

Serological Evidence of Newcastle Disease Virus Antibodies in Wild Birds in Zaria, Kaduna State, Nigeria

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Veterinaria Italiana 2023, **59** (2), 139-143. doi: 10.12834/VetIt.2710.17457.2

Accepted: 06.12.2023 | Available on line: 30.06.2023

Keywords

APMV-2,
Haemagglutination
Inhibition (HI),
Newcastle disease,
Seroprevalence,
Wild birds.

Summary

Wild birds have been reported to be reservoirs of viral diseases of poultry, and play an epidemiological role in their maintenance and spread. A serological survey was undertaken to determine the evidence of Newcastle disease virus (NDV) antibodies in wild birds in Zaria Kaduna State, Nigeria. A total of 150 apparently healthy wild birds comprising 30 each laughing dove, speckled pigeons, cattle egrets, village weavers and African silver bills were sampled. Sera collected were analysed for the presence of antibodies against NDV and avian paramyxovirus-2 (APMV-2) using the haemagglutination inhibition test. The results showed an overall seroprevalence of 4% (95% CI: 2.05-10.1) to NDV. African silver bill showed a seroprevalence of 10.0% (95% CI: 2.61-24.9) NDV antibodies while seroprevalence of 3.3% (95% CI: 0.16-15.4) was recorded for cattle egrets, village weavers and laughing doves respectively. No statistically significant difference existed for NDV seroprevalence ($P>0.05$) among the different species of wild birds. All the 150 sera tested negative for APMV-2 antibodies. The result of this study confirmed the exposure of wild birds to NDV in the study area. Continuous surveillance with isolation and characterization of NDV in the wild birds is therefore recommended for strategic planning for control.

Introduction

Newcastle disease (ND) is a devastating viral disease that remained at the forefront of infectious diseases afflicting poultry production after avian influenza (Shittu *et al.*, 2016) causing severe economic losses to the poultry industry globally (Alexander, 2001; Munir *et al.*, 2012; Megahed *et al.*, 2020). ND has been classified as a list A disease by the World Organization for Animal Health (OIE) because it is highly contagious

and has a high morbidity and mortality rate of up to 100% in susceptible birds (Shittu *et al.*, 2016; Megahed *et al.*, 2018). In developing countries, ND is considered a major limiting factor for poultry production which represents a significant source of income and food security (Megahed *et al.*, 2020). ND is caused by virulent strains of avian paramyxovirus type 1 (APMV-1) also known as Newcastle disease virus (NDV), an RNA virus belonging to the genus *Orthoavulavirus*,

subfamily *Avulavirinae*, family *Paramyxoviridae* (OIE, 2021). Twenty-one serotypes of avian paramyxoviruses have been identified and designated APMV-1 to APMV-21. Each virus belongs to different species and three genera: *Metaavulavirus*, *Orthoavulavirus*, and *Paraavulavirus* and infect over 200 species of birds with variations in severity of clinical manifestations dependent on the host and the virus strain (Amarsinghe *et al.*, 2019; ICTV, 2019; OIE, 2021). NDV is mostly pathogenic to domestic chickens, guinea fowls and turkeys. Even though antibodies against the virus usually develop in other poultry and wild birds, clinical manifestations may be mild or absent. Symptoms include mild coughing or sneezing, and partial paralysis of legs and wings rendering birds unable to fly or walk. Wild birds could serve as maintenance hosts of NDV and possible sources of infection to backyard and rural poultry (Mohammed *et al.*, 1998; Alexander, 2001; Sa'idu *et al.*, 2004). ND is endemic in Nigeria and most parts of Africa usually causing outbreaks in commercial and poultry setups. The virus has a substantial negative impact in Nigeria because over 90% of the poultry set-up are free-range or rural poultry where birds scavenge around freely in search of food and water, consequently, interfacing with wild birds which could be carriers of the NDV (Adene and Oguntade, 2006). Wild birds have been reported to be reservoirs of the virus (Alexander, 2001; Takakuwa *et al.*, 1998), with fourteen isolates belonging to the orders *Passeriformes*, *Charadriiformes*, and *Anseriformes* in Australia (Alexander *et al.* 1986). This study was undertaken to assess the seroprevalence of NDV and APMV-2 in the wild bird population in Zaria Kaduna State, Nigeria at the interface with domestic birds. The resulting data obtained is expected to contribute to extant information on NDV in wild birds in Nigeria for a strategic control plan for the disease.

Materials and methods

Ethical Considerations

The use of wild birds in this study was approved by the Ahmadu Bello University Committee on Animal Use and Care (ABUCAUC) with approval number ABUCAUC/2017/031.

Study Area

This study was carried out in Zaria, Kaduna State, Nigeria and its environs. Zaria is situated at geographic coordinates of 7°43'11.802" E and 11°5'7.948" N with an average elevation of 644 metres above sea level, covering an area of about 300 square kilometres. Zaria is a large, heterogeneous city with an approximate population of 1,490,000 (Ehimiyen *et al.*, 2018; Wungak *et al.* 2021).

Sampling Method

Between March through December 2017, a total of 150 apparently healthy wild birds were selected using a convenience sampling method both captured using wooden traps set around poultry houses and sampled from live bird markets (LBM) based on their availability. The sampled species included: Laughing dove (*Spilolepia senegalensis*), speckled pigeon (*Columba guinea*), cattle egret (*Bubulcus ibis*), village weaver (*Ploceus cucullatus*) and African silver bill (*Euodice cantans*). These species of wild birds were selected for the study as there are the major ones seen on a regular basis scavenging freely for food and water around the poultry houses.

Blood Sample Collection

Using sterile hypodermic syringes and needles, 0.5-2 ml of blood sample was collected from the wing vein of 150 wild birds captured in this study, into sterile glass test tubes. Serum was harvested from each of the blood samples collected and was transferred into sterile cryo-vials, well labelled and transported in a cool box to the Regional Laboratory for Animal Influenza and other Transboundary Animal Disease, National Veterinary Research Institute (NVRI), Vom, and stored at -20°C until used for NCD antibody detection.

Sample Analysis

Sera were analysed for antibodies against NDV and also for APMV-2 using haemagglutination inhibition (HI) tests according to the OIE Terrestrial Manual (2021). HI titres greater than or equal to 3log₂ (2³ or log₂3) were considered as positive. NDV and APMV-2 positive antigens and antisera were provided by the Regional Laboratory for Animal Influenza and other Transboundary Animal Disease Laboratory, NVRI Vom.

Data Analysis

Descriptive statistics such as frequency and percentages were used to present the estimated NDV seroprevalence in the study.

Results

An overall NDV seroprevalence of 4.0% (95% CI: 2.05-10.1; n=6) was recorded in wild birds. African silver bill showed a seroprevalence of 10.0% (95% CI: 2.61-24.9; n=3) with antibody titre range from 3Log₂ (1:8) to 5Log₂ (1:32) while seroprevalence of 3.3% (95% CI: 0.16-15.4; n=1) was recorded for cattle egrets, village weavers and laughing dove with an antibody titre of 3Log₂ (1:8) recorded for each species (Table I and Figure I). No antibody titre was recorded for

speckled pigeons (Table I and Figure I). There was no statistical difference ($P>0.05$) in seroprevalence among the different species of wild birds (Table I). All the 150 sera screened were negative for APMV-2 antibodies using the same HI test.

Table I. Seroprevalence of NDV in Wild birds in Zaria, Nigeria using HI Test.

Species of Bird	N. of sera tested	N. of sera positive	Prevalence (%)	95% CI
African silver bill (ASB)	30	3	10.0	2.607-24.85
Cattle egret (CE)	30	1	3.3	0.1664-15.36
Laughing dove (LD)	30	1	3.3	0.1664-15.36
Speckled pigeon (SP)	30	0	0.0	0.0-9.504
Village weaver (VW)	30	1	3.3	0.1664-15.36
Total	150	6	4.0	2.051-10.11

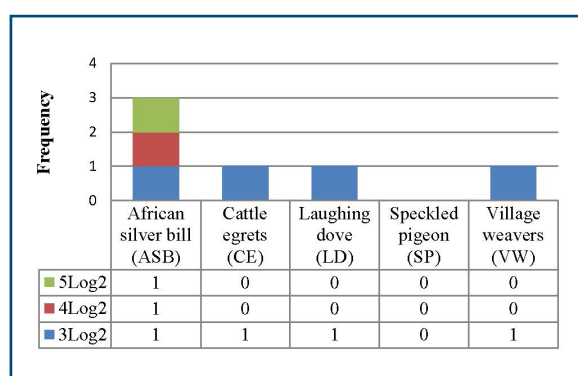


Figure 1. A bar chart showing NDV antibody titres in Wild birds in Zaria, Nigeria.

Discussion

This study detected antibodies to NDV in apparently healthy wild birds in Zaria, Kaduna State. An overall seroprevalence of 4.0% was recorded. The seroprevalence detected in this study is however lower than that reported in different studies carried out in the

State: 7.0% in North-central Nigeria (Ibu *et al.*, 2009), 10.76% in Kano Metropolis (Adamu *et al.*, 2017), 27.1%, 29.2% and 60.0% in Kogi State (Ameji *et al.* 2015; 2016). The difference in seroprevalence in these studies may be due to the difference in sample size, season of sampling, location, and in addition, the diagnostic methods used. The detection of NDV in laughing doves in this study was in contrast with previous reports of Ibu *et al.* (2009) and Ameji *et al.* (2016) which failed to detect NDV in this species. However, Adamu *et al.* (2017) reported seroprevalence of 16.0% and 17.39% in laughing doves and speckled pigeons which is higher than the reports of this study. This might be due to the large sample size and a wide area of coverage in the previous report compared to this study. The presence of antibodies against NDV in these birds may suggest natural exposure to the virus as well as their susceptibility to NDV as these birds were apparently healthy with no history of vaccination. Commercial and rural poultry at the interface are probably the source of infection to these wild bird species. NCD spillover from commercial and free-range poultry has been incriminated as the possible source of infection to wild birds as a result of their association or interactions. Transmission can occur via the airborne route or through scavenging on feed substances that were in contact with infected domestic birds (Sa'idu *et al.*, 2004; Ameji *et al.*, 2016). Antibodies to APMV-2 were not detected in this study. This is in contrast with the recent findings of Bitrus *et al.* (2022) who reported the first evidence of antibodies to APMV-2 in peri-domestic birds in Bauchi State, Nigeria. The major limitation of this study was the small sample size. This could not allow for definitive conclusions about the status of NCD in wild birds at the interface with domestic birds. However, the results of this study confirmed the exposure of wild birds to NDV, suggesting that they may play a role in the maintenance and transmission of the disease to backyard and commercial poultry. Therefore, future studies should be extended to cover more sample size, virus isolation and characterization.

Acknowledgement

The Authors wish to acknowledge the Authorities of the National Veterinary Research Institute, Vom, Plateau state, Nigeria, for granting us permission to carry out this research work in their laboratory.

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