Occurrence of *Listeria* and *Salmonella spp* in chicken meats from different poultry production systems

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Abstract
Consumption of chicken in Nigeria is on the increase and the need to regularly assess its quality in terms of presence of pathogens is necessary to forestall food-borne diseases. A total of 290 samples were evaluated for the presence of Salmonella and Listeria spp. The Total heterotrophic counts (THC) of Organic chicken thigh/wings (OCT and OCW) ranged from Log_{10}cfu/g 6.15 to 7.22 and 6.46 to 7.46 respectively. Conventional chicken thigh /wings (CCT and CCW) counts ranged from 5.48 to 7.43 and 5.54 to 7.52 respectively. The chicken meat types exceeded the microbial limit for fresh and refrigerated chicken meat. However, the differences in the chicken types was not statistically significant ($p<0.05$). Molecular characterization of isolates revealed their identity as L. monocytogenes (40%) and other Listeria spp (60%), Salmonella typhimurium (70%) and Salmonella Quakam (30%) for both chicken types. Organic chicken meat (OC) had higher occurrence of Salmonella spp(70%) and (30%) for conventional chicken(CO)while the Conventional chicken meat (CC) had higher occurrence of Listeria monocytogenes.(65%) and (35%)for organic chicken (OC)All L. monocytogenes were 100% sensitive to tested antibiotics except cephotaxime. Salmonella spp showed varied results from sensitivity to resistance. Results revealed that rearing and processing methods affect the microbial quality of chicken meat. The presence of pathogens in chicken products is objectionable. Action must be taken by NAFDAC to ensure compliance to the guidelines by vendors.

***Keywords**: Organic chicken, Conventional cnicken, Listeria monocytogenes, Salmonella*

Introduction

Poultry refers to domesticated birds such as chicken, turkey, ducks and other water fowls kept for egg or meat (Sams, 2001). Traditionally, "Broilers are reared for meat while "Layers are reared for eggs production. Nearly a third of globally consumed meat comes from poultry (Raloff, 2003). During the Second World War eating of chicken increased because unlike red meat, poultry was not rationed. In spite of the huge loss of poultry birds to diseases and poor feed quality, from 1940 to 1945, broiler production nearly tripled (Martinez, 1999). Within the last decades, poultry production volume, marketing and consumption has increased to meet global public demand because it is now considered an important part of human diet (Omorodion and Odu 2016a).

Poultry farming in Nigeria has now assumed significance as source of animal protein (Folorunsho and Onibi, 2005). Household and commercial poultry production now complement imported poultry meat, although the former is more widespread due to cost (Alabi and Aruna, 2005). Consumption of chicken overshadows other poultry meat in Nigeria.

(Olabode *et al.*, 2008). Chicken provide good quality protein and low fat poultry meat at lower cost, hence it's preferable. With high acceptance of chicken eggs and meat, due in part to it not having religious restriction, their demand is ever increasing (Geidam *et al*., 2006). Yet, poultry meat is seen as being expensive for an average Nigerian. In Villages, eating of poultry meat is kept for important events, meat and eggs are gotten from household flocks. Those living in the cities consume larger quatity of poultry due to their relatively higher income and they have quick access to fresh or frozen products in markets and fast food outlets. Poultry are used for all kinds of ceremonies/events such as socio-cultural and religious events in the Nigeria, causing demand for poultry meat to spike around Christmas, New Year, and Easter (Omorodion and Odu 2016b).

As nutritious and healthy as poultry meat, its production and processing for consumption can introduce both pathogenic and spoilage microorganisms into them (Kabour, 2011). Human illness may follow from handling of raw meat, undercooking or mishandling of the cooked product. Food-borne illnesses from poultry consumption are of serious public health concern (Myint, 2014). These pathogens can come from farms, during transportation, slaughter and particularly when processing although modern practices requires sterility of the final products (Myint, 2014).The presence of few pathogens in uncooked meats raises no objection as they can be handled through cooking before ingestion. Meat can be processed under hygienic conditions and properly stored yet not immune to contamination from natural microflora which maybe pathogenic. Important pathogenic microorganisms commonly found in meat include *Listeria monocytogenes, Campylobacter spp, Salmonella spp, Escherichia coli, and Yersinia enterocolitica, Staphylococcus aureus* (Omorodion and Odu 2016c).

Organic poultry are birds grown in an ecologically and economically sustainable manner, without chemicals additives (Galgano *et al*., 2016). In local parlance they are the native birds (chicken) which we consider more nutritious and tasty. Conventional poultry are birds grown using the full complement of modern farming technology involving the use of herbicides, pesticides, hormones and other chemical enhancement that can boost the production of bird often on a large scale basis. The organic food market is growing in response to an ever increasing demand for organic products. From a nutritional and safety standpoint, organic poultry is preferred to conventional even though the body of scientific studies do not support that claim completely. Pathogenic bacteria contaminate organic poultry as they do conventional. Galgano *et al*., (2016) concluded whatever differences are observed between organic and conventional might come from choice of breed, which ultimately embroil meat quality such as appearance and nutritive value. Since chicken protein is a good media supporting microbial growth, any unsanitary condition during the rearing, processing and retailing of poultry meat which would have an effect on the bacterial load of the poultry meat. The presence of pathogens of any kind in food is undesirable, hence the setting up of standards. It is in the public interest that food sold in the open market be regularly monitored for presence of pathogens like *Salmonella spp* and *Listeria spp.* The aim of this study is to evaluate the bacterial load and incidence of foodborne pathogens in Organic and conventional chicken and molecular characterization of associated *Salmonella spp* and Listeria *monocytogenes.*

Materials and Methods

Collection of Samples

One hundred and twenty (120) raw poultry meats samples (Organic chicken meat and conventionally processed chicken meat) purchased from 10 markets and 10 Retail stores in the city of Port Harcourt metropolis, where sampled in this study. The samples were aseptically

transported in sterile polythene bags in ice packed cooler to the laboratory and analysed within 2 hours of collection.

Total Viable Count (TVC) of Chicken Sample

225 ml of 0.1% buffered peptone water was transferred into a plastic bag containing 25 g of the poultry meat sample and a homogenized suspension was made. Dilutions ranging from 10^{-1} - 10^{-13} were prepared from following the recommendation of International Organization for Standardization, 1995 and 0.1ml of the different dilutions plated onto Plate count Agar and incubated at 37^0c for 24 to 48 hrs .Colonies between 30-300 were obtained.

Isolation and Identification of *LISTERIA SPP*

After incubation at 37^0C for 48 hrs, Colonies that appeared grayish colonies surrounded by black halos and sunken centers with possible greenish sheen on PALCAM agar at five characteristic colonies was selected from the Palcam plates and streaked onto tryptone soya yeast glucose agar plates for purification. Isolates were tested for catalase, Gram reaction, motility test, carbohydrate utilization, as described by (Alsheikh *et al.*, 2012).

Isolation and Identification of *SALMONELLA SPP*

After incubation period colonies of *Salmonella spp* colonies were picked from the different plates based on different colonial characteristics and sub cultured onto nutrient agar date for purification before transferring onto Nutrient agar slants and incubated at 37ºC for 24 hours. The isolates were characterized presumptively by colonial morphology, Motility, pigmentation, Gram staining and biochemical test including Urease, Sugar fermentation, Indole, Catalase, Methyl–red, Coagulase Test, test, Voges – Proskauer and Oxidase test.

Antimicrobial Susceptibility Testing for *LISTERIA SPP*

Method is as described by Morobe *et al. (*2009). Isolates were inoculated on Mueller-Hinton broth (Oxoid, Basingstoke, and Hampshire, England) and incubated at 37˚C on a shaker (200 rpm) for 24 hrs. Normal saline was used to bring the turbidity of the actively growing broth culture to the 0.5 McFarland standard. One milliliter of the cell suspension was transferred afterwards onto the surface of Mueller-Hinton agar and then spread evenly. The disk-agar method susceptibility testing of the National Committee for Clinical Laboratory Standards (NCCLS, 1998) was used to test each isolate against selected antibiotics.

Antimicrobial Susceptibility Testing for *SALMONELLA SPP*

Method is as described as Bauer *et al.* (1966). Isolates were grown on autoclaved Mueller Hinton broths for 18 hr at 37°C.About 100–300 µl of the inoculum was spread plated onto petri plates of 120 mm in diameters containing autoclaved Mueller Hinton agar before placing antimicrobial discs and incubating at 37°C for 18–48 hr. The zone of inhibition was measured in diameter as being resistant, intermediate or sensitive as described by Khan *et al*. (2010

Identification of the Isolates by DNA sequencing

Sub culture on Palcam Agar and Salmonella shigella gar (*Listeria)* and (*Salmonell*a) Phylo tree by NCBI CLUSTA OMEGA, Primer used: Bacteria: 16S, 27-F, 1492-R.DNA Extraction was performed at Nigerian Institute of Medical Research Yaba Lagos, while sequencing analysis was done at Inqaba Biotechnology West Africa. DNA extraction was from a 24 hours growth of microbial isolates in BHI broth harvested by centrifugation at 14, 000 x g for 10 minutes. DNA was extracted using the ZR Soil Microbe DNA Kit™ following manufacturer's protocol(http://www.zymoresearch.com).DNA sequencing was performed by Sanger Technique using PCR cycle- Sanger Sequencer™ 3730/3730XL . Results were obtained as

nucleotides IN FASTA format. Identification of the specie present was done using the resultant nucleotides base pairs. This was performed by BLAST analysis by direct blasting on http://blast.ncbi.nlm.nih.gov. For every set of isolate, a read was BLASTED and minimum E-score for every top BLAST result showing species name was used to name the specific organism.

Result

Bacterial count ranged from 6.3 to 7.22 log_{10} cfu/g for organic chicken thighs (OCT), 6.46 to 7.47 log_{10} cfu/g for organic chicken wings (OCW), 5.54 to 7.52 log_{10} cfu/g for conventional chicken wings (CCW) and 5.48 to7.23 log_{10} cfu/g for conventional chicken thigh (CCW) (Fig 1- 6). Fig 7 shows the mean total bacterial counts for chicken meat samples, with OCW having the highest count of 7.1 log_{10} cfu/g and the least count is 6.5 for CCW.

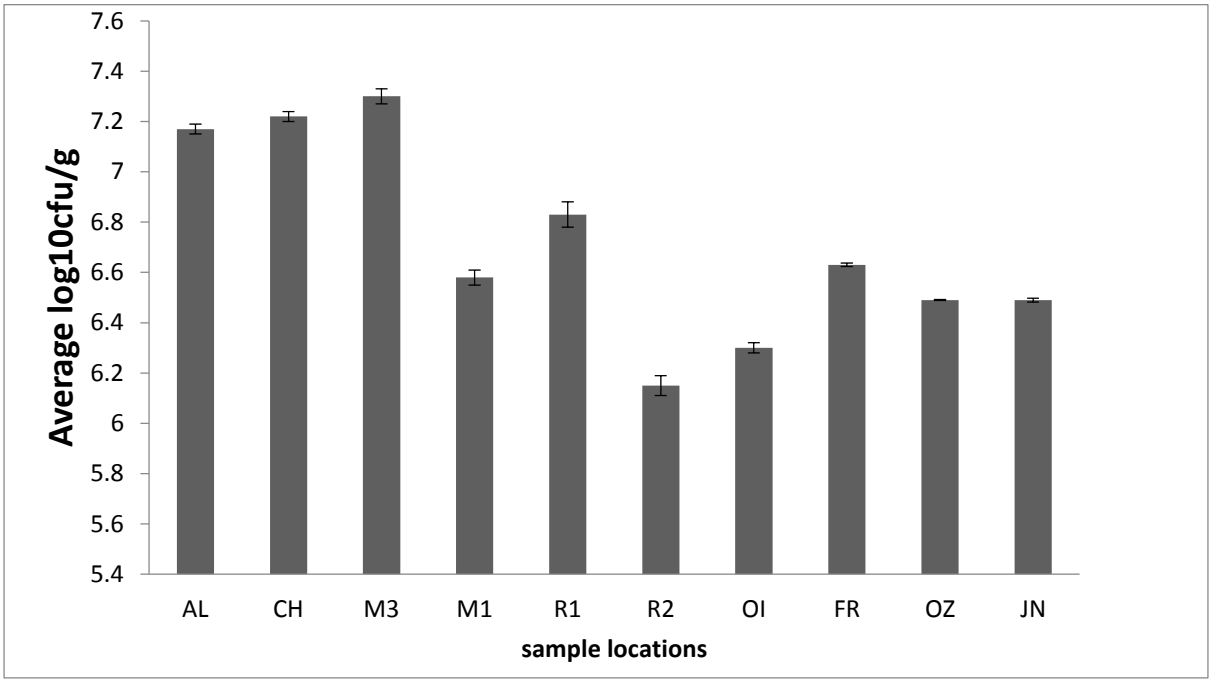

Fig1 Total Bacterial Counts of Organic Chicken Thighs from Different Locations Legend;Al-Aluu,Ch-Choba,M3-Mile3,M1-Mile 1,R1 -Rumuosi,R2-Rumuokoro,Oz-Ozouba,Fr-Fruitmarket,O-I Oillmill,J-Junction Each Error Bar Rep Mean ± Std Dev

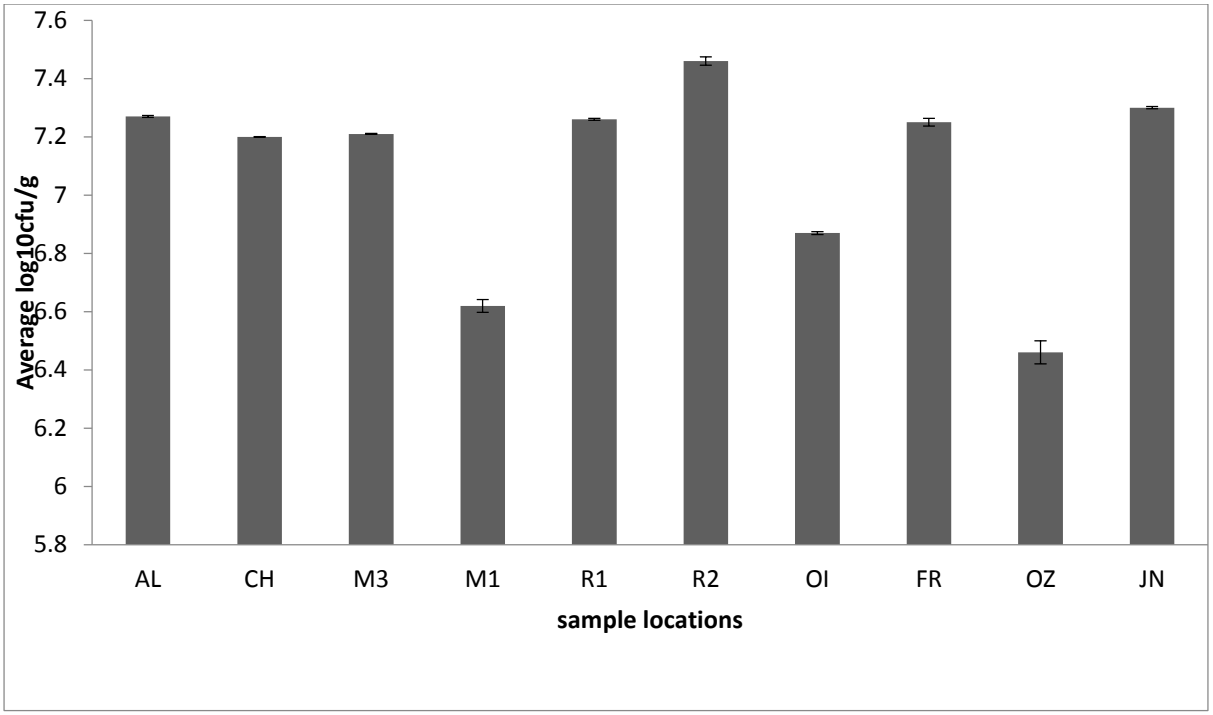

Fig2: Total Bacterial Counts of Organic Chicken Wings from Different Locations
Legend;

AL-Aluu, CH-Choba, M3-Mile 3, M1-Mile 1,R1 -Rumuosi,R2-Rumuokoro,OZ-Ozouba,FR-Fruitmarket,OL-Oillmill,JN-Junction
EACH ERROR BAR REP MEAN ± STD DEV

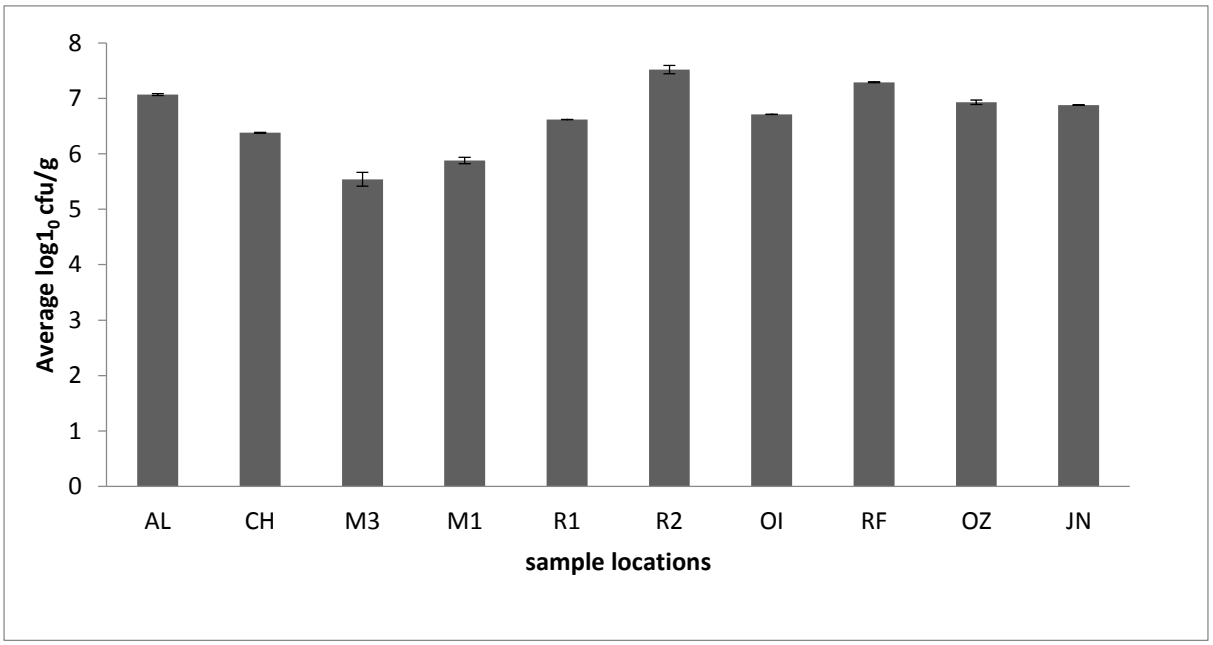

Fig3: Total Bacterial Counts of Conventional Chicken Wings from Different Locations
Legend
AL-Aluu, CH-Choba, M3-Mile 3, M1-Mile 1, R1 -Rumuosi,R2-Rumuokoro,OZ-Ozouba,FR-Fruitmarket,OI-Oillmill,JN-Junction
EACH ERROR BAR REP MEAN ± STD DEV

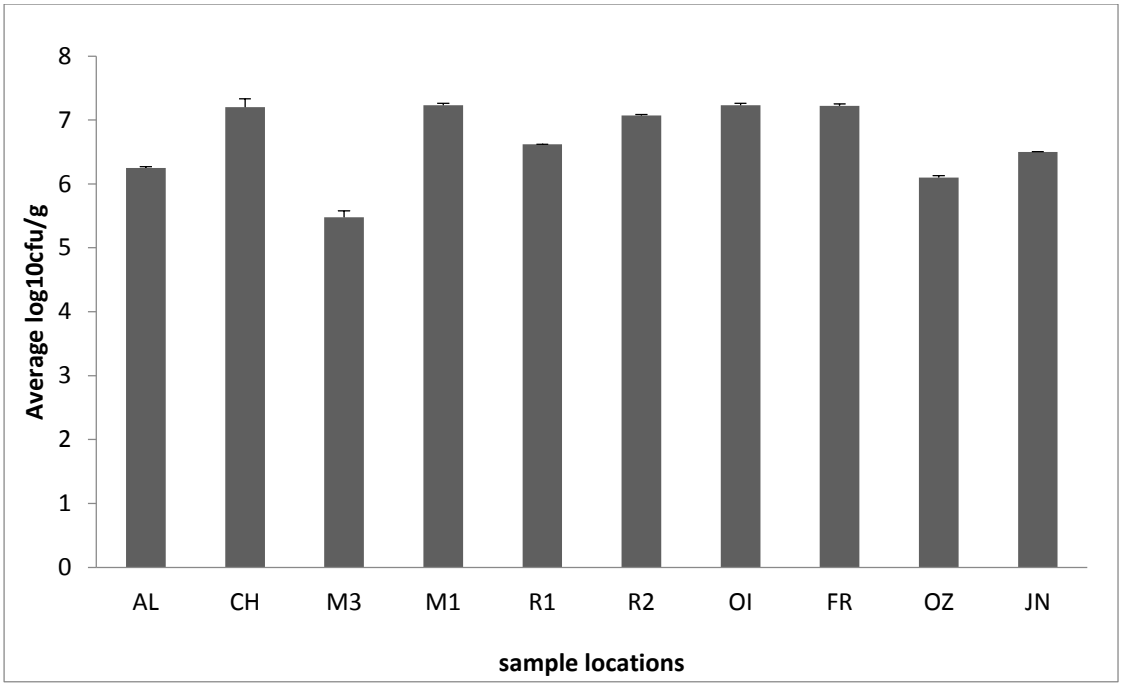

Fig4 Total Bacterial Counts of Conventional Chicken Thighs From Different Locations
Legend Al-Aluu,Ch-Choba,M3-Mile 3,M1-Mile 1,R1 -Rumuosi,R2-Rumuokoro,Oz-Ozouba,Fr-Fruitmarket,Oi-Oillmill,Jn-Junction Each Error Bar Rep Mean ± Std Dev

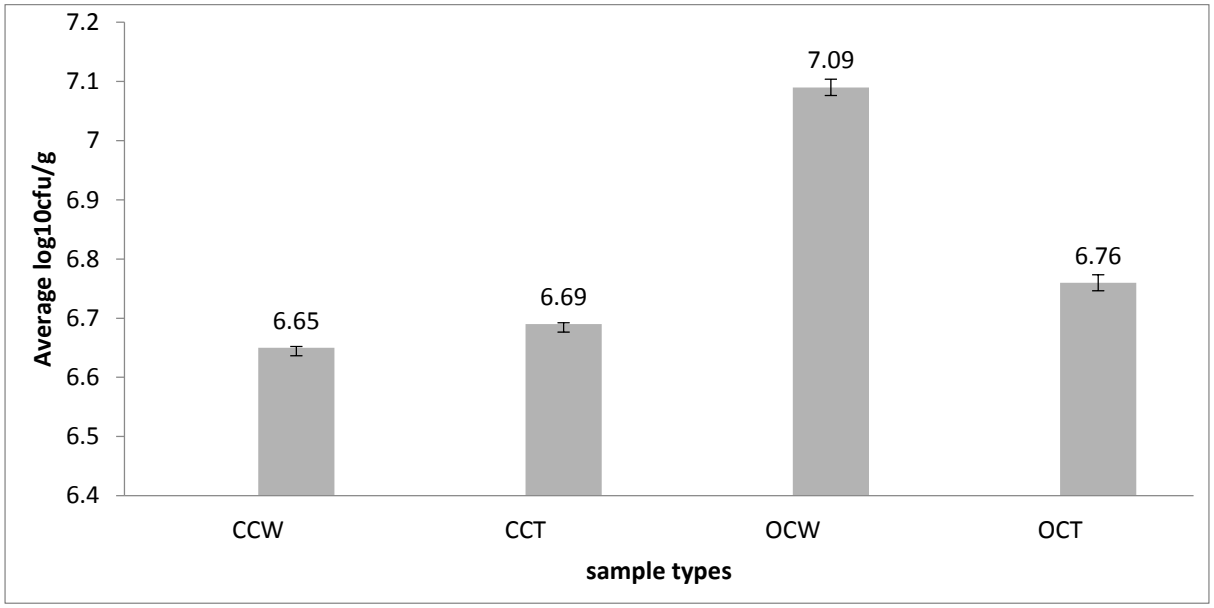

Fig5 Total Mean Bacterial Counts Of Organic And Conventional Wings And Thighs From Different Locations.
Legend Cct: Conventional Chicken Thighs, Ccw ;Conventional Chicken Wings , Oct ; Organic Chicken Thigh ,Ocw; Organic Chicken Wings.
Each Error Bar Rep Mean ± Std Dev

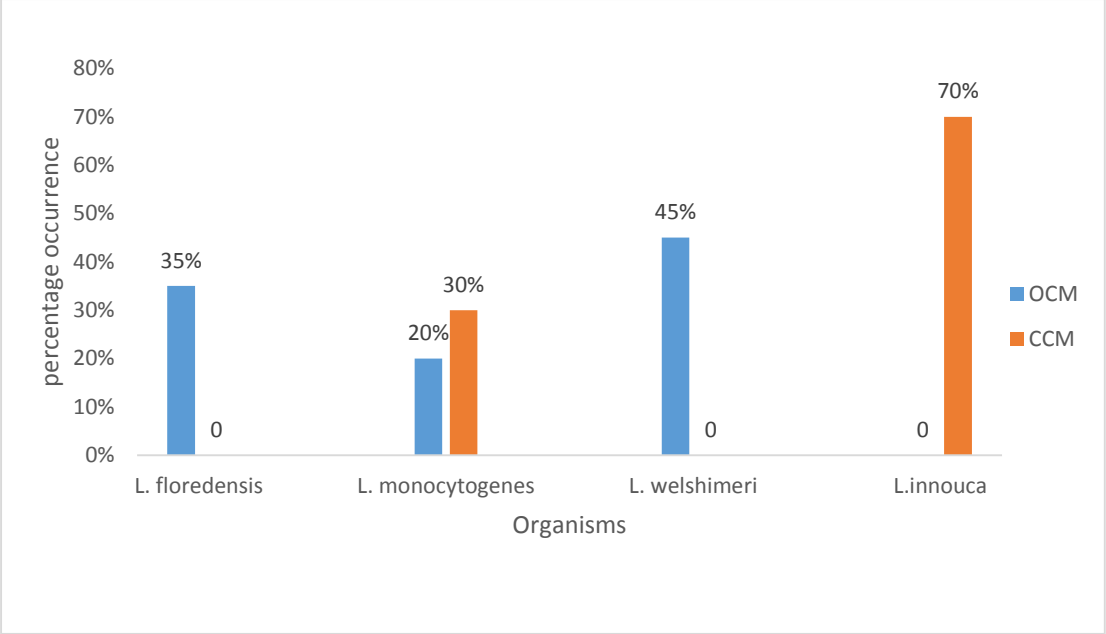

Fig 6; Percentage occurrence of *Listeria spp* in different chicken meat
OCM-Organic chicken meat
CCM- Conventional chicken meat

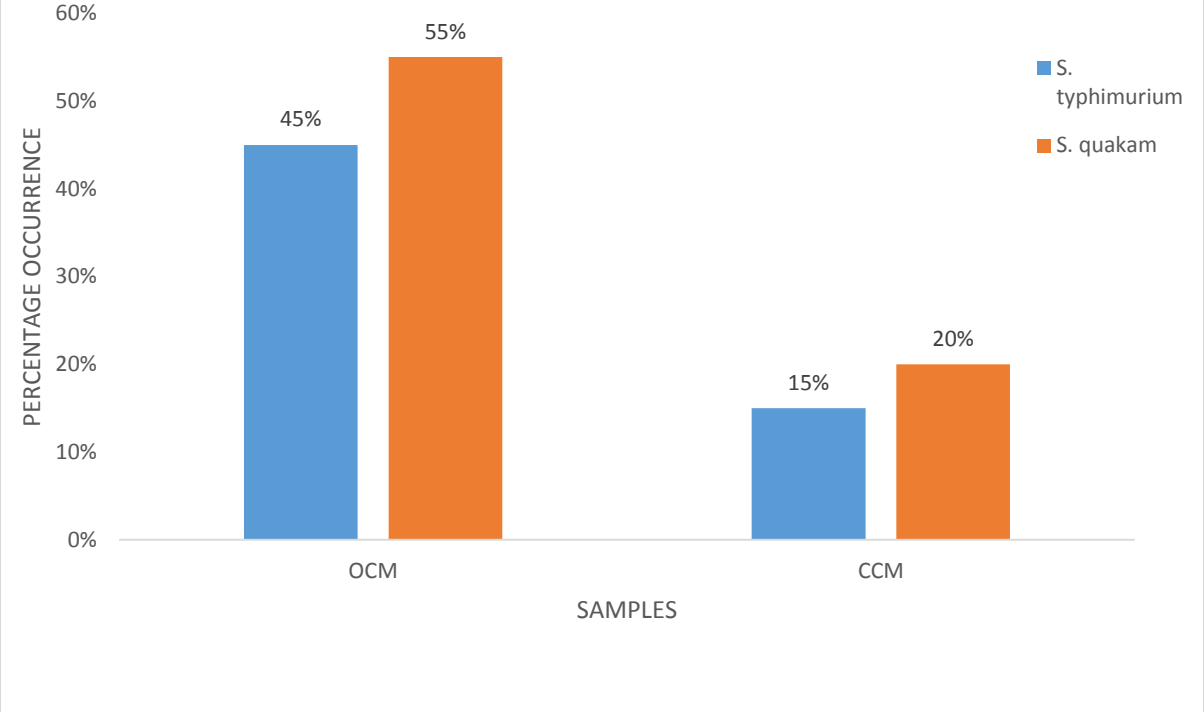

Fig 7; Percentage occurrence of *Salmonella spp* in different chicken meat
OCM-Organic chicken meat
CCM- Conventional chiken meat

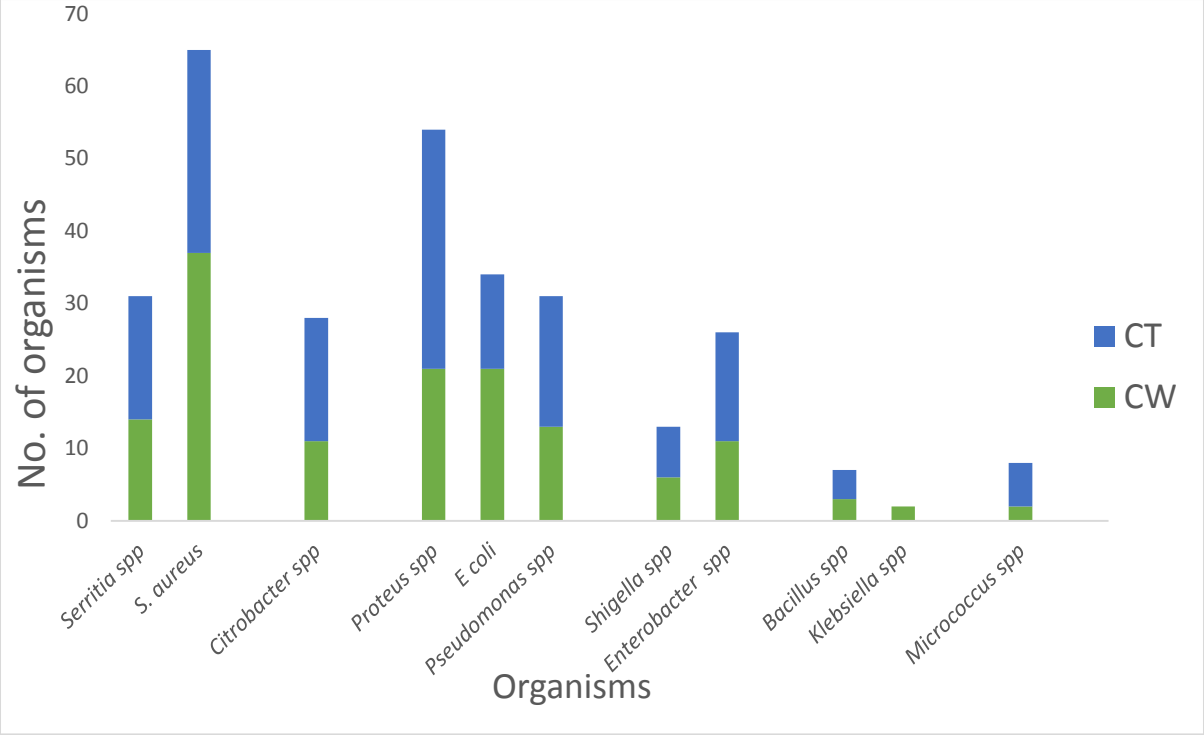

Fig 8; Other Organisms isolated from Conventional Chicken Wings and Thighs
LEGEND
CT; Conventional Thighs CW ;Conventional Wings

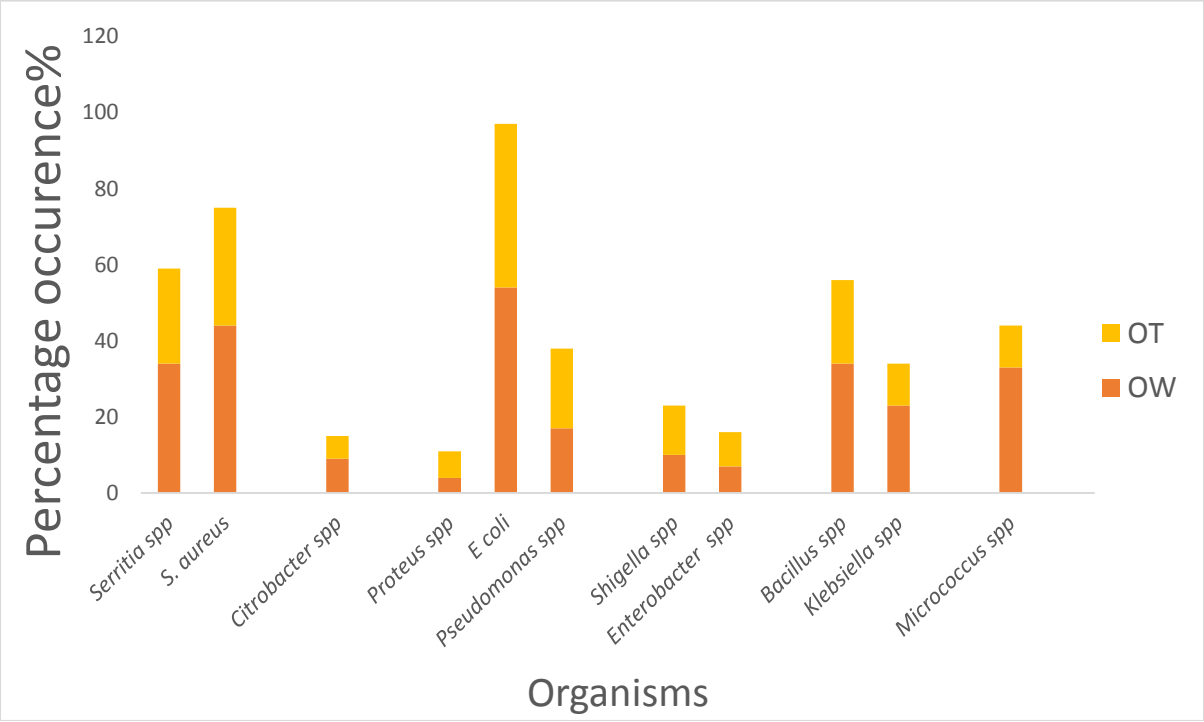

Fig 9; Other Organisms isolated from Organic Wings and Thighs.
LEGEND
OW; Organic Wings , OT ;Organic Thighs

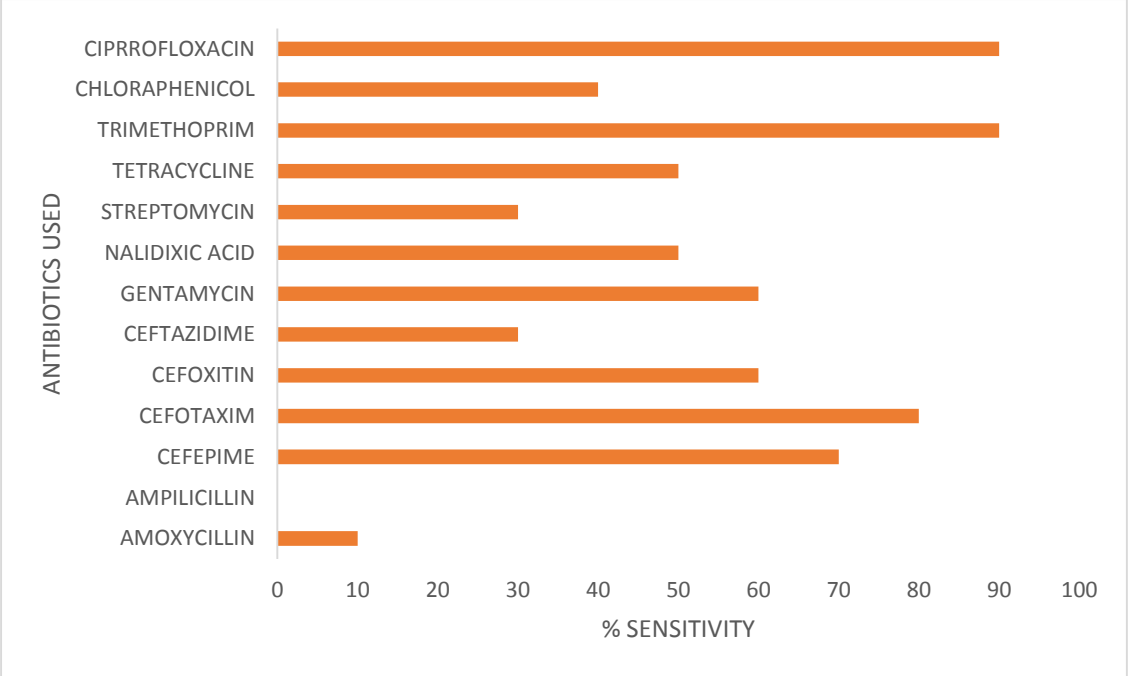

Fig 10 Percentage sensitivity of *Salmonella spp* to the different antibiotics

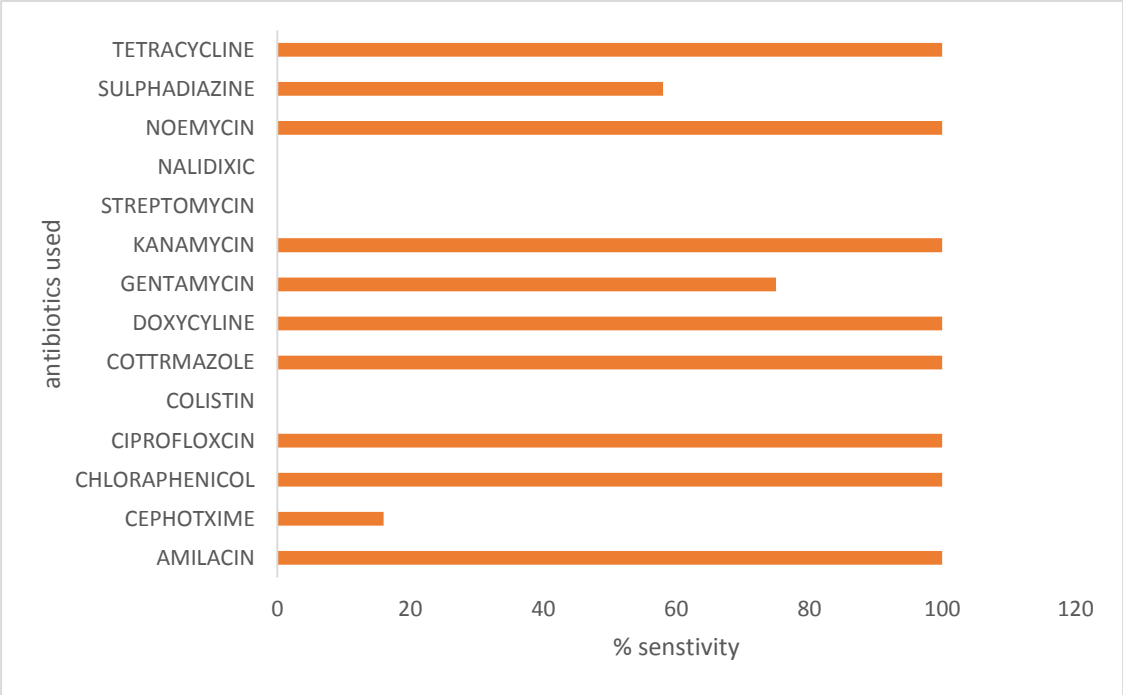

Fig 11; Percentage sensitivity of *Listeria monocytogenes* to the different antibiotics

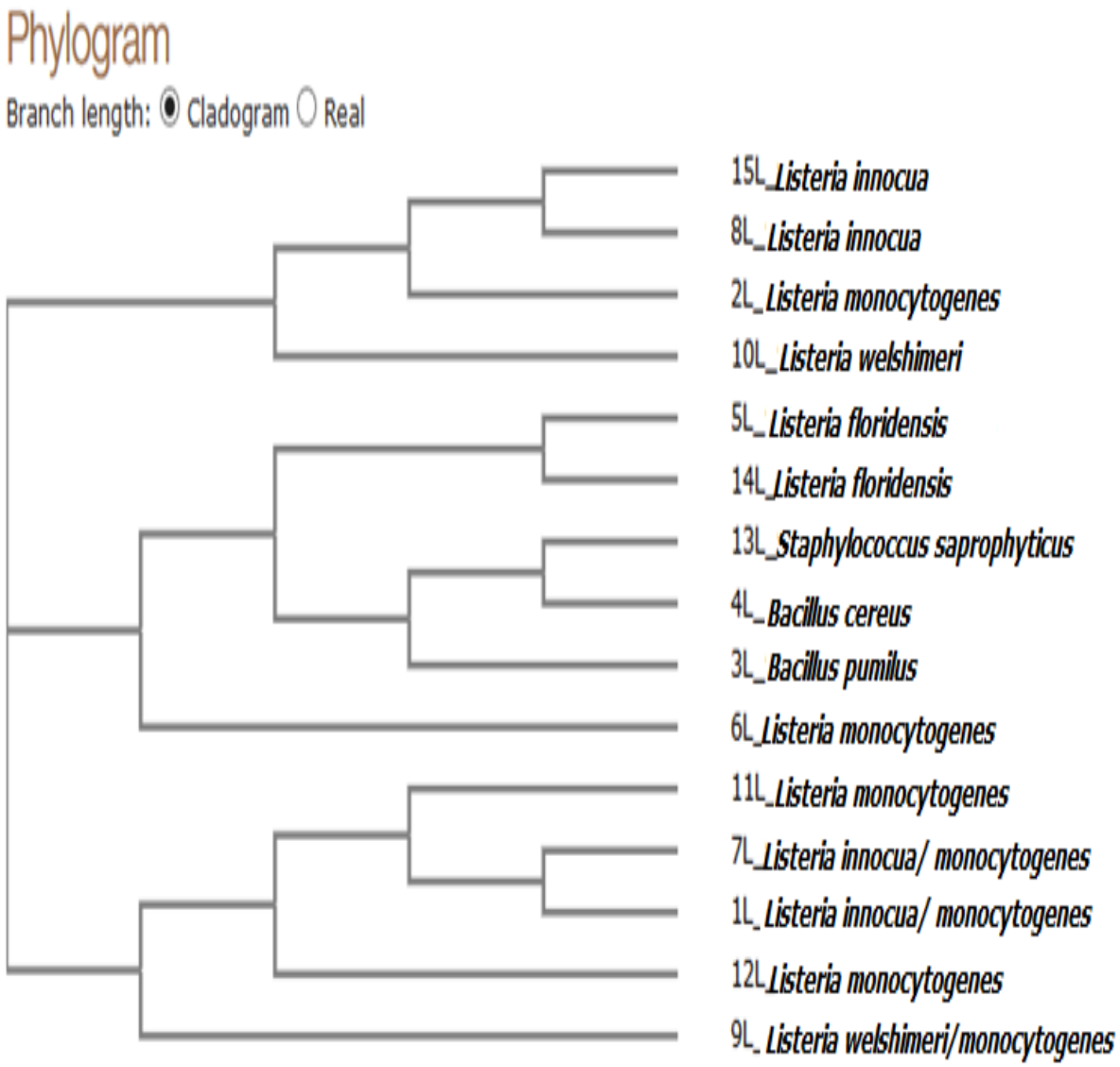

FIG 12; PHYLOGENTIC TREE OF LISTERIA ISOLATES

COMPARISON OF THE SEQUENCES OBTAINED BY 16S DNA SEQUENCING WITH THOSE IN NCBI REVEALED THE PRESENCE OF THESE ORGANISMS.

Listeria innoca /Listeria monocytogenes NCBI accession number -MF652063

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Listeria monocytogenes MF652064

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CAGG

Listeria floridensis *MF652067*

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Listeria monoctogenes MF652068

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Listeria innocua / Listeria monocytogenes MF652068

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Listeria innocua MF652069

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Listeria welshimeri/ Listeria monocytogenes MF652070

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Listeriawelshimeri MF652071

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GCTTTCTGGTTAGATACCGTCAAGGGACAAGCAGTTACTCTTATCCTTGTTCTTCT
CTAACAACAGTACTTTACGATCCGAAAACCTTCTTCATACACGCGGCGTTGCTCC
GTCAGACTTTCGTCCATTGCGGAAGATTCCCTACTGCTGCCTCCCGTAGGAGTCT
GGGCCGTGTCTCAGTCCCAGTGTGGCCGATCACCCTCTCAGGTCGGCTATGCATC
GTTGCCTTGGTAGGCCATTACCCTACCAACTAGCTAATGCACCGCGGGCCCATCT
GTAAGCGATAGCCGAAACCATCTTTCAAAGCCGTGGCATGCGCCACACTATTATT
CGGTATTAGCCCCGGTTTCCCGGAGTTATCCCCAACTTACAGGCAGGTTGCCCAC
GTGTTACTCACCCGTCCGCCACTAACTTTGGAAGAGCAAGCTCTTCCTCCGTTCG
TTCGACTTGCATGTATTAGGCACGCCGCCAGCGTTCGTCTGAGCCAGACAAACCT

Listeria monocyogenes MF652072

TGGGGGGGRRGTGCTTAATGCGTTAGCTGCAGCACTAAGGGGCGGAAACCCCCT
AACACTTAGCACTTCGTTTACGGCGTGGACTACCAGGGTATCTAATCCTGTTTGC
TCCCCACGCTTTCGCGCCTCAGCGTCAGTTACAGACCAGAGAGTCGCCTTCGCCA
CTGGTGTTCCTCCACATATCTACGCATTTCACCGCTACACGTGGAATTCCACTCTC
CTCTTCTGCACTCCAGTCTTCCAGTTTCCAATGACCCTCCCCGGTTAAGCCGGGG
GCTTTCACATCAGACTTAAAAGACCGCCTGCGCGCGCTTTACGCCCAATAAATCC
GGACAACGCTTGCCACCTACGTATTACCGCGGCTGCTGGCACGTAGTTAGCCGTG
GCTTTCTGGTTAGATACCGTCAAGGGACAAGCAGTTACTCTTATCCTTGTTCTTCT
CTAACAACAGTACTTTACGATCCGAAAACCTTCTTCATACACGCGGCGTTGCTCC
GTCAGACTTTCGTCCATTGCGGAAGATTCCCTACTGCTGCCTCCCGTAGGAGTCT
GGGCCGTGTCTCAGTCCCAGTGTGGCCGATCACCCTCTCAGGTCGGCTATGCATC
GTTGCCTTGGTAGGCCATTACCCTACCAACTAGCTAATGCACCGCGGGCCCATCT
GTAAGCGATAGCCGAAACCATCTTTCAAAGAGCGTGGCATGCGCCACACTCTAT

CATTCGGTATTAGCCCCGGTTTCCCGGAGTTATCCCCAACTTACAGGCAGGTTGC
CCACGTGTTACTCCCCGTCCGCCACTAACTTTGGAAGAGCAAGCTCTTCCTCCGT
TCGTTCGACTTGCATGTATTAGGCACGCCGCCAGCGTTCGTCCTGAGCAGATCAA
ATCAAGC

Listeria monocyogenes MF652073

CAGGCCGGTGCTTAATGCGTTAGCTGCAGCACTAAGGGGCGGAAACCCCCTAAC
ACTTAGCACYCWTCGTTTACGGCGTGGACTACCAGGGTATCTAATCCTGTTTGCT
CCCCACGCTTTCGCGCCTCAGCGTCAGTTACAGACCAGAGAGTCGCCTTCGCCAC
TGGTGTTCCTCCACATATCTACGCATTTCACCGCTACACGTGGAATTCCACTCTCC
TCTTCTGCACTCCAGTCTTCCAGTTTCCAATGACCCTCCCCGGTTAAGCCGGGGG
CTTTCACATCAGACTTAAAAGACCGCCTGCGCGCGCTTTACGCCCAATAAATCCG
GACAACGCTTGCCACCTACGTATTACCGCGGCTGCTGGCACGTAGTTAGCCGTGG
CTTTCTGGTTAGATACCGTCAAGGGACAAGCAGTTACTCTTATCCTTGTTCTTCTC
TAACAACAGTACTTTACGATCCGAAAACCTTCTTCATACACGCGGCGTTGCTCCG
TCAGACTTTCGTCCATTGCGGAAGATTCCCTACTGCTGCCTCCCGTAGGAGTCTG
GGCCGTGTCTCAGTCCCAGTGTGGCCGATCACCCTCTCAGGTCGGCTATGCATCG
TTGCCTTGGTAGGCCATTACCCTACCAACTAGCTAATGCACCGCGGGCCCATCTG
TAAGCGATAGCCGAAACCATCTTTCAAAAGCGTGGCATGCGCCACATTATCATTC
GGTATTAGCCCCGGTTTCCCGGAGTTATCCCCAACTTACAGGCAGGTTGCCCACG
TGTTACTCACCCGTCCGCCACTAACTTGGAAGAGCAAGCTCTTCCTCCGTTCGTTC
GACTTGCATGTATTAGGCACGCCGCCAGCGTTCGTCCTGAGCCAGATAAACTTGG

Listeria floridensi MF652075

TCCGGCGGGAGTGCTTAATGCGTTTGCTGCAGCACTAAGGGGCGGAAACCCCCT
AACACTTAGCCCATCGTTTACGGCGTGGACTACCAGGGTATCTAATCCTGTTTGC
TCCCCACGCTTTCGCGCCTCAGCGTCAGTTACAGACCAGAGAGCCGCCTTCGCCA
CTGGTGTTCCTCCATATATCTACGCATTTCACCGCTACACATGGAATTCCACTCTC
CTCTTCTGCACTCCAGTCTCCCAGTTTCCAATGACCCTCCCCGGTTAAGCCGGGG
GCTTTCACATCAGACTTAAGAAACCGCCTGCGCGCGCTTTACGCCCAATAATTCC
GGACAACGCTTGCCACCTACGTATTACCGCGGCTGCTGGCACGTAGTTAGCCGTG
GCTTTCTGGTTAGATACCGTCAGGGGATGAACAGTTACTTCATCCTTGTTCTTCTC
TAACAACAGTGCTTTACGATCCGAAAACCTTCTTCACACACGCGGCGTTGCTCCG
TCAGACTTTCGTCCATTGCGGAAGATTCCCTACTGCTGCCTCCCGTAGGAGTCTG
GGCCGTGTCTCAGTCCCAGTGTGGCCGATCACCCTCTCAGGTCGGCTATGCATCG
TTGCCTTGGTAGGCCTTTACCCCACCAACTAGCTAATGCACCGCGGGCCCATCTA
TCAGTGACAGCCGAAACCGTCTTTCAAAAGGGTTCATGCGAACCTCTTTGTTATG
CGGTATTAGCACCTGTTTCCAAGTGTTATCCCCCGCTGATAGGCAGGTTGCCCAC
GTGTTACTCACCCGTCCGCCACTCACCGACAGAGAAGCAAGCTTCTCTTTGGTTC
GTTCGACTTGCATGTATTAGGCACGCCGCCAGCGTTCGTCCTGAGCAGATCAAAC
TGG

Listeria innocua MF652076

CCGGGCGGGGTGCTTAATGCGTTAGCTGCAGCACTAAGGGGCGGAAACCCCCTA
ACACTTAGCCCATCGTTTACGGCGTGGACTACCAGGGTATCTAATCCTGTTTGCT
CCCCACGCTTTCGCGCCTCAGCGTCAGTTACAGACCAGAGAGTCGCCTTCGCCAC
TGGTGTTCCTCCACATATCTACGCATTTCACCGCTACACGTGGAATTCCACTCTCC
TCTTCTGCACTCCAGTCTTCCAGTTTCCAATGACCCTCCCCGGTTAAGCCGGGGG
CTTTCACATCAGACTTAAAAGACCGCCTGCGCGCGCTTTACGCCCAATAAATCCG
GACAACGCTTGCCACCTACGTATTACCGCGGCTGCTGGCACGTAGTTAGCCGTGG

CTTTCTGGTTAGATACCGTCAAGGGACAAGCAGTTACTCTTATCCTTGTTCTTCTC
TAACAACAGTACTTTACGATCCGAAAACCTTCTTCATACACGCGGCGTTGCTCCG
TCAGACTTTCGTCCATTGCGGAAGATTCCCTACTGCTGCCTCCCGTAGGAGTCTG
GGCCGTGTCTCAGTCCCAGTGTGGCCGATCACCCTCTCAGGTCGGCTATGCATCG
TTGCCTTGGTAGGCCATTACCCTACCAACTAGCTAATGCACCGCGGGCCCATCTG
TAAGCGATAGCCGAAACCATCTTTCAAGAGCGTGGCATGCGCCACACTCTATCAT
TCGGTATTAGCCCCGGTTTCCCGGAGTTATCCCCAACTTACAGGCAGGTTGCCCA
CGTGTTACTCACCCGTCCGCCACTAACTTTGGAAGAGCAAGCTCTTCCTCCGTTC
GTTCGACTTGCATGTATTAGGCACGCCGCCAGCGTTCGTCTGAGCCAGATCAAAC
CAACS

Salmonella enterica subsp. enterica serovar Ouakam MF652079
CGGGGCGGGTCTATTAACGCGTTAGCTCCGGAAGCCACGCCTCAAGGGCACAGC
CTCCAAGTAGACATCGTTTACGGCGTGGACTACCAGGGTATCTAATCCTGTTTGC
TCCCCACGCTTTCGCACCTGAGCGTCAGTCTTGTCCAGGGGGCCGCCTTCGCCAC
CGGTATTCCTCCAGATCTCTACGCATTTCACCGCTACACCTGGAATTCTACCCCCC
TCTACAGACTCAGCCTGCCAGTTTCGAATGCAGTTCCCAGGTTGAGCCCGGGGAT
TTCACATCCGACTTGACGACCGCCTGCGTGCGCTTTACGCCCAGTAATTCCGATT
AACGCTTGCACCCTCCGTATTACCGCGGCTGCTGGCACGGAGTTAGCCGGTGCTT
CTTCTGCGGGTAACGTCAATGCTGGGTTATTAACCACAACCCTTCCTCCCCGCTG
AAAGTACTTTACAACCCAAGGCCTTCTTCATACACGCGGCATGGCTGCATCAGGC
TTGCGCCCATTGTGCAATATTCCCCACTGCTGCCTCCCGTAGGAGTCTGGACCGT
GTCTCAGTCCAGTGTGGCTGTCATCCTCTCAGACCAGCTAGGGATCGTCGCCTGG
TGAGCCGTTACCTCACCACAGCTAATCCCATCTGGGCACATCCGGTGGCAAGAG
GCCCGAAGTCCCCTCTTTGGTCTTGCGACRTTATGCGGTATTAGCTACCGTTTCCA
GTAGTTATCCCCCTCACCGGGCAGTTCCCAGACATTACTCACCCGTCCGCCACTC
GTCAGCAAGCAGCAAGCTGCTTCCTGTTACCGTTCGACTTGCATGTGTTAGGCCT
GCCGCCAGCGTTCAATCTGAGCAGATCAAACCAGGG

Salmonella enterica subsp. enterica serovar Typhimurium (Salmonella typhimurium)
LN99999
CCCCCCRGCGGTCKAMTTAACGCGTTAGCTCCGGAAGCCACGCCTCAAGGGCAC
AACCTCCAARTMGACATCGTTTACGGCGTGGACTACCAGGGTATCTAATCCTGTT
TGCTCCCCACGCTTTCGCACCTGAGCGTCAGTCTTTGTCCAGGGGGCCGCCTTCG
CCACCGGTATTCCTCCAGATCTCTACGCATTTCACCGCTACACCTGGAATTCTACC
CCCCTCTACAAGACTCWAGCCTGCCAGTTTCGAATGCAGTTCCCAGGTTGAGCCC
GGGGATTTCACATCCGACTTGACAGACCGCCTGCGTGCGCTTTACGCCCAGTAAT
TCCGATTAACGCTTGCACCCTCCGTATTACCGCGGCTGCTGGCACGGAGTTAGCC
GGTGCTTCTTCTGCGGGTAACGTCAATYGCYRMGGTTATTAACCWYAACRCCTT
CCTCCCCGCTGAAAGTRCTTTACAACCCGAAGGCCTTCTTCAYACACGCGGCATG
GCTGCATCAGGCTTGCGCCCATTGTGCAATATTCCCCACTGCTGCCTCCCGTAGG
AGTCTGGACCGTGTCTCAGTTCCAGTGTGGCTGGTCATCCTCTCAGACCAGCTAG
GGATCGTCGCCTWGGTGAGCCGTTACCYCCWACTAGCTAATCCCATCTGGGCAC
ATCTGATGGCAWGAGGCCCGAAGGTCCCCCTCTTTGGTCTTGCGACRTTATGCGG
TATTAGCYACCGTTTCCAGTAGTTATCCCCCTCCATCAGGCAGTTTCCCAGACATT
ACTCACCCGTCCGCCRCTCGTCACCSAAGARSCAAGCTGCTTCCTGATACCGCTC
GACGTGCATGTGTGAGGCGTGCCCCCMGYGTTCTATMTGAGCCATGMWMAAAR
CTATGGGSSCAAMGGGGGGGGGGGGSATTGMGCCTCCMTATATAYCAAYSAGAG
GARAAACTYCCCTCTGGGTATATATCACCAAAARAATAATAAAAAAMAAAAGK
GGGCYTTTCCKWCTSKGRAAARAASAAAAAAKGKSGCGGGTWTTGTGYCTCCTC

WCCCTCTTCTGTGYGTKATAWAGWAGRAGMAGTARAYWTMACCACCSACAGG
AGMGGCATCTCTMCTWCATTCTMTTSTCKGCTGGGCMTGCGAKSGTGAGTCTSK
SCCMAMGARTAATASATASATCRCACYYSAGMGYMGGYASTGGCWGACGCACK
GATAGCGGACGAGAYAGACCACGMCGTMGGYGSGSKMMTCGCT

Discussion

Poultry meat contamination with microorganisms can lead to illnesses which can sometimes results to death (Lynch *et al.*, 2006). The sanitary quality of chicken meat bought by the consumer rely on the butchering process, hygienic practice during operation and packaging, ensuring a cold condition storage from operation to the sell of the goods to the buyer. The bacteriological count of chicken meat as determined in the present study revealed that organic chicken meats (OC) had high aerobic counts than conventional chicken meats (CC) with he total mean to $\log_{10}$ ranging from 6.76- 7.09. High aerobic counts in organic chicken meat may arise from poor sanitary practices in the poultry abattoir and also lack of proper disinfection during processing, (Kingsbury, 2006). The ICMSF acceptable upper limit for aerobic plate count for fresh poultry meat is 6.7 $\log^{10}$cfu/g (ICMSF, 2005). Aerobic plate count for OCT from Alakahia, Choba, Mile 1 and Rumokoro markets exceeded the permissible limits while OCT from Fruit market, Oil mill market, Junction market were within the stated limits. For OCW, samples from Alakahia, Choba, Mile 3, Rumuokoro, Rumousi, Oil mill, fruit and junction market all exceeded the limit while sample bought from Mile 3, and Ozouba market were within limit. Microorganisms isolated from OC samples were *Staphylococcus aureus, Micrococcus spp, Klebsiella spp, Bacillus spp, Escherichia coli, Serretia spp, Salmonella spp, Listeria monocytogenes, Listeria welshimeri, Listeria floridensis, Salmonella typhimurium Salmonella enterica subsp. Enterica serovar Ouakam*.

The aerobic plate count for CC ranged from 6.65-6.69 $\log^{10}$cfu/g, which is marginally lower than the OC counts. Microorganisms isolated from *Enterobacter spp, Citrobacter spp Staphylococcus aureus ,Escherichia coli, Micrococcus spp, Klebsiellaspp, Psedomonas spp, Bacillus spp, Serretia spp, , Shigella spp, Salmonella spp, ,Listeria monocytogenes , Listeria innoua, Salmonella typhimurium, Salmonella enterica subsp. Enterica serovar Ouakam.* Microbial specification for refrigerated chicken is 10^5 to 10^6 colonies per gram of meat (ICMSF 2005). When aerobic plate count of refrigerated chicken range within 10^6-10^8, the product is accepted as moderately satisfactory for human consumption, but not when it is above. The CCW and CCT in this study were moderately satisfactory for human consumption as their aerobic counts were within 10^6-10^8. This is similar to the studies of Rumni *et al*., (2012), Al-groom and Abu Shapra (2014). Statistical difference does not exist between the chicken meat types ($p>0.05$) this might have been as a result of the difference in processing technique as asserted by Tayebel *et al*., 2015). There are different opinions concerning the occurrence of *Listeria monocytogenes* and *Salmonella spp in poultry meat.*

This study reported high occurrences of *Listeria monocytogenes* in CC when compared to OC. The frequency of *Listeria monocytogenes* was found to be 18% and 32% for OC and CT respectively. This corroborated the finding of Capita *et al*. (2001). Conventional chicken meats are often refrigerated and *L. monocytogenes* thrive under low freezing temperatures. Listeriosis is a fatal *L. monocytogenes* infection with symptoms which may include meningitis, encephalitis, septicemia, spontaneous abortion, stillbirth, and influenza-like symptoms (Chengchu *et al*., 2016).

Salmonella spp isolated were *Salmonella enteria sub sup. Enteria servorQuakam* and *S enteria sub sp enteria servor Typhimurium. Salmonella spp* were more frequently isolated from OC than from CC, the high level of *Salmonella spp* in OC might be as a result of these foodborne

pathogen in soil or exercta and the surrounding .Bailey and Cosby (2005) and Cu *et al.*, 2005) reported in their studies that *Salmonella spp* in OC exceeded those found in CC. Reports suggest that occurrence of *Salmonella* in chicken varies with country, with developing countries having more frequent contamination (Van *et al*, 2007; Zhao *et al.*, 2003).

Antibiogram of *Listeria monocytogenes* Isolated From Chicken Meat

The sensitivity and resistance pattern against *Listeria monocytogenes* isolates observed in the present study for 14 different antibiotics revealed that *Listeria monocytogenes* is sensitive to all the antibiotics tested that are commonly used in human (medicine) against listeriosis. *Listeria monocytogenes* showed complete resistance to nalidixic acid and colistin which are most commonly used in poultry practice. This shows that there should be rational use of antibiotics in poultry care. Our study agrees with several researchers who recorded *Listeria monocytogenes* sensitivity to antibiotics used in human medicine such as gentamicin, ciprofloxacin, tetracycline, chloramphenicol, ofloxacin, tetracycline, Streptomycin, doxycycline, trimethoprim (Wong *et al.*,2012; Yucel *et,al.*, 2005). Kanamycin showed sensitivity and this corroborates to reported sensitivty by Srinivasan *et al.*, (2005), though Jamali *et al.* (2014) reported resistance to Kanamycin. In this study *Listeria monocytogenes* were highly sensitive to amikacin; cefotaxime; chloramphenicol; ciprofloxacin; trimethoprim; streptomycin; tetracycline, this similar to the findings of Safdar and Armstrong, 2003). Contrary to our findings (Jamali *et al.*, 2014) reported 100% resistance to these antibiotics such as amikacin; cefotaxime; chloramphenicol; ciprofloxacin; trimethoprim; streptomycin, tetracycline. Transmission of resistance by *Listeria monocytogenes* to other microorganisms may prove dangerous to human health (De Reu, 2006). It can be said that *Listeria monocytogenes* is becoming resistant to antibiotics and continued surveillance is crucial (Tayedah *et al.*, 2015).

Antibiogram of *Salmonella Spp* Isolated From Chicken Meat

Antibiotic susceptibility testing of *Salmonella typimurium* and *Salmonella quakam* showed intermediate and senstivity to the following antibioitics cefepime, cefotaxime, cefoxitin, ceftazidime, gentamicin, nalidixic acid streptomycin, tetracycline trimethoprim, chloramphenicol, ciprofloxacin. This is in agreement with the findings of Kumar *et al.* (2009). *Salmonella typhimurium* was resistant (100%) to amoxicillin, ampicillin, tetracycline and chloramphenicol while *Salmonella Qukam* was resistant (100%) to ampicillin this in line with the findings of (Yan *et al*., 2010). *Salmonella* antimicrobial-resistant results from antibiotics use in animal breeding and can be transmitted to humans (White *et al*, 2001; Tayebeh *et al*., 2015). The use of antibiotics in any milieu creates selection push that favour the survival of antibiotic resistant pathogens (White *et al.*, 2002). *Salmonella typhimurium* was sensitive to ciprofloxacin in the reports of (Zahrei *et al*.,2005) and also sensitivity was found to chloramphenical as reported by (Hui and Das 2001).The general or ubiquitous use of antibiotics in food and animal production has resulted to resistant of *Salmonella* to different antibiotics which can transferred to humans via food of animal origin and this continuous antibiotics therapy may introduce the emergence of antibiotic resistant strain of *Salmonella* spp

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