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Effect of determining protective antibodies on the efficacy of two types Newcastle disease vaccines in broilers

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Abstract

A total of 60 one-day-old Ross broiler chicks were used in this investigation. The birds were categorized into four groups, with each group including 15 birds. Group A was administered a 0.5 ml dosage of the LaSota live vaccination against Newcastle disease using the oral approach on the first day of their lives, using a 1 ml syringe. On the other hand, Group B got the dead vaccine by a subcutaneous injection. Group C was administered two distinct forms of vaccine: live and dead, whilst Group D was designated as the control group. On the 35th day, the birds were euthanized in order to obtain blood samples for the purpose of studying the impact of various vaccination types on the immunological response to the ND vaccine. The response was evaluated using an ELISA test. The findings demonstrated statistically significant differences ($P \leq 0.05$) in antibody titers between group B and the control group. Additionally, groups C and A exhibited substantial increases ($p<0.05$) in antibody titers compared to the control group, which experienced a significant drop ($P \leq 0.05$) in antibody titers. Overall, the results indicated that the inactivated vaccine produced a higher level of antibodies. However, further evidence demonstrated that administering a live virus vaccination on the first day after birth resulted in the suppression of the mother's immune response by the vaccine virus. Hence, it is crucial to ascertain the antibody titer prior to determining the vaccine's course.

Keywords: Newcastle disease; Vaccines; Antibody Titers, broilers

Introduction

Newcastle disease (ND) is a globally prevalent viral virus that is extremely infectious and causes severe mortality in several species of domestic and wild birds. This is a result of the significant economic repercussions on the chicken business that occurred as a consequence of disease outbreaks. The sickness is caused by a paramyxovirus (1,2). Newcastle disease (ND) is distinguished by respiratory, digestive, and neurological symptoms. In extreme cases, the morbidity and death rates in vulnerable birds may exceed 100%. Birds that have not been vaccinated are particularly sensitive to the illness (3). Biosecurity and immunization have long been effective strategies in combating Newcastle Disease and mitigating its transmission (4). Chandrasekar et al. (5) stated that immunization protects the birds by generating both humoral and cell-mediated immune responses. Both of these reactions are crucial for comprehensive defense against infections. According to a study by (6), it has been shown that live vaccines given to chickens either eye drop or oral administration may stimulate the production of immunoglobulin (Ig)A antibodies, leading to the development of protective mucosal immunity. In contrast, Folitse et. al. (7) discovered that administering inactivated vaccines by injection resulted in the generation of substantial quantities of serum antibodies, so inducing humoral immunity that effectively protects chickens against viral infection. As stated in reference (8), inactivated oil emulsion vaccinations lack the ability to stimulate local immunity in the respiratory and digestive systems, which is a drawback when compared to live vaccines. However, they do confer protection, although at a slower pace. Live vaccinations are less costly and easier to give compared to killed vaccines. Scientists have done several experiments in order to create a single yearly vaccination schedule that may effectively manage ND and decrease the expense of immunization. In Iraq, particularly in Basra, a range of vaccinations and schedules are used in chicken broiler houses to manage Newcastle Disease (ND). The objective of this research was to establish an immunization schedule that would enhance the antibody response and provide effective defense against ND.

Materials and Methods

In this study, 60 Ross broiler chicks, just a day old, were procured from Al-Qurnah Hatchery in Basrah Province. They were individually housed in cages within the experimental facility of the Department of Pathology and Poultry Diseases at Basra University's College of Veterinary Medicine. Stringent sanitation measures were adhered to, following standard management procedures. Throughout the entire experiment, the chicks had unrestricted access to pellet feed and water. The researchers cared for them for a span of 35 days.

Vaccine Strain

The live LaSota virus vaccine (commercially produced by FATRO) and the galimune inactivated vaccine virus of Newcastle disease vaccine (commercially manufactured by Merial) were administered following the instructions provided by the manufacturers.

Experimental design

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We randomly assigned one-day-old Ross broiler chicks into four groups labeled as A, B, C, and D, each comprising fifteen birds. On their first day, Group A received immunization using the LaSota ND vaccine via a single oral dose administered to each chicken using a syringe technique. The vaccinations were prepared by reconstituting them in distilled water to achieve a field dosage of 0.5 ml, where each 0.1 ml of the vaccine contained a minimum of 10^7 and was administered separately. On the first day of their lives, we administered inactivated vaccinations to the hens in group B to protect them against Newcastle Disease (ND). We injected a single subcutaneous dosage into the neck of each chicken using a syringe. The chicks in Group C were administered live vaccinations orally and then terminated by subcutaneous injection. The control group included of chicks assigned to group D.

Monitoring chickens

We performed clinical surveillance of the chickens throughout the duration of the trial in order to assess the impact of the immunization. The mortality rate was a key indicator in the clinical monitoring of chickens.

Serological examination

Upon hatching, blood samples were obtained from five chicks immediately after decapitation in order to assess maternal antibodies to ND. Subsequently, on day 35, five birds from each group were euthanized to collect blood. The avian blood samples were obtained and promptly placed into a sterile test tube. They were then left to coagulate at room temperature to separate the serum. Subsequently, the samples were frozen at a temperature of -20 oC until the serological tests were conducted. An ELISA kit from Synbiotics Elisa Kits Company, USA, was used to measure antibody levels against the ND vaccination, following the instructions provided by the manufacturer (9).

Statistical analysis

The data analysis was conducted using one-way analysis of variance in the SPSS software version 19, based on the experimental design. Significant differences ($P \leq 0.05$) were evaluated using the least significant differences (10).

Results

The vaccination of chickens has positive and negative effects. Positive, known as 'herd immunity', and negative, known as post-vaccine reaction. One of the negative effects of vaccination is mortality. Table 1 illustrates the findings from observing chickens throughout the experiment, displaying the mortality rates across all groups during the study duration. The results indicated mortality rates of 6.6% for group A, 13% for group B, and 20% for groups C and D, respectively. Group C had a higher number of deceased birds compared to other groups, yet statistically, there was no significant variance among all groups at the $p<0.05$ threshold.

Table 1: Mortality rate (%) along study period.

Groups	No. of birds	No. dead birds	Mortality %
A	15	1	6.6
B	15	2	13
C	15	3	20
D	15	1	6.6

On the first day of age, ELISA tests indicated that the average level of maternally derived antibodies (MDA) in five birds was 1600. The ELISA test conducted at 35 days of age revealed the antibody titer of the ND vaccine. The results, as shown in Table (2), indicated that group A, which received the live vaccine LaSota orally, had an antibody titer of 929.60 ±53.15 BC. In contrast, group B, which received the killed vaccine via injection, had an antibody titer of 3061.20 ±911.84 A. The antibody titers for groups C and D were 1440.20 ± 276.11 B and 492.00 ±112.13 BC, respectively. The findings demonstrated a statistically significant difference ($p<0.05$). The findings of Group A exhibited more pronounced disparities in comparison to the other groups.

Table 2: The mean and standard deviation of ELISA antibody titers against the ND vaccine at 35 days old.

Group	Mean
A	929.60± 53.15 BC
B	3061.20 ±911.84 A
C	1440.20± 276.11B
D	492.00± 112.13BC

***Distinct vertical letters denote significant differences between groups (P<0.05); N=5 sample in each group.**

Discussion

The impact of the vaccination on the birds' clinical condition throughout the duration of the trial is reflected by the death rate shown in Table 1. The mortality rate of Group A vaccinated chickens was reduced compared to the mortality rate of birds in other groups. This finding confirmed the results of (11), which indicated that the birds who were vaccinated with LaSota had low mortality. Group B has a somewhat higher death rate in comparison to Group D (12). The use of both killed and live vaccines (C) resulted in a significant rise in the

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mortality rate. This increase could be attributed to the impact of the ND vaccine on chickens as a stressor (13). The specific factors contributing to this effect may include the type of vaccine, the strain of chickens, or the systemic reaction caused by administering the vaccine through both drinking and subcutaneous methods simultaneously (14). The antibody titer, as shown in Table 2, revealed that the titer rose after vaccination in group B compared to the other groups, and this outcome was more statistically significant. This finding corroborated the results of a previous study (15) which shown that immunization with inactivated ND vaccines resulted in elevated levels of antibodies. These antibody levels continued to rise from the 21st to the 28th day after vaccination, providing robust protection and maintaining excellent health for an extended period (16). The administration of both live and dead vaccinations resulted in a higher level of antibodies compared to the control group (D), but this rise was less pronounced than in group A. Furthermore, the outcome of immunization alone with the live vaccine (A) yielded a decreased titer. The neutralization of maternal immunity with a live vaccination is responsible for this, with a little increase seen with a dead vaccine. This finding was consistent with the study conducted by (17), which indicated that antibody levels declined as a consequence of the vaccination being neutralized by maternal antibodies. In contrast, the titer in the control group exhibited a progressive reduction from the 1st to the 35th days. This results supports the claim made in (18) that passive immunity tends to be short-lived, usually lasting 1-2 weeks and often less than 4 weeks. Its main role is to protect young chicks during their early weeks when their immune system isn't fully developed to handle threats effectively. An obstacle lies in determining the optimal vaccination timing after the decline of maternal protective antibodies (19). Thus, conducting regular ELISA tests to assess antibody levels becomes crucial for a successful vaccination strategy.

Conclusion

The current research demonstrated that the dead vaccine generated a greater level of antibodies, but with a delayed response. Additionally, it has been observed that vaccinating with a live vaccine on the first day of life resulted in the neutralization of maternal immunity by the vaccine virus.

Recommendation

It is advisable to carry out an extensive investigation into alternative approaches for vaccine delivery at various stages of life based on maternal immunity titers.

Competing interests

There are no conflicts of interest between the authors and the subject matter of the paper.

Author Contributions: Hassan M. Al-Tameemi and Harith Abdulla Najem were concerned together to conducted conceptualization, investigation, data curation, and study validation; Harith Abdulla Najem was involved in the visualization and original draft preparation; Hassan M. Al-Tameemi worked on writing review and editing and assumed supervisory responsibilities; ; Hassan M. Al-Tameemi was followed project administration. All authors gave approval to the final version of the manuscript.

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Data Availability

Data employed for verifying the outcomes of this investigation are accessible upon request from the corresponding author.

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Ethics approval Statement

The techniques used in this investigation, which included dealing with birds and vaccine injections, were approved by the Ethical Committee of the Faculty of Veterinary Medicine at Basra University (Reference No. 81/2023). All participants agreed to collect samples and asked to keep their identities, especially.

Reference

1. Aldous E, Alexander D. Detection and differentiation of Newcastle disease virus (avian paramyxovirus type 1). Avian Pathol. 2001;30(2):117-28. https://doi.org/10.1080/03079450120044515

2. Zalid A, Saeedi T. Preparation of live attenuated and killed vaccines of Newcastle disease (strain AG 68) and immunity evaluation. QJVMS. 2014;13(1):30-36.

3. Alexander D. Newcastle disease and other paramyxovirus infections. 1991.

4. Mansur-ud-Din Ahmad M, Mamoona Chaudhry MC, Rai M, Rashid H. Evaluation of two vaccination schemes using live vaccines against Newcastle disease in chickens. 2007.

5. Chandrasekar S, Venkatesan R, Padmanaban V, Masillamony P. Nature of protective immunity in chicken against ranikhet disease. 1989.

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www.qu.edu.iq/journalvm

6. Jayawardane G, Spradbrow P. Mucosal immunity in chickens vaccinated with the V4 strain of Newcastle disease virus. Vet Microbiol. 1995;46(1-3):69-77.
https://doi.org/10.1016/0378-1135(95)00073-J

7. Folitse R, Halvorson D, Sivanandan V. Efficacy of combined killed-in-oil emulsion and live Newcastle disease vaccines in chickens. Avian Dis. 1998:173-8.
https://doi.org/10.2307/1592591

8. Van Eck J. Immunity to Newcastle disease in fowl of different breeds, primarily vaccinated with commercial inactivated oil-emulsion vaccines: A laboratory experiment. Vet Q. 1987;9(4):296-303.
https://doi.org/10.1080/01652176.1987.9694117

9. Miers L, Bankowski R, Zee Y. Optimizing the enzyme-linked immunosorbent assay for evaluating immunity of chickens to Newcastle disease. Avian Dis. 1983:1112-25.
https://doi.org/10.2307/1590211

10. Steel RG, Torrie JH. Principles and procedures of statistics mcgraw-hill book co. Inc, New York. 1980;481.

11. Mrzel I, Josipović D, Čajavec S, Cizelj A, Viduka D, Tuta I, et al. Immunization of broilers in the hatchery against infectious bronchitis and Newcastle disease with bivalent live vaccines. 1992.

12. Elbestawy A, Ellakany H, Sedeik M, Gado A, Abdel-Latif M, Noreldin A, et al. Superior efficacy of apathogenic genotype I (V4) over lentogenic genotype II (LaSota) live vaccines against Newcastle disease virus genotype VII. 1.1 in pathogen-associated molecular pattern-H9N2 vaccinated broiler chickens. Vaccines. 2023;11(11):1638.
https://doi.org/10.3390/vaccines11111638

13. Wang X, Liu X, Liu S, Qu J, Ye M, Wang J, et al. Effects of anti-stress agents on the growth performance and immune function in broiler chickens with vaccination-induced stress. Avian Pathol. 2023;52(1):12-24.
https://doi.org/10.1080/03079457.2022.2114874

14. Birhane N, Fesseha H. Vaccine failure in poultry production and its control methods: A review. Biomed J Sci Tech Res. 2020;29:22588-96.
https://doi.org/10.26717/BJSTR.2020.29.004827

15. Stone HD. The preparation and efficacy of manually emulsified Newcastle disease oil-emulsion vaccines. Avian Dis. 1991:8-16.
https://doi.org/10.2307/1591288

16. Ahad EA. Post-vaccinal reaction for some vaccines used against Newcastle disease in Sulaimaniyah province. AL-Qadisiya Journal of Veterinary Medicine Sciences. 2012;11(1):133-143.
https://doi.org/10.29079/vol11iss1art181

17. Tizard IR. Veterinary Immunology-E-Book: Veterinary Immunology-E-Book: Elsevier Health Sciences; 2017.

18. Najem HA. EVALUATION OF INTRAYOLK SAC INOCULATION OF INFECTIOUS BURSAL DISEASE VACCINE ON IMMUNE RESPONSES IN NEWLY HATCHED BROILER CHICKS. Basrah Journal of Veterinary Research. 2018;17(1):52-62.
https://doi.org/10.33762/bvetr.2018.143559

19. Oberländer B, Failing K, Jüngst CM, Neuhaus N, Lierz M, Möller Palau-Ribes F. Evaluation of Newcastle Disease antibody titers in backyard poultry in Germany with a vaccination interval of twelve weeks. PLoS One. 2020;15(8):e0238068.
https://doi.org/10.1371/journal.pone.0238068