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Efficacy of Feed Coated Newcastle Disease I_2 Vaccine in Village Chickens in Gombe State, Nigeria

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Abstract

A study of response of village chickens to vaccination with ND I_2 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 I_2 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 titres 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 I_2 vaccine to village chickens.

Keywords: Newcastle disease I_2 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_4 and ND I_2 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 I_2 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) I_2 vaccine

The Newcastle disease I_2 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 giving 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 I_2 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 I_2 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

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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_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_2 vaccine was administering to the village chickens as previously described by Alders and Spradbrow [17].

Vaccination procedure

The village chickens from the selected households in the five LGAs were locked up in cages, raffia baskets and empty rooms when they returned to their owners' houses to roost in the evening from the scavenging of the day. They were denied access to any source of feed throughout the night before administering the ND I_2 vaccine coated feed to them the following morning. Some village chickens from a different village were used for the normal oral vaccination in water. Each of the birds used in the study were labeled using small number tags tied to their wings and were bled through the wing web vein prior to vaccination.

Blood sample collection

The vaccinated village chickens were bled twice on days zero and 28 post vaccination. Blood samples was collected from the live experimental village chickens through the brachial vein (wing vein) or jugular vein of adult and grower village chickens of both sexes using sterile 2 ml syringes and 21G needles. Each blood was carefully dispensed into plain vacutainer tubes, labeled appropriately and kept at a slanting position at room temperature to allow blood samples to clot. For chicks with tiny brachial veins through which a syringe and needle could not be used to collect blood directly, their veins were punctured using sterile 23G needles and then labeled strips of filter paper (Whatman® filter paper 1, Cat No 1001 125) were used to tap blood samples from the punctured veins and allowed to saturate up to a distance of 1-2 cm of the length of the strip as previously described [25,26]. Samples were air dried, labeled on both sides and stored in plastic bags and stored at 4°C for onward transport to the laboratory. In the laboratory, serum samples were eluted from the strips by punching 2 disks (6 mm in diameter) using a file punch and placed in a well of a microtitre plate and 100 µl of normal saline was added and the plate incubated at 4°C overnight.

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 $X_{geo}=\text{antilog}_{10}\{1/n\ (\Sigma f_i \log_{10} X_i)\}$ where n=number tested, X_i=the reciprocal of dilution and f_i=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 Statgraphic 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 1:128 and GMT of 14.1 as against the day 28 PV titres of 1:16 to 1:8192 and GMT of 190.1 (Tables 1 and 2). The vaccinated chicks exhibited 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_2

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	3	2.2
Kwami	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 1: Distribution of Newcastle disease HI antibody titres in sera of adult village chickens collected prior to vaccination with Newcastle disease I_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	6	24	6	4	8	1	245.1
Akko	80	71 (88.8)	0	0	0	1	2	10	23	10	13	7	3	1	0	114.4
Kwami	80	75 (93.8)	0	0	0	1	6	12	27	11	14	3	0	0	1	119.4
Yamaltu Deba	80	80 (100)	0	0	0	6	3	12	27	18	7	6	1	0	0	149.6
Funakaye	80	78 (97.5)	0	0	0	3	8	15	30	14	4	2	2	0	0	109.5
Total	**400**	**377(94.3)**	**0**	**0**	**0**	**13**	**19**	**53**	**125**	**59**	**62**	**24**	**10**	**9**	**2**	**190.1**

Table 2: Distribution of ND HI antibody titres in sera of adult village chickens 28 days post-vaccination with ND I_2 vaccine coated on maize grit 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	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 I_2 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 I_2 vaccine coated on maize grit in some Local Government Areas of Gombe State.

Sampling period	Number tested	No. (%) positive samples	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	3.6
Post- vaccination	24	24 (100%)	0	0	0	0	0	0	0	0	10	10	4	861

Table 5: Distribution of ND HI antibody titres of village chickens pre- vaccination and post-vaccination with oral drenches of ND I_2 vaccine.

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 I_2 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 records in Mozambique which indicates that ND I_2 vaccine provided approximately 80% protection in the field in the face of an outbreak when coated on suitable carrier food [17] and also confirmed the findings of Echeonwu et al. [22] who reported the efficacy of the same vaccine under laboratory trials using maize meal waste (maize offal) as the vaccine carrier. The efficacy of any vaccine is determined mainly by assessment of the level of antibody produced in the target birds and the ability of the vaccinated bird to resist exposure to the virulent infectious agent when compared to the unvaccinated birds [30]. The advantage of the feed coated ND I_2 vaccine over the use of drinking 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 feeds 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 expose 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 I_2 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 I_2 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_4 vaccine. It is therefore suggestive that thermostable ND I_2 vaccine coated on feed such as maize grit be used to vaccinate free-living and scavenging birds.

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