

Endoscopy gender determination and reproductive hormone profiles of Painted Terrapins (*Batagur borneoensis*) subjected to ex situ incubation

ABSTRACT

Vibrio harveyi causes vibriosis in various commercial marine fish species. The infection leads to significant economic losses for aquaculture farms, and vaccination is an alternative approach for the prevention and control of fish diseases for aquaculture sustainability. This study describes the use of formalin-killed *Vibrio harveyi* (FKVh) strain Vh1 as a vaccine candidate to stimulate innate and adaptive immunities against vibriosis in a marine red hybrid tilapia model. Tilapia are fast growing; cheap; resistant to diseases; and tolerant to adverse environmental conditions of fresh water, brackish water, and marine water and because of these advantages, marine red hybrid tilapia is a suitable candidate as a model to study fish diseases and vaccinations against vibriosis. A total of 180 healthy red hybrid tilapias were gradually adapted to the marine environment before being divided into two groups, with 90 fish in each group and were kept in triplicate with 30 fish per tank. Group 1 was vaccinated intraperitoneally with 100 μ L of FKVh on week 0, and a booster dose was similarly administered on week 2. Group 2 was similarly injected with PBS. Skin mucus, serum, and gut lavage were collected weekly for enzyme-linked immunosorbent assay (ELISA) and a lysozyme activity assay from a total of 30 fish of each group. On week 4, the remaining 60 fish of Groups 1 and 2 were challenged with 10⁸ cfu/fish of live *Vibrio harveyi*. The clinical signs were monitored while the survival rate was recorded for 48 h post-challenge. Vaccination with FKVh resulted in a significantly ($p < 0.05$) higher rate of survival (87%) compared to the control (20%). The IgM antibody titer and lysozyme activities of Group 1 were significantly ($p < 0.05$) higher than the unvaccinated Groups 2 in most weeks throughout the experiment. Therefore, the intraperitoneal exposure of marine red hybrid tilapia to killed *V. harveyi* enhanced the resistance and antibody response of the fish against vibriosis.

Keyword: Marine red hybrid tilapia; *Vibrio harveyi*; Immune response; Formalin-killed vaccine