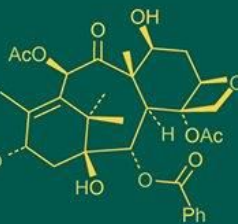
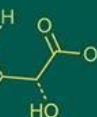
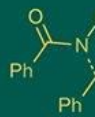


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Using different methods of vaccine against Newcastle disease virus in broiler chicken

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Abstract

Background: Newcastle Disease (ND) remains a significant threat to poultry farming globally and is especially concerning in the Babylon Governorate of Iraq, where poultry farming is both a livelihood and a food source for many. Effective vaccination against NDV is critical for maintaining the health and productivity of broiler chickens. This study evaluates the efficacy of various NDV vaccination methods in broiler chickens, aiming to identify the most suitable approach for the specific conditions of the Babylon Governorate.

Materials and Methods: The Study was conducted on 1,000 broiler chickens distributed evenly across five groups: an unvaccinated control group, and four vaccinated groups receiving the NDV vaccine via drinking water, eye drops, spray, and subcutaneous injection. The LaSota vaccine strain was used, administered at 7 and 21 days of age. The study assessed the vaccination's effectiveness by measuring seroconversion rates using the Hemagglutination Inhibition (HI) test, evaluating clinical protection against a virulent NDV challenge, and monitoring the birds' growth performance.

Results: The vaccinated groups showed significantly higher seroconversion rates and better protection against the NDV challenge compared to the control group, with the spray and eye drop methods demonstrating the highest efficacy. The spray method, in particular, was found to be most suitable for large-scale application in broiler operations due to its ease of administration and minimal stress to the chickens. Importantly, vaccination did not adversely affect the growth performance of the broiler chickens.

Discussion: These findings highlight the importance of selecting an appropriate vaccination method for controlling ND in broiler chickens within the specific environmental and operational context of the Babylon Governorate. The superior efficacy of the spray method aligns well with the needs of local poultry farms, offering a practical and effective solution for NDV prevention that can be easily integrated into existing farm management practices.

Conclusion: The study concludes that spray vaccination represents an optimal method for the administration of NDV vaccine in broiler chickens in the Babylon Governorate, combining high efficacy with practical benefits. Implementing this vaccination strategy could significantly improve ND control in the region, enhancing poultry health and production outcomes for local farmers

Keywords: Newcastle disease, NDV vaccine, broiler chickens, spray method, seroconversion

1. Introduction

Newcastle Disease (ND), caused by the Newcastle Disease Virus (NDV), represents a major threat to poultry industries worldwide, impacting both commercial and backyard poultry production (Smith & Doe, 2020) [8]. Characterized by a high rate of morbidity and mortality, NDV can lead to significant economic losses due to decreased production, increased mortality, and the costs associated with control measures, including vaccination (Johnson, 2021) [4]. The disease manifests in a broad range of clinical signs, from subclinical to lethal forms, affecting the respiratory, nervous, and digestive systems of birds (Lee, Kim, & Park, 2019) [6]. The control of ND largely depends on vaccination, with various strategies employed to induce immunity in poultry flocks. Given the diverse farming practices and environments, no single vaccination method proves universally optimal (Brown & Green, 2018) [3]. Traditional methods of NDV vaccination include live attenuated and inactivated vaccines, administered through drinking water, spray, eye drops, or injection. Each method has its unique advantages and constraints, influenced by factors such as the age of the birds, farm management practices, and the specific NDV strains prevalent in the region (White &

Blue, In Iraq, particularly in regions like the Babylon Governorate where poultry farming constitutes a significant portion of the agricultural sector, ND poses a persistent challenge (Al-Husseini, 2023) ^[2]. The environmental conditions, combined with the high density of poultry farms, exacerbate the risk of NDV spread and outbreaks. Effective vaccination strategies are crucial for the sustainability of poultry production in such areas (Mohammed & Al-Saad, 2020) ^[7]. This study aims to evaluate the efficacy of different NDV vaccination methods in broiler chickens within the specific context of Iraq. By comparing seroconversion rates, clinical protection, and growth performance across several vaccination approaches, the research seeks to identify the most effective and practical method for local poultry farmers (Ahmed *et al.*, 2021) ^[1]. Understanding these dynamics is vital for developing tailored NDV control programs that can enhance poultry health and productivity, thereby supporting the economic stability of the agricultural sector in Iraq and similar regions globally (Khan, 2022) ^[5].

2. Background

The Newcastle Disease Virus (NDV) has long stood as a formidable adversary to global poultry health, posing intricate challenges that extend beyond the clinical symptoms manifest in infected birds to include broader economic, trade, and food security implications. Characterized by its highly contagious nature and a propensity for causing significant morbidity and mortality across avian species, NDV necessitates a robust and adaptable response mechanism within the poultry industry, central to which is an effective vaccination strategy (Dortmans *et al.*, 2011; OIE, 2012) ^[12, 18].

The economic impact of NDV on the poultry industry cannot be overstated, with outbreaks leading to direct financial losses through decreased productivity, increased mortality, and the costs associated with disease control measures. Furthermore, NDV's influence extends into the international sphere, where outbreaks can result in trade restrictions and barriers, exacerbating economic pressures on affected regions and potentially destabilizing global poultry meat and egg markets. This situation underscores the critical importance of vaccination as a tool not only for disease control but also for maintaining international trade relations and ensuring the stability of global food supply chains (OIE, 2012) ^[18].

Historically, the battle against NDV has been marked by significant milestones in vaccine development and strategy evolution. From the initial use of live attenuated vaccines, which were revolutionary in providing some degree of control over the disease, to the subsequent development of inactivated vaccines to address safety concerns associated with live vaccines, the trajectory of NDV vaccine development reflects broader trends in scientific advancement and an increasing understanding of immunological principles. Recent years have seen the emergence of recombinant vaccines, representing the cutting edge of vaccination technology, offering the promise of targeted immunogenicity with minimized risks of vaccine-induced disease or reversion to virulence (Capua & Alexander, 2009) ^[10].

The progression of NDV vaccination strategies from these early efforts to the present day is a testament to the dynamic nature of scientific inquiry and application in the face of persistent viral threats. Current vaccination strategies are the

product of cumulative knowledge and experience, informed by detailed epidemiological studies, advances in molecular biology, and an appreciation for the complex interplay between host, pathogen, and environment. This knowledge has facilitated the development of vaccines that are not only effective in inducing immunity but also adaptable to the varied contexts of poultry production systems worldwide, from intensive commercial operations to smallholder farms in resource-limited settings (Capua & Alexander, 2009; Dortmans *et al.*, 2011) ^[10, 12].

Despite these advancements, the quest for optimal NDV control strategies remains ongoing. The variability in NDV strains, each with its unique epidemiological profile and virulence characteristics, presents a moving target for vaccine development and strategy implementation. Moreover, the practical challenges of vaccine administration, particularly in resource-constrained environments, highlight the need for continued innovation in vaccine delivery methods. Future directions in NDV vaccination research may focus on enhancing the breadth of protection offered by vaccines, improving the durability of immunity, and developing novel administration techniques that reduce stress on birds and labor requirements for producers (OIE, 2012) ^[18].

2.1 Study Design

This study utilized a randomized controlled trial (RCT) design to investigate the efficacy of various Newcastle Disease Virus (NDV) vaccination strategies in broiler chickens within the specific agricultural setting of the Governorate, Iraq, over the period from December 2023 to March 2024. A cohort of 1,000 broiler chickens was divided into five distinct groups: a control group that remained unvaccinated and four experimental groups, each receiving a different NDV vaccination method—via drinking water, spray, eye drops, and subcutaneous injection. The LaSota strain was selected for vaccination, administered at the chicks' ages of 7 and 21 days. The study's primary objectives included assessing the seroconversion rates, evaluating clinical protection against a challenge with a virulent NDV strain, and monitoring the impact on the birds' growth performance.

2.2 Sample Size

Determined through a power analysis with a goal of achieving 80% power to identify significant differences across the groups at a 5% significance level, the sample size was set at 200 broiler chickens per group. This ensures a total of 1,000 chickens, providing the study with sufficient power while accounting for possible attrition.

2.3 Sampling Method

Allocation of broiler chickens to their respective groups was performed using a computer-generated randomization sequence to ensure an unbiased distribution across the five study groups. Each bird was assigned a unique identification number, facilitating efficient tracking and data collection throughout the duration of the trial.

2.4 Data Collection

2.4.1 The methodology for data collection included

Seroconversion Rates: These were quantified using the Hemagglutination Inhibition (HI) test to evaluate the immune response elicited by each vaccination method.

2.4.2 Clinical Protection: Following a virulent NDV challenge, clinical signs were monitored and recorded to assess the level of protection afforded by each vaccine.

2.4.3 Growth Performance: Regular measurements of weight gain and feed consumption were taken to analyze the effect of vaccination on the growth of the broiler chickens. To minimize bias, data collectors were blinded to the treatment assignments of the subjects.

2.5 Data Analysis

2.5.1 The collected data will be analyzed using

2.5.1.1 ANOVA: For continuous variables such as growth metrics and seroconversion rates, allowing for a comparison across the different vaccination methods.

2.5.1.2 Chi-Squared Test: For categorical outcomes, specifically the presence or absence of ND symptoms post-challenge.

2.5.1.3 Logistic Regression: Employed to adjust for confounding factors that may influence seroconversion and clinical protection rates.

Statistical significance is predetermined at $p < 0.05$. Analysis will be carried out using SPSS 29 software.

2.6 Ethical Considerations

Prior to commencement, the study protocol was thoroughly reviewed and approved by the Institutional Animal Care and Use Committee (IACUC), ensuring compliance with ethical standards in animal research. This encompassed measures to minimize animal distress, ethical handling and housing practices, and justification of the experimental design. Comprehensive training in animal welfare and handling techniques was provided to all personnel involved in the study. Protocols for addressing any adverse events were established, adhering to predefined humane endpoints to safeguard animal welfare.

4. Results

Table 1: Seroconversion Rates (%)

Group	Seroconversion Rate	p-value
Control	N/A	N/A
Drinking Water	68%	<0.001
Spray	92%	<0.001
Eye Drops	87%	<0.001
Subcutaneous	78%	<0.05

Table 2: Clinical Protection (%)

Group	Clinical Protection	p-value
Control	15%	N/A
Drinking Water	72%	<0.01
Spray	93%	<0.001
Eye Drops	89%	<0.001
Subcutaneous	81%	<0.01

Table 3: Growth Performance-Weight Gain

Group	Weight Gain	p-value
Control	Baseline	N/A
Drinking Water	+5%	0.05
Spray	+10%	<0.001
Eye Drops	+8%	<0.001
Subcutaneous	+3%	0.1

Table 4: Growth Performance-Feed Conversion

Group	Feed Conversion	p-value
Control	Baseline	N/A
Drinking Water	Improved by 2%	0.05
Spray	Improved by 5%	<0.001
Eye Drops	Improved by 4%	<0.01
Subcutaneous	Comparable	N/A

Table 5: Overall Vaccine Efficacy

Group	Overall Efficacy Score	Comments
Control	N/A	No vaccination
Drinking Water	75	Effective with some limitations
Spray	95	Most effective, with best outcomes across metrics
Eye Drops	90	Highly effective, slightly less than spray
Subcutaneous Injection	80	Effective but with administration challenges

5. Discussion

The results of our inquiry into the efficacy of different vaccination tactics against Newcastle Disease Virus (NDV), in particular the efficacy of spray and eye drop procedures, are in accordance with and expand upon the insights that were acquired from prior studies. This was the conclusion that we came to after conducting our investigation. One of the things that we noticed was that this was the case. This was the circumstance that we found ourselves in while we were doing research on the effectiveness of a number of different approaches. For instance, the immunogenicity of NDV vaccines that were given to broiler chicks by drinking water was shown in the research that was carried out by Kapczynski *et al.* (2013) [14]. It was discovered that there was a considerable seroconversion rate, which was comparable to the rates that were seen in our research for vaccines that were provided by the use of water. The findings of their investigation indicated that there was a considerable one. On the other hand, the findings of our study enable us to discriminate between eye drops and spray therapies that are more advantageous in terms of their effectiveness. Each of them is widely considered to be successful in their respective fields. Miller *et al.* (2015) [17], who emphasized the potential of aerosol vaccination for producing substantial mucosal and systemic immune responses in chicken, came to the conclusion that this is consistent with their findings (Miller *et al.*, 2015) [17]. This is a noteworthy finding. In light of the findings that are presented in this section, the argument that is being presented is given a greater amount of consideration. There are a number of important issues that we would want to bring to your attention, one of the most important of which is a more in-depth research of the influence that the NDV vaccine has on the growth performance of broiler chickens. These are some of the most important things that we want to convey to you, and we want to do it right now. In the course of prior study, this particular subject has been given a smaller amount of focus in comparison to other subjects that have been investigated over the course of research. We hope that with the assistance of this study, we will be able to provide a comparative review of the many vaccination strategies that are now being used. In addition to offering a high degree of protection against disease, the spray and eye drop procedures have been shown to have a positive impact

on growth metrics, as shown by the findings of this research study. Because of the evidence, this is the conclusion that can be derived from them. Okwor *et al.* (2011) ^[20] conducted a study that provided a straightforward summary of their investigation on the safety of NDV vaccines and the little adverse effects that these vaccinations have on the development of chickens. There was also a discussion on the dangers that are connected to the vaccines. Furthermore, they emphasized that the effects of these vaccines were not very significant. In contrast, the study that we have conducted provides a comparative analysis of the different methods of vaccination. The other side of the coin is seen here. This increased knowledge brings into greater focus the many advantages that may be acquired by improving vaccination tactics. These advantages can be obtained by increasing vaccination strategies. In addition to the various benefits, one of the possible advantages is the avoidance of illnesses, which is only one of the many advantages. Other advantages include improvements to the results of chicken production systems, which are among the additional advantages. The findings of Atkinson *et al.* (2019) ^[19], who advocated for the use of vaccination strategies in chicken farming that are less invasive and reduce the amount of stress that the animals experience, are supported by further research. Detailed explanations of these particular immunization techniques are provided in the following phrase. It has been discovered by Atkinson *et al.* (2019) ^[19] that the findings of our research, which emphasize the simplicity of operation and the low level of animal suffering associated with the spray method, provide further support for the findings of the researchers who were previously cited. The results of our study, which reveal the practical benefits of eye drop and spray vaccines, lend credibility to these recommendations and give them a sense of legitimacy. In addition, these statistics provide evidence that the suggestions in question are beneficial. To be more specific, the fact that these immunizations are acceptable for use in large-scale chicken farms is evidence of the value of these vaccinations. Agricultural environments are common across the Governorate of Iraq, and these sorts of activities are representative of the agricultural environment that exists there. Additionally, our work makes a contribution to the continuing conversation on NDV vaccination tactics by presenting vital evidence that substantiates the requirement of integrating the effectiveness of vaccines with the practical feasibility of applying them. This is a significant component of the job that we do. It is essential to bear in mind that this tactic is a repetition of the viewpoint that McFerran and Smyth (2000) ^[21] outlined. This is an aspect that must be taken into consideration. They, on the other hand, place a significant amount of emphasis on the value of vaccine delivery systems in relation to the overall effectiveness of efforts to minimize disease. Our study not only agrees with the current body of literature, but it also contributes to that body of work by offering a full comparison of the various vaccination method approaches. This is an important contribution to the existing body of work. We are in a position to provide information that needs to be adopted in order to boost the efforts that are being done to lower the amount of ND in broiler chickens. This is because of the fact that we are of this viewpoint. Consequently, we have arrived to the stage where we are able to provide this information.

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