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Seroprevalence of avian influenza in free-range domestic ducks in some selected households in Oyo State, southwestern Nigeria

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Abstract

Since the report of the first case of highly pathogenic avian influenza (HPAI) in Nigeria, surveillance of the disease has mostly been in chickens, with minimal focus on ducks. This work aimed to conduct a longitudinal study to determine the prevalence and temporal patterns of antibodies against Avian Influenza viruses (AIV) in healthy, unvaccinated scavenging ducks in some Local Governments Areas (LGAs) in Oyo State. We used a competitive ELISA to identify AI virus antibodies in a total of 200 duck sera collected from different households in Akinyele, Iseyin and Ibarapa Central Local government areas (LGAs) during dry and wet seasons as part of ongoing research on AI in the southwest, Nigeria. The overall seroprevalence obtained by ELISA was 42.5% (85/200). A significantly higher seroprevalence of 60% (60/100) of AI was found in the dry season than in the wet season with 25% (25/100). This study provides evidence of ongoing circulation of Avian influenza in the indigenous duck population in some selected local government areas in Oyo State, which may be a risk factor for future outbreaks of AI in chickens and possibly humans. Proper biosecurity and continuous surveillance are hereby advocated for effective prevention and control. Additionally, keeping ducks and chickens together should be discouraged both on farms and in households, particularly during the dry season.

Keywords: Avian influenza, Ducks, ELISA, Oyo State, Seroprevalence

Introduction

Poultry production is an important agriculture-based industry in Nigeria. In 2019, the estimated number of commercially raised chickens was 1.321 billion (FAOSTAT, 2021). It is one of the easiest ways to increase the availability of protein in food because eggs and meats contain essential nutrients such as amino acids, minerals, and vitamins that can augment protein deficiency in rural and urban households in Nigeria (Alhaji & Suleiman, 2017). According to the Food and Agriculture Organization reports (FAOSTAT, 2021), Nigeria has a low animal protein intake with an average of 6 g per head per day, while the world average is 34 g per head per day.

The significance of poultry farming for the economic, social, and biological needs of people in any nation cannot be over-emphasized (Oladipo *et al*., 2020). In

recent times, it has been observed that the improvement of the poultry industry in Nigeria is threatened by outbreaks of infectious diseases such as Newcastle disease (ND), infectious bursal disease, coccidiosis and avian influenza (AI) among others, that cause high mortality and huge economic losses to farmers as well as their psychosocial well-being (Oladipo *et al*., 2020).

Avian influenza is a highly infectious disease caused by type A influenza viruses from the *Orthomyxoviridae* family (Fouchier & Munster, 2009). Although influenza A viruses have antigenically similar nucleocapsid and matrix proteins, they are divided into subtypes based on their haemagglutinin (H) and neuraminidase (N) antigens (Aji *et al*., 2021). Previously, 16H and 9N influenza A virus subtypes were known in bats but newer investigations have found additional H17N10 and H18N11 subtypes (Fouchier & Munster, 2009). Aquatic birds that are naturally healthy contribute significantly to the spread of these subtypes due to the high likelihood of re-assortment. H5N1 viruses are currently associated with duck disease and mortality since 2002 (Aji *et al*., 2021). However, infected wild ducks with the influenza virus are frequently asymptomatic (Feare & Yasué, 2006). Furthermore, domestic ducks play an important role in the pathogenesis and dissemination of HPAI between wild waterfowl and domestic poultry. The potential of domestic ducks to propagate HPAI viruses raises concerns about a public health risk, necessitating the management of their current circulation and dissemination (Zanna *et al.,* 2017). To assess the hypothesis that ducks contribute to the maintenance and transmission of avian influenza viruses, we conducted a longitudinal study to determine the prevalence and temporal patterns of antibodies against AI in unvaccinated scavenging ducks in Oyo State.

Plate I: Free-range ducks cohabiting with chickens in a household of farmers in Ibadan
Dark arrow: Free-range chickens
Blue arrow: Free-range ducks

Materials and Methods

This study was carried out in Oyo State of Nigeria between September 2021 and August 2022 during the dry and wet seasons. Oyo State is located in southwest Nigeria. Oyo State lies between Latitude 7^{o} 23'N and 9^{o} 25'N and longitude 3^{o} 55'N and 52^{o} 50'N. The capital of Oyo state is located in Ibadan, which is the second largest city in Africa. Different households from three local government areas (LGAs) (Akinyele, Iseyin and Ibarapa Central) in Oyo State were purposively selected because of the prevalence of duck farmers and their willingness to allow for sample collection in their animals. This was arrived at from the record of the Duck Farmers Association of Nigeria, Oyo State branch.

About 5 ml of blood samples were collected randomly from the jugular vein and the wing vein of 200 healthy free-range ducks (Plate I). The samples collected from the various households were 80 in Akinyele, 60 in Iseyin, and 60 in Ibarapa Central (Local government areas all in Oyo States, Southwestern, Nigeria during the dry and wet seasons. The blood samples were collected into sample bottles (without anticoagulant) and centrifuged at 3000 rpm for five minutes before the sera were decanted into Eppendorf tubes.

The clear sera collected were stored, labelled appropriately and transported to the Avian Disease Laboratory of the Department of Veterinary Medicine, University of Ibadan. The samples were stored at -20^{o} C until further processing for serological study.

The sera were analyzed by competitive ID Screen® influenza A antibody competition multi-species test kit (IDEXX Laboratories Inc., Maine, USA) used for detection of antibodies against nucleoprotein of the Influenza A virus in avian, porcine or equine serum and plasma according to the manufacturer's instructions.

The results were read at a wavelength of 450 nm using a microplate ELISA reader (Optic Ivymen System, Model 2100C, Biotech SL, Madrid, Spain). The relative level of antibody was determined by calculating the competition percentage S/N (%)

which is shown below. Serum samples with S/N (%)≤ 45% were considered positive and those with 45%< S/N (%) < 50% were considered doubtful, whereas the serum samples with S/N (%)≥50% were considered negative.

$$S/N = \frac{OD_{Sample.}}{OD_{NC}} \times 100$$

Statistical analysis

Data obtained were analysed with column statistics and Fisher's exact test (two-tailed) using Graph Pad Prism version 9.0 (Graph Pad Software, San Diego, CA, USA), and *p* values <0.05 were considered statistically significant.

The prevalence rate was calculated using the formula:

$$\text{Prevalence rate} = \frac{\text{Positive samples} \times 100}{\text{Total samples analyzed}}$$

Results and Discussion

The serological screening of 200 sera samples collected from the selected households of Akinyele, Iseyin, and Ibarapa Central LGAs for Avian Influenza (AI) virus antibodies in free-range ducks was done using ELISA. Out of the 200 samples collected and analyzed, only 85 (42.5%) of the sample were positive for AI (Table 1). This represents 26.5% (21 out of 80) in Akinyele, 58.33% (35 out of 60) in Iseyin, and 48.33% (29 out of 60) in Ibarapa Central Local Government Areas.

The prevalence of AI antibodies in the free-range ducks during the dry and wet seasons in the three local government areas in Oyo State is shown in Table 2. Out of the 100 sera sampled each screened during the dry and wet seasons, 60 (60%) and 25 (25%) were positive for AI antibody, respectively. In addition, the dry season was significantly higher (P<0.05) than the wet season.

The existence of avian influenza antibodies in apparently healthy ducks demonstrates the significance of these species in the maintenance and spread of the virus (Verhagen *et al*., 2021) especially countries like Nigeria where vaccination against AI is prohibited. Relocation of people away from outbreak areas and attempts by poultry farmers to sell diseased birds to offset their financial losses are frequently linked to virus contamination in live bird markets (LBMs). Our findings revealed an overall prevalence (42.5%) of antibodies against the influenza A virus in asymptomatic, unvaccinated free-range ducks in households in some selected local government areas in Oyo State, Southwest, Nigeria. The 42.5% seroprevalence of antibodies against the influenza A virus obtained in Oyo State is of great concern as it is higher than the findings of Chinyere *et al.* (2020) who reported a seroprevalence of 17.86% in Plateau State and Zanna *et al.* (2017) with 5% in Borno State. The high prevalence rate observed in this study could be due to the long life span of ducks, which might have caused repeated exposures to the virus, resulting in antibody maintenance over a long period, or it could be due to the mingling of ducks with wild migratory birds at crop fields and/or near water reservoirs where wild migratory birds used to scavenge and this component may lead to natural infection in ducks (Capua & Alexander, 2004).

The prevalence of AI antibodies in this study showed a higher prevalence in the dry season compared to the wet season. This is consistent with the findings of

Table 1: Prevalence of avian influenza virus in free-range ducks in different households located in Akinyele, Iseyin and Ibarapa central LGA in Oyo State

Location/LGA	Total number of samples	Total positive number (%)
Akinyele	80	21 (26.25%)
Iseyin	60	35 (58.33%)
Ibarapa Central	60	29 (48.33%)
Total	200	85(42.5%)

Table 2: Prevalence of Avian Influenza virus in Free-range ducks in different households located in Akinyele, Iseyin and Ibarapa central LGA during dry and wet seasons

Locations/LGA	Total number of samples	Dry season		Wet season	
		Total number of samples	Number positive (%)	Total number of samples	Number positive (%)
Akinyele	80	40	16(40%)	40	5(12.5%)
Iseyin	60	30	25(83.3%)	30	10(26.7%)
Ibarapa Central	60	30	19(63.3%)	30	10(13.3%)
Total	200	100	60(60%) *	100	25(25%)

*Statistically significant

p < 0.05, OR = 9.4 (95% CI: 1.7–51.0)

Kent *et al*. (2022), who discovered a high prevalence of the avian influenza virus during the dry season. Many cases of AI antibodies in chickens have been reported during the dry season, and because ducks cohabit with chickens, the risk of ducks contracting the virus during the dry season may be higher than during the wet season.

In conclusion, live bird markets should be reconfigured in addition to other interventions such as biosecurity to deter the practice of mixing species in the same cages. Poultry farms, where multi-age birds of various types, origins, and varieties are crowded together, must be the starting point for this. So that the least susceptible species like ducks will not be a source of transmission to the more susceptible species like turkeys and chickens which are the primary economy birds in the poultry industry. Also, continuous surveillance is hereby advocated to effectively prevent and control avian influenza in Oyo State, Nigeria.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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