Development and immunogenic potentials of chitosan-saponin encapsulated DNA vaccine against avian infectious bronchitis coronavirus

ABSTRACT

Infectious Bronchitis (IB) is an economically important avian disease that considerably threatens the global poultry industry. This is partly, as a result of its negative consequences on egg production, weight gain as well as mortality rate.The disease is caused by a constantly evolving avian infectious bronchitis virus whose isolates are classified into several serotypes and genotypes that demonstrate little or no cross protection. In order to curb the menace of the disease therefore, broad based vaccines are urgently needed. The aim of this study was to develop a recombinant DNA vaccine candidate for improved protection of avian infectious bronchitis in poultry. Using bioinformatics and molecular cloning procedures, sets of monovalent and bivalent DNA vaccine constructs were developed based on the S1 glycoprotein from classical and variants IBV strains namely, M41 and CR88 respectively. The candidate vaccine was then encapsulated with a chitosan and saponin formulated nanoparticle for enhanced immunogenicity and protective capacity. RT-PCR assay and IFAT were used to confirm the transcriptional and translational expression of the encoded proteins respectively, while ELISA and Flow-cytometry were used to evaluate the immunogenicity of the candidate vaccine following immunization of various SPF chicken groups (A-F). Furthermore, histopathological changes and virus shedding were determined by quantitative realtime PCR assay and lesion scoring procedure respectively following challenge of various subgroups with respective wild-type IBV viruses. Results obtained from this study showed that, groups vaccinated with a bivalent DNA vaccine construct (pBudCR88-S1/M41-S1) had a significant increase in anti-IBV antibodies, CD3+ and CD8+ T-cells responses as compared to non-vaccinated groups. Likewise, the bivalent vaccine candidate significantly decreased the oropharyngeal and cloacal virus shedding ($p < 0.05$) compared to non-vaccinated control. Chickens immunized with the bivalent vaccine also exhibited milder clinical signs as well as low tracheal and kidney lesion scores following virus challenge when compared to control groups. Collectively, the present study demonstrated that bivalent DNA vaccine co-expressing dual S1 glycoprotein induced strong immune responses capable of protecting chickens against infection with both M41 and CR88 IBV strains. Moreso, it was evident that encapsulation of the vaccine with chitosan-saponin nanoparticle further enhanced immune responses and abrogates the need for multiple booster administration of vaccine. Therefore, the bivalent DNA vaccine could serve as efficient and effective alternative strategy for the control of IB in poultry.

Keyword: Bivalent DNA vaccine; Plasmid; Infectious bronchitis virus; Coronavirus; Immunogenicity; Poultry; Chitosan; Saponin; Nanoparticle