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Research Article

Influence of Sex and Management System on Seroprevalence of Newcastle Disease Antibodies in Indigenous Chicken in Ashanti Region, Ghana

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ABSTRACT

This study sought to provide data on influence of sex and management system on seroprevalence of Newcastle disease (ND) in unvaccinated indigenous chicken in Ashanti Region, Ghana. A total of seventy-one (71) local chickens were screened for ND virus antibodies using haemagglutination inhibition (HI) test. The overall seroprevalence of 69.0% was obtained. A higher ND antibodies seroprevalence of 60.56% was recorded in local chicken at Aboaso (kept under extensive system) than those from Amakom (kept under intensive system) with 8.45%. More female birds from extensive system (11 (69.1%) tested positive for the ND antibodies also a higher mean titer of 6.4 were obtained in positive male birds also the same system. The differences in seroprevalence with respect to management systems and the mean titre values with respect to sex of birds were statistically significant ($p<0.05$). The findings indicate that ND is endemic in Ashanti region particularly at Aboaso where extensive system is practised. It is imperative to conclude that the extensive system of management of indigenous chicken play a role in the spread of ND in Ghana.

Keywords: *Newcastle disease, seroprevalence, indigenous chicken, Management systems, Ghana*

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INTRODUCTION

In Ghana, Agriculture contributes about 22.0% to the Ghanaian gross domestic product (GDP). Poultry production being an integral part of the livestock sector of Agriculture plays a vital role in the country's economy due to its immense impact on the Agricultural contribution to GDP in Ghana (Ghana Statistical Service, 2014). The poultry Industry in Ghana contributes massively to the Agricultural sector which contributes 34.0%. The population of poultry in Ghana is estimated to be 37 million (Tay *et al*, 2017).

The poultry industry plays numerous roles serving as a source of employment and income to many Ghanaians, source of animal protein and source of organic manure for crops and fish farming (Aning *et al*., 2016). Family poultry production is a vital agricultural activity practice in most rural areas in Africa. In Ghana, family poultry production is mainly based on the extensive system of raising chickens, guinea fowl and ducks on free range (Tay *et al*, 2017). There is also an active growing commercial sector concentrated mainly in Ashanti, Brong-Ahafo and Greater Accra Regions (Aning, 2016).

Newcastle disease (ND) is a highly contagious viral disease that affects many species of domestic and wild birds in the world including developing countries (Al-Garib *et al*, 2003). Having been identified as a major impediment to poultry production particularly among the rural poultry population in Ghana, about 80% of the annual mortality of rural poultry has been attributed to outbreaks of Newcastle disease (VSD, 1998). The disease is characterized by coughing, gasping, sneezing and rales as well as dropping wings, dragging legs, swelling of the tissues around the eye and the neck, circling and cessation of egg production (Wakamatsu ,2006). Newcastle Disease is considered an important disease of local chickens in Ghana and Africa as a whole and is often tentatively diagnosed by experience (based on clinical signs), with little or no laboratory investigation. Literature on Newcastle disease(ND) in poultry is available for many countries worldwide, however, such information especially in local chicken in Ghana is very scanty especially in respect to the influence of management syatems and sex. It

is therefore relevant to determine and document ND specific antibodies in indigenous chicken in respect to these factors in Ashanti region, Ghana.

Study location and Design: The study was carried out in Amakom (Latitude 6'41''N, Longitude 1'36''W) within the Kumasi metropolis and Aboaso (Latitude 6'49''N, Longitude 1'36''W) within the Kwabre East municipality all in the Ashanti region of Ghana. Selection of the study area was carried out using stratified random sampling technique. The three regions where poultry populations are high in Ghana were listed to include Brong-Ahafo, Ashanti, and Greater Accra. Simple random selection was used to select Ashanti Region as well as the Kwabre East Municipality was chosen because of the concentration of local chicken. The study was conducted between January and March, 2020.

Study population and adopted system of management: In this study, a total of seventy-one (71) local chickens were sourced from Amakom and Aboaso respectively. Out of the 71 local chickens, forty-eight (48) were obtained from Aboaso whilst twenty- three (23) were sourced from Amakom. Local chicken from Aboaso were raised on extensive system whilst that of Amakom were raised in intensive system.

Sample collection and storage: Blood volume of about 2mls was collected aseptically from wing vein of each bird using sterile 2ml disposable plastic syringe. The blood sample were kept in flask containing ice park and carried to the regional veterinary laboratory, Amakom. Serum were obtained from each of the blood samples, labelled appropriately and stored in Eppendorf tubes under -20 degrees until Haemagglutination Inhibition (HI) test was carried out.

Preparation of chicken red blood cell (RBC) suspension: 5 ml chicken blood was collected aseptically using a disposable syringe into a test tube containing about 1ml Alsever's solution as anticoagulant. The blood was centrifuged at 4900 rpm for 5minutes and plasma and buffy coat were removed with a pipette. After washing three times with phosphate buffered saline (PBS) 1% suspension in PBS was prepared for Haemagglutination Inhibition (HI) test.

Haemagglutination Inhibition (HI) test: The HI test was performed according to the OIE standard protocol. Briefly,0.025ml of PBS was dispensed into each well of plastic V-bottomed microliter plate then 0.025ml of serum was placed into the first well of the plate. Two-fold serial dilution of 0.025ml serum was made with PBS in V-bottomed microliter plates up to 11^{th} well. 0.025ml Newcastle viral antigen was added up to 11^{th} well and kept at room temperature for 30minutes.Chicken red blood cells (0,025ml of 1%(v/v)) was then added to each well. After gentle mixing, the RBC's were allowed to settle at room temperature for 30minutes and agglutination was assessed by tilting the plates. The samples showing peculiar central button shaped settling of RBC's were recorded as positive and maximum dilution of each sample causing haemagglutination inhibition was the end point. The HI titre of each serum was expressed as reciprocal of the serum dilution.

Data analysis: Serological data obtained was subjected to descriptive statistics using Microsoft Excel Version 2010 and Statistical Package for Social Sciences (SPSS) Version 20. The frequencies, percentages and means of the serological data were derived. The results were presented using cross-tabulations. The serological data with respect to the sex and location of birds were evaluated using the Chi-square test at 95% confidence interval. All p values less than 0.05 were deemed to be significant.

RESULTS

Prevalence of Newcastle Disease Antibodies by Location

Out of the 71 samples screened, the results show that 49 samples representing 69.01% were positive for Newcastle disease virus (NDV) antibodies as shown in Table 1, whilst 22 samples (30.99%) were negative. Findings in Table 1 also shows that samples collected from birds (kept under extensive system) at Aboaso presented higher prevalence of ND of 60.56% than those collected from birds (kept under intensive system) in Amakom which presented a seroprevalence of 8.45%. The differences in seroprevalence from different locations were found to be statistically significant ($p<0.05$).

Table 1:
Prevalence of Newcastle disease antibodies in local chickens from two localities in Ashanti region.

	Outcome of Newcastle Titres					
Location	**Number sampled**	**Positive**	**Negative**	**HI Seroprevalence**	x^2	**p-value**
Amakom (Intensive system)	23(32.4%)	6 (26.08%)	17 (73.92%)	6 (8.45%)	27.93	0.0000*
Aboaso (Extensive System)	48(67.6%)	43 (89.60%)	5 (10.41%)	43 (60.56%)		
Total	**71 (100%)**	**49 (69.01%)**	**22 (30.99%)**	**49 (69.01%)**		

**= statistical significance at significance level of p≤0.05.*

Table 2:
Distribution of Newcastle diseases antibodies titre ranges in the indigenous chickens

	Newcastle Titre Range (log_2)					
Location	**0**	**1-5**	**6-10**	**Above 10**	**Totals**	**P value**
Amakom	17 (73.92%)*	6 (26.08%)*	0	0	23 (100%)	<0.0000
Aboaso	5 (10.41%)*	11 (22.92%)*	29 (60.42%)*	3 (6.25%)*	48 (100%)	
Overall	**22 (30.99%)**	**17 (23.94%)**	**29 (40.84%)**	**3 (4.23%)**	**71 (100%)**	

**= statistical significance at significance level of p≤0.05.*

Table 3:
Distribution of prevalence of Newcastle disease antibodies by sex of birds

Sex of Chicken	Location	No of birds	No. of positive	Average Titre	P value
	Amakom	3(13.0%)	1(33.3%)	2	0.0002*
Males	Aboaso	13(27.1%)	10(76.9%)	7.2	
	Overall	**16 (22.5%)**	**11(68.8%)**	**6.4**	
	Amakom	20(87.0%)	5(25%)	1.5	
Females	Aboaso	35(72.9%)	33(94.3%)	5.4	
	Overall	**55(77.5%)**	**38(69.1%)**	**4.6**	

*****= *statistical significance at significance level of p≤0.05.*

Table 2 showed the various titer ranges of local chicken birds from Amakom and Aboaso, where birds that tested negative or had no detectable ND antibodies were designated 0, and those that tested positive for ND virus antibodies were grouped into categories; 1-5, 6-10 and above 10(log_2). At Amakom, where intensive system was used, most of the birds (73.92%) tested negative for ND antibodies whilst 6 (26.08%) of the birds tested positive within the 1-5 log_2 titre range. In Aboaso, where extensive system was adopted, 29 (60.42%) of the birds were positive within the 6-10 log_2 titre range whereas 11 (22.92%) presented titers within 1-5 (log_2) and 3 (6.25%) presented titres above 10 log_2. However, 5 (10.41%) of the birds at Aboaso tested negative. With the overall outcome, more 22 (40.84%) of the ND titres were in the 6-10 log_2 range. The noted difference in the recorded titre values were found to be statistically significant ($p<0.05$) (Table 2).

Prevalence of Newcastle Disease Antibodies by sex: In this study, the prevalence of ND antibodies with respect to sex was as shown in Table 3. More female birds (11 (69.1%) tested positive for the ND antibodies as compared to the males (38 (68.8%). It was also recorded that the overall mean titer of ND antibodies of 4.6 in the positive female birds were lower as compared to the mean titer of 6.4 in positive male birds. With respect to males, 76.95% tested positive in Aboaso whilst 33.3% males tested positive in Amakom. The mean ND titre values for male birds of 7.2 in Aboaso were higher than the mean titre value of 2 in Amakom. For the female birds, the 69.1% prevalence of positive ND antibodies in females in Aboaso was higher than the 94.3% prevalence of ND antibodies at Amakom. In addition, the mean titers of 5.4 for ND antibodies in female birds at Aboaso were higher than that 1.5 mean titre recorded for female birds in Amakom (Table 3). The differences between the prevalence of ND antibodies in males and females showed to be statistically significant ($p<0.05$).

DISCUSSION

This survey was aimed at assessing the seroprevalence of Newcastle in indigenous chicken in selected areas of Ashanti region, Ghana. The findings revealed the presence of circulating antibodies of Newcastle disease among local chickens in the Ashanti region of Ghana, with an overall prevalence of 69.01%. The seroprevalence in this study is quite higher than the 66.5% recorded by Owoya *et al*., (2016) in Nigeria but similar to the findings of Boakye *et al* (2016) which was higher (81.8%) as compared to this study. The differences in these differences could be as a result of differences in the locations of each study.

The prevalence of ND was higher in birds at Aboaso (60.56%) which were kept on extensive system as compared to those in Amakom (8.45%) which were kept in intensive system. The differences in the seroprevalence could be attributed to the different system of management employed. The higher seroprevalence in birds at Aboaso could be explained by the continuous of these free range birds to the ND virus while those in confinement are less exposed. This findings clearly showed that exposure to ND virus of indigenous chicken is often by the free range system adopted.

With respect to sex of birds, a higher overall prevalence of ND antibodies was recorded in females. This finding agrees with the finding of other workers (Sarkelm *et al*. 2005, Boakye *et al* 2016) who reported ND was higher ND antibodies in female bird than in male birds, however, the findings of this study is in sharp contrast to finding of Aschalew *et al*. (2005) who reported a higher prevalence of ND antibodies among males (21.74%) as compared to females (19.16%). In this study also, the males presented higher average antibodies titers females which is in agreement with findings of Boakye *et al*. (2016) in Ghana with average titre of 9.0 for males and 8.2 for females.

Results in this study pointed out that more (40.84) % of the local birds especially those on free range in Abaoso, were within the ND virus titre limit of 6-10 (log_2). This finding is in agreement with that of Boakye *et al*., (2016) who also reported that most of the local chickens from households presented titers greater than 6 log_2. This shows that in the Ashanti Region of Ghana, higher ND titres are common to local chicken that are exposed to the virus through the extensive system while those in confinement or under intensive system with ND titre values within the 1-5 (log_2) range will need regular boosters as often given in commercial poultry production.

In conclusion, this study showed overall prevalence of 69.0% with 60.56% prevalence for indigenous chicken on free range (Aboaso) and 8.45% for those in intensive system at Amakom respectively. System of management and sex of birds had a significant effect on the seroprevalence of local chicken in this study. This indicates that ND is endemic in unvaccinated indigenous chicken in Ashanti region and level

of seroprevalence of ND antibodies is influenced by system of management of birds and sex. More research should be done on the use of thermostable and oral or in-feed vaccine delivery systems for rural poultry production.

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