PREVALENCE AND MULTIDRUG RESISTANCE OF *SALMONELLA* ISOLATES FROM CATTLE FAECES AND BEEF IN OGBOMOSO, NIGERIA

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ABSTRACT

Antimicrobial-resistant bacteria pose a significant threat to sustainable livestock production and present a serious risk to public health. This study investigated the prevalence and antimicrobial resistance profiles of *Salmonella* in slaughter cattle faeces and retail beef in Ogbomoso, Nigeria. A total of 150 faecal and 50 beef samples were collected from the central slaughter facility and beef market. Forty-four isolates were recovered from the 200 samples, with prevalence rates of 18.7% and 32% in faecal and beef samples, respectively. Susceptibility of the isolates to six antibiotics was determined using the Kirby-Bauer disk diffusion method. All isolates were resistant to at least two antibiotics, with multidrug resistance detected in 87.5% of beef isolates and 75% of faecal isolates. Resistance to oxytetracycline, ciprofloxacin, and erythromycin was particularly high across both sources. Nineteen distinct resistance patterns were observed, and the multiple antibiotic resistance index ranged from 0.3-1.0. These findings suggest that apparently healthy cattle and beef may disseminate multidrug-resistant *salmonella*, urgently calling for rational antimicrobial use and controlled access in production systems and strengthened food safety measures in slaughter facilities.

Keywords: Antimicrobial resistance, Beef, Cattle, *Salmonella*, Nigeria

Description of Problem

Fever, anorexia, decreased milk yield, diarrhoea, and abortion during early pregnancy are common clinical manifestations of bovine *salmonellosis* that impair herd productivity and cause significant economic losses (1). In humans, infection is primarily acquired through the consumption of contaminated animal-derived products such as meat, milk, eggs, and remains a significant public health challenge globally (2). Antimicrobial resistance is driven by factors such as their indiscriminate use, including overreliance on them for growth promotion, prophylaxis, and therapy in livestock, as well as their widespread application in human medicine (3). Although the transmission dynamics of antimicrobial-resistant bacteria to humans are complex (4), some studies argue that these bacteria may be transmitted directly via contact with animals or their environment, or indirectly through contaminated food products (1). Numerous studies worldwide have reported its prevalence in bacteria, especially those recovered from food-producing animals (5, 6, 7). Despite these concerns, there are currently no published studies on antimicrobial-resistant *salmonella* in cattle within this region, leaving a critical knowledge gap. This study investigated the prevalence and antimicrobial resistance profiles of *salmonella* in slaughter cattle faeces and retail beef from Ogbomoso, Nigeria. The findings will provide baseline epidemiological data on antimicrobial-resistant *salmonella*.

Materials and Methods

Study Area

The study was conducted at the central slaughter slab and its adjoining beef market in Ogbomoso, Oyo State, Nigeria, between April and July 2025. This facility serves as the primary site for cattle slaughtered within Ogbomoso town, with meat distributed to retailers and consumers within and around the town.

Study Design, Sample Size, and Sampling

This cross-sectional study employed a simple random sampling technique to select cattle at

the slaughter slab and beef from vendors at the adjoining central market in Ogbomoso. A total of 200 samples were collected, with the sample size determined using the Thrusfield formula (8). One hundred and fifty rectal faecal samples were collected using sterile swab sticks, and fifty beef samples were obtained from selected vendors. All samples were immediately placed on ice and transported to the Veterinary Microbiology Laboratory for processing.

Isolation and Identification of *Salmonella*
Samples were enriched in buffered peptone water for 24 hrs, inoculated onto Xylose Lysine Deoxycholate agar, and incubated at 37 °C for 24 hrs (9). After culturing and subculturing, presumptive *salmonella* isolates were subjected to biochemical characterization for further identification.

Antimicrobial Susceptibility Test
Antimicrobial susceptibility testing of the isolates was performed using the Kirby-Bauer disk diffusion method following the guidelines of the Clinical and Laboratory Standards Institute (CLSI) (10). The antimicrobials tested included Oxytetracycline (OXT-30µg), Ciprofloxacin (CIP-5µg), Colistin (CT-10µg), Erythromycin (ERY-15µg), Amoxicillin-Clavulanic acid (AUG-30µg), Sulfamethoxazole-Trimethoprim (SXT-25µg) (Oxoid, UK). Interpretation of results was carried out according to CLSI (2019) breakpoints.

Statistical Analysis
Descriptive statistics were used to summarize the data and analysed using the Statistical Package for Social Sciences (Version 20). Results were presented in tables and figures. The Multiple Antibiotic Resistance Index (MARI) was calculated as the ratio of antibiotics to which an isolate showed resistance to the total number of antibiotics tested. MARI values greater than 0.2 indicate isolates originated from environments where antibiotics are frequently used (11).

Results
From the 200 samples examined, 44 (22%) *salmonella* isolates were recovered, including 28 (18.7%) from slaughter cattle and 16 (32%) from beef (Table 1). *Salmonella* isolates from both faecal and beef samples showed resistance to at least two antibiotics. Among the faecal isolates, resistance was highest to erythromycin (89.29%) and lowest to colistin (14.29%). Beef isolates showed the highest resistance to oxytetracycline (100%) and the lowest to colistin (37.5%) (Figure 1). Multidrug resistance, defined as resistance to three or more antibiotics, was detected in 75% of faecal isolates and 87.5% of beef isolates (Figure 1). Fourteen distinct resistance patterns were identified among isolates from slaughter cattle, and 9 among those from beef. The most frequent pattern in beef isolates was ErySxtCtOxtAmcCip, which represented complete resistance to all 6 classes of antimicrobials tested. The Multiple Antibiotic Resistance Index (MARI) of *salmonella* isolates ranged from 0.3 to 1.0 across different resistance patterns. (Table 2).

Table 1: Prevalence of *Salmonella* Isolates from Cattle Faeces and Beef in Ogbomoso, Nigeria

Source	Number of Samples	Number of Isolates	Prevalence (%)
Cattle Faeces	150	28	18.7
Beef	50	16	32
Total	200	44	22

Discussion
The detection of *Salmonella* spp. in cattle faeces (18.7%) and beef (32%) highlights the role of apparently healthy animals as carriers and the potential for cross-contamination during slaughter and meat processing. Although the higher prevalence in beef may partly reflect a smaller sample size, it also points to possible hygienic lapses common in slaughter facilities across developing countries like Nigeria (8). These prevalence rates are higher than reports from Jos (2.95%) and Kano (1.5%), but lower than 61.6% in Ibadan (6, 8, 12). Comparable prevalence has been noted in Ethiopia (31.5%), while lower values (0.85–12.3%) are reported elsewhere (7, 13). Variations likely reflect differences in study design, sample collection methods, and laboratory procedures, among others.

All isolates showed resistance to two or more antibiotics, with beef isolates completely resistant to oxytetracycline (100%). Similar

high resistance profiles to various antibiotics have been reported in other studies (5, 6, 8). Notably, the high resistance to ciprofloxacin here disagrees with reports of greater efficacy (14, 15) but aligns with findings from Ibadan, Nigeria (8) and Central Ethiopia (5). These results highlight the consequences of widespread and uncontrolled antibiotic use in livestock production systems, especially in developing countries (15).

The observed resistance to ciprofloxacin, colistin, erythromycin, and amoxicillin-clavulanic acid is particularly alarming, as the WHO categorizes these drugs as critically important antimicrobials (CIAs) for human medicine (16).

Multidrug resistance (MDR), defined as resistance to ≥3 antibiotics, was markedly high in beef (87.5%) and faecal (75%) isolates, consistent with earlier reports (5, 15, 17). The high multiple antibiotic resistance index (MARI) values observed (0.3-1.0), with 1.0 being the most frequent, further indicate the exposure to intense antimicrobial pressure (11), highlighting the risk of MDR *Salmonella* entering the food chain and threatening public health.

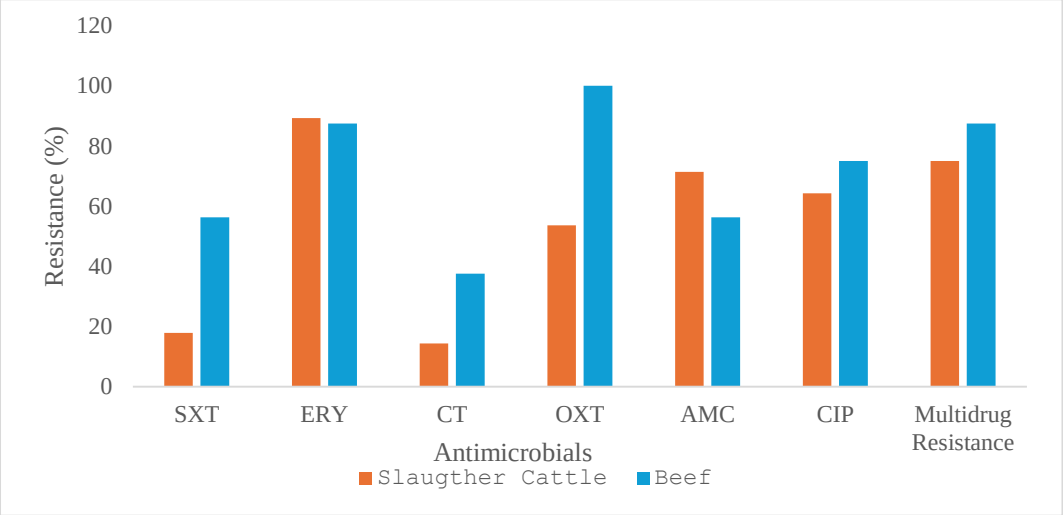

Figure 1: Antimicrobial Resistance Profiles of *Salmonella* Isolates from Cattle Faeces and Beef in Ogbomoso, Nigeria

Conclusion and Application

This study revealed alarming multidrug resistance in *Salmonella* spp. from cattle faeces and beef, including resistance to WHO-classified critically important antibiotics. It is therefore recommended that antimicrobial resistance (AMR) surveillance be strengthened within a One Health framework and expanded to include local and remote areas. Policies regulating antimicrobial use should be strictly enforced, with antibiotics made available only on prescription. Compliance with drug withdrawal periods must be ensured before food animal products are sold and consumed. Promoting antimicrobial stewardship across relevant sectors, together with targeted awareness campaigns for farmers and the public, will further encourage prudent use of antimicrobials. Routine antimicrobial susceptibility testing should guide treatments, while sustainable farm practices such as improved biosecurity, vaccination, and good husbandry should be prioritized to limit the spread of disease-causing organisms. Exploring alternative disease management strategies will also help reduce dependence on antibiotics. Strict hygiene protocols must be implemented in abattoirs and other slaughter facilities to safeguard food safety across the beef value chain.

Table 2: Antimicrobial Resistance Patterns of *Salmonella* Isolates from Cattle Faeces and Beef in Ogbomoso, Nigeria

Resistance Pattern	Number of Isolates Per Source	
	Slaughter Cattle (MARI)	Beef (MARI)
ErySxtCtOxtAmcCip	-	5 (1)
ErySxtOxtAmcCip	1 (0.8)	-
ErySxtOxtCtCip	-	1 (0.8)
EryOxtAmcCip	3 (0.7)	3 (0.7)
ErySxtAmcCip	1 (0.7)	-
ErySxtOxtAmc	1 (0.7)	-
EryOxtCtCip	3 (0.7)	-
EryOxtAmc	3 (0.5)	1 (0.5)
EryAmcCip	4 (0.5)	-
SxtAmcCip	1 (0.5)	-
ErySxtAmc	1 (0.5)	-
EryOxtCip	3 (0.5)	2 (0.5)
ErySxtOxt	-	1 (0.5)
SxtOxtCip	-	1 (0.5)
AmcCip	2 (0.3)	-
EryAmc	3 (0.3)	-
SxtOxt	-	1 (0.3)
EryOxt	1 (0.3)	1 (0.3)
EryCt	1 (0.3)	-

Ery: Erythromycin, Sxt: Sulfamethoxazole-Trimethoprim, Ct: Colistin, Oxt: Oxytetracycline, Amc: Amoxicillin-Clavulanic acid, Cip: Ciprofloxacin, (MARI): Multiple Antibiotic Resistance Index

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