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MICROBIAL EVALUATION OF RAW BEEF AND ANTIBIOTIC RESISTANCE PROFILE OF *SALMONELLA* AND *ESCHERICHIA COLI* ISOLATES FROM SELECTED ABATTOIRS IN SOUTHEAST NIGERIA.

Uzoigwe, N.E[1]., Chagwa, L.L[2]., Ezeh, G.C[3]., Itodo, J.I.[4]*, Odunbaku, T[5]., Chukwu V.E[1]., [6]Enid, G., Enem, S.I.[6] and Adah, S.O.[7]

[1]Agricultural Rural Development (ARD) Secretariat, Veterinary Services Department, Federal Capital Territory Administration, Garki Area 11, Abuja.
[2]Nigeria Agricultural Quarantine Services, Headquarters Abuja, Department of Planning and Research Development.
[3]Department of Animal Science, Faculty of Agriculture, Alex Ekwueme Federal University Ndufu Alike Ebonyi State
[4]Department of Animal Science, Federal University Lafia, Nasarawa State, Nigeria.
[5]Ogun State Ministry of Agriculture, Abeokuta.
[6]Department of Veterinary Public Health and Preventive Medicine, Faculty of Veterinary Medicine, University of Abuja, Nigeria
[7]Department of Medical Laboratory Science, Federal University Lafia, Nasarawa State, Nigeria.

(***Author for correspondence**.: Itodo, J.I. E-mail: iyojojoy@gmail.com)
ORCID NO:0000000293932899

ABSTRACT

Meat contamination during slaughter and processing remains a major public health concern due to microbial proliferation that compromises safety and nutritional quality. This study assessed the bacterial quality of raw beef and the antibiotic resistance profiles of Salmonella spp. and Escherichia coli isolated from selected abattoirs in Southeast Nigeria. A cross-sectional survey was conducted from January to May 2025 in abattoirs located in Owerri (Imo State), Umuahia (Abia State), and Nsukka (Enugu State). A total of 324 samples; raw beef, table swabs, and floor swabs (108 per abattoir) were collected using systematic random sampling based on slaughter output. Total viable bacterial counts (TVBC) and total coliform counts (TCC) were determined using standard microbiological procedures, while isolation and confirmation of E. coli and Salmonella spp. followed established cultural and biochemical protocols. Data were analyzed using ANOVA and Chi-square tests. Mean aerobic plate and coliform counts were significantly higher ($p < 0.05$) on table and floor surfaces than on beef, indicating poor hygiene and cross-contamination risks. Antimicrobial susceptibility tests showed high resistance (80-100%) to amoxicillin/amoxiclav, streptomycin (79-100%), and tetracycline (76-100%) in both pathogens. Moderate resistance was recorded for neomycin (41-62.5%), ciprofloxacin (33-53.8%), and nitrofurantoin (41.6-58%), while lower resistance occurred with sulphamethoxazole-trimethoprim (12.3-47%), doxycycline, and gentamicin (11.730.8%). The presence of multidrug-resistant Salmonella and E. coli, alongside elevated microbial loads, highlights major sanitary lapses in the studied abattoirs. Strengthening hygiene practices, routine microbial surveillance, and prudent antibiotic use is critical to improving meat safety and protecting public health.

Keywords: Abattoir, Raw beef, Bacterial Contamination, *Salmonella spp*, *Escherichia coli*, Antibiotic Resistance.

1.0 INTRODUCTION

Foodborne diseases are illnesses that result from the ingestion of pathogenic microorganisms or their toxins present in contaminated food (Okonko *et al.*, 2010). Meat is one of the most perishable animal-derived foods due to its rich nutrient composition, which supports the growth of a wide range of spoilage and pathogenic microorganisms (Birhanu *et al*., 2017). The term "meat" generally refers to the edible flesh of mammals, while "raw meat" denotes uncooked muscle tissue used for human consumption (Ashwathi, 2017). Because of its nutrient richness and handling conditions, meat is prone to microbial contamination at various stages—from slaughter to distribution and consumption.

Contamination in abattoirs and meat retail outlets often arises from several unhygienic practices, including the use of contaminated water, dirty equipment, and unsanitary display surfaces such as tables and floors (Fasanmi *et al*., 2010). The bacteriological quality of meat is influenced by multiple factors, notably the health status of animals before slaughter, the hygiene of slaughtering and processing environments, and the sanitary practices of meat handlers (Uzoigwe *et al.*, 2021). Ensuring that only healthy animals are slaughtered is critical because it is nearly impossible to obtain pathogen-free meat from diseased or unclean animals (Oyeleke & Manga, 2008).

Meat-contact surfaces-including cutting knives, tables, aprons, weighing scales, and handlers' hands-are significant vehicles for cross-contamination (Tavakoli & Razipour, 2008). Foodborne diseases are particularly prevalent in developing countries, where poor hygiene, inadequate infrastructure, lack of food safety education, and weak regulatory systems compromise food safety (World Health Organization (WHO), 2004). Assessing the bacterial load of meat provides insight into its hygienic quality and potential risk to public health (Uzoigwe *et al.*, 2021).

A variety of bacterial genera are commonly associated with meat contamination during slaughtering, cutting, packaging, transportation, and retail display. These include Salmonella, Campylobacter, Escherichia, Staphylococcus, Clostridium, Klebsiella, Proteus, Bacillus, and Listeria species (Tenover, 2006). Among these, Salmonella spp. are particularly significant because they are frequently found on the animal's body surface and in feces, and can be transferred to carcasses during slaughter (Yan *et al*., 2003). Salmonella infections are among the leading causes of foodborne illness globally, responsible for millions of infections each year, primarily through the consumption of undercooked or mishandled meat products (Panisello *et al*., 2000).

Similarly, *Escherichia coli* (*E. coli*) a natural inhabitant of the intestines of humans and warm-blooded animals serves as an indicator organism for fecal contamination and antimicrobial resistance in foods (Miranda *et al*., 2008). Certain pathogenic strains, such as verotoxigenic *E. coli*, can cause severe gastrointestinal diseases. The growing emergence of multidrug-resistant (MDR) *E. coli* and *Salmonella* strains has become a serious global public health concern, leading to frequent therapeutic failures and more severe disease outcomes (Finch *et al.*, 2006).

In many developing countries, including Nigeria, abattoirs are often managed by local authorities that lack enough technical expertise and resources to enforce good hygiene practices (Gali *et al.*, 2020). In several cases, animals are slaughtered directly on the floor, and meat is processed under unsanitary conditions, increasing the risk of microbial contamination (Ezenduka *et al*., 2010; Bersisa *et al*., 2019). Such practices contribute to the dissemination of antibiotic-resistant pathogens and and compromise the microbiological safety of meat intended for human consumption.

Therefore, this study aims to assess the bacterial quality of raw beef, isolate and identify *Salmonella and E. coli* from selected abattoirs in Southeast Nigeria, and determine the antibiotic resistance profiles of these isolates. The findings will provide insight into the microbial safety of meat and contribute to public health strategies for improving hygiene and antibiotic stewardship in abattoir operations.

2.0 MATERIALS AND METHODS

2.1 Study Area and Design

The study was conducted in three selected municipal slaughterhouses located in South-Eastern Nigeria: Owerri, Umuahia, and Nsukka. Owerri, the capital of Imo State, is situated within the rainforest vegetation zone of Nigeria between latitudes 5°41′-6°31′N and longitudes 6°15′-7°34′E. Abia State, created from part of Imo State, has Umuahia as its capital, located at 5.4309°N, 7.5247°E. Nsukka, situated in Enugu State, lies between latitude 6°51′24″N and longitude 7°23′45″E. These slaughterhouses serve as the main sources of beef distributed and sold to the general public in their respective cities.

2.2 Sampling Method and Sample Size

A cross-sectional survey design was employed over a five-month period, from January to May 2025, to collect meat samples and analyze their microbial quality. A total of 5 geographical zones are in south east which are Imo, Abia, Enugu, Anambra and Ebonyi States. Therefore a simple random technique was used to select three slaughterhouses in the south-eastern region which are in Owerri in Imo State, Umuahia in Abia State, and Ikpa slaughterhouse in Nsukka, Enugu State. The average daily cattle slaughter capacity of the selected slaughterhouses was 88 in Owerri, 72 in Umuahia, and 59 in Nsukka. A systematic random sampling approach was used in each slaughterhouse, selecting specific animals at defined intervals each day of sampling.

In Owerri and Umuahia, as well as Nsukka, slaughtering was performed on the floor. Differences in meat handling practices were observed: in Owerri, freshly slaughtered cattle were not flayed but carried on butchers' shoulders or wheelbarrows to meat tables; in Umuahia, flayed carcasses were transported on the heads of carriers or in wheelbarrows; in Nsukka, fresh meat was immediately washed in water-filled drums before being placed on the meat tables.

Sampling occurred once weekly in each slaughterhouse for 12 weeks. During each visit, 10 g meat samples were collected from the thigh muscles of three selected cattle on the floor and three corresponding samples from the meat tables, totaling nine samples per visit. Overall, 108 meat samples were collected across the three locations (9 samples × 12 visits). Samples were transported in sterilized tubes within ice packs to the Public Health Laboratory, University of Nigeria, Nsukka, for microbial analysis.

2.3 Microbial Analysis

Enumeration of Aerobic Plate Count and Total Coliform Count

The aerobic bacterial load of beef samples was determined using the serial dilution and plating method as described by Cappuccino and Sherman (2008).

For each sample, 10 g of meat was homogenized in 90 mL sterile peptone water to achieve a 1:10 (10^-1) dilution using sterile stomacher bags. Serial dilutions up to 10^-10 were prepared according to the International Organization for Standardization (IOS, 1981).

Aerobic Plate Count (APC): 0.1 mL of each dilution (10^-5 to 10^-10) was spread onto nutrient agar plates using sterile glass spreaders. Dilutions 10^-1 to 10^-4 were excluded due to overgrowth. Plates were incubated aerobically at 30 °C for 72 hours. Colonies were counted using a colony counter, and colony-forming units per gram (cfu/g) were calculated using the formula:

C = n/vd

Where:

= colony-forming units per gram (cfu/g)

= number of colonies

= volume plated (mL)

= dilution factor

Total Coliform Count (TCC): 0.1 mL of each dilution (10^-5 to 10^-10) was plated on MacConkey agar. Plates were incubated at 30 °C for 72 hours. Pink lactose-fermenting colonies were counted as cfu/g. Plates with <50 colonies were considered too few to count (TFTC), and plates with >500 colonies were too numerous to count (TNTC) and were excluded.

2.4 Isolation and Identification of Pathogenic Bacteria

Salmonella

Salmonella isolation followed ICMSF (1996) guidelines. Meat samples were pre-enriched in 10 mL buffered peptone water for 24 h at 37 °C. Subsequently, 0.1 mL was inoculated into 1 mL Rappaport Vassiliadis (RV) broth for selective enrichment at 42 °C for 24-48 h. Enrichment cultures were streaked onto MacConkey and Brilliant Green agar and incubated at 37 °C for 24 h. Colonies were examined for characteristic morphology: colorless on MacConkey agar and red-pink with clear zones on Brilliant Green agar. Suspected isolates were Gram-stained, sub-cultured on nutrient agar slants, and stored at 4 °C for further testing.

Escherichia coli

Isolation of E. coli was performed following ICMSF (1996). Samples were streaked on MacConkey agar and incubated at 37 °C for 24 h. Pink colonies were sub-cultured on fresh MacConkey agar for purification, Gram-stained, and further sub-cultured on Eosin Methylene Blue (EMB) agar. Colonies displaying greenish metallic sheen were identified as presumptive *E. coli*.

Biochemical confirmation of *Salmonella* and *E. coli* isolates was performed using standard tests: indole, methyl red, Voges-Proskauer, Simmons citrate, urease, and triple sugar iron (Cappuccino & Sherman, 2008).

2.5 Antimicrobial Susceptibility Testing

The antibiotic resistance profiles of Salmonella and E. coli isolates were determined using the disk diffusion method (CLSI, 2010). Ten antibiotics were tested: neomycin (30 µg), doxycycline (30 µg), amoxicillin-clavulanic acid (30 µg), gentamicin (30 µg), tetracycline (30 µg), amoxicillin (10 µg), sulfamethoxazole/trimethoprim (25 µg), nitrofurantoin (300 µg), ciprofloxacin (5 µg), and streptomycin (10 µg).

Standardized bacterial suspensions (0.5 McFarland, ~2×10^8 cfu/mL) were inoculated onto Mueller-Hinton agar plates. Antibiotic disks were placed aseptically, and plates incubated at 35°C for 24h. Zones of inhibition were measured, and isolates were classified as resistant, intermediate, or susceptible according to CLSI (2010) guidelines

2.6 Data Analysis

Mean aerobic plate counts and total coliform counts were calculated and analyzed using two-way ANOVA. Associations between prevalence of *Salmonella*, *E. coli* and study locations were assessed using Chi-square tests, with significance set at $p<0.05$.

3.0 RESULTS AND DISCUSSION

3.1 Total Viable Aerobic Plate Count (TVAC)

The total viable aerobic plate counts (TVAC) of beef and environmental samples from abattoirs in Owerri, Umuahia, and Nsukka are presented in **Table 1**.

All recorded bacterial loads across sampling points (beef, floor, table) significantly exceeded the World Health Organization's acceptable limit for fresh meat (< 10^6 cfu/g; WHO, 2007).

A two-way ANOVA on $\log_{10}$-transformed data revealed a significant main effect of **Sampling Point** ($F_{2,99}$ = 4.81, p = 0.010), but no significant effect of Abattoir (p = 0.426) or interaction (p = 0.394). This indicates that contamination levels differ systematically between beef, floor, and table surfaces, regardless of the abattoir. Post-hoc analysis (Tukey HSD) confirmed that table and floor surfaces generally harbored higher bacterial loads than beef muscle samples.

Owerri Abattoir (Imo)

Beef from the floor had high bacterial loads, but the highest counts were consistently found on table surfaces. This suggests that post-slaughter handling, display, and cross-contamination from equipment and vendors significantly contribute to microbial proliferation.

Nsukka Abattoir (Enugu)

Similar to Owerri, environmental surfaces (floors and tables) showed high contamination. The practice of flaying and dressing animals directly on the floor likely contributes to initial contamination, which is then transferred to table surfaces.

Umuahia Abattoir (Abia)

Umuahia exhibited comparatively lower, though still unacceptable, bacterial loads. This may be attributed to marginally better structural conditions or handling practices, but the overall counts still indicate critical lapses in hygiene management.

Comparative Evaluation

While this statistical analysis showed no significant difference between abattoirs, descriptive trends in the data suggest a pattern of Owerri ≥ Nsukka > Umuahia. The consistently high counts across all locations underscore widespread sanitary deficiencies. The findings align with studies from Lafia Metropolis, Nigeria (Chuku *et al.*, 2016), and Ethiopia (Haileselassie *et al*., 2013; Bersisa *et al*., 2019), which attribute such contamination to floor slaughtering and poor hygienic practices.

Table 1: Total Aerobic Plate Count (TAPC) from Selected Abattoirs in Southeast Nigeria

Abattoir	Sampling Point	n	Mean $\log_{10}$ CFU/g ± SEM	Geometric Mean (CFU/g)	95% CI (CFU/g)
Owerri	Beef (Thigh Muscle)	12	8.29 ± 0.49	2.0×10^8	$2.1 \times 10^7 – 1.8 \times 10^9$
	Floor Swab	12	8.46 ± 0.34	2.9×10^8	$6.4 \times 10^7 – 1.3 \times 10^9$
	Table Swab	12	8.91 ± 0.35	8.2×10^8	$1.7 \times 10^8 – 4.0 \times 10^9$
Umuahia	Beef (Thigh Muscle)	12	7.85 ± 0.49	7.1×10^7	$7.8 \times 10^6 – 6.5 \times 10^8$
	Floor Swab	12	8.75 ± 0.27	5.6×10^8	$1.7 \times 10^8 – 1.9 \times 10^9$
	Table Swab	12	8.38 ± 0.31	2.4×10^8	$5.9 \times 10^7 – 9.6 \times 10^8$
Nsukka	Beef (Thigh Muscle)	12	7.15 ± 0.51	1.4×10^7	$1.4 \times 10^6 – 1.4 \times 10^8$
	Floor Swab	12	8.82 ± 0.38	6.7×10^8	$1.2 \times 10^8 – 3.6 \times 10^9$
	Table Swab	12	8.43 ± 0.34	2.7×10^8	$5.9 \times 10^7 – 1.2 \times 10^9$

Data were $\log_{10}$ -transformed prior to analysis. Two-way ANOVA revealed a significant main effect of sampling point ($p = 0.010$) but no significant effect of abattoir or interaction.

3.2 Total Coliform Count (TCC)

The total coliform count (TCC) for samples from the three abattoirs is summarized in **Table 2**. The two-way ANOVA showed no significant effects of Abattoir ($p = 0.961$), Sampling Point ($p = 0.300$), or their interaction ($p = 0.998$). This indicates that fecal contamination, as indicated by coliforms, is uniformly high and statistically similar across all abattoirs and sampling points.

Despite the lack of statistical significance, all values drastically exceeded the WHO (2007) permissible limit (10^6 cfu/g). The elevated coliform levels are likely due to unhygienic practices such as slaughtering on bare floors, using contaminated water for washing, and transporting meat with unclean equipment like wheelbarrows. These findings are consistent with other studies in southeastern Nigeria (Ezenduka et al., 2010; Adetunji & Odetokun, 2011) and highlight a systemic failure in maintaining basic sanitary standards.

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Table 2: Total Coliform Count (TCC) from Selected Abattoirs in Southeast Nigeria

Abattoir	Sampling Point	N	Mean $\log_{10}$ CFU/g ± SEM	Geometric Mean (CFU/g)	95% CI (CFU/g)
Owerri	Beef (Thigh Muscle)	12	7.68 ± 0.51	4.7×10^7	$4.6 \times 10^6 - 4.8 \times 10^8$
	Floor Swab	12	7.41 ± 0.41	2.6×10^7	$4.1 \times 10^6 - 1.6 \times 10^8$
	Table Swab	12	7.26 ± 0.37	1.8×10^7	$3.5 \times 10^6 - 9.6 \times 10^7$
Umuahia	Beef (Thigh Muscle)	12	7.82 ± 0.40	6.6×10^7	$1.1 \times 10^7 - 3.9 \times 10^8$
	Floor Swab	12	7.38 ± 0.36	2.4×10^7	$4.7 \times 10^6 - 1.2 \times 10^8$
	Table Swab	12	7.18 ± 0.34	1.5×10^7	$3.2 \times 10^6 - 7.2 \times 10^7$
Nsukka	Beef (Thigh Muscle)	12	7.82 ± 0.44	6.7×10^7	$9.3 \times 10^6 - 4.8 \times 10^8$
	Floor Swab	12	7.41 ± 0.36	2.6×10^7	$5.1 \times 10^6 - 1.3 \times 10^8$
	Table Swab	12	7.37 ± 0.46	2.3×10^7	$3.0 \times 10^6 - 1.9 \times 10^8$

3.3 Prevalence of E. coli in Beef from Selected Abattoirs

The detection of E. coli, an indicator of fecal contamination, revealed significant hygiene lapses. The prevalence data is presented in **Table 3**. Nsukka abattoir showed the highest E. coli prevalence in both floor (45%) and table samples (63%), followed by Owerri. The lower prevalence in Umuahia suggests possible variations in handling practices. The higher contamination rates in table samples compared to floor samples in Nsukka and Owerri indicate substantial post-slaughter contamination, likely from the use of non-potable water for washing and unhygienic display practices, as reported by Ezenduka et al. (2010).

Table 3: Prevalence of Escherichia coli in Beef Samples

Abattoir	Sampling Point	Number of Samples	Number Positive	Prevalence (%)
Owerri	Beef (Floor)	36	11	30.6%
	Beef (Table)	36	18	50.0%
Umuahia	Beef (Floor)	36	7	19.4%
	Beef (Table)	36	10	27.8%
Nsukka	Beef (Floor)	36	16	44.4%
	Beef (Table)	36	23	63.9%

Data were $\log_{10}$ -transformed prior to analysis. Two-way ANOVA

3.4 Prevalence of *Salmonella* in Selected Abattoirs

As shown in **Table 4**, Salmonella was isolated at a much lower rate than E. coli. Nsukka abattoir had a markedly higher prevalence (33.3% from the floor, 41.7% from the table) compared to Owerri and Umuahia. This stark difference strongly suggests varying levels of hygiene and environmental management. The high prevalence in Nsukka is likely linked to contamination during washing with non-potable water and direct contact with heavily contaminated surfaces. The rates in Nsukka are consistent with other reports from southeastern Nigeria, such as Abakaliki (29.3%, Iroha *et al*., 2010) and Awka (33.5%), indicating a regional challenge.

Table 4: Prevalence of Salmonella in Beef Samples

Abattoir	Sampling Point	Number of Samples	Number Positive	Prevalence (%)
Owerri	Beef (Floor)	36	2	5.6%
	Beef (Table)	36	3	8.3%
Umuahia	Beef (Floor)	36	4	11.1%
	Beef (Table)	36	5	13.9%
Nsukka	Beef (Floor)	36	12	33.3%
	Beef (Table)	36	15	41.7%

Data were $\log_{10}$-transformed prior to analysis. Two-way ANOVA

3.5 Antibiotic Resistance Profile of *E. coli* and *Salmonella* from Owerri, Nsukka, and Umuahia Abattoirs

Across the three abattoirs Owerri, Nsukka, and Umuahia *Escherichia coli* and *Salmonella* isolates exhibited high levels of multidrug resistance (MDR), though the degree and antibiotic-specific resistance patterns varied slightly by location. In Nsukka, *E. coli* isolates were completely resistant (100%) to amoxicillin, streptomycin, and amoxicillin–clavulanic acid, with moderate resistance to neomycin, tetracycline, and nitrofurantoin (40–60%), and lower resistance to ciprofloxacin, sulphamethoxazole/trimethoprim, and gentamicin (Iroha *et al*., 2010; Unamba-Opara *et al*., 2012) **(Table 5, Fig.1)**. Similarly, Salmonella isolates from Nsukka showed complete resistance to amoxicillin and streptomycin, but lower resistance to tetracycline, neomycin, and nitrofurantoin (≈40%), while remaining largely susceptible to doxycycline and gentamicin. In Owerri, the resistance trend was also pronounced: *E. coli* showed 100% resistance to amoxicillin, over 80% to amoxicillin–clavulanic acid, and above 70% to tetracycline and streptomycin. Gentamicin remained the most effective agent with only 13% resistance. Salmonella isolates followed a similar pattern universal resistance to amoxicillin–clavulanic acid and high resistance to streptomycin (≈88%) and tetracycline (≈76%) but remained fully susceptible to gentamicin and doxycycline. Recent findings from Umuahia abattoir also report comparable resistance profiles. *E. coli* isolates showed complete resistance to β-lactam antibiotics (amoxicillin, ampicillin), tetracycline, and streptomycin, with moderate resistance to fluoroquinolones (ciprofloxacin) and sulfonamides, but low resistance to gentamicin and doxycycline (Okorie *et al.*, 2023; Nwosu *et al.*, 2022) **(Table 5, Fig.1)**. Salmonella isolates from Umuahia demonstrated marked resistance to amoxicillin-clauvalanic acid, tetracycline, and sulphamethoxazole/trimethoprim, consistent with previous reports from Nsukka and Owerri, but remained largely susceptible to gentamicin and ciprofloxacin **(Table 6, Fig.2)**. Overall, the persistence of resistance to common veterinary antibiotics such as amoxicillin, streptomycin, and tetracycline across all three abattoirs suggests a widespread and unregulated use of these drugs in livestock production. The generally low resistance to gentamicin and doxycycline may indicate limited exposure or more restricted use in animal treatment. These findings align with broader regional studies showing that antibiotic misuse in animal husbandry has significantly contributed to the spread of MDR bacteria capable of transmission through the food chain (Marshall & Levy, 2011; Fashae *et al*., 2018) **(Table 6, Fig.2)**.

Table 5: Antibiotic Resistance Profile of *E. coli*

E. coli/ Drugs	Owerri	Nsukka	Umuahia
Amoxicillin	100%	100%	100%
Amoxicilln Clauvalanic acid	87.5%	100%	100%
Tetracycline	79.1%	44.4%	100%
Streptomycin	79.1%	100%	100%
Doxycline	62.5%	16.6%	30.8%
Neomycine	62.5%	61.1%	61.5%
Streptomycine	50%	33.3%	53.8%
Ciprofloxacine	37.5%	33.3%	53.8%
Nitrofuratoin	25%	44.4%	46.2%
Gentamycin	12.5%	16.6%	30.8%

Data were $\log_{10}$ -transformed prior to analysis. Two-way ANOVA

Figure 1: Antibiotic Resistance Profile of *E. coli*

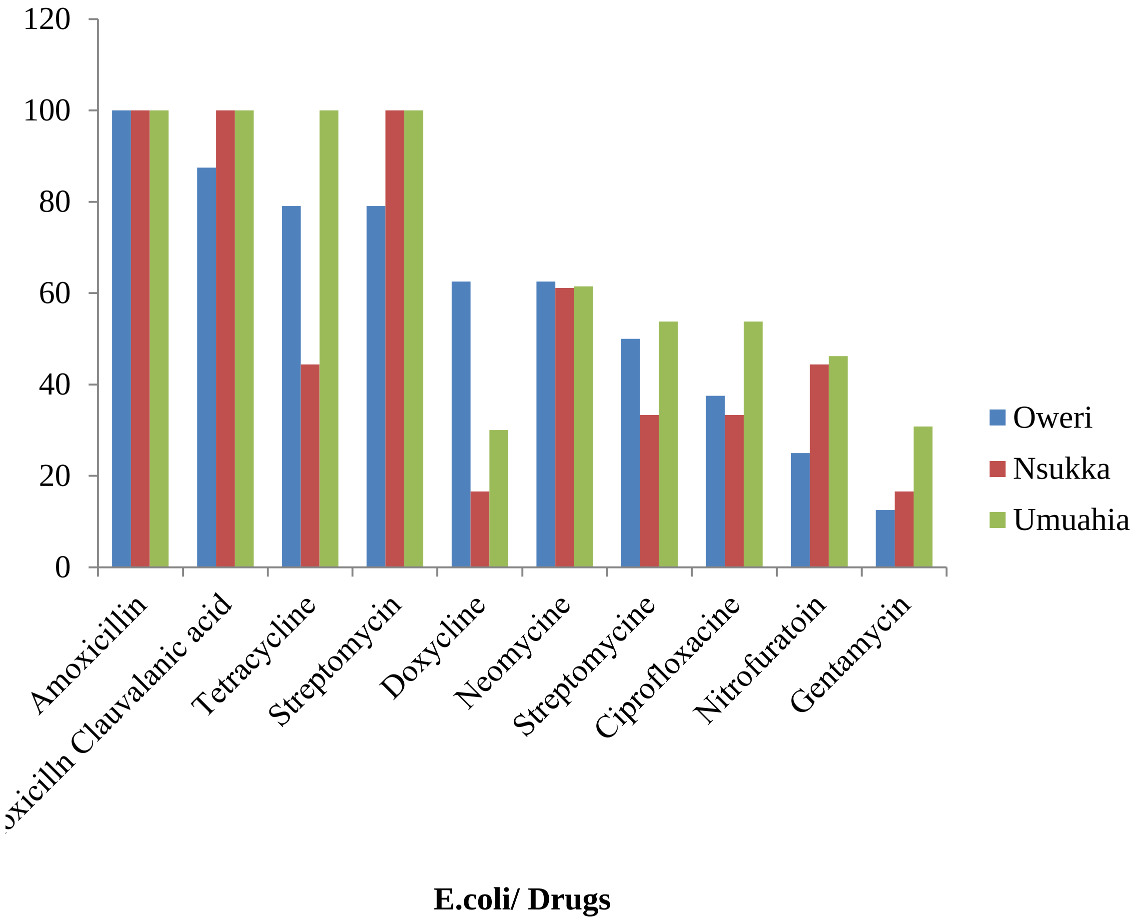

Table 6: Antibiotic Resistance Profile of *Salmonella spp*

Drugs	Owerri	Nsukka	Umuahia
Amoxicillin	76.4%	100%	80%
Amoxicilln Clauvalanic acid	100%	8.3%	100%
Tetracycline	76.4%	41.6%	100%
Streptomycin	88.2%	70.5%	60%
Doxycline	15.3%	8.3%	20%
Neomycine	23.5%	41.6%	100%
Streptomycine	23.5%	16.6%	100%
Ciprofloxacine	47.0%	16.6%	40%
Nitrofuratoin	58.8%	41.6%	80%
Gentamycin	11.7%	16.6%	40%

Data were $\log_{10}$ -transformed prior to analysis. Two-way ANOVA

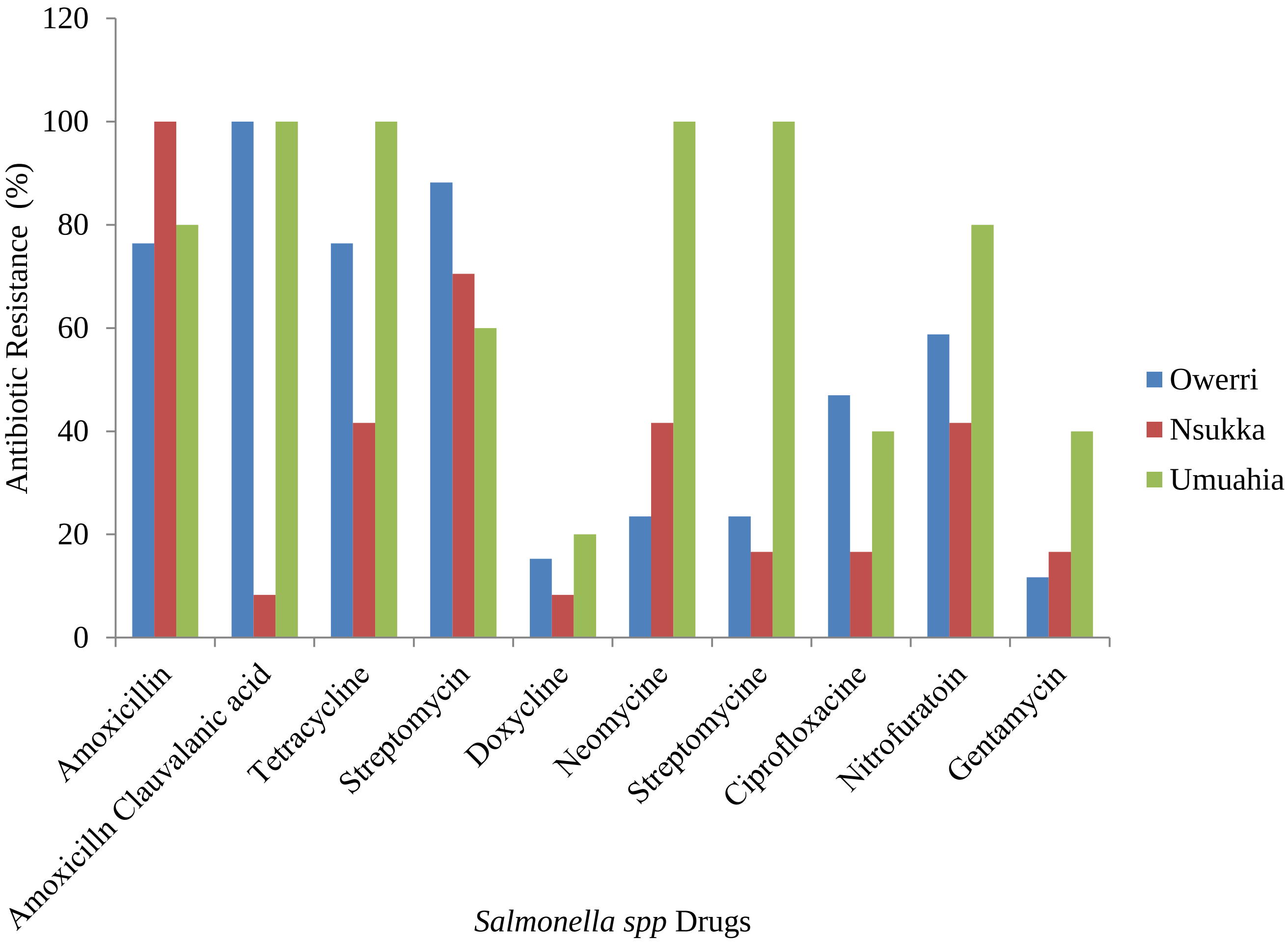

Figure 2: Antibiotic Resistance profile of *Salmonella spp*

4.0 CONCLUSION AND RECOMMENDATION

4.1 Conclusion

This study provides significant insight into the microbiological quality and public-health implications of raw beef slaughterd in selected abattoirs across South-East Nigeria. The microbial evaluation revealed that raw beef samples generally harbored high levels of total aerobic bacteria, coliforms, and pathogenic species, indicating inadequate hygienic practices during slaughtering, processing, and handling. The frequent detection of *Salmonella spp*. and *Escherichia coli*, including strains with confirmed pathogenic potential, underscores the persistent risk of foodborne infections associated with consumption of poorly handled or undercooked beef in the region.

The antibiotic resistance profiling further revealed alarming patterns of multidrug resistance among isolates. Both *Salmonella* and *E. coli* exhibited high resistance to commonly used antibiotics such as amoxicillin, streptomycin, amoxi-clauv, and tetracycline, while ciprofloxacine and neomyxin showed a moderate resistance then gentamycin and doxycycline showed a better susceptibility. The widespread resistance patterns observed likely reflect the uncontrolled use and misuse of antibiotics in livestock production, weak regulatory systems, and limited surveillance of antimicrobial usage.

Overall, the findings demonstrate serious gaps in abattoir hygiene, beef handling practices, and antimicrobial stewardship. Without immediate intervention, these conditions will continue to promote the dissemination of resistant pathogens through the food chain, posing significant threats to consumer health.

4.2 Recommendations

The study recommends:

1.Strict enforcement of sanitary standards in abattoirs,

2. Public-health education of butchers and meat handlers,

3. Strengthened regulations on veterinary antibiotic use.

Implementing these measures will enhance meat safety, limit the spread of antimicrobial resistance, and improve public health outcomes in South-East Nigeria.

Declaration of Conflict of Interest

The authors declare no conflict of interest.

Data Availability

Data are available upon request from the corresponding author.

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