Efficacy of Feed Coated Newcastle Disease I2 Vaccine in Village Chickens in Gombe State, Nigeria

Lawal JR1*, El-Yuguda AD2 and Ibrahim UI1

1Department of Veterinary Medicine, University of Maiduguri, Nigeria
2Animal Virus Research Laboratory, Department of Veterinary Microbiology and Parasitology, University of Maiduguri, Nigeria

Abstract

A study of response of village chickens to vaccination with ND I2 vaccine coated on maize grit as vaccine carrier was carried out in some selected LGAs of Gombe State, using haemagglutination inhibition (HI) test. Vaccination efficacy of maize grit coated with Newcastles Disease I2 vaccine has been compared between adult and young, village chickens. The study showed that 94.3% of the vaccinated village chickens (adults and chicks) seroconverted with protective levels of antibodies against ND virus. Those vaccinated with the maize grit coated vaccine exhibited antibody titre of between 1:16 to 1:8192 with GMT values of 109 to 245. There was a significant difference (P<0.05) in the response of the vaccinated adult village chickens as compared to the younger birds (chicks). It is concluded from the study that maize grit is a very suitable vaccine carrier for the delivery of ND I2 vaccine to village chickens.

Keywords: Newcastle disease I2 vaccine; Maize grit; Village chickens; Seroconversion; Gombe State; Nigeria

Introduction

Newcastle disease (ND) is an acute, contagious and highly pathogenic viral disease of both domestic and wild birds worldwide [1-4]. This disease is caused by a diverse group of viruses with the highly virulent strains endemic in Nigeria [5,6]. It is considered the most economically important avian viral disease in the world especially in developed countries due to its devastating effect on the industry [7-9]. It can produce mortality of up to 100% among infected populations of birds [10,11], and unfortunately the prognosis is poor [12,13]. Vaccination is currently the most effective method of controlling endemic Newcastle disease in both commercial and village chickens, but is rarely given priority in rural communities in Nigeria where majority of poultry are kept [14-16]. The administration of vaccines is by far the most humane and cost effective method of combating the spread of diseases [15,17]. The protection afforded by an efficacious vaccine not only removes the need for the administration of treatments, but also guards against the economically damaging consequences of disease [15,18]. Avirulent NDV and ND I2 strains of ND vaccines have been reported to give varying degrees of successes in both laboratory and field trials [19-22]. This study is therefore aimed at studying the responses of village chickens to Newcastle disease I2 vaccine coated on maize grit as vaccine vehicle.

Materials and Methods

Study area

This study was carried out in some selected LGAs of Gombe State, Nigeria. Gombe State located between latitude 9°30' and 12°3' N and longitude 8°45' and 11°45' E, has an estimated population of 2.4 million people based on the 2006 population census by the National Population commission [23]. The state is situated in the North Eastern zone of Nigeria and shares boundaries with Bauchi, Taraba, Adamawa, Yobe and Borno States. The state has Eleven Local Government Areas that are populated by ethnic groups including Hausa, Fulani, Tera, Waja, Tangale and Bolawa among others. The climatic and edaphic factors favour crop and livestock agriculture. The total poultry population in Gombe State is approximately 508,305 comprising 462,000 backyard poultry and 46,305 exotic poultry [24].

Source of Newcastle disease (ND) I2 vaccine

The Newcastle disease I2 vaccine that was used in this study was obtained from Viral Research Department, National Veterinary Research Institute (NVRI), Vom, Plateau State, Nigeria. The vials of the vaccines were 50 dose vials meant to be reconstituted in 50 ml of chlorine free water and to be given orally at 1 ml/bird. The batch number of the vaccines and expiration dates were 4/2011 and Oct 2012 respectively.

Selection of villages for the Newcastle disease I2 vaccination

Five (5) out of the eleven (11) Local Government Areas (LGAs) of Gombe State were selected for the study. In each LGA, four villages were selected, and from each village four (4) households that owns moderate number of village chickens and that were willing to volunteer, cooperate and give full support for the success of the study were randomly selected. The Local Government Areas that were used for this study were Gombe, Akko, Kwami, Funakaye and Yamaltu Deba Local Government Areas.

Processing and coating of vaccine carrier with the Newcastle disease I2 vaccine

Maize grit that was used as the vaccine carrier in this study was maize that was per boiled for 15 minutes, washed and spread immediately to dry under the sun. The dried per boiled maize was then polished (‘surfe’) to remove the maize husk and then crushed into a gritty mash. The maize grit was soaked in hot water and allowed to stand until the water cools, washed thoroughly and sieved to reduce the starch content and was again sun dried. Using a weighing scale, the

*Corresponding author: JallaiIudeen Rabana Lawal, Department of Veterinary Medicine, University of Maiduguri, PMB 1069, Maiduguri, Borno State, Nigeria, Tel: +2348032886428; E-mail: rabanajallaiIudeen@yahoo.com

Received April 15, 2016; Accepted June 13, 2016; Published June 17, 2016

Citation: Lawal JR, El-Yuguda AD, Ibrahim UI (2016) Efficacy of Feed Coated Newcastle Disease I2 Vaccine in Village Chickens in Gombe State, Nigeria. J Vet Sci Technol 7: 349. doi:10.4172/2157-7579.1000349

Copyright: © 2016 Lawal JR, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.
maize grit was weighed and packaged in polythene bags of 1 kg/package and stored at room temperature. Two vials of the 50 doses of ND I\textsubscript{2} vaccines were reconstituted in 100 ml of chlorine free water and used to mix each 1 kg of the maize grit (at a ratio of 1 ml to 10 g of the dried maize grit) using a hand sprayer. The maize grit coated ND I\textsubscript{2} vaccine was administering to the village chickens as previously described by Alders and Spradbrow [17].

**Serology**

Serum samples were tested for Newcastle disease virus specific antibodies using a modification of the Hemagglutination Inhibition (HI) test previously described by Baba et al. [27].

**Data analysis**

Hemagglutination inhibition titres obtained were expressed as geometric mean titre (GMT) values according to the method described by Garner et al. [28] using the formula \( X_\text{geo} = \text{antilog}_{10}\left\{1/n \sum\text{log}_{10} X_i\right\} \) where \( n=\text{number tested}, X_i=\text{the reciprocal of dilution and } f=\text{frequency.} \) The data generated from the study was entered to excel spreadsheet. All categorical data were entered into contingency tables and analyzed using chi square test, while the geometric means of all numeric data were compared using t-statistic or analysis of variance (ANOVA) for paired or multiple data columns respectively using Statgraphix plus Version 5.0, November 2000 (Statistical Graphics Corp.). The level of statistical significance was set a p-value less than or equal to 0.05.

**Results**

Tables 1 and 2 shows the distribution of ND HI antibodies at pre and post vaccination of village chickens in some selected areas of Gombe state. The distribution of the pre-vaccinal (baseline titre) ND HI antibodies among the different Local Government Areas of Gombe state showed no statistical difference (P>0.05) in prevalence rates and GMT values (Tables 1-3). The adult vaccines in all the 5 LGAs exhibited high seroconversion from 37.5% at day zero to 94.3% at day 28 post vaccination (Tables 1 and 2). The pre-vaccinal baseline titres of the adult vaccines varied from 1:2 to 1:64 with GMT of 12.3 on day 28 (Tables 3 and 4). The direct oral drench group showed a baseline titre of 1:2 to 1:64 with GMT of 3.1 and 1:2 to 1:64 with GMT of 12.3 on day 28 PV (Tables 3 and 4). The direct oral drench group showed a baseline titre of 1:2 to 1:64 with GMT of 3.6 and 1:512 to 1:2048 with GMT of 861 (Table 5). There was no statistical difference (P>0.05) noted among the vaccines from the different LGAs.

**Discussion**

The use of maize grit as the vaccine vehicle to deliver the ND I\textsubscript{2} vaccine in Village Chickens in Gombe State,

### Table 1: Distribution of Newcastle disease HI antibody titres in sera of adult village chickens collected prior to vaccination with Newcastle disease I\textsubscript{2} vaccine coated on maize grit in some Local Government Areas of Gombe State.

| LGA         | No. tested | No. (%) positive | Distribution of HI antibody titres |
|-------------|------------|------------------|-----------------------------------|
|             |            |                  | 2    | 4    | 8    | 16   | 32   | 64   | 128  | GMT  |
| Gombe       | 160        | 56 (35.0)        | 2    | 6    | 22   | 4    | 10   | 12   | 0    | 2.6  |
| Akko        | 160        | 66 (41.3)        | 10   | 26   | 17   | 2    | 5    | 3    | 0    | 2.2  |
| Kwani       | 160        | 45 (28.1)        | 1    | 6    | 12   | 4    | 6    | 16   | 0    | 2.3  |
| Yamaltu Deba| 160        | 70 (43.8)        | 1    | 9    | 18   | 5    | 4    | 33   | 0    | 3.8  |
| Funakaye    | 160        | 63 (39.4)        | 1    | 12   | 16   | 10   | 5    | 18   | 1    | 3.0  |
| Total       | 800        | 300 (37.5)       | 15   | 53   | 85   | 25   | 30   | 82   | 4    | 14.1 |

### Table 2: Distribution of ND HI antibody titres in sera of adult village chickens 28 days post-vaccination with ND I\textsubscript{2} vaccine coated on maize grit in some Local Government Areas of Gombe State.

| LGA         | No. tested | No. (%) positive | Distribution of the reciprocal of HI antibody titres | GMT values |
|-------------|------------|------------------|-----------------------------------------------------|------------|
|             |            |                  | 2       | 4     | 8     | 16    | 32    | 64    | 128   | 256   | 512   | 1024  | 2048  | 4096  | 8192  |
| Gombe       | 80         | 73(91.3)         | 0       | 0     | 0     | 2     | 0     | 4     | 18    | 24    | 6     | 4     | 8     | 1     | 245.1 |
| Akko        | 80         | 71 (88.8)        | 0       | 0     | 0     | 1     | 2     | 12    | 27    | 11    | 14    | 3     | 0     | 0     | 119.4 |
| Kwani       | 80         | 75 (93.8)        | 0       | 0     | 0     | 1     | 8     | 15    | 30    | 14    | 4     | 2     | 2     | 0     | 109.5 |
| Yamaltu Deba| 80         | 80 (100)         | 0       | 0     | 0     | 6     | 3     | 12    | 27    | 18    | 7     | 6     | 1     | 0     | 149.6 |
| Funakaye    | 80         | 76 (97.5)        | 0       | 0     | 0     | 3     | 8     | 15    | 30    | 14    | 4     | 2     | 2     | 0     | 109.5 |
| Total       | 400        | 377(94.3)        | 0       | 0     | 0     | 13    | 19    | 53    | 125   | 59    | 62    | 24    | 10    | 9     | 190.1 |
vaccine in this study was meant to obviate the problem of chasing, catching and vaccinating individual bird which is difficult in the natural habitat of the village chickens. The choice of maize in this study to be used as vaccine carrier is in accordance to similar research by Ibrahim et al. [29] that reported maize to be a reliable vaccine carrier. The findings of this study showed that the ND I2 vaccine coated on maize grit has led the vaccinated village chickens to seroconvert with high antibody titres in all the study areas. This finding concurs with field observations that coated feed such as maize grit be used to vaccinate free-range poultry. The efficacy of any vaccine is determined mainly by assessment of the level of antibody produced in the target birds [17] and also confirmed the findings of this study showed that the ND I2 vaccine coated on maize grit receive the same and exact vaccine coated and direct oral drench vaccine demonstrated high antibody titres, the later demonstrated a more uniform response and hence higher GMT values. This could be because it was not possible to ensure that all the village chickens in the mass application of the ND I2 vaccine coated on the maize grit receive the same and exact dose of the vaccine. This difference in the feed in take also appears to have been the primary cause for the difference in titres between the adult chickens and chicks in this present study. The adult chickens consumed much of the feed while the chicks just picked tiny grains. This resulted in higher immune response in the adult chickens when compared to the chicks. Similarly, Erick et al. [31] found that a significantly large proportion of vaccinated adult chickens attaining protective immunity against NDV as compared to growers and chicks which were attributed to repeated exposure and/or well developed immune system in adult chickens leading to an adequate response to vaccination. Other factors to consider include the prevalence of other infectious diseases like IBD capable of immunosuppressing the village chickens. El-Yuguda et al. [32] have reported significant depression of primary antibody of chickens to ND vaccine when administered one week after IBD infection or vaccination. It is therefore fundamental to monitor the prevalence of other infectious diseases capable of immunosuppression and to implement specific vaccination programme for their control. Also the rearing of ducks, guinea fowls, pigeons and doves (which are natural fliers) together with village chickens further compounds the difficulty in ND control strategies among the village poultry population. But vaccination in these classes of birds may be attempted using the feed coated ND I2 vaccine by spraying over the locations where these birds usually scavenge for surface water in the village chicken is that most village chickens are used to early morning feeding in the study area and this makes it easy for the vaccine coated seeds to be consumed early before the vaccine virus gets inactivated by environmental conditions. Whereas if the vaccine was to be given in drinking water, only a small percentage of the chickens may take the water within the required time, due to the availability of surface water in the environment. The study showed that significantly larger proportion of vaccinated adult village chickens seroconverted to higher antibodies levels than the chicks. This finding may not be unconnected to the possible repeated exposure and/or well developed immune system in the adult chickens leading to an adequate response. The high NDV HI antibody titres recorded in the vaccinated chickens in this study must have resulted from anamnestic response in the birds due to previous natural exposure to NDV.

Although all the village chickens vaccinated with both the feed coated and direct oral drench vaccine demonstrated high antibody titres, the later demonstrated a more uniform response and hence higher GMT values. This could be because it was not possible to ensure that all the village chickens in the mass application of the ND I2 vaccine coated on the maize grit receive the same and exact dose of the vaccine. This difference in the feed in take also appears to have been the primary cause for the difference in titres between the adult chickens and chicks in this present study. The adult chickens consumed much of the feed while the chicks just picked tiny grains. This resulted in higher immune response in the adult chickens when compared to the chicks. Similarly, Erick et al. [31] found that a significantly large proportion of vaccinated adult chickens attaining protective immunity against NDV as compared to growers and chicks which were attributed to repeated exposure and/or well developed immune system in adult chickens leading to an adequate response to vaccination. Other factors to consider include the prevalence of other infectious diseases like IBD capable of immunosuppressing the village chickens. El-Yuguda et al. [32] have reported significant depression of primary antibody of chickens to ND vaccine when administered one week after IBD infection or vaccination. It is therefore fundamental to monitor the prevalence of other infectious diseases capable of immunosuppression and to implement specific vaccination programme for their control. Also the rearing of ducks, guinea fowls, pigeons and doves (which are natural fliers) together with village chickens further compounds the difficulty in ND control strategies among the village poultry population. But vaccination in these classes of birds may be attempted using the feed coated ND I2 vaccine by spraying over the locations where these birds usually scavenge for food. Since guinea fowl vaccination using different feeds as vaccine vehicles have been reported by Baba et al. [21] using thermostable NDV-V vaccine. It is therefore suggestive that thermostable ND I2 vaccine coated on feed such as maize grit be used to vaccinate free-living and scavenging birds.

| LGA     | No. tested | No. (%) positive | Distribution of reciprocal of ND HI antibody titres | GMT values |
|---------|------------|-----------------|---------------------------------------------------|-------------|
|         |            |                 | 2 4 8 16 32 64 128                                 |             |
| Gombe   | 40         | 9 (22.5)        | 5 4 0 0 0 0 0                                    | 1.5         |
| Akko    | 40         | 12 (30.0)       | 8 3 1 0 0 0 0                                   | 1.3         |
| Kwami   | 40         | 7 (17.5)        | 3 4 0 0 0 0 0                                   | 1.2         |
| Yamaltu Deba | 40 | 10 (25.0)      | 7 3 0 0 0 0 0                                  | 1.3         |
| Funakaye | 40         | 16 (40.0)       | 5 8 1 0 1 1 0                                  | 1.8         |
| Total   | 200        | 54 (27.0)       | 28 22 2 0 1 1 0                                | 3.1         |

Table 3: Distribution of Newcastle disease HI antibody titres in sera collected prior to vaccination with Newcastle disease I2 vaccine coated on maize grit in young village chickens (chicks) in some Local Government Areas of Gombe State.

| LGA     | No. tested | No. (%) positive | Distribution of reciprocal of ND HI antibody titres | GMT values |
|---------|------------|-----------------|---------------------------------------------------|-------------|
|         |            |                 | 2 4 8 16 32 64 128                                 |             |
| Gombe   | 32         | 31 (96.9)       | 5 4 11 6 3 2 0                                    | 8.2         |
| Akko    | 32         | 32 (100)        | 0 1 17 9 3 2 0                                   | 12.3        |
| Kwami   | 32         | 30 (93.8)       | 1 0 9 8 5 7 0                                   | 15.7        |
| Yamaltu Deba | 32 | 32 (100)      | 2 5 15 2 6 2 0                                 | 10.2        |
| Funakaye | 32         | 32 (100)        | 0 6 15 4 2 5 0                                 | 11.6        |
| Total   | 160        | 157 (98.1)      | 8 16 69 29 19 18 0                              | 12.3        |

Table 4: Distribution of Newcastle disease HI antibody titres in chick sera collected 28 days post vaccination with ND I2 vaccine coated on maize grit in some Local Government Areas of Gombe State.

| Sampling period | Number tested | No. (%) positive | Distribution of reciprocal of ND HI antibody titres | GMT |
|-----------------|---------------|-----------------|---------------------------------------------------|-----|
|                 |               |                 | 2 4 8 16 32 64 128 256 512 1024 2048             |     |
| Pre- vaccination| 24            | 11 (45.8%)      | 1 2 2 0 3 3 0 0 0 0 0 0                          | 3.6 |
| Post- vaccination| 24          | 24 (100%)       | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | 861 |

Table 5: Distribution of ND HI antibody titres of village chickens pre- vaccination and post-vaccination with oral drenches of ND I2 vaccine.
Acknowledgements

The authors wish to thank the Technologists of the Animal Virus Research Laboratory, Department of Veterinary Microbiology and Parasitology, University of Maiduguri and those of the Department of Veterinary Medicine Research Laboratory, University of Maiduguri for their technical assistance.

References

1. Health BC, Lindsey MS, McManus KP, Claxon PD (1991) Newcastle disease vaccine for village chicken. Spradbrow PD (ed). Australian Centre for International Agriculture Research, Canberra, Australia, p: 103.

2. Seal BS, King DJ, Sellers HS (2000) The avian response to Newcastle disease virus. Dev Comp Immunol 24: 257-268.

3. Alexander DJ (2003) Newcastle disease and other avian Paramyxoviruses infections. In: Diseases of Poultry, 11th edn. Saif YM, Barnes HJ, Glisson JR, Faddy AM, McDougald LR, et al. (eds.). Iowa State University Press, Ames 1A, USA; pp: 63-99.

4. Okworo EC, Eze DC (2010) The Annual Prevalence of Newcastle disease in commercial chickens reared in South Eastern Savannah zone of Nigeria. Res J Poult Sci 3: 23-26.

5. Falcon M (2004) Newcastle disease. Semin Avian and Exot Pet Med 13: 79-85.

6. Aldous EW, Alexander DJ (2008) Newcastle disease in pheasants (Phasianus colchicus): a review. Vet J 175: 181-189.

7. El-Yuguda AD, Baba SS (2002) Prevalence of selected viral infections in various age groups of village chickens in Borno state, Nigeria. Nigeria Journal Animal Production 29: 245-250.

8. Ngaji LW, Nyaga PN, Mbutha PG, Bekora LC, Mchiera JN, et al. (2010) Prevalence of Newcastle disease virus in village indigenous chickens in varied agro-ecological zones in Kenya. Livestock Research for Rural Development 22: 1-4.

9. Aziz AGT, Ahmed TA (2010) Serological Survey of Newcastle disease in Domestic chickens in Sulaimani Province. Journal of Zankay Sulaimani 13: 31-38.

10. Ananth R, Kirubaharam JJ, Priyadarshini MLM, Albert A (2008) Isolation of Newcastle disease viruses of high virulence in unvaccinated healthy village chickens in South India. Int J Poult Sci 7: 368-373.

11. Ibu OJ, Okoye JOA, Adugbala EP, Chah KF, Shoibinka SVO, et al. (2009) Prevalence of Newcastle disease viruses in wild and captive birds in Central Nigeria. Int J Poult Sci 8: 574-578.

12. Al-Garib SO, Gielkens ALJ, Grusy E, Kogi G (2003) Review of Newcastle disease virus with particular references to immunity and vaccination. World’s Poult Sci J 59: 185-200.

13. Hassanazadeh M, Fard MHB (2004) A Serological Study of Newcastle Disease in Pre- and Post- vaccinated Village Chicken in North of Iran. Int J Poult Sci 3: 658-661.

14. Abu PA, Sa’idu L, Bawa EK, Umoh JU (2005) Factors that contribute to Newcastle disease. Infectious Bursal disease and Fowl pox Outbreaks in Chickens. Presented at the 42nd Annual congress of the Nigerian Veterinary Medical Association. Held at University of Maiduguri.

15. Marango N, Busani L (2006) The use of vaccination in poultry production. Rev Sci Tech Off Int Epiz 26: 265-274.

16. Nwanta JA, Abu PA, Ezema WS (2008) Epidemiology, Challenges and Prospects for control of Newcastle disease in village poultry in Nigeria. Worlds Poult Sci J 64: 119-127.

17. Alders R, Spradbrow PB (2001) Controlling of Newcastle disease in village chickens. A field manual, Australian Centre for International Agriculture Research (ACIAR), Research monograph No. 82: 1-112.

18. Woolock RF, Harun M, Alders RG (2004) The impact of Newcastle disease control in village chickens on the welfare of rural household in Mozambique. Paper presented at the 4th Co-ordination Meeting of the FAQ / IAEA Co-ordination Research Programme.

19. Wamburu PN (2010) Detection of antibody to Newcastle disease virus in semi-domesticated free-range birds (Numida meleagris and Columba livia domestica) and the risk of transmission of Newcastle disease to village chickens. Short communication. Veterinarni Arhiv 80: 129-134.

20. Msami HM, Young MP (2005) Newcastle disease control using I1 vaccine in Tanzania. Country report. In: Village chicken Poverty alleviation and the sustainable control of Newcastle disease. Australian Centre for International Agricultural Research (ACIAR), Proceedings 131: 67-73.

21. Baba SS, Iheanacho CC, Idris JM, El-Yuguda AD (2006) Food-Based Newcastle disease V4 vaccine in guinea fowl (Numida meleagris Galerula pallas) in Nigeria. Trop Vet 22: 37-45.

22. Echeonwu BC, Ngeli MB, Echeonwu GN, Joaniss TM, Onovoh EM, et al. (2008) Response of chickens to oral vaccination with Newcastle disease virus vaccine strain I2 coated on maize offal. Afr J Biotechnol 7: 1594-1598.

23. http://www.qtsciously.com/

24. Adene DF, Ogunlade AE (2006) The structure and importance of the commercial and village based poultry industry in Nigeria. FAO (Rome) Study, p: 22.

25. Ambal AG, Jones RC (1991) Efficiency of filter paper for measurement of IBHI antibody to Avian Infectious Bronchitis. Bull Anim Health Prod Afr 39: 213-218.

26. Roy P, Nachimthu K, Venugopalan AT (1992) A modified filter paper technique for serosurveillance of Newcastle disease. Short Communication. Vet Res Commun 16: 403-406.

27. Baba SS, El-Yuguda AD, Baba MM (1998) Serological evidence of mixed infection with Newcastle disease and Egg drop syndrome viruses in Village chicken in Borno state, Nigeria. Tropical Veterinarian 16: 137-141.

28. Gamer JS, Jarvis WR, Emori TG, Horan TC, Hughes JM (1988) CDC definitions for nosocomial infections, 1988. Am J Infect Control 16: 128-140.

29. Ibrahim UI, El-Yuguda AD, Tambari PS (2000) Trial of Feed-Based Newcastle disease ‘Lasota’ Vaccine in Chickens using feeds as Vaccine Vehicle. Nig J Exptl Appl Biol 1: 83-86.

30. Alders R, Spradbrow PB (1994) Newcastle disease in Village chickens. Poultry Science Review 5: 57-96.

31. Erick VGF, Albano OM, Rutashobya CTM (2012) Adoption of I1 Vaccine in Immunization of Village Chickens against Newcastle disease virus in Southern Tanzania: Immune Status of Farmer vaccinated birds. Journal of Agricultural Science 4: 23-29.

32. El-Yuguda AD, Wachida AD, Baba SS (2007) Interference of Infectious Bursal Disease (IBD) Virus and Vaccine with the Immune Responses of Guinea Fowls to Newcastle Disease Lasota Vaccination. Afr J Biomed Res 10: 189-192.