EVALUATION OF SAFETY AND HUMORAL ANTIBODY RESPONSE OF NEWCASTLE DISEASE ORAL PELLET VACCINE IN THE FIELD CONDITION

M. Madhanmohan*[1], J. John Kirubakaran[2] and T. Ravimurugan[3]

Vaccine Research Centre-Viral Vaccines
Centre for Animal Health Studies
Tamil Nadu Veterinary and Animal Sciences University
Madhavaram Milk Colony, Chennai, Tamil Nadu, India

ABSTRACT

Newcastle Disease (ND) is a highly infectious disease of poultry causing huge economic loss to the poultry farmers. Newcastle Disease is controlled by vaccination of commercial or backyard poultry using inactivated or live ND vaccines. In the present study, safety and humoral antibody response in birds vaccinated with Newcastle disease virus oral pellet vaccine (NDV OPV) was studied in field conditions. A total of 300 backyard poultry (n=100/ farm) from three different farms were vaccinated with NDV OPV. The vaccinated birds were monitored for any adverse reactions or mortality up to 28 days post vaccination (dpv). There were no untoward reactions or mortality in the vaccinated birds in all the three farms up to 28 dpv. Blood samples (n=8/farm) were collected randomly from vaccinated birds on 0 and 28 dpv in each farm and were subjected to heamagglutination inhibition (HI) test. The mean HI titre was 66, 56 and 25 in farm 1, farm 2 and farm 3 respectively at 28 dpv. All the vaccinated birds had protective HI titre of ≥16 at 28 days post vaccination. In conclusion, Newcastle disease virus oral pellet vaccine (NDV OPV) is safe and induces good protective humoral antibody response and can be used to control ND in backyard poultry.

Key words: Backyard poultry, D58 strain, Oral pellet, Newcastle Disease, Thermostable

INTRODUCTION

Newcastle Disease (ND) is a highly infectious disease of poultry causing economic loss to the poultry farmers (Cattoli *et al.,* 2011; Dimitrov *et al.,* 2017).

Newcastle disease is caused by virulent strains of Avian avulavirus type 1 (AAvV-1), belongs to genus *Avian orthoavulavirus 1* (AOAV-1) within the subfamily *Avulavirinae* of the family *Paramyxoviridae* (Rima *et al*., 2019; Alexander and Senne, 2008). Newcastle disease is endemic in India and outbreaks are recorded throughout the year in commercial and backyard poultry farms.

*Corresponding author, email: muthukrishnan.madhanmohan@gmail.com
[1]Assistant Professor
[2]Professor and Head, Department of Veterinary Microbiology, Madras Veterinary College, Tamil Nadu Veterinary and Animal Sciences University, Chennai, Tamil Nadu, India
[3]Associate Professor and Head, Department of Animal Genetics and Breeding, Veterinary College and Research Institute, Tamil Nadu Veterinary and Animal Sciences University, Tirunelveli, Tamil Nadu, India

Backyard poultry farming contributes about 11% of total egg production of India (Kumaresan *et al.,* 2008) and serves as an important activity in the rural population, improving the economic status of poor people (Gueye, 2000). Prevention and control of ND in backyard poultry is crucial and is achieved by vaccinating the same using inactivated or live ND vaccines (Senne *et al.,* 2004; Dimitrov *et al.,* 2017; OIE, 2018). The various commercial live ND vaccines include Hitchner-B1, LaSota, V4, NDW, I2 of lentogenic strain; and Roakin, Mukteswar and Komarov of mesogenic strain (Dimitrov *et al.,* 2017; OIE, 2018). However, most of the backyard poultry are not regularly vaccinated against ND due to (i) higher cost of the vaccine, (ii) non-availability of vaccines in remote areas with proper cold chain maintenance, (iii) non-availability of smaller vaccine dose suitable for small poultry farmers, and (iv) lack of awareness among backyard poultry farmers.

Owing to the importance of improving the vaccination status of backyard poultry to control ND, the Department of Veterinary Microbiology, Madras Veterinary College, Tamil Nadu Veterinary and Animal Sciences University (TANUVAS) had developed a thermostablilized live Newcastle disease virus (NDV) oral pellet vaccine (OPV). The Newcastle disease virus oral pellet vaccine (NDV OPV) was developed using lentogenic D58 strain that was isolated during an outbreak in backyard poultry in Tamil Nadu (Kirubaharan and Palaniswami, 2003). The D58 strain is a naturally occurring lentogenic strain with an intra-cerebral pathogenicity index (ICPI) of 0.14, with a proven record of significant cellular and mucosal responses (Shilpa *et al*., 2014) and transcriptional cytokine responses (Kumar *et al.,* 2013*;* Ranjani *et al.,* 2019). The Newcastle disease virus oral pellet vaccine (NDV OPV) has the advantage of being available in small doses (10 or 25 pellets) that can be stored in room temperature (25-30^{o}C) for about two- three days without affecting the vaccine potency. Earlier studies suggested that the NDV OPV was safe, efficacious and did not affect egg production in backyard poultry (Senthilkumar *et al.,* 2015; Reetha *et al.,* 2016). The aim of the current study was to evaluate the safety and humoral antibody response of NDV OPV in backyard poultry in field conditions.

MATERIALS AND METHODS

The Newcastle disease virus oral pellet vaccine (NDV OPV) was produced by the Department of Veterinary Microbiology, Madras Veterinary College, TANUVAS, Chennai. This vaccine contained live D58 strain of Newcastle disease virus (lentogenic) in pellets made up of lactose, starch and amaranthus dye. The vaccine had been tested for its safety, purity and potency as per OIE (2018) protocol.

Three backyard poultry farms in Kanyakumari district were selected for this study. In farm1(n=100) and farm 3 (n=100), grama priya day old chicks procured from Institutional livestock farm complex, Veterinary College and Research Institute, Tirunelveli were housed; and in farm 2 (n=100) desi chicks were maintained in semi-intensive system of management. All the chicks were provided with starter feed up to one month of age thereafter the chicks

were provided with own feed prepared by the farmers. Water was provided ad libitum throughout the day.

All the chicks were vaccinated at eighth week of age. One pellet per bird was given orally. The vaccinated birds were monitored for any adverse reactions or mortality up to 28 days post vaccination. A random of eight birds (n=8) were selected in each farm for blood collection before vaccination (0 dpv) and after vaccination (28 dpv). Blood sample was collected in filter paper from wing vein, dried at room temperature (25-30°C) for 2-3 hours and serum was eluted at the time of performing HI. The eluted serum samples (0 and 28 dpv) were subjected to haemagglutination inhibition (HI) test as per OIE (2018) protocol.

Student't' test was used to compare the HI titre between 0 and 28 dpv serum samples at each farm. One-way analysis of variance (ANOVA) was used to compare the HI titre between the farms.

RESULTS AND DISCUSSION

Newcastle disease is a major viral disease that causes death in all age-groups of backyard poultry. Control of ND in backyard poultry would benefit the poultry farmers in the rural areas. Vaccination practices used in commercial poultry are inappropriate for backyard poultry in rural areas, where cold chain maintenance is difficult, dosage formulations are not available for smaller flocks and vaccine services are provided by the Animal husbandry department at weekends, where birds need to be brought to the hospital for vaccination. In order to mitigate the problem, Newcastle disease virus oral pellet vaccine (NDV OPV), which is (i) thermostable eliminating the need for cold chain maintenance; (ii) available in smaller doses thus cost effective for farmers owning smaller flock; and (iii) easy to be administered by the farmers themselves, was evaluated for safety and humoral antibody response in the field condition.

In the current study, there was no mortality in the vaccinated birds in all three farms throughout the study period. Similarly, there were no untoward reactions in the vaccinated birds in all three farms during the study period. These results suggested that the NDV OPV is safe to use in backyard poultry. At 0^{th} day, the mean HI titre was 1, whereas at 28 dpv, the mean HI titre was significantly higher ($p<0.001$) with 66, 56 and 25 in farm 1, farm 2 and farm 3 respectively (Fig.1). This suggests that all the vaccinated birds in this study have achieved a protective antibody titre of ≥1:16 at 28 dpv (Senthilkumar *et al.,* 2015; Reetha *et al.,* 2016), which is essential for prevention of ND in susceptible birds (Boven *et al.*, 2008). A single dose of NDV OPV showed a HI titre of ≥25, which correlates with an earlier finding whereas single vaccination with live lentogenic vaccine produced a HI titre of about 16 – 64 in birds (Allan *et al.,* 1978).

There was significant difference ($p<0.05$) in mean HI titre between farm 1 and farm 3. This may be due to the differences in the management practices of the farm. However, there was no significant difference in mean HI titre between farm 1 and 2; and farm 2 and 3.

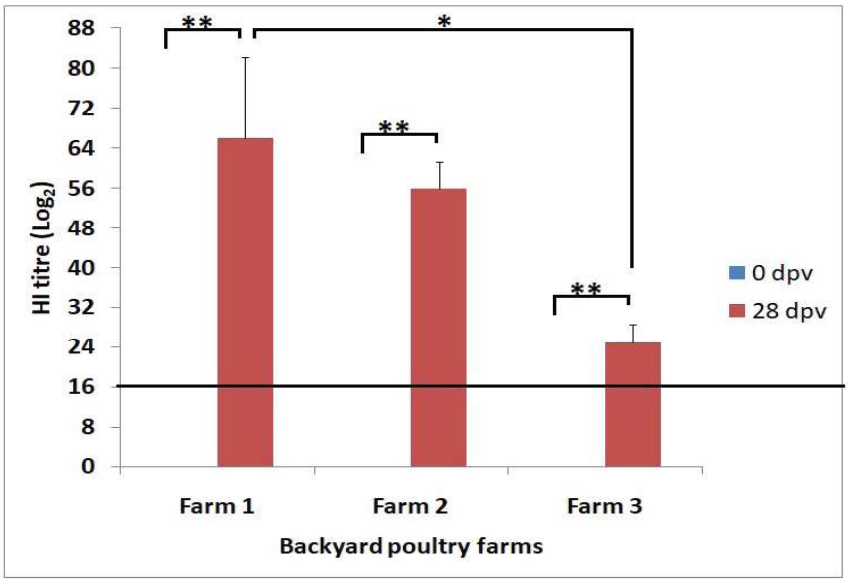

Figure 1. Haemagglutination inhibition titre of different backyard poultry farms.

Error bar indicates the standard error. *- significant difference 0.05 level ($p \leq 0.05$).
**- significant difference at 0.01 level ($p \leq 0.001$). Solid line indicates the protective HI titre (≥16)

In summary, safety and humoral antibody response of NDV OPV was evaluated in backyard poultry farms. A total of 300 birds from three different backyard poultry farms were vaccinated with NDV OPV. There were no untoward reactions or mortality in the vaccinated birds up to 28 dpv. All the vaccinated birds showed protective HI titre of ≥16 at 28 dpv. The NDV OPV is safe and induces protective humoral antibody titre. This vaccine would be helpful to control ND in backyard poultry. Furthermore, the thermostable NDV OPV is suitable for any age group of backyard poultry above 6 – 8 weeks of age and it can be easily administered through feed or water by the farmers without any help from trained personal.

ACKNOWLEDGEMENT

The authors are grateful to Tamil Nadu Veterinary and Animal Sciences University, Chennai for providing necessary financial assistance and facilities to carry out this research work.

REFERENCES

Alexander, D.J. and Senne, D.A. (2008). Newcastle Disease and Other Avian paramyxoviruses. *In*: A Laboratory Manual for the Isolation, Identification and Characterization of Avian Pathogens, Dufour-Zavala L. (Editor in Chief) Swayne D.E., Glisson J.R., Jackwood M.W., Pearson J.E., Reed W.M. and Woolcock P.R., 4th

ed., American Association of Avian Pathologists, Athens, GA, pp. 135–141.

Allan, W.H., Lancaster, J.E. and Toth, B. (1978). Newcastle Disease Vaccines. FAO, Rome, Italy.

Boven, M.V., Bouma, A., Fabri, T.H., Katsma, E., Hartog, L. and Koch, G. (2008). Herd immunity to Newcastle disease virus in poultry by vaccination. *Avian Pathology,* **37**: 1–5.

Cattoli, G., Susta, L., Terregino, C. and Brown, C. (2011). Newcastle disease: A review of field recognition and current methods of laboratory detection. *Journal of Veterinary Diagnostic Investigation,* **23:** 637-656.

Dimitrov, K.M., Afonso, C,L., Yu, Q. and Miller, P.J. (2017). Newcastle disease vaccines - A solved problem or a continuous challenge? *Veterinary Microbiology*, **206**: 126-136.

Gueye, E.F. (2000). The role of family poultry in poverty alleviation, food security and the promotion of gender equality in rural Africa. *Outlook on Agriculture,* **29(2)**: 129-136.

Kirubaharan, J. and Palaniswami, K.S. (2003). Final report of the ICAR scheme on preparation and standardization of oral pellet vaccine against Newcastle disease, Department of Veterinary Microbiology, Madras veterinary College, Chennai, India.

Kumar, R., Kirubaharan, J.J., Chandran, N.D.J. and Gnanapriya, N. (2013). Transcriptional response of chicken embryo cells to Newcastle disease virus (D58 strain) infection. *Virus Disease*, **24**: 278-283.

Kumaresan, A., Bujarbaruah, K.M., Pathak, K.A., Chettri, B., Ahmed, S.K. and Haunshi, S. (2008). Analysis of a village chicken production system and performance of improved dual purpose chickens under a subtropical hill agro-ecosystem in India. *Tropical Animal Health Production,* **40**: 395-402.

OIE. (2018). Manual of Diagnostic Tests and Vaccines for Terrestrial Animals. Newcastle disease (Infection with Newcastle disease virus); Paris: OIE Publication, pp. 964-983.

Ranjani, R., Kirubaharan, J.J., Vidhya, M., Shilpa, P. and Chandran, N.D.J. (2019). Pro-inflammatory cytokine and apoptotic gene mRNA levels against lentogenic and velogenic Newcastle disease virus pathotypes in in-vivo and in-vitro biological systems. *Indian Journal of Animal Research,* **53(4)**: 515-522.

Reetha, T.L., Rajeswar, J.J., Harikrishnan, T.J., Sukumar, K, Srinivasan, P. and Kirubakaran, J.J. (2016). Studies on the effectiveness of oral pellet vaccine in improving egg production and egg quality in desi chicken, *Veterinary World,* **9(8)**: 900-903.

Rima, B., Balkema-Buschmann, A., Dundon, W.G., Duprex, P., Easton, A., Fouchier, R., Kurath, G., Lamb, R., Lee, B., Rota, P., Wang, L. and ICTV Report Consortium (2019). ICTV Virus Taxonomy Profile: Paramyxoviridae. *Journal of General Virology*, **100**:1593–1594.

Senne, D.A., King, D.J. and Kapczynski, D.R. (2004). Control of Newcastle disease by vaccination. *Developments in Biologicals (Basel),* **119:** 165-170.

Senthilkumar, S, Prathaban, S, Kirubaharan, J.J. and Manivannan, C. (2015). Efficacy of oral pellet vaccine for Newcastle disease in desi chicken of Tamil Nadu. *Indian Journal of Poultry Science,* **50(3)**: 340-341.

Shilpa, P., Kirubaharan, J.J., Chandran, N.D. and Gnanapriya, N. (2014). Assessment of cellular and mucosal immune responses in chicks to Newcastle disease oral pellet vaccine (D58 strain) using qPCR. *Virus Disease*, **25 (4):** 467 – 473.