

A novel 'in-feed' delivery platform applied for oral DNA vaccination against IPNV enables high protection in Atlantic salmon (*Salmon salar*)

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Background DNA vaccination has emerged as a promising tool against infectious diseases of farmed fish. Oral delivery allows stress-free administration that is ideal for mass immunization and of paramount importance for infectious pancreatic necrosis (IPN) and other viral disease that affect young salmonids and cause economic losses in aquaculture worldwide. Methods We describe the development and in vivo assessment of an 'in-feed' formulation strategy for oral immunization with liposomal DNA vaccines, by delivering a vaccine construct coding for an immunogenic region of the VP2 capsid protein. A challenge against IPNV was carried out to determine the vaccine efficacy, by comparing the mortality of pre-smolt Atlantic salmon immunized and non-immunized with the oral vaccine. The antibody response (ELISA) and hematological parameters after immunization were examined, as well as the vaccine effect on the growth and internal structures of fry salmon (histological analysis). The vaccine distribution in the experimental tank after oral administration was investigated by HPLC and PCR amplification. Results The oral vaccine induced detectable levels of VP2-specific antibodies and conferred significant protection following IPNV challenge, with relative percent survivals (RPS) of 58.2%, for single dose (1 mgpDNA/kgfish?d), and 66% for double dose (2 mgpDNA/kgfish?d). We further provide evidence in favour of the vaccine safety to fish and demonstrated absence of pDNA in the tank water, but presence of vaccine residues in faeces and

unconsumed feed sediments (solid wastes). Conclusion The delivery platform for liposomal DNA vaccination via feed was successfully proved against IPNV in Atlantic salmon, showing the oral vaccine to be immunogenic and safe for fish, and providing significant protection after oral administration. The 'in-feed' technology for oral DNA vaccination holds potential to be applied against IPNV and other pathogens that currently threaten the aquaculture worldwide. © 2016

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Atlantic salmon

DNA vaccine

DOTAP

Feed

IPNV

Liposome

Oral delivery

Salmon salar

1,2 dioleoyl 3 trimethylammonio propane

DNA vaccine

infectious pancreatic necrosis virus vaccine

protein VP2

unclassified drug

virus vaccine

DNA vaccine

drug carrier

immunological adjuvant

liposome

virus antibody

animal food

animal tissue

antibody detection

aquaculture

Article

controlled study

DNA immunization

drug safety

histology

in vivo study

infectious pancreatic necrosis

infectious pancreatic necrosis virus

liposomal delivery

liver

mortality

nonhuman

pancreas

particle size

priority journal

provocation test

Salmo salar

animal

animal structures

birnavirus infection

blood

enzyme linked immunosorbent assay

fish disease

immunology

infectious pancreatic necrosis virus

oral drug administration

pathology

survival analysis

treatment outcome

veterinary

Adjuvants, Immunologic

Administration, Oral

Animal Structures

Animals

Antibodies, Viral

Birnaviridae Infections

Drug Carriers

Enzyme-Linked Immunosorbent Assay

Fish Diseases

Infectious pancreatic necrosis virus

Liposomes

Salmo salar

Survival Analysis

Treatment Outcome

Vaccines, DNA