Fish diseases, parasites and vaccines

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A major difficulty for aquaculture is the tendency towards monoculture and the associated risk of widespread disease. Aquaculture is also associated with environmental risks; for instance, shrimp farming has caused the destruction of important mangrove forests throughout southeast Asia.[118]

In the 1990s, disease wiped out China's farmed Farrer's scallop and white shrimp and required their replacement by other species.[119]

Needs of the aquaculture sector in vaccines[edit]

Aquaculture has an average annual growth rate of 9.2%, however the success and continued expansion of the fish farming sector is highly dependent on the control of fish pathogens including a wide range of viruses, bacteria, fungi, and parasites. In 2014, it was estimated that these parasites cost the global salmon farming industry up to 400 million Euros. This represents 6-10% of the production value of the affected countries, but it can go up to 20% (Fisheries and Oceans Canada, 2014). Since pathogens quickly spread within a population of cultured fish, their control is vital for the sector. Historically, the use of antibiotics was against bacterial epizootics but production of animal proteins has to be sustainable, which means that preventive measures that are acceptable from a biological and environmental point of view should be used to keep disease problems in aquaculture at an acceptable level. So, this added to the efficiency of vaccines resulted in an immediate and permanent reduction in the use of antibiotics in the 90s. At the beginning there were fish immersion vaccines efficient against the vibriosis but proved ineffective against the furunculosis, hence the arrival of injectable vaccines: first water-based and after oil-based, much more efficient (Sommerset, 2005).

Development of new vaccines[edit]

It is the important mortality in cages among farmed fish, the debates around DNA injection vaccines, although effective, their safety and their side effects but also societal expectations for cleaner fish and security, lead research on new vaccine vectors. Several initiatives are financed by the European Union to develop a rapid and cost-effective approach to using bacteria in feed to make vaccines, in particular thanks to lactic bacteria whose DNA is modified (Boudinot, 2006). In fact, vaccinating farmed fish by injection is time-consuming and costly, so vaccines can be administered orally or by immersion by being added to feed or directly into water. This allows to vaccinate many individuals at the same time, while limiting the associated handling and stress. Indeed, many tests are necessary because the antigens of the vaccines must be adapted to each species or not present a certain level of variability or they will not have any effect. For example, tests have been done with 2 species: Lepeophtheirus salmonis (from which the antigens were collected) and Caligus rogercresseyi (which was vaccinated with the antigens), although the homology between the two species is important, the level of variability made the protection ineffective (Fisheries and Oceans Canada, 2014).

Recent vaccines development in aquaculture[edit]

There are 24 vaccines available and one for lobsters. The first vaccine was used in the USA against enteric red mouth in 1976. However, there are 19 companies and some small stakeholders are producing vaccines for aquaculture nowadays. The novel approaches are a way forward to prevent the loss of 10% aquaculture through disease. Genetically modified vaccines are not being used in the EU due to societal concerns and regulations. Meanwhile, DNA vaccines are now authorised in the EU (Adams, 2019). There are challenges in fish vaccine development, immune response due to lack of potent adjScientists are considering microdose application in future. But there are also exciting opportunities in aquaculture vaccinology due to low cost of technology, regulations change and novel antigen expression and delivery systems. In Norway subunit vaccine (VP2 peptide) against infectious pancreatic necrosis is being used. In Canada, a licensed DNA vaccine against Infectious hematopoietic necrosis has been launched for industry use. Fish have large mucosal surfaces, so the preferred route is immersion, intraperitoneal and oral respectively. Nanoparticles are under progress for delivery purposes. The common antibodies produced are IgM and IgT. Normally booster is not required ifn Fish because more memory cells are produced in response to booster rather than increased level of antibodies. mRNA vaccines are alternative to DNA vaccines because they are more safe, stable, easily producible at large scale and mass immunization potential. Recently these are used in cancer prevention and therapeutics. Studies in rabies has shown that efficacy depends on dose and route of administration. These are still in infancy (Adams, 2019).