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PREVALENCE OF *AEROMONAS* SPP. IN FARMED CATFISH AND TILAPIA FROM A MAJOR FISH MARKET IN KANO, NIGERIA

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ABSTRACT

Bacteriological examination of fish organs (gill, intestine, liver, and spleen) was conducted to determine the distribution and occurrence of *Aeromonas* spp. in *Clarias gariepinus* (African catfish) and *Oreochromis niloticus* (Nile tilapia) obtained from the Galadima Fish Market, Kano Metropolis, Nigeria. A total of 80 fish samples were analyzed using standard bacteriological culture techniques, including selective plating on Rimler-Shotts agar and confirmation through biochemical tests. *Aeromonas* spp. was detected in both fish species at an equal overall isolation rate of 15%. The liver was the most frequently colonized organ, with isolation rates of 40% in *C. gariepinus* and 30% in *O. niloticus*, followed by the spleen (20% in both species), the intestine, and the gill. These findings reveal the systemic colonization potential of *Aeromonas* spp. in commercially sold fish and underscore significant public health risks associated with inadequately handled fish in open markets. Improved bacteriological surveillance, hygienic fish-handling practices, and antibiotic stewardship in aquaculture are recommended.

Key words: *Aeromonas* spp., antimicrobial resistance, bacterial contamination, *Clarias gariepinus*, fish market, food safety, Kano, Nigeria, *Oreochromis niloticus*

1.0 INTRODUCTION

Fish and fish products represent one of the most important sources of high-quality animal protein and essential micronutrients for human populations worldwide (FAO, 2022). Global aquaculture and fisheries production reached approximately 214 million tonnes in 2020, underscoring the sector's central role in global food security (Jeamsripong *et al*., 2025). In Nigeria, fish contributes approximately 40% of the total animal protein consumed, making it an indispensable dietary component, particularly among low-income populations. However, the safety of fish sold in open markets is frequently compromised by inadequate handling, poor sanitation, and a lack of cold-chain infrastructure, all of which facilitate the proliferation of bacterial pathogens (Adah *et al*., 2024).

Aeromonas spp. are Gram-negative, oxidase-positive, facultative anaerobes ubiquitously distributed in freshwater and estuarine environments (Fernandez-Bravo and Figueras, 2020). They are recognized as significant opportunistic pathogens of both fish and humans, causing motile Aeromonas septicemia (MAS), hemorrhagic septicemia, fin rot, and ulcer disease in fish, and gastroenteritis, bacteremia, wound infections, and sepsis in humans (Janda and Abbott, 2010; Tomas, 2021). The genus currently encompasses more than 30 validated species, with *A. hydrophila, A. caviae, A. veronii*, and *A. dhakensis* being the most clinically significant (Fernandez-Bravo and Figueras, 2020). Several of these species harbor multiple virulence determinants, including aerolysin, hemolysin, cytotoxic enterotoxin, and cytotonic enterotoxin, which collectively contribute to their pathogenic potential (Tao and Shan, 2026).

Of growing concern is the emergence of multidrug-resistant (MDR) *Aeromonas* strains in aquaculture systems, driven largely by the indiscriminate use of antimicrobials in fish farming (Jeamsripong *et al*., 2025). A recent systematic review and meta-analysis reported a pooled prevalence of *A. hydrophila* of 30.7% in aquatic food animals, with resistance rates exceeding 80% to penicillin, 70% to oxytetracycline, and 68% to macrolides (Jeamsripong *et al*., 2025). In Nigerian aquaculture specifically, *A. hydrophila, A. caviae, A. veronii*, and *A. dhakensis* have been isolated from *C. gariepinus* with multiple antibiotic resistance (MAR) index values ranging from 0.20 to 0.80, indicating extensive antibiotic pressure within Nigerian fish farms (Adah *et al*., 2024). The Kano Metropolis is one of the most densely populated cities in northern Nigeria and a major commercial centre with consistently high fish consumption. The Galadima Fish Market is among the busiest fish distribution hubs in the region, yet bacteriological data on the quality of fish sold there remain largely unavailable. The present study was therefore undertaken to determine the distribution and occurrence of *Aeromonas* spp. in *C. gariepinus* and *O. niloticus* from the Galadima Fish Market, with a view to assessing attendant public health risks and recommending evidence-based control measures.

2.0 MATERIALS AND METHODS

2.1 Study Area

The study was conducted at the Galadima Fish Market, located in Kano Metropolis, Kano State, Nigeria (approximately 11.99°N, 8.52°E). This market is one of the most prominent fish distribution centres in northern Nigeria, supplying both fresh and processed fish to consumers across the metropolis and neighbouring states. Fish are sourced from local aquaculture ponds, capture fisheries on inland water bodies, and distant suppliers, resulting in a heterogeneous stock with varying bacteriological profiles

2.2 Sample Collection

A total of 80 apparently fresh fish samples were randomly purchased from different vendors across different sections of the market: 40 specimens of *C. gariepinus* (African catfish) and 40 specimens of *O. niloticus* (Nile tilapia). Sampling was designed to capture vendor-to-vendor variability. All fish samples were individually placed in sterile polythene bags, immersed in ice-filled coolers, and transported to the laboratory within two hours of collection to minimize post-collection bacterial proliferation.

2.3 Laboratory Analysis

2.3.1 Isolation of *Aeromonas* spp.

In the laboratory, the external surfaces of fish were decontaminated with 70% ethanol. Four organs—gill, intestine, liver, and spleen—were then aseptically excised under a Class II laminar flow safety cabinet. Each organ was homogenized in 9 mL of sterile phosphate-buffered saline (PBS, pH 7.2) and serial tenfold dilutions were prepared. Aliquots of 0.1 mL were plated onto Rimler-Shotts (RS) agar supplemented with novobiocin (5 µg/mL) and onto MacConkey agar, following protocols described by Adah *et al*. (2024). Plates were incubated aerobically at 35°C for 24–48 hours. Presumptive Aeromonas colonies (yellow on RS agar; pink, non-lactose-fermenting on MacConkey) were sub cultured onto Tryptone Soya Agar (TSA) for purification.

2.3.2 Identification

Purified isolates were characterized using standard biochemical tests in accordance with Janda and Abbott (2010) and Fernandez-Bravo and Figueras (2020): Gram staining, oxidase test, catalase test, indole production, methyl red and Voges–Proskauer reactions, citrate utilization, hydrogen sulfide production, and motility testing. Isolates positive for oxidase, glucose fermentation, and resistance to the vibriostatic agent O/129 (150 µg) were provisionally assigned to the genus *Aeromonas*.

2.4 Data Analysis

Prevalence was calculated as the percentage of organ samples yielding confirmed *Aeromonas* isolates relative to the total number of samples examined per organ and per species. Data were entered and analyzed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA). Results are presented as frequencies and percentages, and organ-specific prevalence values are displayed in tabular form

3.0 RESULTS

The organ-specific isolation rates and associated descriptive statistics for *Aeromonas* spp. in both fish species are presented in Table 1. The overall isolation rate was 15% in both *C. gariepinus* and *O. niloticus*. Liver colonization rates were the highest across both species (40% in *C. gariepinus*; 30% in O. niloticus), followed by the spleen (20% in both species), the intestine (15% and 10%, respectively), and the gill (10% and 5%, respectively). Chi-square analysis revealed no statistically significant difference in *Aeromonas* prevalence between the two species for any organ examined (Table 1; all $p > 0.05$. The detailed frequency distribution of positive and negative outcomes for each species–organ combination is further summarized in Table 2.

Table 1. Organ-specific Isolation Rates, 95%Confidence Intervals, and Chi-Square Statistics for *Aeromonas* spp. in *Clarias gariepinus* and *Oreochromis niloticus* at Galadima Fish Market, Kano, Nigeria.

Organ	*C. gariepinus* (n = 40) No.Positive	Isolation Rate (%)	95% CI (%)	*O. niloticus* (n = 40) No. Positive	Isolation Rate (%)	95% CI (%)	χ^2 (df = 1)	p-value
Liver	16	40.0	24.8–55.2	12	30.0	15.8–44.2	0.952	0.329
Spleen	8	20.0	7.6–32.4	8	20.0	7.6–32.4	0.000	1.000
Intestine	6	15.0	3.9–26.1	4	10.0	0.7–19.3	0.417	0.519
Gill	4	10.0	0.7–19.3	2	5.0	0.0–11.8	0.541	0.462
Overall	**34**	**21.3**	—	**26**	**16.3**	—	—	—

Note: SE = Standard Error; 95% CI = 95% Confidence Interval; χ^2 = Chi-square statistic; df = degrees of freedom; $p > 0.05$ for all comparisons (not significant).

Table 2: Frequency Distribution of *Aeromonas spp.* Isolation Outcomes by Organ and Fish Species

Organ	Fish Species	Positive (n)	Negative (n)	Total (n)	Prevalence (%)	SE (%)	95% CI (%)
Liver	*C. gariepinus*	16	24	40	40.0	7.7	24.8–55.2
	O. niloticus	12	28	40	30.0	7.2	15.8–44.2
Spleen	*C. gariepinus*	8	32	40	20.0	6.3	7.6–32.4
	O. niloticus	8	32	40	20.0	6.3	7.6–32.4
Intestine	*C. gariepinus*	6	34	40	15.0	5.6	3.9–26.1
	O. niloticus	4	36	40	10.0	4.7	0.7–19.3
Gill	*C. gariepinus*	4	36	40	10.0	4.7	0.7–19.3
	O. niloticus	2	38	40	5.0	3.4	0.0–11.8

Note: SE = Standard Error; 95% CI = 95% Confidence Interval. All values computed using IBM SPSS Statistics v25.0. n = 40 per species per organ.

4.0 DISCUSSION

The 15% overall isolation rate of *Aeromonas spp.* recorded in this study is lower than the 30.7% pooled prevalence reported globally by Jeamsripong *et al*. (2025) and the 40.9% rate documented in diseased farmed fish in Nigeria (Adah *et al*., 2024). This difference may reflect the market setting of the present study, where fish represent a mixed population from multiple origins and not all specimens were clinically diseased at the time of sampling. Comparable isolation rates of approximately 15% from fish handlers and market environments in northern Nigeria have been documented in previous market surveillance studies, suggesting that open fish markets in this region harbour consistent, low-to-moderate levels of *Aeromonas contamination*.

Liver colonization rates were the highest in both species (40% in *C. gariepinus*; 30% in *O. niloticus*), consistent with the findings of Tao and Shan (2026), who noted that systemic *Aeromonas infection* preferentially targets blood-filtering organs with high immune cell activity. Adah *et al*. (2024) similarly reported the liver and spleen as principal sites of *Aeromonas isolation* in farmed *C. gariepinus* in Nigeria. The absence of statistically significant inter-species differences in organ-specific prevalence (χ^2 test, $p > 0.05$ for all organs; Table 1) suggests that both fish species are equally susceptible to *Aeromonas colonization* under the prevailing market conditions, and that organ tropism rather than host species identity drives the observed distribution pattern. The slightly higher liver and gill rates in *C. gariepinus* may reflect this species' bottom-feeding ecology and greater direct exposure to sediment-associated bacterial loads. The organ-specific distribution pattern — liver > spleen > intestine > gill — reflects the known pathogenesis of *Aeromonas infection* in fish. Following initial colonization of the external surfaces or gastrointestinal tract, virulent strains penetrate the intestinal epithelium, gain access to the circulatory system, and disseminate to visceral organs (Tomas, 2021). These findings have direct public health implications: gutted fish sold at market level, where the liver and spleen are routinely removed during processing, may present lower but not negligible risks if hygiene standards are not maintained during evisceration (Daskalov, 2019).

Although antimicrobial susceptibility testing was outside the scope of this study, the existing body of evidence on *Aeromonas AMR* in Nigerian fish warrants serious attention. Adah *et al*. (2024) reported MAR index values of 0.20–0.80 for *Aeromonas isolates* from *C. gariepinus* farms in Nigeria, with resistance to multiple antibiotic classes including beta-lactams, tetracyclines, and sulfonamides. The meta-analysis by Jeamsripong *et al*. (2025) found that resistance rates to penicillin, oxytetracycline, and macrolides exceeded 67% across aquatic food animals globally, and that resistance was disproportionately higher in African isolates compared with Asian ones, attributable to weaker antibiotic governance in African aquaculture. Future investigations in Kano and other northern Nigerian fish markets should therefore prioritize molecular and phenotypic AMR profiling of isolates.

5.0 CONCLUSION

This study confirmed the presence and distribution of *Aeromonas* spp. in *Clarias gariepinus* and *Oreochromis niloticus* from the Galadima Fish Market, Kano Metropolis, Nigeria, with an overall isolation rate of 15% in both species. The liver and spleen were the most frequently colonized organs, consistent with systemic bacteremia associated with *Aeromonas infection* in fish, and no statistically significant difference in organ-specific prevalence was detected between the two species ($p > 0.05$). These findings, viewed in the context of global trends in MDR *Aeromonas and* documented high isolation rates in Nigerian catfish farms, highlight the public health risk posed by inadequately screened fish in open markets. Establishment of a robust bacteriological surveillance framework for fish markets in northern Nigeria, underpinned by a One Health approach, is urgently recommended. Additionally, investment in cold-chain infrastructure, targeted training of fish vendors and handlers, and strengthening of antimicrobial stewardship policies in Nigerian aquaculture are essential to mitigate the risks identified in this study.

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