

Endocrine-Immune Co-modulation by a ZnO/Chitosan-Chlorella vulgaris Nanovaccine in VNN-Challenged Hybrid Grouper

Uun Yanuhar*

Study Program of Fisheries Resources Management, Faculty of Fisheries and Marine Sciences, Brawijaya University, East Java, Indonesia

Muhamad Amin

Study Program of Fisheries Resources Management, Faculty of Fisheries and Marine Sciences, Brawijaya University, East Java, Indonesia & Department of Environmental and Life Science, Faculty of Science, University Brunei Darussalam, Brunei Darussalam, Gadong, Brunei

Alfi Nur Rusydi

Study Program of Fisheries Resources Management, Faculty of Fisheries and Marine Sciences, Brawijaya University, East Java, Indonesia

Heru Suryanto

Department of Mechanical and Industrial Engineering, Faculty of Engineering, Universitas Negeri Malang, Malang, Indonesia

Ranjith Kumar Rajamani

Department of Pharmacology, Saveetha Medical College and Hospital, SIMATS, Saveetha University, Chennai, Tamil Nadu, India

Defa Rizqi Machfuda

Master of Aquaculture Study Program, Faculty of Fisheries and Marine Sciences, Brawijaya University, Veteran Street, Malang, East Java, Indonesia

Abstract

Viral Nervous Necrosis (VNN) infection in grouper can reduce survival and affect growth. This research explores the potential of ZnO/Chitosan–Chlorella vulgaris nanovaccines in enhancing immune protection and growth in hybrid grouper (*Epinephelus* sp.) infected with VNN. The research used an experiment with two controls (K–, K+) and five treatment doses (T1–T5). The nanovaccine is administered twice: on days 0 and 14. The VNN challenge is given on day 28, with observations up to day 56. The parameters measured include hematology, leukocyte differential, growth hormone, cytokines, testosterone, and estradiol. Treatment with a dose of 33 µL (T3) showed the best results, with a Survival Rate of 95% and Relative Percent Survival of 92%. These results correlated with increased growth; T3 showed a final length of 12.76 cm and a weight of 18.03 g, which was higher than the positive control group (K+). Hematological measurements showed an increase in erythrocyte count at T3 to 2.78×10^6 cells/µL, with the highest hemoglobin level at 8 g/dL. Leukocytes at T3 increased to 1.52×10^3 cells/µL, indicating a better immune response. The levels of GnRH (49,296 pg/mL), GH (71,937 pg/mL), and IGF (417,915 pg/mL) in T3 showed a positive effect of the nanovaccine on growth. IL-6 expression decreased and IL-10 increased at T3, indicating effective inflammatory modulation. This study shows that ZnO/Chitosan–C. vulgaris nanovaccine is effective in improving survival, growth, and modulating the immune response in VNN-infected grouper.

Index Terms

Viral Nervous Necrosis (VNN), ZnO/Chitosan–Chlorella vulgaris nanovaccine, grouper fish, immune response, growth hormones