SHORT COMMUNICATION

Sokoto Journal of Veterinary Sciences

(P-ISSN 1595-093X: E-ISSN 2315-6201)

http://dx.doi.org/10.4314/sokjvs.v21i3.7

Kabantiyok *et al.* /*Sokoto Journal of Veterinary Sciences*, **21**(3): 151 – 154.

Peri-urban wildlife as sentinels for antimicrobial resistance: Insights from owlets (*Tyoto alba*) in Jos, Nigeria

D Kabantiyok[1]*, LE Logyan[2], AO Ogundeji[1], J Budaye[3], I Adonyikwu[1], GOA Agada[1], GD Moses[1] & AA Masooq[3]

1. *Sentinel Laboratory for Antimicrobial Resistance, Central Diagnostic Department, National Veterinary Research Institute, Vom, Nigeria*
2. *Veterinary Pathology Department, Central Diagnostic Department, National Veterinary Research Institute, Vom, Nigeria*
3. *Parasitology Department, National Veterinary Research Institute, Vom, Nigeria*

*Correspondence: Tel.: +2347060975980; E-mail: denzelkbt@gmail.com

Publication History:
Received: 16-04-2023
Revised: 26-06-2023
Accepted: 04-08-2023

Abstract

There is a growing concern for exploring the animal-human interface through surveillance of peri-urban animals. Wildlife at this interface has been reported to pick up and redistribute antimicrobial-resistant bacteria and other infectious diseases. Samples from two stray Owl fledglings found at the National Veterinary Research Institute, Nigeria were used for this study. *Corynebacterium amycolatum*, *Mammalicoccus siuri*, and *Escherichia coli* were isolated and identified from cloacal and oropharyngeal swabs collected from the birds. Almost all (4/5) of the isolates had multidrug resistance. Also, three species of Leptospira (*L. enterohaemorrhagica. L grippotyphosa, and L. mini*) were identified by the microscopic agglutination technique (MAT). Our findings emphasised the growing One Health concerns for antimicrobial resistance (AMR) spread in the environment and the importance of Wildlife in peri-urban centres as sentinels for potential zoonotic transmission.

Keywords: Barn Owls, Corynebacterium, Jos, Leptospira, Multidrug Resistance (MDR), Peri-urban, Wildlife

Introduction

The peri-urban setting is an active conduit in the transmission of diseases from the wild to humans; due to the overlap of humans and animals. Wildlife ecology in the peri-urban setting is significantly affected by anthropogenic activities and vice versa (Daszak & Hyatt 2001; Keesing & Ostfeld, 2021). Urban expansions due to an increasing global population have triggered changes in land use which led to an overlap between humans and animals (Patz *et al.,* 2008; Myers, 2012). This relationship is often complex, making it difficult to understand, in detail, the events that lead to spillover of zoonotic diseases into humans (Kabantiyok *et al.,* 2022).

Owls are common nocturnal raptors found in residential areas where they prey mainly on rodents. Although they are kept as pets in other climes (Nijman & Nekaris, 2017), they are associated with fetish and superstitious undertones in Africa (Coker & Mikkola 2001). Owls are known to be great indicators of ecosystem health in the areas where they are found (Kovács *et al.,* 2008). The close association of barn owls with humans; as it is with other prey birds found close to humans, is that of necessity- mostly nutritional. They brood in arrears with a substantial population of rodents and form part of the food web (Trejo & Lambertucci, 2007), which is why they are great indicators of the ecosystems in areas where they are found. Despite this advantage, they can be reservoirs of zoonotic diseases and antimicrobial-resistant microbes in the course of their interaction with the environment and other species. In most communities in Nigeria, owls are stigmatized and associated with negative traditional perceptions (Tally, 2022), making them unwanted neighbours. Yet, they occupy open spaces in old buildings and find their way into rooftops of most houses where they brood their offspring.

Despite the wealth of studies on avian pathogens and microflora, there is a dearth of studies involving wild birds including owls in Nigeria (Monne *et al.,* 2015). In this study, we investigated the zoonotic and antimicrobial resistance potential of Barn owls in Jos, Nigeria. The findings of this study will contribute to our knowledge of the peri-urban interface and provide important information for the development of effective public health interventions to prevent the transmission of zoonotic diseases.

Materials and Methods

Two owl fledglings were identified at the Diagnostic Laboratory Services Department of the National Veterinary Research Institute (NVRI), Vom on the 10th of January, 2022. Pictures of both birds were sent to APLORI (A.P. Leventis Ornithological Research Institute) for species identification. From each bird, blood samples were humanely collected from the wing veins. Oropharyngeal and cloacal swabs were also collected before they were released. The blood samples were screened for Leptospira by Microscopic Agglutination Technique (MAT) and for blood parasites, while the swabs were tested for (Newcastle disease Virus) NDV and Avian Influenza (AI) by hemagglutination inhibition test (HI) (Taylor, 2014). Nasopharyngeal and cloacal swabs were inoculated on blood and MacConkey agar, and isolates were preliminarily identified using biochemical tests and fermentation sugars (lactose, urea, TSIA, indole, catalase, and oxidase). The isolates were further identified using matrix-assisted laser desorption ionization-time of flight mass spectrometry (MALDI-TOF MS) using VITEK2 (BioMérieux, France). Antimicrobial susceptibility test (AST) was carried out using the Kirby Bauer disk diffusion method on the bacterial isolates using six (6) different classes of antibiotics (Oxoid^{TM}, UK); Quinolones, Tetracyclines, Cephalosporins, Sulfonamides, Penicillins, and Beta Lactams. Results of the antimicrobial susceptibility tests were interpreted using the CLSI (Clinical Laboratory Standard International) (Melbvin *et al.,* 2020) for Enterobacteriaceae and *Mammalicoccus sciuri* which until recently was classified as *Staphylococcus sciuri* (Madhaiyan, Wirth, & Saravanan 2020). The zones of inhibition for *Corynebacterium* spp were interpreted using the CLSI breakpoints for *Staphylococcus* spp (Akwuobu *et al.,* 2023) except for penicillin due to EUCAST (2014) provisions for breakpoints of penicillin against *Corynebacterium* spp.

Results and Discussion

The birds were identified as Barn Owls (*Tyto alba*). Three serotypes of Leptospira (*L. enterohaemorrhagica. L. grippotyphosa* and *L. mini*) were identified from the blood samples tested by MAT, while *Corynebacterium amycolatum, Mammalicoccus sciuri*, and *Escherichia coli* were isolated with 99.9% accuracy using MALDI-TOF MS from the cloacal and oropharyngeal swab cultures. The owls shared similar bacteria except *Escherichia coli L. Icterohaemorrhagia* and *L. grippotyphosa* which were detected in only one raptor.

Tests for AI, NDV, and blood parasites were negative for the owls. There have been reports of avian influenza (AI) in owls, some of which have resulted in mortality (CDC, 2023), a prevalence study on AI in the Eurasian eagle owl (*Strix aluco*) by Sara (2022) found that all 71 owls sampled were negative for AI. It is therefore not surprising that the fledglings in our study tested negative for AI. However, more research is needed to understand the pathogenicity of AI in owls. The negative NDV results obtained were in sharp contrast to a report by Haddas *et al.* (2014) who reported NDV from owls in an Israeli zoo. Although our finding differs, it is not sufficient to make a strong argument on the infection of owls with NDV or AI. All the isolates from the owls except one (*Mammalicoccus sciuri*) showed multidrug resistance. To the best of our knowledge, this is the first report of *Mammalicoccus sciuri*, *L. enterohaemorrhagica, L* *grippotyphosa*, *L. mini,* and *C. amycolatum* and MDR isolates in owls from Nigeria. The findings on MDR bacteria in peri-domestic wildlife highlight the need for a more comprehensive understanding of the ecological drivers of antimicrobial resistance. Although our study was short of sample size, it provides an important peek into an underrepresented group of peri-urban drivers of zoonosis and AMR (Swift *et al.,* 2019). A similar study reported antimicrobial-resistant bacteria in vultures by Suárez-Pérez *et al.* (2023).

Our findings are an important lead in unravelling the spread of these pathogens and the distribution of antimicrobial resistance in wildlife. Worthy of note is the presence of *C. amycolatum*(the most significant non-diphtheritic Corynebacteria) which is not known for its pathological severity like *C. diphtheria*, although human infections with *C. amycolatum* has been associated with an array of health outcomes especially in immunocompromised patients (Sengupta *et al.,* 2015; Akwuobu *et al.,* 2023; Dalal *et al., 2023*),. In a study published in 2023, Akwuobu *et al*. found that the pathogen *Corynebacterium amycolatum* showed varying degrees of antimicrobial resistance. This finding corroborates our own findings that *C. amycolatum* is notorious for its resistance to antibiotics. All other isolates did express antimicrobial resistance to at least one class of antibiotic. Reports of antimicrobial resistance among antibiotic-naive animals in the wild are of growing concern (Elsohaby *et al.,* 2021; Wang *et al.,* 2017), especially in this instance since the birds are fledglings. The presence of Leptospira species can be connected to their source of feeding because owls predominantly prey on rodents which are established reservoirs for Leptospira (Boey *et al.,* 2019).

The emergence of antimicrobial-resistant species in wildlife populations highlights how environmental impact reflects on wildlife. More worrisome is that fledgling owls were identified to harbour MDR bacteria. This can have a profound impact on human health, animal welfare and ecosystem health. Further research is needed to identify the sources of antimicrobial resistance in wildlife and factors that promotes their distribution in different population; to develop strategies to mitigate its impact on human and animal health

Acknowledgement

We acknowledge that this research was made possible through access to facilities at the National Veterinary Research Institute Vom. We appreciate the technical support from the following researchers at the NVRI: Uhiara Uchechi Gift, Rimfa Gambo, Thomas Dauda, Elmina Abiaye, Idowu. O. Fagbamila, Nanven Abraham Maurice, Chukwu Doris, Clement Meseko & Sati Ngulukun.

Funding

No funding was received.

Conflict of Interest

The authors declare that there is no conflict of interest.

References

Akwuobu CA, Danladi DH, Patience DI, Emmanuel ON, Levi MM & Raphael AO (2023). Prevalence of *Corynebacterium* species among slaughtered ruminants in Makurdi, Nigeria: A preliminary study. *European Journal of Veterinary Medicine,* **3**(1): 1–5.

Boey K, Shiokawa K & Rajeev S (2019). Leptospira infection in rats: A literature review of global prevalence and distribution. *PLoS Neglected Tropical Diseases*, doi.10.1371/journal.pntd.0007499.

CDC (2023). H5N1 Bird Flu: Current Situation Summary. https://www.cdc.gov/flu/avianflu/wildbirds.htm, retrieved 20-06-2023.

Coker M & Mikkola H (2001). Magic, myth and misunderstanding: Cultural responses to owls in Africa and their implications for conservation. *Bulletin of African Bird Club,* **8** (1): 30–35.

Dalal A, Urban C, Segal-Maurer S (2023) Endocarditis Due to *Corynebacterium amycolatum*. *Journal of Medical Microbiology*, doi.10.1099/jmm.0.2008/003343-0.

Daszak P, Cunningham AA & Hyatt AD (2001). Anthropogenic environmental change and the emergence of infectious diseases in wildlife. *Acta Tropica,* **78** (2):103–116.

Elsohaby I, Ahmed S, Elmoslemany A, Mohammed A, Mohamed A, Ali A, Theeb AM, Ayman E & Mahmoud F (2021). Migratory wild birds as a potential disseminator of antimicrobial-resistant bacteria around Al-Asfar Lake, Eastern Saudi Arabia. *Antibiotics*, doi.org/10.3390/antibiotics10030260.

EUCAST European Committee on Antimicrobial Susceptibility Testing (2014). Breakpoint tables for interpretation of MICs and zone diameters. Version 4.0. 2014. http://www.eucast.org/fileadmin/src/media/PDFs/EUCAST_files/Breakpoint_tables/Br eakpoint_table_v_4.0.pdf, retrieved 11-03-2023.

Haddas R, Meir R, Perk S, Horowitz I, Lapin E, Rosenbluth E & Lublin A (2014) Newcastle disease virus in little owls (*Athene noctua*) and African penguins (*Spheniscus demersus*) in an Israeli zoo. *Transboundary and Emerging Diseases*, **61**(6): e79-82.

Kabantiyok D, Ninyio N, Shittu I, Meseko C, Emeto TI & Adegboye OA (2022). Human respiratory infections in Nigeria: Influenza and the emergence of SARS-CoV-2 pandemic. *Vaccines,* doi.10.3390/vaccines10091551.

Keesing F & Ostfeld RS (2021). Impacts of Biodiversity and biodiversity loss on zoonotic diseases. *Proceedings of the National Academy of Sciences of the United States of America*, doi.10.1073/pnas.2023540118.

Kovács A, Ubbo C, Mammen C & Chris VW (2008). European monitoring for raptors and owls: State of the art and future needs*. Science of the Total Environment,* **37** (6): 408–412.

Madhaiyan M, Joseph SW & Venkatakrishnan SS (2020). Phylogenomic analyses of the *Staphylococcaceae* family suggest the reclassification of five species within the genus *Staphylococcus* as heterotypic synonyms, the promotion of five subspecies to novel species, the taxonomic reassignment of five Staphylococcus species to Mammaliicoccus gen. Nov., and the formal assignment of Nosocomiicoccus to the family *Staphylococcaceae*. *International Journal of Systematic and Evolutionary Microbiology,* **70** (11): 5926–5936.

Melbvin PW, Lewis JS, Bobenchik AM, Cullen SK, Galas MF, Gold H & Kirn TJ (2020). M100 Performance Standards for Antimicrobial Susceptibility Testing. Wayne, IL, USA. **10**:132–40.

Monne I, Meseko C, Joannis T, Shittu I, Ahmed M, Tassoni L, Fusaro A & Giovanni Cattoli G (2015). Highly pathogenic avian influenza A (H5N1) virus in poultry, Nigeria, *Emerging Infectious Diseases,* doi.10.3201/eid2107.150421.

Myers SS (2012). Land use change and human health. Integrating ecology and poverty reduction: *Ecological Dimensions*, doi.10.1007/978-1-4419-0633-5_11.

Nijman V and Nekaris KA (2017). The harry potter effect: The rise in trade of owls as pets in Java and Bali, Indonesia*. Global Ecology and Conservation,* doi.10.1016/j.gecco.2017.04.004.

Patz JA, Olson SH, Uejio CK & Gibbs K (2008). Disease emergence from global climate and land use change. *Medical Clinics of North America*, **92**(6): 1473-1491.

Sara KK (2022). *Investigating Avian Influenza A Infection in A Predator-Prey System Resident Tawny Owl (Strix Aluco) and Migrating Passerine Birds in Central Norway*. MSc. Thesis, Department of One Health, Faculty of Veterinary Medicine, Nord University. Pp 1-63.

Sengupta M, Balaji PN & Anandan S (2015). *Corynebacterium Amycolatum*: An unexpected pathogen in the ear. *Journal of Clinical and Diagnostic Research,* doi.10.7860/JCDR/2015/15134.7002.

Suárez-Pérez A, Juan AC, Margarita GM & María TT (2023). Antimicrobial resistance patterns of bacteria isolated from chicks of Canarian Egyptian Vultures (*Neophron Percnopterus* Majorensis): A 'one health' problem? *Comparative Immunology, Microbiology and Infectious Diseases,* 10.1016/j.cimid.2022.101925.

Swift BMC, Bennett M, Waller K, Dodd C, Murray A, Gomes RL, Humphreys B, Hobman JL, Jones MA, Whitlock SE, Mitchell LJ, Lennon RJ & Arnold KE (2019). Anthropogenic environmental drivers of antimicrobial resistance in wildlife. *Science of the Total Environment*, doi.10.1016/j.scitotenv.2018.08.180.

Talley R (2022). The Symbolic Meaning of Owls in Prophecies and Omens -BahaiTeachings.org https://bahaiteachings.org/symbolic-meaning-owls-prophecies-omens/, retrieved on 2023-02-06.

Taylor LH (2014). OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals. State, Rome. Pp 12.

Trejo A & Lambertucci S (2007). Feeding habits of barn owls along a vegetative gradient in northern Patagonia. *Journal of Raptor Research,* doi.10.3356/0892-1016(2007).

Wang, J, Zhen-Bao M, Zhen-Ling Z, Xue-Wen Y, Ying H, Jian HL & Jing W (2017). The role of wildlife (Wild birds) in the global transmission of antimicrobial resistance genes. *Zoological Research,* **38**(2): 55–80.