Popular Article

Genotype- Aligned vaccines: A critical requirement for Newcastle Disease control in India

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Abstract

Newcastle disease (ND) remains a major economic threat to the poultry industry despite being preventable through vaccination. A key challenge lies in the genetic and antigenic divergence between circulating Newcastle disease virus (NDV) strains and the commonly used vaccines, which are primarily derived from early genotypes I and II. This mismatch raises critical concerns about the efficacy of existing vaccines in providing adequate protection. Recent advancements in vaccine development have led to genotype-matched formulations that elicit a more robust and protective immune response against currently circulating strains. These findings underscore the urgent need to update vaccination strategies in India to include genotype-specific vaccines for more effective control and prevention of ND outbreaks.

Introduction

Newcastle disease virus (NDV) is a highly contagious and often lethal pathogen affecting a wide range of avian species, presenting a substantial threat to global poultry production. While strict biosecurity measures are essential, vaccination remains the cornerstone of NDV control. Although current commercial vaccines confer partial protection, their field efficacy is often compromised, particularly against virulent NDV genotypes. This limitation is further exacerbated by the logistical complexities of vaccine deployment in diverse farming environments. In this context, a genotype-matched NDV DNA vaccine represents a promising alternative, offering the potential for improved immunogenicity and protective efficacy. By aligning antigenically with circulating strains, such a targeted vaccine strategy could enhance immune responses and mitigate the risk of vaccine failure associated with genotype mismatch.

Key Obstacles in Newcastle Disease Control

One of the primary challenges in controlling Newcastle disease (ND) is the extensive genetic diversity of Newcastle disease virus (NDV). The virus comprises multiple genotypes, each exhibiting unique genetic and antigenic properties, resulting in significant regional variation in circulating strains. In India, several genotypes have been documented, including VI.2.1.1.1 (VI) and VII.1.1 (VII), as well as genotype XIII.2.2 (XIIIe) in Tamil Nadu and XIII.2.2 in Gujarat. Central India has reported genotypes VII.1.1 (VII) and XIII.2.2 (XIIIb), while Uttar Pradesh has identified the presence of

VIIi and XIII.2.2 (XIIIb). Furthermore, novel genotypes XIII.2.2, XXII.1, and XXII.2 have recently been reported from the North-Eastern region. The use of conventional vaccines, which are predominantly based on a narrow set of early NDV strains, often fails to provide sufficient cross-protection against these diverse and evolving genotypes. This antigenic mismatch is a major factor contributing to persistent outbreaks and highlights the need for genotype-matched vaccine strategies tailored to the currently circulating strains in India.

Commercial vaccines available at present

Currently, the most commonly used vaccines against Newcastle Disease (ND) are derived from early NDV genotypes I and II, originally isolated approximately 70 years ago. However, the NDV strains now prevalent in poultry populations worldwide predominantly belong to later genotypes—such as genotypes VI, VII, XII, and XXII—which exhibit considerable genetic and antigenic divergence from traditional vaccine strains. In pigeons, genotype VI is commonly detected, further highlighting host-specific viral evolution. Live attenuated ND vaccines, particularly lentogenic strains like La Sota and B1, remain widely employed for routine prophylaxis. LaSota is known for its strong tropism toward the respiratory tract and its ability to elicit robust humoral immune responses, rendering it suitable for regions where virulent NDV strains are endemic. The VG/GA strain, with its dual affinity for the respiratory and gastrointestinal tracts, enhances mucosal immunity and offers broader protection. The B1 strain, characterized by its low virulence and high safety profile, is often used in young chicks to control mild infections. Additionally, the mesogenic R2B strain is administered intramuscularly as a booster dose to reinforce immunity during the production cycle. Despite their widespread use, these vaccines may offer limited protection against genetically distinct field strains, emphasizing the need for updated, genotype-matched vaccination strategies.

Significance of Genotype - Specific Vaccines

E Genotype-matched vaccines offer a promising solution to the challenges posed by Newcastle Disease (ND). By specifically tailoring vaccines to the circulating strains in different geographical regions, these vaccines can enhance the immune response in poultry, providing superior protection against ND outbreaks. The efficacy of a vaccine is largely determined by its alignment with the prevailing virus strains; thus, genotype-specific vaccines significantly reduce infection rates and associated mortality.

Poultry farming is a vital source of income for millions of households in India, and outbreaks of Newcastle disease can lead to substantial mortality and morbidity, resulting in significant financial losses. The economic burden is further exacerbated by costs related to veterinary interventions, decreased productivity, and trade restrictions during outbreaks. By preventing such outbreaks, genotype-matched vaccines can stabilize the poultry industry, helping farmers preserve their livelihoods and contribute to national food security.

In addition to their economic impact, genotype-matched vaccines support broader public health objectives. Poultry is a

primary source of protein for many communities, and disruptions in poultry production can result in food shortages. By ensuring the health of poultry populations, these vaccines play a critical role in maintaining a stable supply of affordable meat and eggs, which is essential for improving nutrition and food availability across the country.

Essential Contribution of Genotype-Specific Vaccines

The increasing demand for genotype-matched vaccines reflects a shift in the approach to effective disease management. Farmers, veterinarians, and governmental agencies are progressively acknowledging the limitations of traditional vaccination strategies. Several studies indicate that the administration of live Newcastle Disease (ND) vaccines matching circulating viral strains can significantly reduce virus shedding in poultry flocks, a key metric for evaluating the efficacy of novel recombinant genotype VII NDV vaccines. Commercial recombinant NDV (rNDV) genotype VII.1.1 vaccines, based on La Sota and VG/GA strains, have demonstrated protective immune responses, whereas genotype II-based vaccines were less effective in mitigating virus shedding. Notably, the genotype VII SG10 vaccine exhibited superior protection compared to the La Sota vaccine against genotype VII NDV. Furthermore, both recombinant inactivated and live attenuated genotype-matched vaccines have shown to reduce virus shedding and enhance egg production in commercial laying hens exposed to virulent genotype VII viruses.

Several live recombinant NDV vaccines have been successfully commercialized, such as the Himmvac Dalguban N+ Live Vaccine in Korea, the live attenuated RINNOVAC™ELI-7 in Egypt, and Genovax N5 in Mexico. However, in India, there is a critical need for enhanced research and collaboration among key stakeholders, including vaccine manufacturers, public health authorities, and agricultural scientists, to develop and deploy these specialized vaccines. Investment in research is essential to gain a comprehensive understanding of NDV epidemiology in India, including the identification of circulating genotypes and their regional distribution. Surveillance systems are crucial for monitoring the spread of NDV strains and guiding vaccine development initiatives. Moreover, public awareness campaigns are vital to educate farmers on the benefits of genotype-matched vaccines, thereby encouraging their adoption and promoting best practices in poultry management.

Conclusion

In conclusion, the circulation of diverse NDV genotypes in India, coupled with the limited effectiveness of currently used genotype-II vaccines in preventing viral shedding—despite proper and repeated vaccination—underscores the need for improved vaccine strategies. Novel genotype-matched vaccines offer promising results by inducing stronger immune responses and reducing viral shedding, thus highlighting the necessity for updated vaccination approaches to combat ongoing Newcastle Disease threats. By addressing the challenges posed by the genetic diversity of NDV strains, these vaccines have the potential to enhance animal health, improve economic stability for farmers, and contribute to national food security.

Collaborative efforts in research, policy development, and education will be critical for the successful implementation of these tailored vaccination strategies, ultimately strengthening the resilience of India's poultry industry and ensuring a reliable and sustainable food supply for its growing population. The adoption of genotype-matched vaccines promises substantial economic benefits for poultry farmers and plays a vital role in food security.

Reference

1. Gopalakrishnan, G., Deepa, P. M., Rajasekhar, R., Janus, A., Bipin, K. C., Rathish, R. L., & Sulficar, S. (2024). Epidemiology and Molecular Characterization of Genotype XIII. 2.2 of Class II Newcastle Disease Virus from Vaccinated Flocks in Kerala, India. Journal of Advances in Microbiology, 24(8), 52-64.
2. Khorajiya, J. H., Joshi, B. P., Mathakiya, R. A., Prajapati, K. S., & Sipai, S. H. (2018). Economic impact of genotype-XIII Newcastle disease virus infection on commercial vaccinated layer farms in India. International Journal of Livestock Research, 8(5), 280-288.
3. Khorajiya, J. H., Mathakiya, R. A., Joshi, B. P., Prajapati, K. S., Acharya, A. T., & Rajpura, R. M. (2015). Isolation, identification, biological characterization and patho-epidemiology of genotype-XIII Newcastle disease virus outbreak in commercial vaccinated broiler farms. Indian Journal of Poultry Science, 50(2), 132-137.
4. Khorajiya, J. H., Pandey, S., Ghodasara, P. D., Joshi, B. P., Prajapati, K. S., Ghodasara, D. J., & Mathakiya, R. A. (2015). Patho-epidemiological study on Genotype-XIII Newcastle disease virus infection in commercial vaccinated layer farms. Veterinary World, 8(3), 372.
5. Kurkure, N.V. & Kaore, M.P. (2024). Control of Newcastle disease: Do we need to change vaccine candidate. Indian Journal of Veterinary Pathology, 48(2): 99-105.