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Research Article

Field Investigation of Infectious Bursal Disease Maternal Antibody Transfer and Decay Rates in Selected Chicken Breeder Flocks and Progeny

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Abstract

Effective control of infectious bursal disease (IBD) is largely dependent on attainment of high level of maternal antibody in chicks. However, outbreaks still occur, and variable antibody titres and duration of immunity have been reported in chicks. Rates of maternal antibody transfer from parent stocks to progeny were determined and decay rates in chicks were evaluated. Four chicken breeder flocks (A, B, C and D) were bled and IBD antibody titers were determined using ELISA. Antibody titres in yolk of eggs laid on the same day of bleeding and chicks hatched from the same batches of eggs at days one and seven, were also determined. Mean titres were compared for significant differences using ANOVA and LSD test of multiple comparisons at $p < 0.05$. Rates of maternal antibody transfer from parent stocks A and B (administered one dose of inactivated vaccine) to their respective progenies were 77.4% and 89.9%, while it was 51.1% and 50.4% in C and D (administered two doses), respectively. However, the rates of decay of maternal antibody from one-day-old to seven-day-old chicks were 58.9%, 48.7%, 24.4% and 54.9% in chicks A, B, C and D, respectively. A negative correlation ($r = -0.9878$) was observed between antibody titres in parent stocks, yolk as well as chicks' sera and maternal antibody decay rates. Multiple administration of inactivated IBD vaccine by point-of-lay caused low rate of maternal antibody transfer to progeny and low maternal antibody titer at 1-day-old caused higher rate of decay in chicks.

Keywords: Decay Rates; Infectious Bursal Disease; Maternal Antibody; Parent Stocks; Transfer Rates

Introduction

Infectious bursal disease (IBD), also known as Gumboro disease is a viral, contagious, and immunosuppressive disease of young chickens and it is responsible for major economic losses in the poultry industry worldwide [1]. The aetiology is a double-stranded RNA virus belonging to the genus *Avibirnavirus.* The virus has re-emerged as variant with very virulent strains being the cause of significant losses and high mortalities in chickens [2]. Control of IBD is largely by vaccination using both live attenuated and inactivated or killed vaccines along with strict hygiene management of farms. The inactivated vaccine is usually given to breeders at the pre-laying stage to ensure good carry over of maternal antibodies to progeny via the yolk. This plays significant role in protection of chicks against IBD prior to development of active immunity [3] However, despite this strategy, outbreaks of IBD are still being observed in chicks very early in life as well as variable antibody titers and duration of immunity.

This study intends to investigate IBD maternal antibody transfer rates from parent stocks to progeny and determine the rate of antibody decay with respect to vaccination, under field conditions.

Materials and Methods

Chickens and fertile eggs

Four chicken breeder flocks, from two selected farms in Ibadan, Oyo State and Mowe, Ogun State, Nigeria were used for this study after obtaining informed consent of the poultry farmers. The four flocks comprised of two pullet breeder flocks A and B and two broiler breeder flocks D and E. Flock history comprising of age and vaccines administered to the flocks were noted. Twelve randomly selected chickens were carefully bled per flock and twelve fertilized eggs were obtained from each flock on sampling day. The same batches of eggs were tracked to the hatchery and 25 one-day-old chicks were randomly selected upon hatching, reared in open-sided tropical cages by flock and fed with chick starter feed up till seven days of age.

Sample collection

Twelve breeder chickens per flock were bled via the right jugular vein using 21g needles and five mL syringes into plain universal bottles. Blood samples were properly preserved and transferred to the laboratory. Exuded serum was harvested from each blood sample into Eppendorf tubes, stored at -20 °C and analysed for IBDV antibody titres within one week of sample collection.

The yolk of each of the twelve eggs collected from each flock were separated from albumen into petri dishes for analysis of IBDV antibody titers. Twelve out of the 25 chicks per flock that hatched from the batch of eggs that were sampled were also bled for serum at one-day-old and seven-day-old to monitor rate of antibody decay.

Determination of infectious bursal disease virus antibody titers in serum and egg yolk

Serum and egg yolk samples were subjected to enzyme linked immunosorbent assay (ELISA) using Flock checker manufactured by Index Laboratories, (IDEXX Laboratories, USA) for the determination of IBD virus antibody titers.

Reagents were left on the bench to warm up to room temperature (18°C - 25°C) and then mixed gently. Antigen coated plates and sample positions were recorded. Serum and yolk samples were diluted 500-fold (1:500) with sample diluent and were mixed properly before being dispensed into the antigen coated plates. Undiluted negative control (100 µL) was dispensed into wells A1 and A2. Undiluted positive control (100 µL) was dispensed into wells A3 and A4. Same volume of diluted test samples (sera and yolk) was dispensed into appropriate wells and the plates were incubated at room temperature (27° C) for 30 mins. Reagents in all wells were aspirated into a waste reservoir and wells were washed approximately thrice with 350 µL of distilled water in each well. The water was aspirated completely from the wells. Goat anti chicken horseradish peroxidase conjugate (100 µL) was then dispensed into each well and incubated at room temperature for another 30 minutes. Plates were washed as before and 100 µL of Tetramethylbenzidine (TMD) substrate solution was dispensed into each well. Plates were incubated again at room temperature for 15 mins after which 100 µL of Stop solution (0.16M Sulphuric acid) was added into each well to stop the reaction. Absorbance was read on a 96 well plate reader (ISELX800, Biotek Instruments Incorporation, USA) at 450 nm.

Analysis of data

Mean ± SEM IBD virus antibody titer in serum of each breeder flock and associated chicks as well as in yolk of fertile eggs was calculated. Rates of maternal antibodies transfer from parents to chicks were determined by expressing antibody titers in chicks as percentage of the titers of the respective breeder flock. Rates of maternal antibody decay were also calculated. Mean titers were compared for significant differences between and within groups using Analysis of Variance and Least Significant Difference test of multiple comparison at $P < 0.05$. Analysis of correlation between IBD virus antibody titers of parent stocks and maternal antibody decay rates was conducted.

Results

History of parent stocks

Parent stocks A and B were 71 and 36 weeks old respectively. Each flock was vaccinated with IBD live vaccine at nine and 19 days old and inactivated oil adjuvanted vaccine at 18-week-old. Parent stocks C and D were 43 and 45 weeks old respectively and were vaccinated with IBD live vaccine at seven and 17 days old and inactivated oil adjuvanted vaccine at six and 19 weeks old.

Infectious bursal disease virus antibody titers in serum and egg yolk

Mean antibody titers in all parent stocks ranged between 3373 ± 353 in Group C and 6858 ± 636 in Group A with titers in Groups A

and D being significantly higher ($P < 0.05$) than B and C and Group B titer was also significantly higher ($P < 0.05$) than Group C (Table 1). Values in egg yolk ranged between 3667 ± 495 in Group C and 5469 ± 333 in Group D with Groups A, B and D being significantly higher ($P < 0.05$) higher than C (Table 1). Also, mean antibody titers in day-old chicks ranged between 1723 ± 213 in Group C and 5309 ± 443 in Group A with Groups A and B being significantly higher ($P < 0.05$) than C and D, and Group D being significantly higher than Group C (Table 1). At 7-day old, values ranged between 420 ± 87 in Group C and 3126 ± 308 in Group A with A and B being significantly higher ($P < 0.05$) than C and D and the titer in D being significantly higher ($P < 0.05$) than that of C (Table 1).

Sample	Group A	Group B	Group C	Group D
Parent stock	6858 ± 636^{a}	5352 ± 327^{b}	3373 ± 353^{c}	6492 ± 329^{a}
Egg yolk	5375 ± 374^{a}	5118 ± 407^{a}	3667 ± 495^{b}	5469 ± 333^{a}
1-day-old chicks	5309 ± 443^{a}	4814 ± 427^{a}	1723 ± 213^{c}	3270 ± 473^{b}
7-day-old chicks	3126 ± 308^{a}	2343 ± 223^{a}	420 ± 87^{c}	1794 ± 255^{b}

Table 1: Mean ± SEM infectious bursal disease virus antibody titers (ELISA) in serum and egg yolk.
Values in the same row with different superscript are significantly different ($P < 0.05$).

Rates of maternal antibody transfer and decay

The rates of transfer of maternal antibody from parent stocks A and B to their respective one-day-old chicks were 77.4% and 89.9%, while it was 51.1% and 50.4% in parent stocks C and D respectively (Table 2). However, the rates of decay of maternal antibody from one-day-old to seven-day-old was 58.9%, 48.7%, 24.4% and 54.9% in Groups A, B, C and D respectively (Table 2). A negative correlation was observed between IBD virus antibody of parent stocks and maternal antibody decay rates ($r = -0.99$).

Groups	A	B	C	D
Parent Stock	6858 ± 636^{a}	5352 ± 327^{b}	3373 ± 353^{c}	6492 ± 329^{a}
Day-old Chicks	5309 ± 443^{a}	4814 ± 427^{a}	1723± 213^{c}	3270 ± 473^{b}
MATR	77.4%	89.9%	51.1%	50.4%
7 day-olds	3126 ± 308^{a}	2343 ± 223^{b}	420 ± 87^{d}	1794 ± 255^{c}
% of day-old	58.9%	48.7%	24.4%	54.9%
MADR	41.1%	51.3%	75.6%	45.1%

Table 2: Infectious bursal disease maternal antibody transfer to 1-day-old chicks and decay by 7-day-old.

Values with different superscript on the same row are significantly different ($P < 0.05$).

MATR: Maternal Antibody Transfer; MADR: Maternal Antibody Decay Rate

Discussion

The four chicken breeder flocks selected for this study were from two different poultry farms with Groups A and B being from one farm and Groups C and D from another. The two farms used different vaccination schedules for IBD. While Groups A and B were administered a single dose of inactivated IBD vaccine at 18-week-old, Groups C and D were administered two doses at six and 19 weeks old.

Expectedly, there was a general decline in antibody titer from parent stock to seven-day-old in all the groups. However, maternal

antibody transfer rates from parent stocks A and B to progeny were much higher (77.4% and 89.9% respectively) than those of Groups C and D (51.1% and 50.4%, respectively). This is in spite of the fact that Group A (71 weeks) was much older than the other three groups and that Group C had a significantly lower ($p < 0.05$) titer i.e., 3373 ± 353 at parent stock level than Group D. This shows that administration of multiple doses of inactivated vaccine by point-of-lay tends to reduce maternal antibody transfer rate even in the face of high antibody titer in parent stock as in Group D with a mean titer of 6492 ± 329. This observation corroborates the findings of Eidson., *et al.* [4] that parent stock that was administered inactivated IBD vaccine only at 20-week-old had higher antibody titers than the group that was administered same vaccine at 12 and 20 weeks old. Repeated vaccination of breeders with inactivated vaccine [5] is a common practice which has been shown by this study to be of no advantage. Also, maternal antibody titers persisted longer in progeny of parent stocks that were administered a single dose of inactivated IBD vaccine.

Maternal antibody was on the average halved in all groups by seven-day-old except in Group C which had only 24.4% antibodies left in serum. However, Group C had the lowest titer ($p < 0.05$) i.e., 3373 ± 353 at parent stock level. A half-life of approximately 3.5 days had earlier been reported for IBD virus maternal antibody [6]. Thus, the maternal antibody decay rates from one-day-old to seven-day-old were 41.1%, 51.3%, 75.6% and 45.1% for Groups A, B, C and D respectively. It is worthy of note from this study that there was a negative correlation ($r = -0.99$) between parent stock antibody titer and maternal antibody decay rate, i.e., the higher the parent stock antibody titer, the lower the maternal antibody decay rate. Although Groups C and D were vaccinated using the same programme, the results of this study showed that their 1-day-old chicks varied in IBD antibody titer which could be due to variations in factors of vaccination such as vaccine brand, potency, and handling [7].

Conclusion

It could be concluded that multiple administration of inactivated IBD vaccine to breeder chickens by point-of-lay results in low rate of maternal antibody transfer to progeny. Also, low titer of maternal antibody at 1-day-old could result in higher rate of decay in chicks. A single dose of inactivated IBD vaccine at point-of-lay for chicken breeders is therefore recommended to ensure high rate of maternal antibody transfer and lower rate of antibody decay in chicks. It is equally important that titers of maternal antibody in one-day-old chicks be determined to ascertain the best time to vaccinate.

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Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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