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INCIDENCE AND ANTIBIOGRAM OF *SALMOENLLA SPECIES* IN POULTRY FEEDS AND DROPPINGS FROM SELECTED FARMS IN BAUCHI METROPOLIS

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ABSTRACT

Background of the Study: Poultry diseases, particularly those caused by Salmonella species, pose significant challenges to poultry production due to associated economic losses and public health implications. The consumption of improperly cooked poultry products has contributed to the global burden of salmonellosis, including typhoid-like illnesses.Study Design: A cross-sectional study was conducted to determine the incidence of Salmonella species in poultry feeds and droppings, as well as their antimicrobial susceptibility patterns in selected farms within Bauchi metropolis.Method: A total of 200 samples comprising poultry feeds and droppings were collected from selected farms. Samples were processed, cultured, and identified using standard microbiological techniques including Gram staining and biochemical tests. Antimicrobial susceptibility testing was performed using the Kirby–Bauer disk diffusion method on Mueller–Hinton agar in accordance with Clinical and Laboratory Standards Institute (CLSI) guidelines.Results: The overall prevalence of Salmonella species was 52.5%, with a higher occurrence in droppings (59.5%) compared to feeds (46%). No statistically significant difference was observed among the farms. The highest resistance was recorded against Streptomycin (61.9%), Ampicillin (55.2%), and Tetracycline (46.7%), while the highest sensitivity was observed for Ciprofloxacin (77.1%), Gentamicin (64.7%), and Cefoxitin (55.2%). The most common multidrug resistance pattern included Ciprofloxacin, Nalidixic acid, Cefoxitin, and Gentamicin.Conclusion: The study confirmed the presence of Salmonella species in poultry environments, with evidence of multidrug resistance posing a public health risk. Strengthening biosecurity and monitoring antimicrobial use is essential to mitigate contamination and resistance spread.Keywords: Salmonella, Antibiogram, Incidence, Poultry, Antimicrobial Resistance.

1.0 INTRODUCTION

1.1 Study Background: Salmonella species are Gram-negative, rod-shaped, facultative anaerobic intracellular bacteria of significant public health importance (Eng *et al*., 2015; World Health Organization, 2020). They are responsible for salmonellosis, a common foodborne infection affecting both humans and animals. Non-typhoidal Salmonella infections typically present with diarrhea, abdominal cramps, nausea, and fever within 6–72 hours after ingestion of contaminated food (Majowicz *et al*., 2010). Globally, foodborne diseases affect nearly one in ten people annually, with Salmonella recognized as one of the leading causative agents of diarrheal illnesses (Havelaar e*t al*., 2015).

The poultry industry has expanded significantly in developing countries, driven by increasing demand for animal protein and commercial poultry products (Food and Agriculture Organization, 2016). Poultry represents a major source of affordable protein, particularly in rural communities where backyard poultry farming accounts for a large proportion of production. However, this expansion has also increased the risk of disease transmission due to inadequate biosecurity, poor feed quality, and improper handling practices (Doyle & Erickson, 2006).

In Nigeria, poultry production contributes substantially to food security, yet it remains vulnerable to microbial contamination, including Salmonella species. Poultry products, if improperly handled or undercooked, can serve as vehicles for transmitting Salmonella infections to humans. Additionally, poultry droppings are widely used as organic fertilizer in agriculture, which may facilitate environmental contamination and further spread of pathogens (Bamidele *et al*., 2022).

Another growing concern is the emergence of antimicrobial-resistant Salmonella strains. The misuse and overuse of antibiotics in poultry farming often for growth promotion and disease prevention have contributed significantly to the development of resistant organisms (Van Boeckel *et al*., 2015). Indiscriminate antibiotic use, prolonged exposure, and incomplete treatment regimens have further accelerated resistance patterns (Aarestrup, 2015). These resistant strains pose a serious challenge to both veterinary and human medicine, limiting treatment options and increasing the risk of treatment failure.

Despite the recognized importance of Salmonella, diagnosis relies heavily on laboratory confirmation, as clinical symptoms alone are insufficient for accurate identification. Isolation, biochemical characterization, and antimicrobial susceptibility testing are essential tools for understanding the epidemiology, virulence, and resistance profiles of Salmonella species (Cheesbrough, 2010). Therefore, continuous surveillance of Salmonella in poultry environments is critical for informing control strategies and public health interventions.

1.2 Research Gap:Despite the increasing prevalence of poultry farming in Bauchi metropolis, there is limited empirical data on the incidence of Salmonella species in poultry feeds and droppings within this region. Most existing studies in Nigeria have focused on poultry meat and eggs, with minimal attention given to environmental sources such as feeds and droppings, which play a crucial role in pathogen transmission and farm contamination. Furthermore, there is insufficient information on the antimicrobial resistance patterns of Salmonella isolates from these sources in Bauchi metropolis. This study therefore addresses this gap by providing localized data on the occurrence and antibiogram of Salmonella species

in poultry feeds and droppings, which is essential for guiding control measures and policy formulation.

1.3 Literature Review: Several studies have reported varying prevalence rates of Salmonella species in poultry farms across different regions, reflecting differences in management practices, environmental conditions, and biosecurity measures. In Nigeria, reported prevalence ranges from 21.4% to over 60%, depending on sample type and study location (Fagbamila *et al*., 2017; Iroha *et al.,* 2016). Globally, poultry has been identified as a major reservoir for Salmonella transmission, with contamination occurring at multiple stages of production, processing, and distribution, thereby posing a continuous risk to public health (Antunes *et al*., 2016). The persistence of Salmonella in poultry environments is often linked to poor hygiene practices, contaminated feed sources, and inadequate waste management systems, which facilitate the spread of the pathogen within and between farms (Doyle & Erickson, 2006). Furthermore, the emergence of antimicrobial resistance among Salmonella isolates has become a major global concern, with high resistance rates reported against commonly used antibiotics such as tetracycline, ampicillin, and streptomycin (Jibril *et al*., 2021). This trend is largely attributed to the widespread and indiscriminate use of antibiotics in poultry production for therapeutic and growth-promoting purposes (Van Boeckel *et al*., 2015). In addition, poultry droppings have been identified as important reservoirs of resistant bacteria, contributing to environmental contamination and increasing the risk of zoonotic transmission to humans (Bamidele *et al*., 2022). These findings underscore the need for continuous monitoring of Salmonella prevalence and antibiotic susceptibility patterns, particularly in developing countries where regulatory control of antimicrobial use is often limited.

2.0 MATERIALSAND METHODS

2.1 Study Area: The study was conducted in Bauchi metropolis, Bauchi State, located in the North-Eastern geopolitical zone of Nigeria. The state covers approximately 49,119 km², representing about 5.3% of Nigeria's total land area, and lies between latitudes 9.3° and 12.30° North and longitudes 8.5° and 11° East (National Bureau of Statistics, 2019). The region experiences a tropical climate with distinct wet and dry seasons, which influences agricultural and poultry production activities.

2.2 Study Design: A cross-sectional study design was employed. The study involved six registered poultry farms within Bauchi metropolis operating under intensive management systems.

2.3 Sample Collection: A total of 200 samples were collected, comprising feeds and droppings. From each farm, 50 samples were obtained (25 feed samples and 25 droppings samples). Approximately 5 grams of each sample were collected aseptically using sterile spatulas into labeled sterile containers, transported in polythene bags, and delivered to the laboratory for analysis.

2.4 Sample Processing and Culture: Each sample (1 g) was homogenized in 9 ml of distilled water and subjected to serial dilution to reduce microbial load. The pour plate method was used to inoculate samples onto *Salmonella-Shigella* agar (SSA) and *MacConkey* agar plates. Plates were incubated at 37°C for 24 hours. Colonies were examined based on morphological characteristics such as shape, size, pigmentation, and lactose fermentation.Suspected *Salmonella* colonies were sub-cultured onto nutrient agar and further confirmed using biochemical tests. Typical characteristics included smooth, round, colorless colonies on *MacConkey* agar and black-centered colonies on XLD agar due to hydrogen sulfide production.

2.4.1 Gram Staining:Gram staining was performed to confirm the Gram-negative nature of the isolates using standard staining procedures (Cheesbrough, 2010). Smears were heat-fixed, stained sequentially with crystal violet, iodine, alcohol-acetone, and safranin, and examined under oil immersion microscopy.

2.4.2 Biochemical Tests:Biochemical confirmation included catalase, indole, motility, oxidase, methyl red, lactose fermentation, and triple sugar iron (TSI) tests to differentiate Salmonella species from other enteric bacteria (Cheesbrough, 2010).

2.5 Antimicrobial Sensitivity Test:Antimicrobial susceptibility testing was conducted using the Kirby–Bauer disk diffusion method on Mueller–Hinton agar following CLSI (2020) guidelines. A standardized inoculum (0.5 McFarland standard) was prepared and swabbed onto agar plates. Antibiotic discs were applied and incubated at 37°C for 24 hours. Zones of inhibition were measured and interpreted according to CLSI standards.Antibiotics tested included Ampicillin, Chloramphenicol, Tetracycline, Streptomycin, Gentamicin, Nalidixic acid, Ciprofloxacin, Cefoxitin, Kanamycin, and Trimethoprim.

2.6 Data Analysis: Data were analyzed using Statistical Package for the Social Sciences (SPSS). Descriptive statistics such as percentages and tables were used. Chi-square test was used to assess differences in prevalence across farms, with significance set at $p < 0.05$.

3.0 RESULTS

3.1 Distribution and Occurrence of Salmonella spp. in Feeds and Droppings Across the Farms:The distribution of Salmonella spp. across the sampled farms is presented in Table 1. Out of the 200 samples analyzed, 105 (52.5%) were positive for Salmonella, indicating a relatively high prevalence. The occurrence was higher in droppings (59 isolates) compared to feeds (46 isolates), suggesting that droppings serve as a more significant reservoir of contamination. Among the farms, Zango Farm recorded the highest prevalence (70%), followed by Dabo Farms (52%), ATBU Farm (48%), and BSADP Farm (40%). Statistical analysis showed no significant difference in the occurrence of Salmonella across the farms ($p = 0.2$), indicating a relatively uniform distribution of contamination within the study area.

3.2 Activity of Antimicrobials Against Isolated Salmonella spp:The antimicrobial susceptibility profile of the isolated Salmonella spp. is summarized in Table 2. The results revealed varying degrees of resistance, intermediate response, and sensitivity to the tested antibiotics. High resistance was observed against Streptomycin (61.9%), Ampicillin (55.2%), and Tetracycline (46.6%), indicating reduced effectiveness of these commonly used antibiotics. Moderate resistance was also recorded for Trimethoprim (38.1%) and Kanamycin (29.5%).Conversely, the isolates exhibited high sensitivity to Ciprofloxacin (77.1%), Gentamicin (64.7%), and Cefoxitin (55.2%), suggesting these antibiotics remain effective for the treatment of Salmonella infections. Intermediate responses were notably high for Chloramphenicol (40%) and Kanamycin (42.8%), indicating potential variability in therapeutic outcomes. Overall, the results highlight a concerning level of antimicrobial resistance among the isolates.

3.3 Antibiotic Resistance Patterns of Salmonella:The multidrug resistance (MDR) patterns of the Salmonella isolates are presented in Table 3. Several resistance combinations involving two or more antibiotic classes were observed. The most frequent resistance pattern was Ciprofloxacin, Nalidixic acid, Cefoxitin, Gentamicin (13 occurrences), followed by Gentamicin, Cefoxitin, Trimethoprim, Ampicillin, Chloramphenicol, Tetracycline (11 occurrences), indicating resistance across multiple antibiotic classes.Other notable patterns included Ampicillin, Chloramphenicol (16 occurrences) and Kanamycin, Gentamicin, Trimethoprim (12 occurrences). The presence of resistance across up to six antibiotic classes demonstrates a high level of multidrug resistance among the isolates, which poses a serious concern for both veterinary and public health.

Table 1: Distribution and Occurrence of *Salmonella specie*in Feeds and Droppings across the Farms.

Number and Percentage positive of isolated Salmonella species				
Sources	**Droppings (%) (n=25)**	**Feeds (%) (n=25)**	**Total**	**P value**
Zango Farm	19	16	35 (70%)	0.2
ATBU farm	13	11	24(48%)	
BSADP farm	12	8	20 (40%)	
Dabo farms	15	11	26 (52%)	
Total (n=200)	59	46	105(52.5%)	

Table 2: Activity of Antimicrobials against Isolated Salmonella specie from Poultry Droppings and Feeds.

Antimicrobial	**Resistant(%)**	**Intermediate(%)**	**Sensitivity(%)**
Ampicillin	58(55.2)	19(18.1)	28(26.6)
Chloramphenicol	18(17.1)	42(40)	45(42.8)
Tetracycline	49(46.6)	11(10.4)	45(42.8)
Streptomycin	65(61.9)	10(9.5)	30(28.5)
Gentamycin	12(11.4)	25(23.8)	68(64.7)
Nalidixic acid	21(20)	37(35.2)	47(44.7)
Ciproflaxacin	09(8.5)	15(14.2)	81(77.1)
Kanamycin	31(29.5)	45(42.8)	29(27.6)
Cefoxitin	13(12.3)	34(32.3)	58(55.2)
Trimethoprim	40(38.1)	13(12.3)	52(49.5)
TOTAL	316(30.1)	251(23.9)	483(46)

Table 3: Antibiotic Resistant Pattern of Salmonella Isolates.

Resistant Pattern	**No. of occurrence**	**Number of antibiotic class**
Amp, Ch,	16	2
Amp, Kan, Gen	6	2
Tet, Ch, Kan,Gen, Trim,	8	4
Tet, Amp, Ch, cef	10	4
Gent, str, Amp, Kan, cipr	2	3
Stre, cep, Trim, ch	6	3
Cip Nal, cef, gen	13	3
Gent, cef, Trim, Amp, ch, tet	11	6
Kan, Gen, Trim	12	2

KEY:AMP= ampicillin; C= chloramphenicol; CIP=ciprofloxacin; GN=gentamycin; CEF=cefoxitin; NA= nalidixic acid; S= streptomycin; K, kanamycin; TRIM= sulphamethoxazole/trimethoprim; TE=tetracycline

4.0 DISCUSSION

The findings of this study confirm that poultry farms serve as significant reservoirs for pathogenic bacteria, particularly Salmonella spp., which are known to cause foodborne illnesses in humans (Antunes *et al*., 2016). The higher prevalence observed in droppings compared to feeds aligns with previous reports that fecal matter is a major source of environmental contamination and plays a critical role in the transmission of Salmonella within poultry farms (Ifeanyichukwu *et al*., 2016).

The overall prevalence rate of 52.5% recorded in this study is relatively high and indicates a substantial public health concern. This finding is consistent with studies by Ezemba et al. (2021) and Madaki et al. (2019), who reported prevalence rates of 62.5% and 66.66%, respectively. Similarly, Mike et al. (2004) reported a higher isolation rate of Salmonella from poultry droppings compared to other environmental sources. However, lower prevalence rates have also been documented, such as 21.4% by Orum et al. (2022) and 2.21% by Martha and Enid (2019). These variations may be attributed to differences in environmental conditions, farm management practices, hygiene standards, and sample sizes (Kabir, 2021).

The high prevalence observed in this study may be linked to poor sanitary conditions and inadequate biosecurity measures in the farms surveyed. Observations during sampling revealed poor hygiene practices, proximity of poultry houses to waste disposal sites, and inadequate separation between poultry facilities and human activities. Such conditions facilitate cross-contamination and enhance the transmission of pathogens through vectors such as rodents, insects, and contaminated equipment (Musa *et al*., 2014; Kabir, 2021).

The antimicrobial susceptibility results showed high resistance to commonly used antibiotics such as Streptomycin, Ampicillin, and Tetracycline. This pattern is consistent with findings from several studies that reported widespread resistance of Salmonella to these antibiotics due to their frequent use in poultry production (Abilla *et al*., 2021; Mohammed & Dubie, 2022). The high level of resistance observed may be attributed to the indiscriminate use of antibiotics as growth promoters and for prophylactic purposes without proper veterinary supervision.

The isolates showed high sensitivity to Ciprofloxacin, Gentamicin, and Cefoxitin, which is consistent with previous reports by James et al. (2016) and Obi and Ike (2015). These antibiotics are less frequently used in poultry production, which may explain their retained effectiveness. However, the emergence of resistance even to these drugs in some isolates is concerning and suggests the potential for future resistance development.The presence of multidrug resistance among the isolates is particularly alarming. In this study, a significant

proportion of isolates exhibited resistance to multiple antibiotic classes, similar to findings reported by Musawa et al. (2021) and Mohammed and Dubie (2022). Multidrug-resistant Salmonella strains complicate treatment options and increase the risk of disease spread, especially in settings with limited access to advanced healthcare.

The widespread use of antimicrobials in livestock production has been identified as a major driver of antimicrobial resistance globally (Van Boeckel *et al*., 2015). In many developing countries, including Nigeria, antibiotics are easily accessible without prescription, leading to misuse and overuse. This practice contributes significantly to the selection and proliferation of resistant bacterial strains within the food chain.

5. CONCLUSION

This study demonstrated a high prevalence of Salmonella spp. in poultry feeds and droppings, along with significant levels of antimicrobial resistance and multidrug resistance among the isolates. These findings highlight the potential risk of transmission of resistant pathogens from poultry to humans through the food chain. It's recommended that; strict biosecurity and hygiene measures should be implemented in poultry farms, the use of antibiotics in poultry production should be regulated and monitored, routine surveillance of antimicrobial resistance should be conducted and further studies should focus on molecular characterization of resistance genes.

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