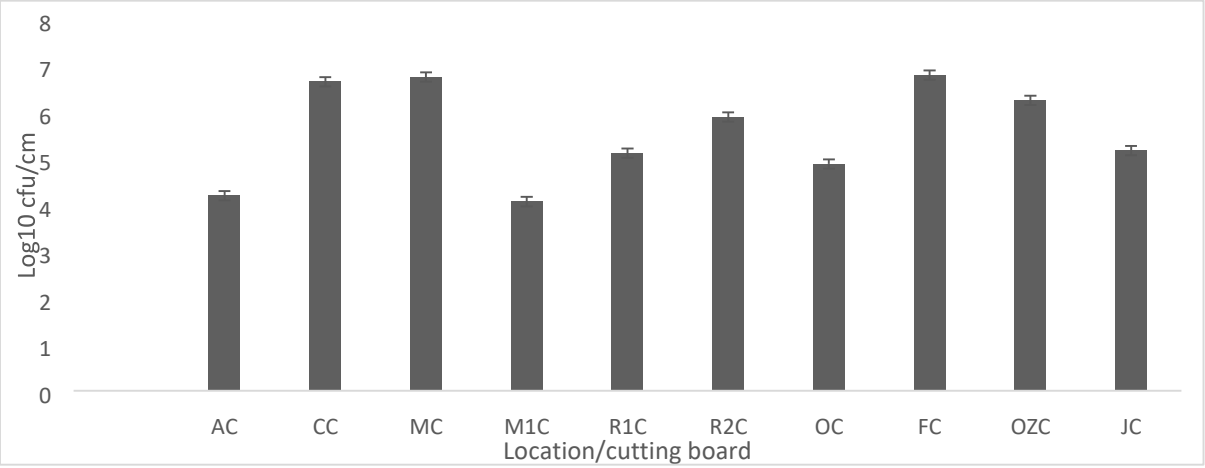


**Fig 4:** Total Bacterial counts of the Cutting board used in the different Retail outlet
A-Aluu, C-Choba, M3-Mile 3, M1-Mile 1, R1 -Rumuosi, R2-Rumuokoro,OZ-Ozouba,FFruitmarket,O-Oillmill,J-Junction

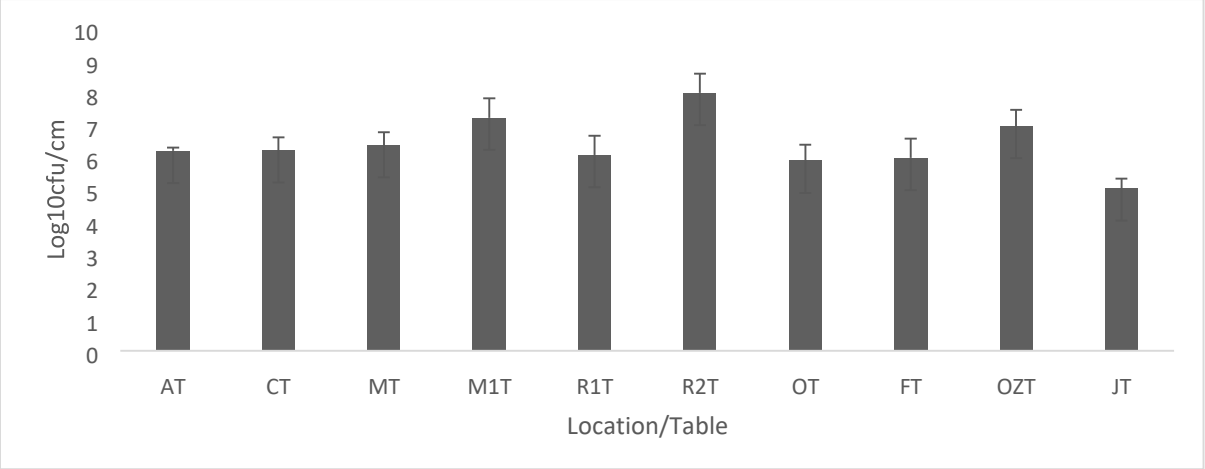


**Fig 5:** Total Bacterial counts of the Tables used in the different Retail outlets
A-Aluu, C-Choba, M3-Mile 3, M1-Mile 1, R1-Rumuosi,R2-Rumuokoro,OZ-Ozouba,FFruitmarket,O-Oillmill,J-Junction

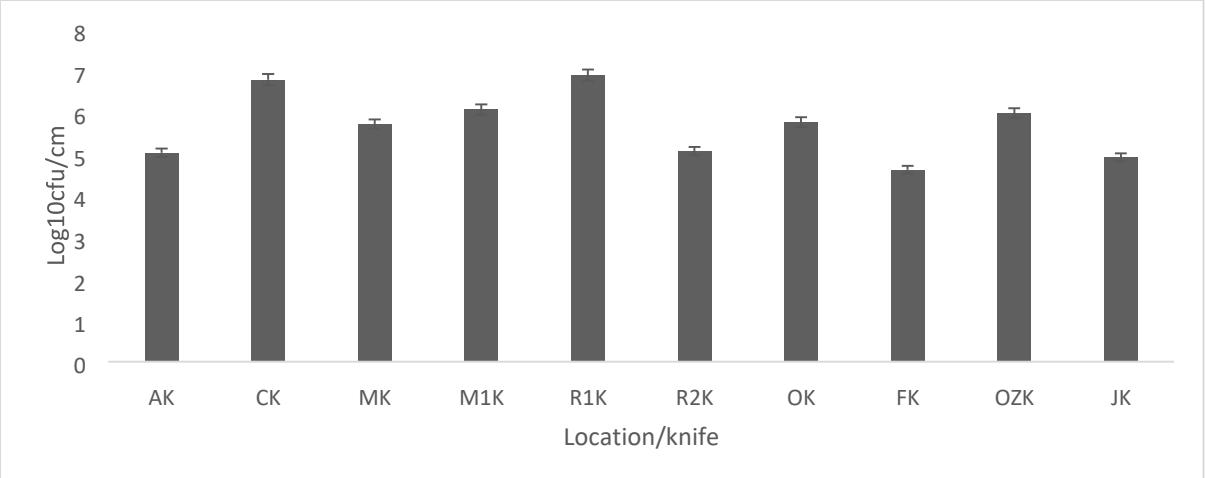


**Fig 6:** Total Bacterial counts of the knifes used in the different Markets A-Aluu,C-Choba,M3 Mile 3, M1-Mile 1, R1 -Rumuosi, R2-Rumuokoro,OZ-Ozouba,F-Fruitmarket,O-Oillmill,JJunction

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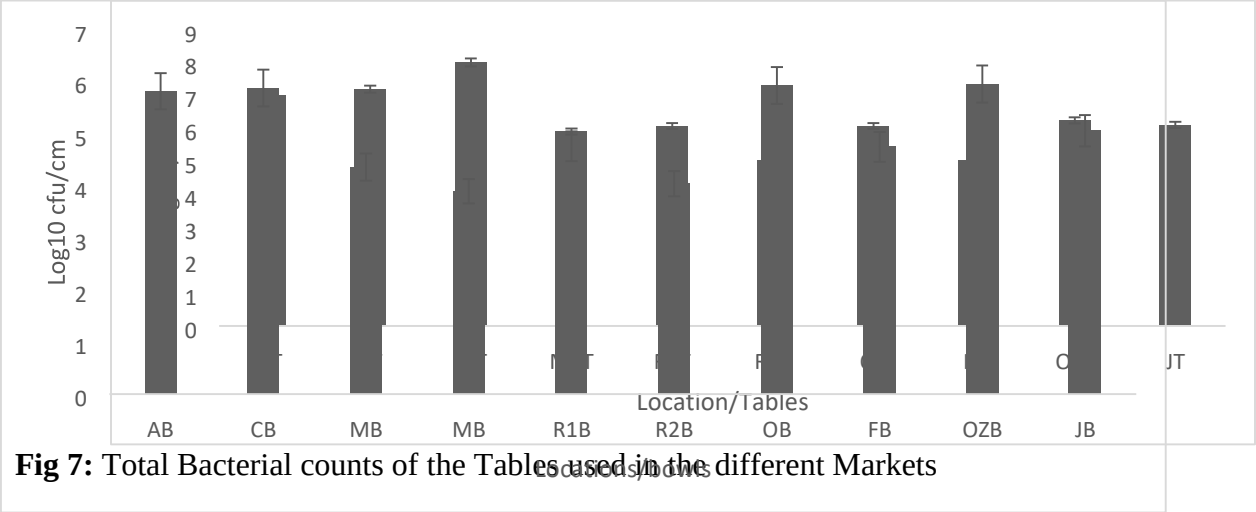


**Fig 7:** Total Bacterial counts of the Tables used in the different Markets

**Fig 8:** Total Bacterial counts of the Bowls used in the different Markets
A-Aluu, C-Choba, M3-Mile 3, M1-Mile 1, R1 -Rumuosi,R2-Rumuokoro,OZ-Ozouba,FFruitmarket,O-Oillmill,J-Junction
A-Aluu, C-Choba, M3-Mile 3, M1-Mile 1,R1 -Rumuosi,R2-Rumuokoro,OZ-Ozouba,FFruitmarket,O-Oillmill,J-Junction


**Fig 9:** Total Bacterial counts of the Butcher han ds from the different Markets A-Aluu,C Choba,M3-Mile 3,M1-Mile 1,R1 -Rumuosi,R2-Rumuokoro,OZ-Ozouba,F-Fruitmarket,O-Oillmill,J-Junction

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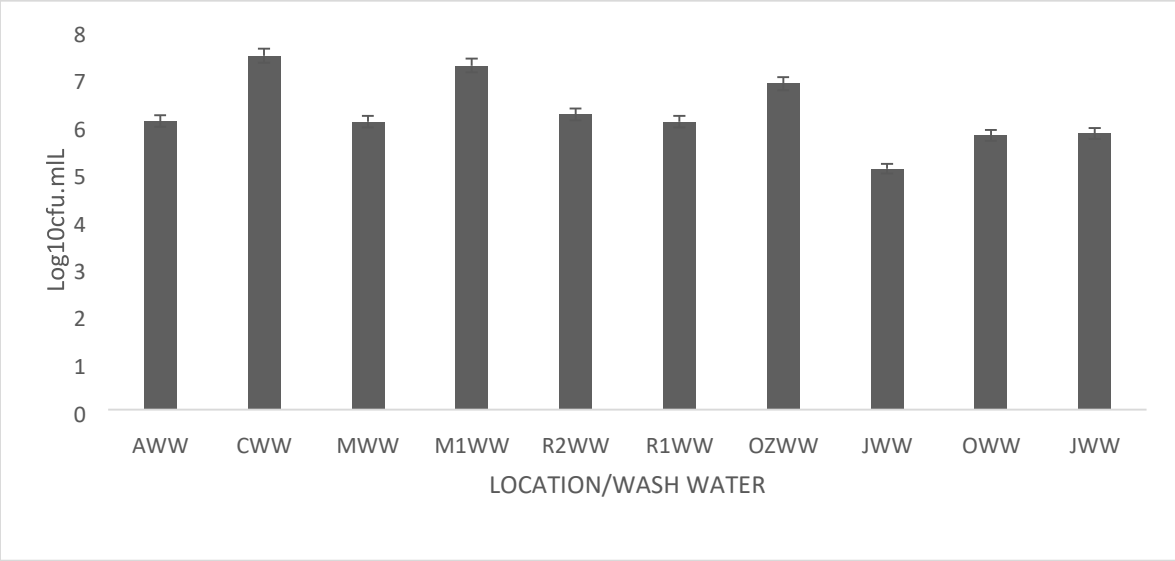


**Fig 10:** Total Bacterial counts of the Washwater used in the different Markets
A-Aluu, C-Choba,M3-Mile 3,M1-Mile 1,R1 -Rumuosi,R2-Rumuokoro,OZ-Ozouba,F-Fruitmarket,O-Oillmill,J-Junction

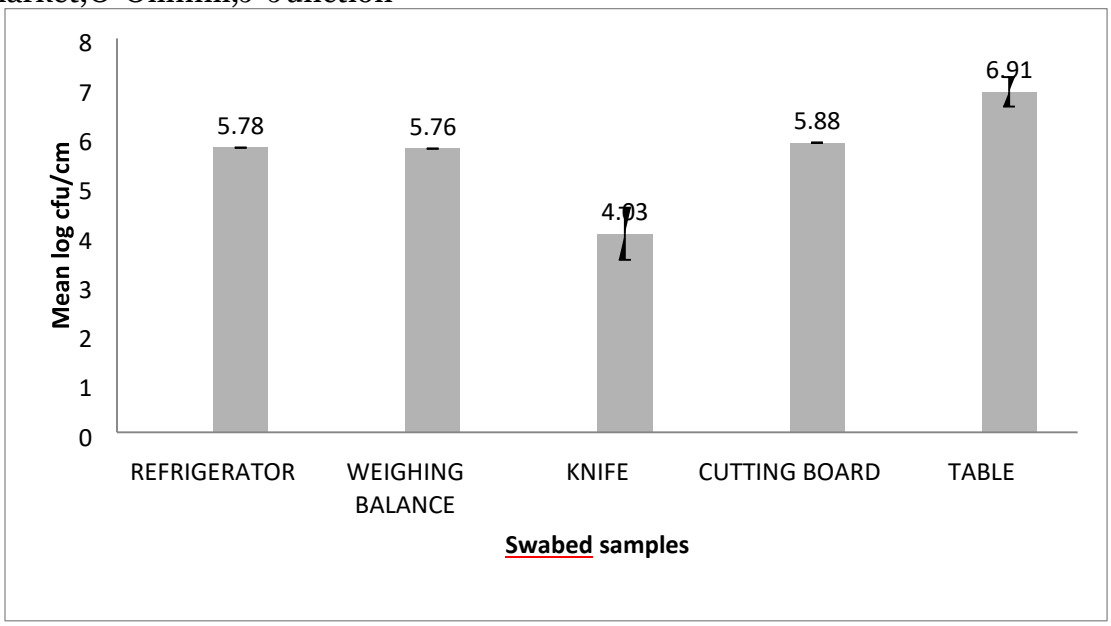


**Fig 11:** Total mean bacterial counts of swab samples obtained from retailer stores /outlet·each error bar rep mean ± std dev

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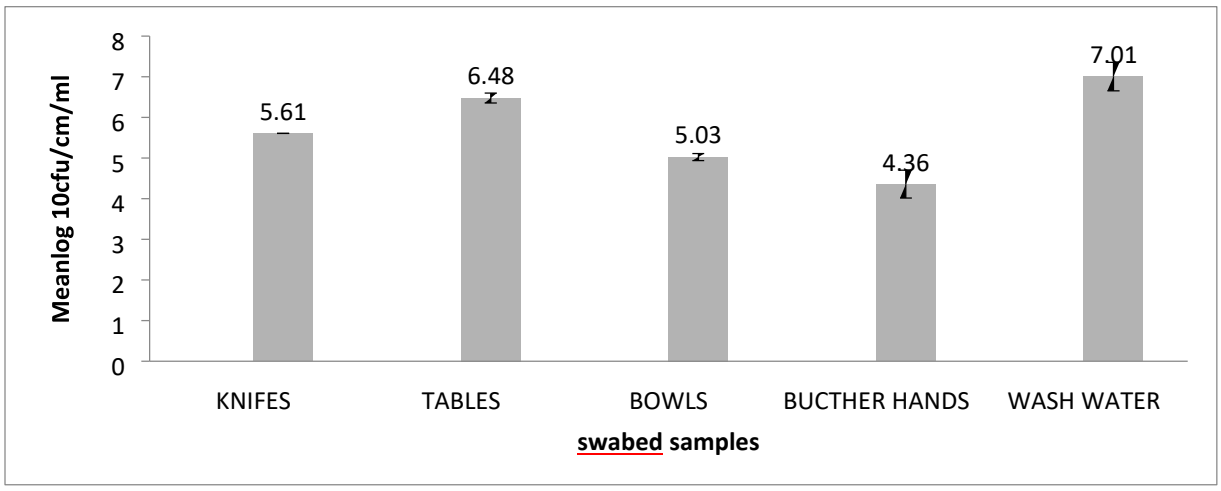


**Fig12:** Total mean bacterial counts of swab samples obtained from markets each error bar rep mean ± std dev

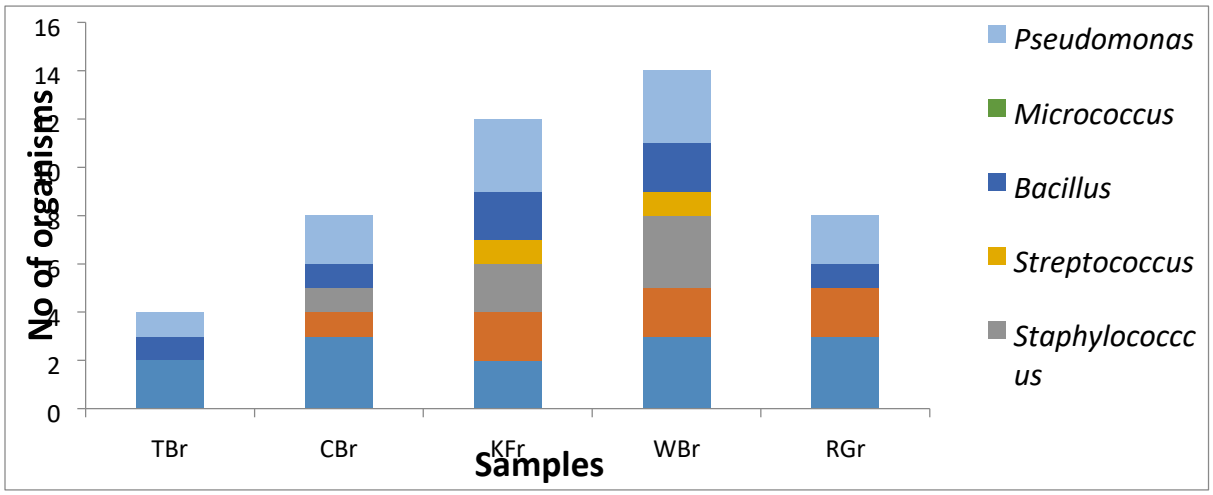


**Fig 13:** Other Organisms isolated from Retailer shop/outlet
Legend; **TBr** =table from retail shop **WBr** = weighing balance from retail shop **RGr** = refrigerator from retail shop **KFr** = knife from retail shop, **CBr** =cutting board from retail shop

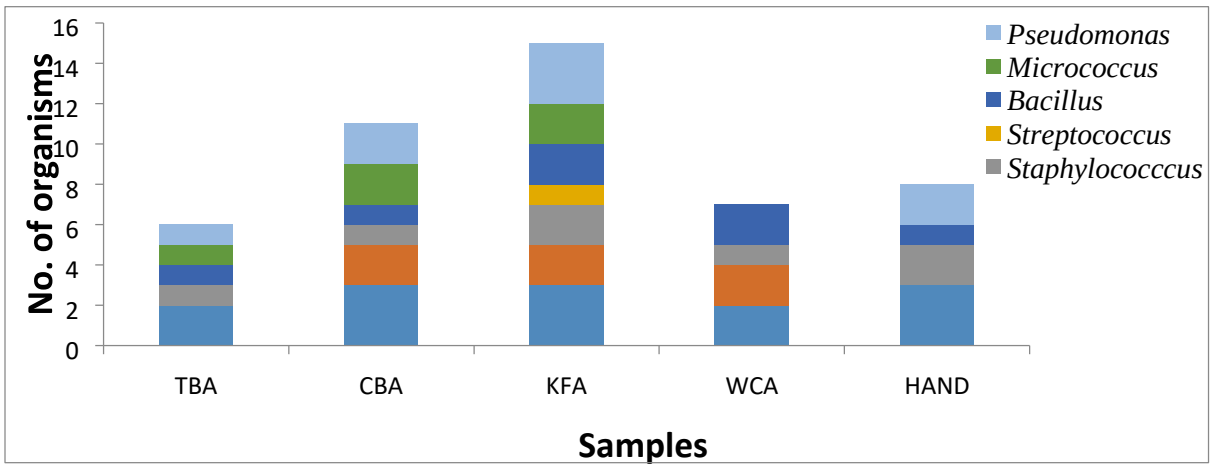


**Fig 14:** Organisms isolated from Local Abattoir (market)
Legend TBA = table from Abattoir, WCA = water used for washing carcass from Abattoir, KFA = Knife from Abattoir

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**Table 1; Presence/Absence of *Listeria Spp* from Swab Samples from the Different Retail Outlets**

| Locations/contact surface | Knifes | Tables | Refrigerators | Weighing balance | Cutting board |
|---|---|---|---|---|---|
| Aluu | – | – | – | – | – |
| Choba | – | + | – | – | + |
| Mile 3 | – | – | – | – | – |
| Mile 1 | – | + | – | – | – |
| Rumuosi | – | – | – | – | – |
| Rumuokoro | – | – | – | – | – |
| Oilmill | – | + | – | – | – |
| Woji | – | + | – | – | – |
| Ozuoba | – | – | – | – | – |
| Junction | – | – | + | – | – |

**Table 2; Presence/absence of *Salmonella spp* from swabed samples from the different retail outlets**

| Locations/contact surfaces | Knife | Tables | Refrigerators | Weighing balance | Cutting board |
|---|---|---|---|---|---|
| **Aluu** | + | – | – | + | – |
| **Choba** | + | – | – | – | – |
| **Mile 3** | – | – | – | – | – |
| **Mile 1** | + | – | + | + | – |
| **Rumuosi** | + | – | – | – | – |

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| | | | | | |
|---|---|---|---|---|---|
| **Rumuokoro** | _ | _ | + | + | _ |
| **Oilmill** | + | _ | _ | _ | _ |
| **Woji** | + | _ | _ | _ | _ |
| **Ozuoba** | + | _ | _ | + | _ |
| **Junction** | _ | + | + | + | + |

**Table 3; Presence/absence of *listeria spp* from swab samples from the different markets (local abattior)**

| Locations/contact surface | Knife | Tables | WashwaterBowls | | Butcher hands |
|---|---|---|---|---|---|
| Aluu | + | + | _ | _ | _ |
| Choba | _ | + | _ | _ | _ |
| Mile 3 | + | + | _ | _ | _ |
| Mile 1 | _ | _ | _ | _ | _ |
| Rumuosi | + | + | _ | + | + |
| Rumuokoro | + | + | _ | + | _ |
| Oilmill | _ | _ | _ | _ | _ |
| Woji | _ | _ | _ | _ | _ |
| Ozuoba | _ | _ | _ | _ | _ |
| Junction | + | + | _ | _ | _ |

**Table 4; Presence/absence of S*salmonella spp* from swab samples from the different markets (local abattior)**

| Locations/contact surface | Knife | Tables | WashwaterBowls | | Butcher hands |
|---|---|---|---|---|---|
| Aluu | + | + | + | _ | _ |

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| | | | | | |
|---|---|---|---|---|---|
| Choba | + | + | + | + | + |
| Mile 3 | – | – | – | – | – |
| Mile 1 | + | + | + | + | – |
| Rumuosi | + | – | – | – | – |
| Rumuokoro | + | + | + | + | + |
| Oilmill | + | + | + | – | – |
| Woji | + | + | + | – | – |
| Ozuoba | + | – | + | | – |
| Junction | + | + | + | – | – |

**Table 5 Percentage occurrence of *Listeria* and *Salmonella* spp from swabed samples**

| Contact surfaces | *Listeria spp* | *Salmonella spp* |
|---|---|---|
| **Tables** | 9(45%) | 9(45%) |
| **Knifes** | 6(30%) | 15(75%) |
| **Weighing balance** | 2(20%) | 5(50%) |
| **Refrigerators** | 1(10%) | 4(40%) |
| **Cutting board** | 1(10%) | 1(10%) |
| **Bowls** | 2(20%) | 3(30%) |
| **Wash water** | 3(30%) | 8(80%) |
| **Butcher hands** | 0 | 2(20%) |

## Discussion

Abattiors in Nigeria can be liken to markets, chicken meat is sold directly to final consumer. (Bradeeba and Sivakamaar 2013) reported that local abattior and retail outlet contain high microbial load which ends up contaminating the meat products. Similar to the condition of abattior and retail outlets from where samples were bought. Hence, microbial contamination of poultry meats might have occurred through cross contamination from persons handling the meats and from contact surface and equipment. This study recorded a log mean total aerobic count for the retail outlet contact surfaces;

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refrigerator, weighing balance, knife, cutting board ,table as 5.78, 5.76, 4.03, 5.88, 6.91 $log_{10}$ cfu/$cm^2$ respectively, while for the local abbiator; knife, tables, bowls, butchers hands, wash water; 5.61, 6.48,5.03, 4.36, 7.06 log cfu/$cm^2$ respectively. Table surfaces of retail stores were the most contaminated. The level is an indication that the tables are not well clean, with settling dust and meat remnant contributing the bio-burden, as supported by the reports of Sudhakar *et al*., (2009) and Hassan *et al*., (2010). The wash water had the highest count from the contact surfaces in the market, this probably due to the fact the processed chicken, butcher hands and utensil were washed in the water. The relatively high values in the local abbiators may be as a result of the free access of animal in the local abbiator. Cross contamination is common in slaughter parlours without the strictest sanitary control (Endale and Hailey 2013; Olayinka and Adeyanju 2014). *Salmonella spp* and *L. monocytogenes* infections can occur through the transfer of faeces to muscle tissue (Blackburn and McClure 2002).

*Listeria spp* 1(10%) and *Salmonella spp* 4(40%) were detected in refrigerators used in the retail stores. Cutting board, weighting balance, knife and swabs from butchers hands were positive for *Salmonella spp*. *Listeria spp* was detected in all the mentioned except from butchers hands. A study by (Howes *et al*., 1996), indicate that improper food /meat handling practices contributed to 97.0% of food borne illnesses.

The frequency of *Salmonella spp* from the hands of the butchers was 2% which is much lower than the study by (Kahraman *et al,* 2010) which was 6.0% .The findings of (Alisarli *et al*.,2003) and (Gorman *et al*.,2002) was 2.0 % and 3.1.% respectively these corroborates our findings. In this present study *Listeria spp* was not detected this is similar to (Aarnisalo *et al*., 2006) and different from (Gudbjorns dotter *et al.,* 2004) which reported that *Listeria spp* was isolated from 1 of 74 (1.34%) and 4 of 26 (15.2%) of personnel and processing environment. From a public health point of view the isolation of bacteria from *Staphylococcus* spp. were of concern as they can cause food poisoning due to neglect in storage and handling. The most worrisome bacteria like *Salmonella* spp and *Listeria spp* which are food borne pathogens and can cause severe infections in ultimate consumers. In order to avoid cross contamination of carcasses in slaughter areas it is necessary to clean and sanitize the most contaminating points such as floors, walls, evisceration platforms, wooden logs etc. Cleaning should start as soon as the butchering operations are completed so as to prevent residue hardening on the surface of floors, walls and platforms. Partitioning of clean and unclean sections should be done to prevent the spread of spoilage or pathogenic organisms. The contamination of the knives cutting boards and weighing balance can be controlled by regular cleaning, washing, sterilization and proper maintenance as this equipment comes in direct contact with carcasses and may act as vehicles. A thorough clean up procedure not only prevents contamination but also creates a clean environment and encourages cleanliness amongst workers. Environmental sources of contamination play a major role in rendering the meat unsafe for human consumption. Education of the meat retailers' community regarding proper maintenance of hygiene and sanitation, enforcement of strict regulations for meat production in traditional meat shops and their regular monitoring is needed. However, a periodic surveillance of environmental contamination is required in the abattoir and the shops. Establishment of control measures depending upon the prevailing conditions with an appropriate monitoring system is necessary so that consumers get safe and wholesome meat.

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