

MICROBIAL ASSESSMENT OF CONTACT SURFACES IN POULTRY SHOPS AND ABATTOIRS IN RIVERS STATE, NIGERIA

¹Emeka Chinedu Okafor and ² Chukwudi Emmanuel Nwafor

¹Department of Microbiology, University of Port Harcourt, P.M.B. 5323, Port Harcourt, Rivers State, Nigeria

², Madonna University, P.M.B. 05, Elele, Rivers State, Nigeria

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Abstract: Bacteriological screening of environmental sources of contamination was carried out in River States Different Local market (abattoir) and retail outlets. A total of 100 swab samples from different contact surfaces were collected and analysed from the abattoir and retail outlets. These samples were processed for total viable count (TVC) and presence and absence of *Listeria* and *Salmonella* spp. The count of swabbed samples ranged from Log₁₀ cfu/cm² 3.53 to 6.94 and Log₁₀ cfu/cm² 3.33 to 7.90 for retail outlets and markets respectively. Swabbed samples obtained from the contact surfaces in the (market) was significantly higher in THC than the retail outlet ($p < 0.05$). The percentage occurrence of the different organisms from the swab samples *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%). *Salmonella* spp. was In addition, wooden Table and cutting board had higher counts in the retail outlets while the wash water and table had counts in the local markets *Listeria* spp 1(10%) and *Salmonella* spp 4(40%) were detected in refrigerators used in the retail stores. Cutting board, weighing balance, knife and swabs from butchers hands were positive for *Salmonella* spp. *Listeria* spp was detected in all the mentioned except from butchers hands.. The bacteria isolated from these sources were of public health importance and thus, these points need proper cleaning and sanitization to avoid cross contamination of the meat. A thorough clean up procedure not only prevents contamination but also providing a clean environment and encourages cleanliness amongst workers. The results obtained is a reflection of the sanitary quality of meat processed and sold in River States.

Keywords: Swabs, bacteria, total viable counts, differential counts, abattoir, and meat shops

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 abattoirs 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 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 (Carpentier and Cerf 1993.) 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 abattoir (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.

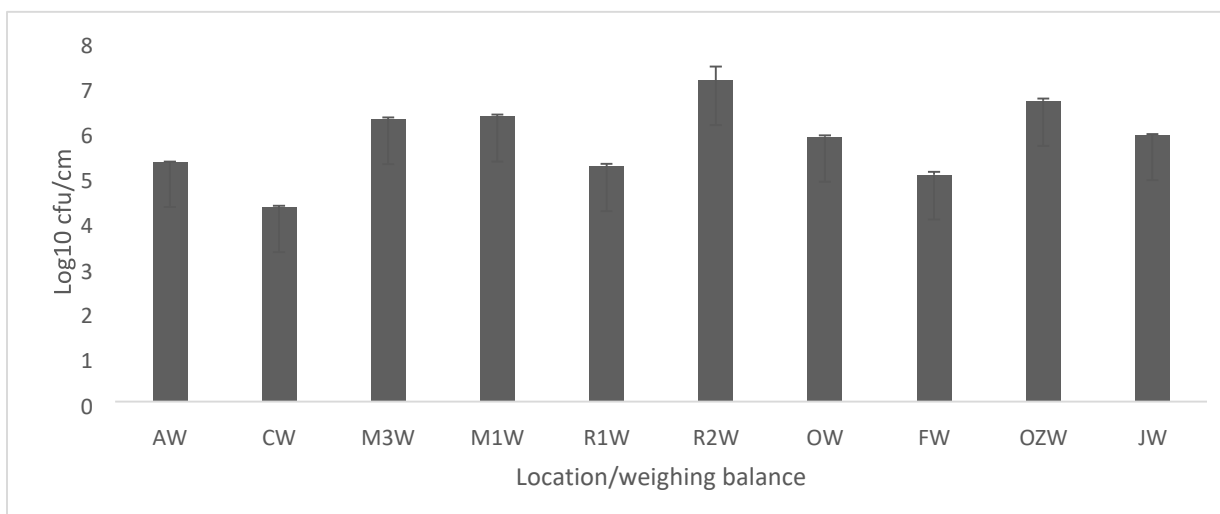


Fig2; Total Bacterial counts of the weighing balance used in the different Retail outlets
Results

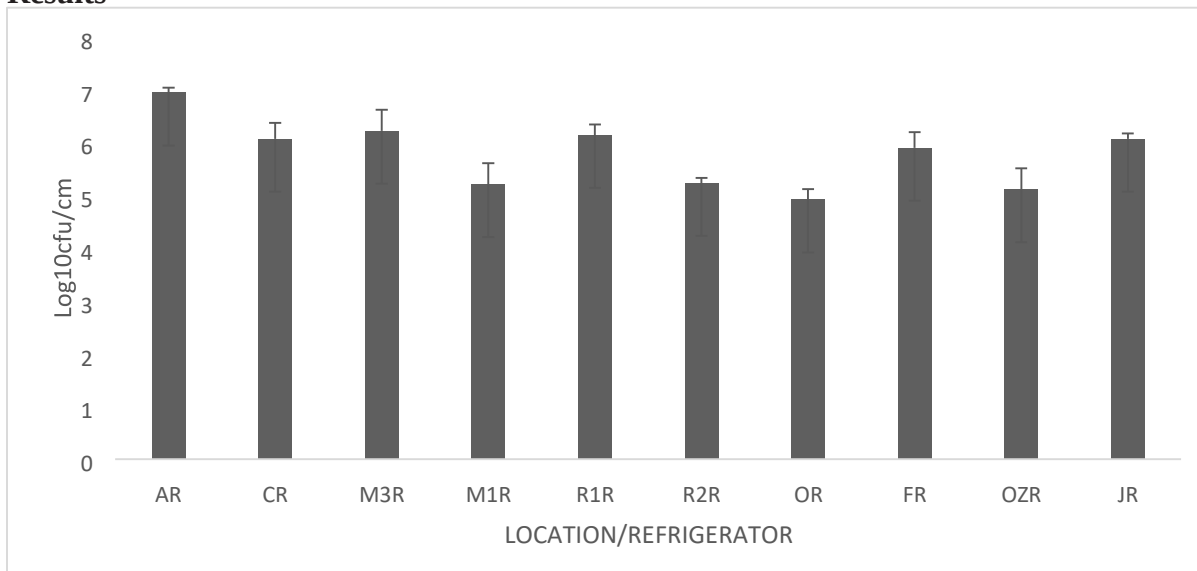


Fig 1; Total Bacterial counts of the Refrigerators used in the different Retail outlets A-Aluu, C-Choba, M3-Mile 3, M1-Mile 1, R1 -Rumuosi, R2-Rumuokoro, OZ-Ozouba, F-Fruitmarket, O-Oillmill, J-Junction
A-Aluu, C-Choba, M3-Mile 3, M1-Mile 1, R1-Rumuosi, R2-Rumuokoro, OZ-Ozouba, F-Fruitmarket, O-Oillmill,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

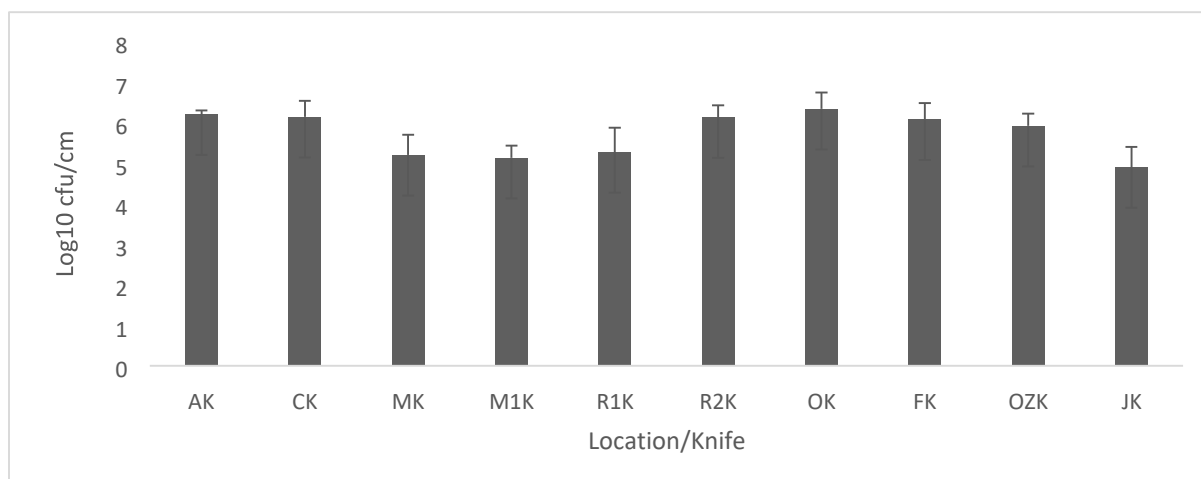


Fig3; Total Bacterial counts of the knife used in the different Retail outlets
A-Aluu, C-Choba, M3-Mile 3, M1-Mile 1, R1 -Rumuosi, R2-Rumuokoro, OZ-Ozouba, FFruitmarket, O-Oillmill, J-Junction

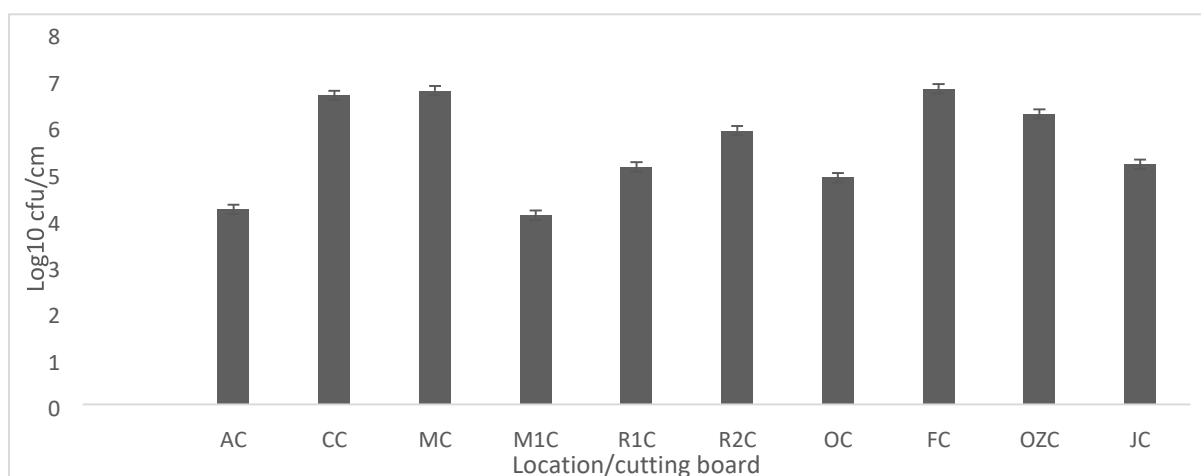


Fig 4: Total Bacterial counts of the Cutting board used in the different Retail outlet
A-Aluu, C-Choba, M3-Mile 3, M1-Mile 1, R1 -Rumuosi, R2-Rumuokoro, OZ-Ozouba, FFruitmarket, O-Oillmill, J-Junction

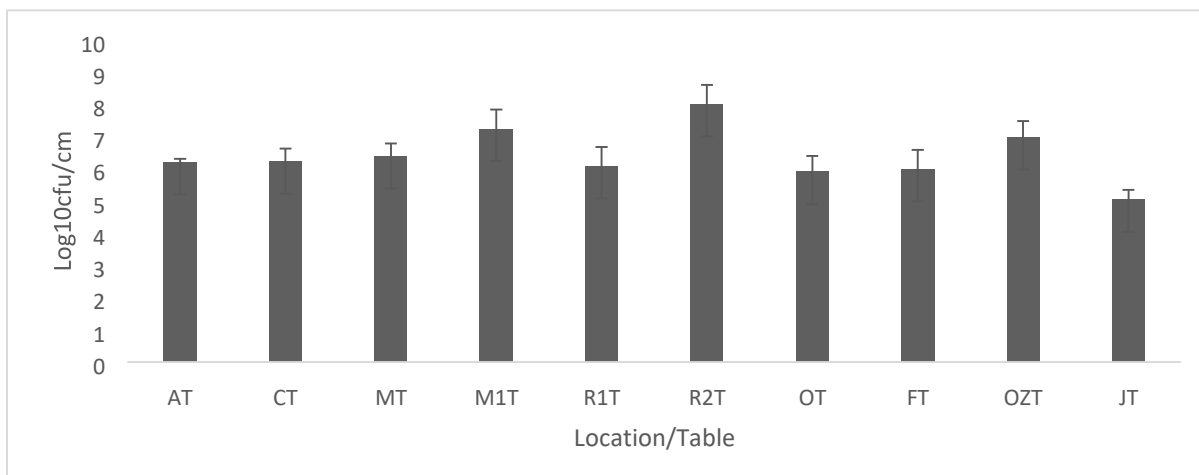


Fig 5: Total Bacterial counts of the Tables used in the different Retail outlets

A-Aluu, C-Choba, M3-Mile 3, M1-Mile 1, R1-Rumuosi, R2-Rumuokoro, OZ-Ozouba, F-Fruitmarket, O-Oillmill, J-Junction

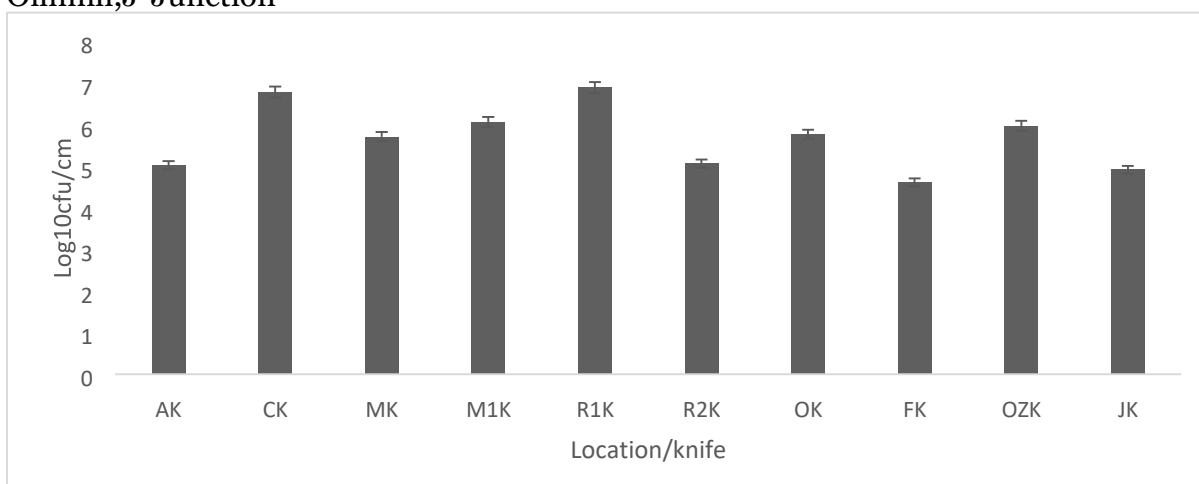


Fig 6: Total Bacterial counts of the knives used in the different Markets A-Aluu, C-Choba, M3

Mile 3, M1-Mile 1, R1 -Rumuosi, R2-Rumuokoro, OZ-Ozouba, F-Fruitmarket, O-Oillmill, J Junction

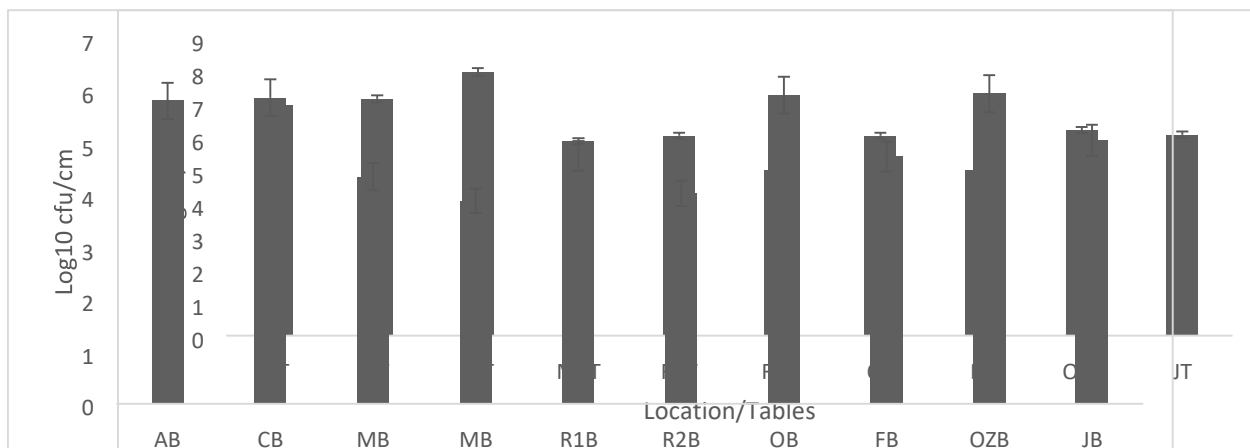


Fig 7: Total Bacterial counts of the Tables used in the different Markets

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 hands 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

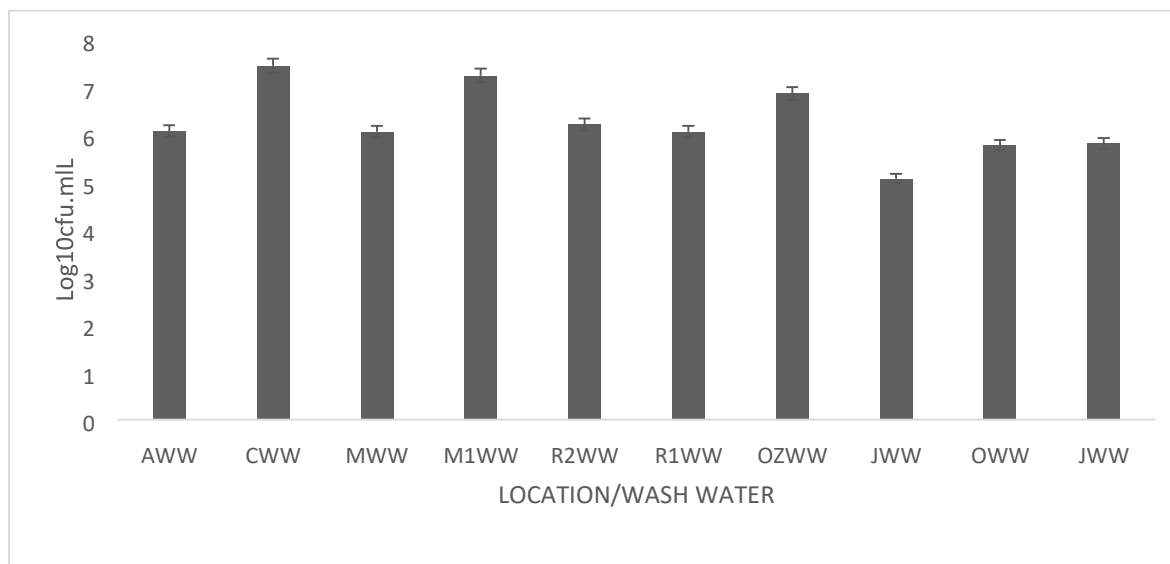


Fig 10: Total Bacterial counts of the Washwater used in the different Markets
A-Aluu, C-Choba, M3-Mile 3, M1-Mile 1, R1 -Rumuosi, R2-Rumuokoro, OZ-Ozouba, F-Fruitmarket, O-Oillmill, J-Junction

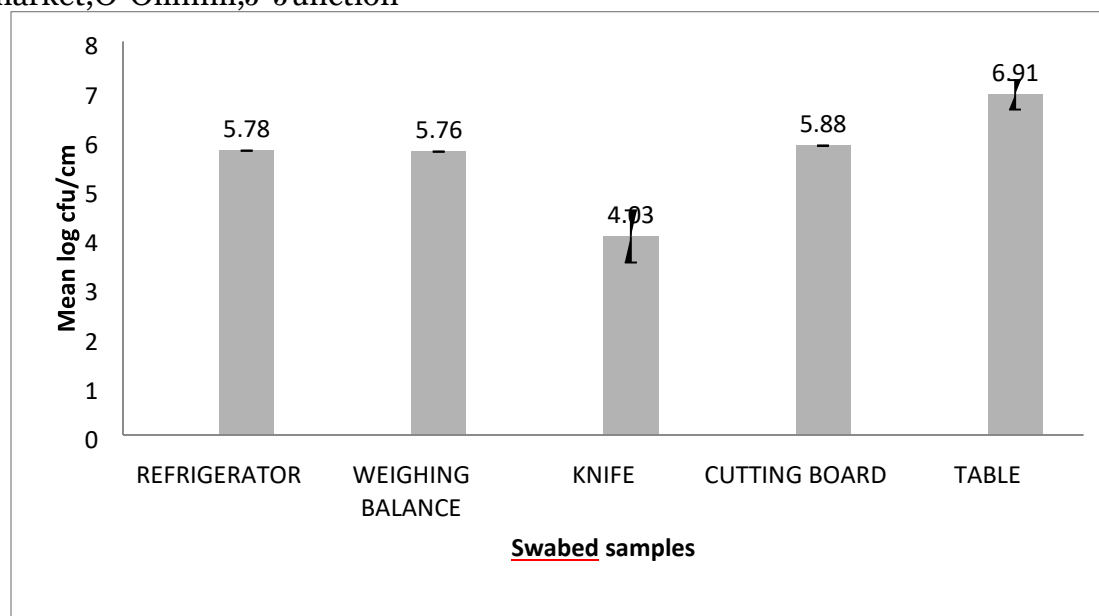


Fig 11: Total mean bacterial counts of swab samples obtained from retailer stores /outlet .each error bar rep mean $\pm$ std dev

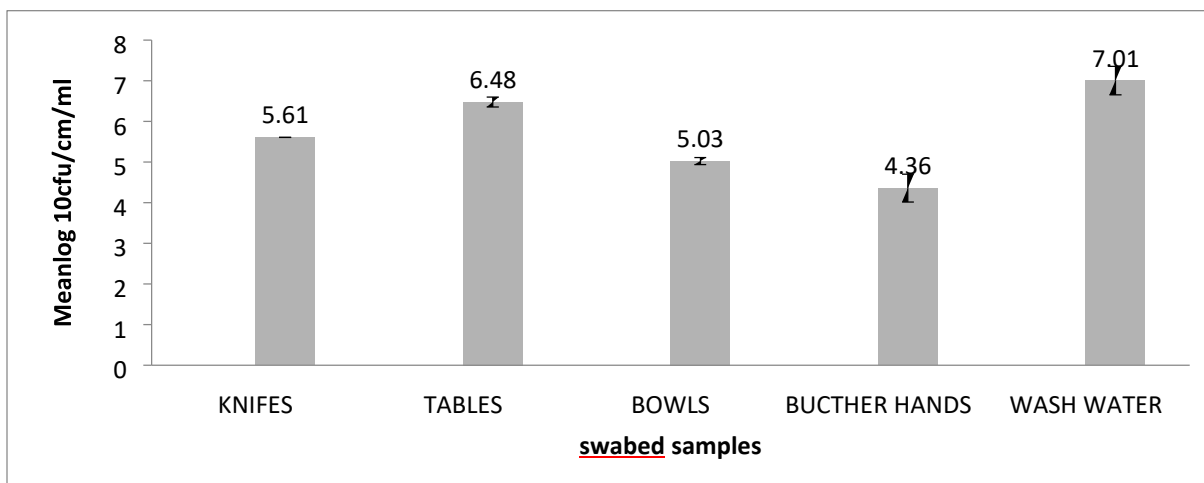


Fig12: Total mean bacterial counts of swab samples obtained from markets each error bar rep mean $\pm$ std dev

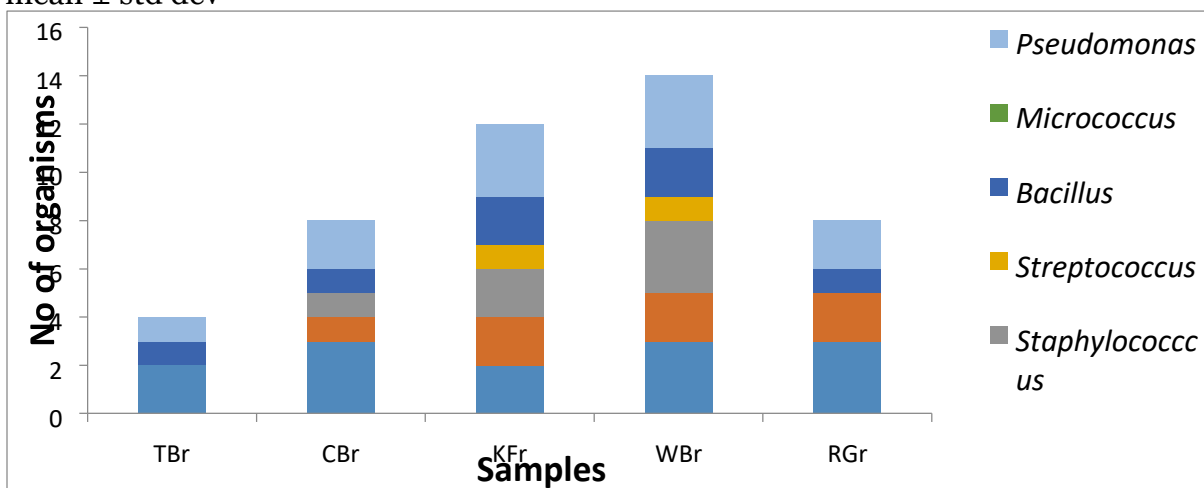


Fig 13: Other Organisms isolated from Retailer shop/outlet
 Legend; **TBr** =table from retail shop **WBr** = weighing balance from retail shop **RGr** = refrigerator from retail shop **KFr** = knife from retail shop, **CBr** =cutting board from retail shop

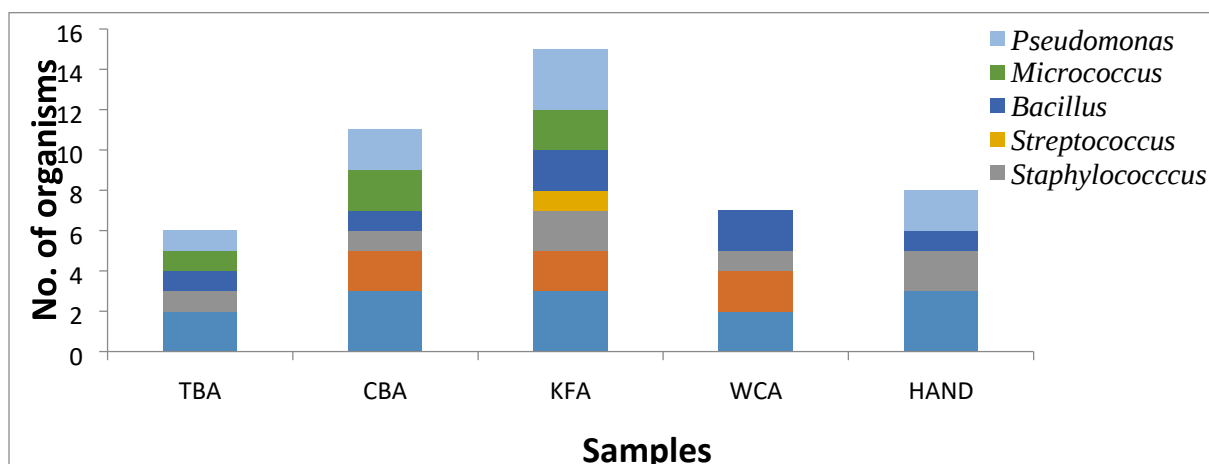


Fig 14: Organisms isolated from Local Abattoir (market)

Legend TBA = table from Abattoir, WCA = water used for washing carcass from Abattoir, KFA = Knife from Abattoir

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

Locations/contact surface	Knives	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	+	—	—	—	—
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 *Ssalmonella 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 5 Percentage occurrence of *Listeria* and *Salmonella* spp from swabed samples

Contact surfaces	<i>Listeria</i> spp	<i>Salmonella</i> spp
Tables	9(45%)	9(45%)
Knives	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; refrigerator, weighing balance, knife, cutting board, table as 5.78, 5.76, 4.03, 5.88, 6.91 log₁₀ cfu/cm² 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/cm² 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, weighing 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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