Awareness of Farmers on Newcastle Disease, its Vaccination and Antibody Titer in Commercial Chickens in Jos South, Nigeria

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ABSTRACT
Newcastle disease is a highly contagious viral disease which affects existing or developing poultry industries. This study was performed to assess the level of awareness of farmers on Newcastle disease and its control through vaccination and also to determine the level of Newcastle disease virus antibody (Ab) titer in commercial layer chicken sera using haemagglutination inhibition test in Jos South Local Government Area, Plateau State, Nigeria. A structured questionnaire was shared to farmers to fill. Thirty four farms were visited and nine districts were randomly selected. A total of 354 sera were collected from commercial chickens; ten from each flock. There was a high level of awareness of farmers (100%) on ND and its vaccination (100%) and all the farmers (100%) had vaccinated their chickens against ND. The HI test revealed that, out of the 354 sera tested, 9 (2.5%) chickens were negative for NDV Abs, which means had NDV antibody titer below the minimum protective titer of log2 3 and 345 chickens (97.5%) were positive for NDV Abs; had NDV antibody titer above log2 3. It was concluded that the level of awareness of farmers on ND and its control through vaccination was incredibly high, also, the level of protection to ND in vaccinated chickens was also very high, in that a higher percentage of the chickens had NDV Antibodies between log2 6 and log2 8, however, inspite of these, ND is still a continual threat to the poultry industry in Nigeria. It is therefore recommended that, other biosecurity measures, such as good management practice, proper hygiene and surveillance be emphasized and ensured, in order to prevent ND infection among flocks.

Key words: Newcastle disease, Antibody titer, Haemagglutination inhibition, Commercial chickens

INTRODUCTION
For the past 50 years, poultry production has recorded greater changes than in any other world’s livestock sub sector of the agricultural production sector (David, 2000). Current trends in livestock production indicate that the global production of poultry meat and dairy will double by 2050 (David, 2000). Newcastle disease (ND) is one of the most important animal diseases in the world; both for the number of animals affected every year and the severe economic impact on the poultry industry (Thompson, 2015). ND is a highly contagious viral disease which is caused by Newcastle disease virus (NDV) which belongs to the Family, Paramyxoviridae and Genus, Rubulavirus (Alexander, 1997). The disease has been reported to be the most important poultry disease (Sonaiya et al., 2000).

ND is also the most important cause of mortality in chickens and many species of domesticated and wild birds have been found susceptible to this disease; mortality of 100% is common (Nguyen, 1992; Wernery et al., 1992; Alders and Spradbrow, 2001; Saidu and Abdus, 2008). ND usually affects the respiratory, gastrointestinal and nervous systems with common signs of listlessness, increased respiratory rate, yellowish to greenish diarrhea and weakness followed later by prostration and death (Chansiripornchai and Sasipreyajan, 2006).
The NDV has been reported endemic in many developing countries of Africa such as Kenya (Njue et al., 2001 and Njagi, 2010); Cameroon (Ekue et al., 2002 and Mai et al., 2014); Tanzania (Salam et al., 2002); Ethiopia (Chaka et al., 2013); Egypt (Mohammed et al., 2011) and Nigeria (Sa’idu et al., 2004; El –Yukuga et al., 2009; Musa et al., 2009; Yauku, 2010; Okwor and Eze, 2010 and Salihu et al., 2012).

The first recorded and confirmed outbreak of ND in Nigeria was between December, 1952 and February, 1953 in and around the city of Ibadan, the Oyo State capital (Hill et al., 1953). The disease has been a notable problem in the country since then (Oladele et al., 2002). ND is widespread in domestic and exotic chickens (Fatumbi and Adene, 1979). The most dreaded poultry disease in Nigeria as reported by Abdu et al. (1992) is ND. Fatumbi and Adene, (1979); Adu et al. (1986); Echeonwu et al. (1994); Sa’idu et al. (1994); Alders and Spradbrow, (2001), also reported that ND is enzootic in Nigeria. Olabode et al. (1992) reported that ND is a threat to poultry industry in Nigeria and it continues to cause havoc to different species of poultry.

Newcastle disease is characterized by signs, such as coughing, gasping, sneezing and rales, nervous signs, greenish-white diarrhea and cessation of egg production (Alexander, 1997 and 2001). ND has become endemic in Nigeria in both local and commercial poultry with annual epidemics recorded in highly susceptible flocks (Halle et al., 1999; Saidu and Abdu, 2008) with pockets of outbreaks occurring between the annual epidemic periods.

Commercial chickens in Nigeria are exclusively exotic chickens which are reared intensively or semi-intensively. In most parts of the country, ND is seen and diagnosed throughout the year in commercial flocks and the incidence varies with season (Chabauf, 1990; Alders and Spradbrow, 2001).

Newcastle disease is an economically important disease of poultry for which vaccination is carried out as a preventive measure in many countries. Orakaja et al. (1999) reported vaccination as the only safe option in control strategies of infection (Orakaja et al., 1999). Mariana et al. (2016) also reported that vaccination of chickens is able to prevent internal egg contamination, reducing egg shell surface contamination and reducing shedding from digestive and respiratory tracts in virulent NDV challenged hens (Mariana et al., 2016).

Nevertheless, outbreaks of ND have been reported in vaccinated poultry populations (Van Boven et al., 2008). Vaccination is practiced widely and different types of vaccines are available but the most successful and widely used ones are the mild live virus vaccines known as the Hitchner B1 and La Sota types (Rathore et al., 1987 and Aliyu et al., 2014). The typical vaccination schedule in layers in Plateau state, Nigeria is as follows; the birds are vaccinated against Newcastle disease (Hitchner B1) intraocular at day one of age on the hatcheries before being sold; they are also given Lasota vaccine orally via the drinking water at the third week of age; at week six of age, they are given kumorov vaccine either subcutaneously or intramuscularly; between week eleven and fifteen, they are given Lasota vaccine orally via drinking water; at week sixteen of age, they are given kumorov vaccine either subcutaneously or intramuscularly and at every three months interval, they are also given kumorov vaccine either subcutaneously or intramuscularly; and the typical schedule of vaccination in broilers is as; birds are given first dose of Lasota vaccine orally at two weeks of age via the drinking water and at forth week of age, they are given the second dose of Lasota vaccine orally via the drinking water.

Newcastle disease alone accounts for more than 50% of total losses in Africa’s poultry flocks (Ezeibe et al., 2006 and Musa et al., 2009). In response to the threat presented by ND, several attempts have been made to put in place vaccination programmes to prevent epidemics of disease. However, outbreaks have been reported in vaccinated populations (Okwor et al., 2010).

Serological tests are useful tools in the diagnosis of infection. Haemagglutination Inhibition (HI) test is the most commonly used test for detection of immune response in affected birds (Alexander and Senne, 2008). Value of serology in diagnosis of disease depends on the vaccination history of birds and on prevailing disease conditions (OIE, 2012). Because NDV can cause a wide variety of disease presentation, it is important to enhance the awareness of field personnel (Thompson, 2015). In view of this and the economic importance of ND, this study was carried out in order to determine the level of awareness of farmers on ND and its control through vaccination and also to determine ND virus antibody titre using haemagglutination inhibition test in commercial chicken sera in Jos South Local Government Area, Plateau State, Nigeria.

MATERIALS AND METHODS
The birds that were sampled in this study were layers (commercial birds). Layers of between age eighteen weeks and twenty four weeks were sampled. A Structured questionnaire was given to farmers. The farmers’ awareness of ND and its vaccination, type of
ND vaccine given, route of administration of ND vaccine, whether or not cold chain was maintained and how it was maintained, service provider, any outbreak or infection with NDV and how the disease was treated; all these information were obtained from the farmers. Table one shows the typical Newcastle disease vaccination in layers and broilers in Plateau state, Nigeria.

Convenience sampling procedure was used to select nine districts under Jos South L.G.A. These districts were; Federal low cost, Rantya, Bukuru, Rayfield, Da zarmangada, Dung village, Dadinkowa, Gyal and State low cost. Furthermore, 1- 3 farms (depending on the number of farms in each district) were also randomly selected from each of the districts and 10 to 20 birds were selected at random from each flock, depending on the number of farms in each district and the flock size, respectively. Structured questionnaire was administered to farmers. Two milliliters of blood was collected aseptically via the wing vein of each bird, using a 21-G sterile hypodermic needle and 5 ml syringe in adult birds (layers) and 23-G sterile hypodermic needle and 2 ml syringe in young birds (pullets). The samples were labeled with the name and location of the farm, type of bird and date of collection. The blood samples were kept in a slanting position at room temperature to allow for clotting and sera formation. The sera were also randomly selected from each of the districts and 10 to 20 birds were selected at random from each flock, depending on the number of farms in each district and the flock size, respectively. Structured questionnaire was administered to farmers. Two milliliters of blood was collected aseptically via the wing vein of each bird, using a 21-G sterile hypodermic needle and 5 ml syringe in adult birds (layers) and 23-G sterile hypodermic needle and 2 ml syringe in young birds (pullets). The samples were labeled with the name and location of the farm, type of bird and date of collection. The blood samples were kept in a slanting position at room temperature to allow for clotting and sera formation. The sera were separated by transferring into a labeled sterile bottle for HI test which was stored frozen at -20°C and sent in a cold pack to regional laboratory for avian influenza and other transboundary animal diseases at the National Veterinary Research Institute (NVRI), Vom, Plateau State, Nigeria. Newcastle disease antigen and ND positive and negative serum were obtained from the National Veterinary Research Institute, Vom, Nigeria. The HI test was carried out by the method described by Office Internationale des Epizooties (2005).

**Preparation of chicken red blood cell suspension**

A total of 4 ml of blood was collected aseptically from ND antibody- negative chicken in a disposable syringe containing 1 ml of Acid Citrate Dextrose (ACD) as anticoagulant. Cells were washed three times in Phosphate Buffered Saline (PBS) of pH 7.2 by centrifuging at 447.2 g for 5 minutes (Allan and Gough, 1984). One percent RBC (packed cell V/V) suspension was prepared by adding 99 ml of Phosphate Buffered Saline (PBS) to 1 ml of washed RBC.

**Statistical analysis**

Data obtained through questionnaire administration were noted. The number recorded for each question was then converted into percentages and tabulated. The Statistical Package for Social Sciences (SPSS) program, version 12 was used to analyze data. Values of P ≤ 0.05 were considered significant.

| Table 1. Typical Schedule of Newcastle Disease Vaccination in Layers and Broilers in Plateau State, Nigeria |
|----------------------------------|------------------------------------------------|-----------------|-----------------|-----------------|
| **Type of bird**                | **Age of bird at administration**            | **Name of vaccine** | **Type of vaccine** | **Route of administration** |
| Layer                           | Day one                                      | Hitchner B1       | Live             | Intraocular      |
|                                 | Three weeks                                  | Lasota            | Live             | Oral via drinking water |
|                                 | Six weeks                                    | Kumorov           | Live             | Subcutaneous or intramuscular |
|                                 | Between eleventh and fifteenth weeks         | Lasota            | Live             | Oral via drinking water |
|                                 | Sixteenth weeks                              | Kumorov           | Live             | Subcutaneous or intramuscular |
|                                 | At three months Interval                      | Kumorov           | Live             | Subcutaneous or intramuscular |
| Broiler                        | Two weeks                                    | Lasota            | Live             | Oral via drinking water |
|                                 | Four weeks                                   | Lasota            | Live             | Oral via drinking water |

**RESULTS**

The questionnaire administered to farmers revealed that all of the commercial poultry farmers (100%) were aware of ND and had vaccinated their birds against ND (Table 2).

Out of the 354 sera tested, 9 (2.6 %) chickens were negative for NDV Abs, that is, had NDV antibody titer below the minimum protective titer of log2, 3 (that is 7 (2.0%) chickens had NDV Ab titer of log2, 1 and 2 (0.6%) chickens had NDV Ab titer of log2, 2). 345 (97.5%) chickens were positive for NDV Abs, that had NDV antibody titer log2, 3 and above log2, 3 (Table 3). Results in table 3 indicated that a higher percentage of the chickens (64.2%) had protective NDV antibodies between log2, 6 and log2, 8.

| Table 2. Awareness of Newcastle disease and its vaccination in commercial chickens and Respondents (farmers) in Jos South Local Government Area, Plateau State, Nigeria |
|----------------------------------|----------------------------------|
| **Awareness of Newcastle disease** | **Respondents (farmers)**          |
| and its vaccination in commercial chickens | (%)                            |
| Yes                              | 34 (100)                        |
| No                               | 0 (0)                           |
| Total                            | 34 (100)                        |
Table 3. Distribution of Newcastle disease virus antibody titers and the corresponding number (percentage) of chickens in February, 2015 in Jos South local Government Area, Plateau State, Nigeria.

<table>
<thead>
<tr>
<th>Antibody Titer (log₂)</th>
<th>2¹</th>
<th>2²</th>
<th>2³</th>
<th>2⁴</th>
<th>2⁵</th>
<th>2⁶</th>
<th>2⁷</th>
<th>2⁸</th>
<th>2⁹</th>
<th>2¹⁰</th>
<th>2¹¹</th>
<th>2¹²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of chickens (Percentage)</td>
<td>7</td>
<td>2</td>
<td>2</td>
<td>11</td>
<td>12</td>
<td>30</td>
<td>37</td>
<td>160</td>
<td>38</td>
<td>28</td>
<td>16</td>
<td>11</td>
</tr>
<tr>
<td>2.0%</td>
<td>0.6%</td>
<td>0.6%</td>
<td>3.1%</td>
<td>3.4%</td>
<td>8.5%</td>
<td>10.5%</td>
<td>45.2%</td>
<td>10.7%</td>
<td>7.9%</td>
<td>4.5%</td>
<td>3.1%</td>
<td></td>
</tr>
</tbody>
</table>

Sera with NDV antibody titre \( \geq \log_2 3 \) were considered positive.

DISCUSSION

The result of this study showed that all the farmers (100%) involved in commercial poultry production in Jos South Local Government Area, were aware of ND. This observation points to the fact that ND is indeed of great economic importance as it is said to be enzootic in Nigeria as reported by Sa’aidu et al. in 1994 and also said to be a major disease problem of poultry in many other countries of the world, especially in Africa and Asia as reported by Spradbrow (1992); Awan et al. (1994) and Oladele et al. (2005).

This study also showed that commercial chickens in Jos South LGA of Plateau State, had NDV antibodies. This indicated that farmers in this area often vaccinate their birds against ND. This supports the report by Sa’aidu et al. (2006) that commercial poultry are routinely vaccinated against ND.

The OIE (2000) recommended that haemagglutination Inhibition (HI) antibody titer between \( \log_2 0 \) and \( \log_2 3 \) is considered negative because they produce no antibody against the virus while HI antibody titer between \( \log_2 3 \) and \( \log_2 12 \) is protective for chickens because it produces antibodies against the virus (Alders and Spradbrow, 2000 and Aldous et al., 2003). An HI antibody titer of \( \log_2 4 \) and the above ones is indicative of exposure to the virus at one time or the other and eventual production of neutralizing antibodies to protect the chicken up to the point of sale (Joseph et al., 2014). The high HI antibody titer may be due to an infection by a virulent strain of the virus such as mesogenic strains which are viruses causing clinical signs consisting of respiratory and neurological signs with low mortality and lentogenic strains which are viruses causing mild infection of the respiratory tract without visible morbidity and mortality (Seal et al., 2000).

A ND-HI titer of \( \log_2 3 \) (i.e, 1:8) and above is generally accepted as an indicative of specific immunity (Allan and Gough, 1974; Spradbrow et al., 1980 and Jagne et al., 1991). Using this criterion in this present study, 2.6% of the total number of commercial chickens tested, showed no serological evidence of specific immunity to NDV while 97.5% of the total number of chickens tested showed serological evidence of the presence of NDV. It is noteworthy that the majority of the chickens tested had a protective level of antibodies to NDV. The HI test revealed that 9 of the chickens tested showed a NDV Ab titer of < \( \log_2 3 \) (1:2 to 1:4). This result showed that the serum antibody titers were too low to protect the birds from NDV infection. Similar results had been described by Awan et al. (1994). There are several possible reasons for this low level of protection in these birds; these may include, vaccine failure, impaired immune competence due to immunosuppressive diseases. Low NDV antibody prevalence is suggestive of an inter-epidemic phase or early phase of ND infection (Awan et al., 1994). Problem of ND outbreak or infection is envisaged and expected in these particular chickens unless the vaccination practice is improved substantially. 345 (97.5%) out of the total number of chickens tested had NDV Ab titer that varied between \( \log_2 3 \) and \( \log_2 12 \). Differentiation between vaccine titer and field challenge is difficult (Awan et al., 1994). In practice, a high antibody titer is indicative of a recent infection (Luc et al., 1992). The wider range of NDV Ab titer in some chickens may be due to natural infection with pathogenic field strain which is known to produce higher antibody titer than vaccination (Luc et al., 1992).

In Nigeria, ND has been noted to be more common during the cold harmattan periods and this is in agreement with the observations of high prevalence from November to February (Abdu et al., 1992 and Saidu et al., 1994). The harmattan period of November to February in Nigeria is characterized by wind drop in ambient temperature, dryness and other harsh weather conditions and this is believed to lower the immune status of birds making it possible for ND to manifest in commercial birds that have ordinary or lowered herd immunity to ND. Some migratory birds and birds of prey are common during this period of harmattan and their role in the epidemiology of ND may be very important.

Newcastle disease was reported prevalent in most parts of the Northern Nigeria with outbreaks seen in Bauchi State (Nwankiti et al., 2010); Borno State (El-Yuguda et al., 2009); Jigawa State (Wakawa et al., 2009); Nassarawa State (Salihu et al., 2012);
Kaduna State (Nwanta et al., 2006) and Plateau State (Musa et al., 2009). A study carried out by Lawal et al. (2015) in Gombe State, Northeastern, Nigeria, revealed an overall prevalence rate of 55.5% of ND in the State. This concurred with previous studies by Nwankiti et al. (2010) who reported prevalence rate of 56.3% in Bauchi State, Northeastern Nigeria. However, it was relatively higher than the prevalence rates of 51.9% as reported by Musa et al. (2009) in Plateau State; 52.2% reported by Sadig et al. (2011) in Borno State and lower than 73.3% reported by Nwanta et al. (2006) in Kaduna State, Northwestern Nigeria.

The most commercial poultry farmers in the study area claimed to have been vaccinating their flocks. Mariana et al. (2016) reported in their study that vaccination of chickens is able to prevent internal egg contamination, reducing egg shell surface contamination and also reducing shedding from digestive and respiratory tracts in virulent NDV challenged hens (Mariana et al., 2016).

In the US, however, the virus has been eradicated due to stringent adherence to poultry management rules and any virulent strains are of foreign origin from places where strict compliance to management regulations and good sanitary practices is lacking (Qin et al., 2008).

The higher NDV antibody titer of between log2 8 to log2 12 in this present study may be suggestive of ND infection and this seems consistent with the findings of Sa’idu et al. (2006) and Nwanta et al. (2006), where both reported the disease to be common during the dry harmattan period (November – March) with cold stress also been reported to exacerbate the epidemiology of the ND. Alders and Spradbrow (2001) reported that the windy harmattan encourages the spread of the NDV. Although, Aliyu et al. (2015), has a contrary findings. The results of the study by Aliyu et al. (2015) showed that the difference in the prevalence of ND in the dry season and in the rainy season was significant. The findings in that study were not in agreement with reports made by Sa’idu et al. (1994) and Hall et al. (1999) on the seasonality of ND, which revealed that the highest prevalence of the disease occurred between October and March, possibly because of the cold weather with high wind velocity (Abdu et al., 1992).

Shafqat et al. (2015) presented a field data suggesting that, despite high levels of anti-NDV antibody titers of >log2 3 HI in 99% of the tested birds in different farms and localities, there was a very high incidence of the disease (Shafqat et al., 2015).

One of the reasons attributed to this change in findings was that poultry farmers are more enlightened about the need for reporting disease outbreak to Veterinary clinic, thus, it was deduced under probability that the high prevalence in the layers may be due to arbitrary vaccination of birds within the egg production period.

Exclusive dependence on the erratic power supply for vaccine storage may lead to vaccine failure (Okwor et al., 2009). The availability of poor quality vaccines and presence of rampant unreliable vaccination schedules against ND could have contributed to the increased rate of the disease. However, the history of vaccination program is very important in the interpretation of results.

CONCLUSION

In conclusion, there is a high level of awareness of farmers in Jos South Local Government Area, Plateau State, of Newcastle disease and its control through vaccination. High percentage of chickens that were positive to NDV Ab in this study indicates that ND is a common and endemic disease of chickens; also, the level of protection of commercial chickens in this study was found satisfactory.

It is therefore recommended, that strict regulations must be adopted against outbreak of NDV infection, such as restriction of movements in and around the farms. Biosecurity measures and continuous surveillance must also be applied. Continual boosting of immunity of birds with NDV vaccine must also be included in order to reduce economic losses usually caused by Newcastle disease outbreak. Farmers must also source and vaccinate their flocks with the help of veterinarians and in accordance with the recommended vaccination program.

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Competing interests

Authors have declared that no competing interests exist as regards this manuscript.

REFERENCES

Abdu PA, Mera UM and Sai’idu LA (1992). Study of chicken mortality in Zaria, Nigeria, In:


Aliyu HB, Sa‘i du L, Abdu PA and Oladele SB (2014). Response of commercial chickens to challenge with Newcastle disease virus (Kudu 113 Strain) following immunization with different Newcastle disease vaccines. Presented at 51st Congress of Nigerian Veterinary Medical Association held in Kaduna. pp 151.


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