ORAL VACCINATION AGAINST INFECTIOUS SALMON ANEMIA IN ATLANTIC SALMON (Salmo salar) INDUCES SPECIFIC IMMUNITY AND PROVIDES PROTECTION AGAINST INFECTIOUS SALMON ANEMIA VIRUS CHALLENGE.

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ABSTRACT

Infectious salmon anemia virus (ISAv) caused by the infectious salmon anemia virus (ISAv) arose in Chile in 2007 and it has become the major cause for Atlantic salmon mortality. The disease affects post-smolt salmon (Salmo salar) regardless of the age of the fish and causes major economic losses to the Chilean salmon industry. Although several ISAv vaccines are available, all of them are currently applied by injection route in freshwater, a procedure which albeit ensures fish-by-fish application, may also induce stress-related effects on fish, such as immunosuppression, reduction in feeding rate and mortality. Moreover, injectable vaccines do not represent a practical choice when fish will need to be boosterized, a procedure intended to enhance or prolong acquired anti-ISAv immune response. We describe here a novel oral ISAv vaccine from Centrovet Laboratory using their unique ISAv-derived antigens expressed in yeast, and encapsulated with proprietary encapsulation technology, MicroMatrix™, of Advanced BioNutrition Corp. Fish fed with MicroMatrix™ encapsulated ISAv vaccine showed specific anti-ISAv antibody titer 1200 degree days after vaccination. Additionally, when fish were challenged with a virulent ISAV strain using a cohabitation challenge model, vaccinated fish showed a Relative Percent Survival (RPS) of 80, and fish survival was correlated with IgM titer. In addition, oral vaccine also induced local immunity, showing mucosal inflammation and antibody generation. Finally, vaccination of fish using MicroMatrix™ encapsulated technology appeared to be safe for fish, since overheating with up to 5x dose did not interfere with fish weight gain. These results suggest that anti-ISAv immunity can be successfully induced by oral route and the ISAv vaccine containing Centrovet recombinant ISAv antigens, and encapsulated using MicroMatrix™ technology, protects Atlantic salmon efficiently upon ISAv challenge.

INTRODUCTION

Infectious salmon anemia virus (ISAv), caused by the infectious salmon anemia virus (ISAv) is a highly contagious disease of Atlantic salmon (Salmo salar) that was first reported in Chile in 2007 (Kilgroe et al., 2004). The disease was subsequently reported from Scotland, Canada and the United States. In 2007, the disease was reported in Chile and since then it has caused a major economic loss estimated at US $100M. In Chile, besides biosafety measures including early harvest and compulsory slaughter of infected stock, there are several commercially available vaccines against ISAv, which are applied by injection in freshwater stage. Although this procedure ensures vaccine application, it has several limitations including immunosuppression and reduction in feeding rate after vaccine application. Furthermore, vaccine protection usually does not cover the entire farming period, rendering fish susceptible to infection at higher sizes. Although a revaccination (booster) could overcome this problem, to inject fish at higher sizes exposes them to infectious agents and risks up vaccine-associated costs. Thus, the availability of an alternative delivery strategy such as oral vaccination represents attractive candidates to evaluate. We report here a novel oral ISAv vaccine from Centrovet Laboratory (Chile) using their unique ISAv-derived antigen expressed in yeast, and encapsulated with a proprietary encapsulation technology, MicroMatrix™, of Advanced BioNutrition Corp., Columbia, Maryland, USA. We showed that vacccinated fish produced specific ISAv antibodies, and the antibody titer is correlated with protection against challenge with a virulent ISAv strain.

MATERIALS & METHODS

- Collection of serum 180, 300, 450, 600, 900 and 1200 dd post-vaccination. ELISA, ISAv neutralizing assay and histology.
- ISAv challenge using cohabitation model at 310, 650, and 830 dd post-vaccination.
- Evaluating ISAv oral vaccine safety at 1X and 5X vaccine dose.

RESULTS

- ISAv challenge by cohabitation vaccine induction (Fig. 1A).
- ISAv-Oral vaccine induces ISAv-specific antibodies and antigens in intestinal tissue induced by oral vaccine. B. Histological sections (H&E) of control and vaccinated fish at 310 dd after vaccination. Arrows show lymphocyte cell in lamina propria of intestinal villi. (Fig. 2B).
- The arrows show ISA-derived CPE on SHK-1 cells.
- Fish vaccinated with 1x and 5x of vaccine dose showed no significant differences in growth (15.40 ± 0.33), (15.44 ± 0.49), and (15.43 ± 0.40) groups.
- The data suggested that inflammation induced by oral vaccine did not affect nutrients absorption parameters, and subsequently growth performance.

CONCLUSIONS

- ISAv-Oral vaccine induces both systemic and mucosal immunity starting at 100 dd and remains at 100 dd post-vaccination.
- Serum from vaccinated fish has ISAv neutralizing activity since it inhibited ISAv infection of SHK-1 cells in vitro assay.
- The anti-ISAv antibody response induced by vaccination correlated with the protection upon ISAv challenge with a virulent strain.
- The vaccine is safe for application, causing no adverse effects when applied up to 5x-fold higher than the recommended dose.