AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly e Newsletter
Volume 3 – Issue 3
Online ISSN: 2582-368X
www.agriallis.com

FISH VACCINES AND THEIR ROLE IN DISEASE MANAGEMENT

Article Id: AL2021152

[1]Priyanka Arya*, [1]Anurag Semwal, [1]Ujjwala Upreti and [1]R. S. Chauhan

[1] Department of Aquaculture, College of Fisheries, G. B. Pant University of Agriculture & Technology, Pantnagar -263145 (Uttarakhand), India

Email: priyankaarya445@gmail.com

Vaccination is an elementary, effective and preventive method of protecting fish from diseases. Vaccines are antigens derived from pathogenic species that have been made non-pathogenic by different methods in order to activate the immune system and improve susceptibility to disease from subsequent infection by a pathogen. Vaccination is the paramount method to increase survival rate and efficiency in aquaculture when used in combination with several factors like a balanced diet, good farming and husbandry practices, proper health monitoring and management, which are necessary to guarantee the highest possible survival rate. In 1976, the first aquaculture vaccine, a yersiniosis vaccine for salmonid fish, was approved in the United States (Plumb 1999). The first report on fish vaccination was given by David C. B. Duff, and he is regarded as "Father of fish vaccination".

Ideal Characteristics of Fish Vaccines

- Cheap and safe
- Easily produced
- Stable
- Sustained immunity and protection
- Easy mass application
- Efficacious for a broad number of species
- Will not interfere with diagnosis
- Easily licensed

Volume 3 – Issue 3
Online ISSN: 2582-368X
www.agriallis.com

Importance of Vaccination

- Use as prophylaxis against the disease before the occurrence of disease.
- Used to prevent a specific disease outbreak from occurring
- Efficient
- No side issues, no accumulation of toxic residue
- Vaccines are not the same as antibiotics; pathogen will not develop resistance.

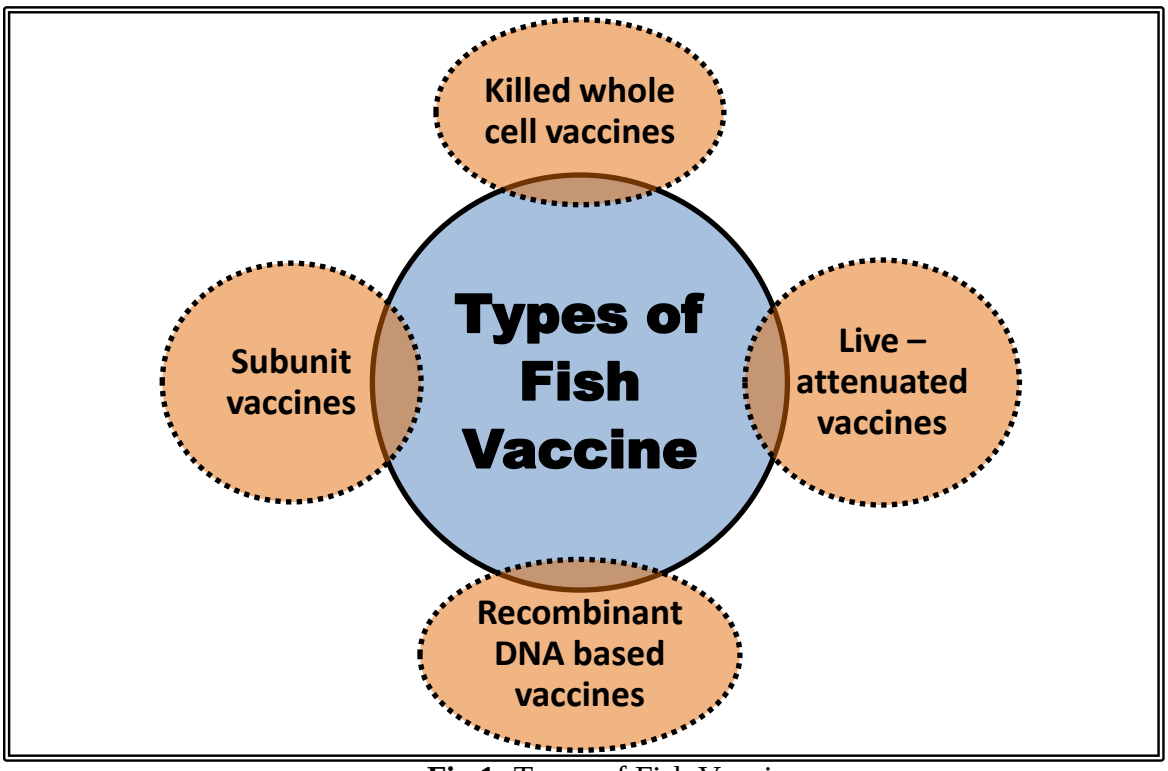

Fig.1: Types of Fish Vaccine

Vaccines aren't the same as antibiotics, and they won't be able to avoid a disease outbreak once it's started. Vaccines are used to prevent the outbreak of a specific disease and are not a remedy. Its efficiency exists for a longer duration with one or more treatments. Vaccination seems to be a more important part of aquaculture because it is a cost-effective way to manage a variety of diseases that pose a threat. Its efficiency exists for a longer duration with one or more treatments. There are different types of fish vaccines produced in aquaculture to induce an immune response in an organism. (Fig.1)

1) **Killed whole cell vaccines:** The vaccines are prepared from the suspension of heat or chemical – killed pathogens. All the killed vaccines are formalin inactivated whole cell vaccines administered with or without adjuvant. They are highly immune-

Volume 3 – Issue 3
Online ISSN: 2582-368X
www.agriallis.com

protective and are cheap to produce. The disadvantages are that they have a little residual effect and weaker stimulation of cell mediated response (Tlaxca *et al*., 2015).

2) **Live – attenuated vaccines:** Suspension of attenuated live pathogens that are capable of replicating inside the host. These are live micro-organisms that have been cultivated under conditions that disable their virulent properties and induce protective immune response but are unable to cause disease. They are capable to induce both humoral and cell mediated immune response. The drawback is facing problem in their storage and shelf-life.**(Roy, 2011)**
3) **Recombinant DNA based vaccines:** They are also called new generation vaccines. Formation of new combinations of genetic material by insertion of nucleic acid molecules produced outside the cell via a vector system.
    - **Recombinant protein vaccines:** Identification of the immunogenic subunit or protein from the pathogens of interest and verification of its immunogenicity *in vitro and in vivo.* The vector system usually used to express recombinant proteins are viruses or bacterial plasmids. Both prokaryotes and eukaryotes expression system have been used.
    - **Peptide vaccine:** Peptide vaccines comprised of synthetic peptides that are able to induce a protective immune response when administrated into the host. For the production of peptide vaccines, it is necessary to immunogenic identity regions or 'epitopes' on the antigens protein.
    - **DNA vaccines:** DNA vaccines consist of a suspension of bacterial plasmids carrying the gene coding for the immunogenic protein under the control of the eukaryotic promoter.
4) **Subunit vaccines:** Subunit vaccines contain a portion of the infectious agent, which is essential for stimulation of protective immunity. Subunit fish vaccines are commercially available. These vaccines are safe and inexpensive, but there may be inadequate cellular immunity **(Seder and Hill, 2000)**.

Adjuvants are a pharmacological or immunological agent that is co-injected with antigen in order to help stimulate and enhance the adaptive immune system into producing antibodies against the antigen.

Volume 3 – Issue 3
Online ISSN: 2582-368X
www.agriallis.com

Vaccination Methods

1. **Injection Vaccination:** Most common method of vaccine delivery by intraperitoneal or intramuscular injections in fish. It is an effective way of provoking an antibody response. The major drawbacks are it is time consuming, labour intensive and consequently expensive to administer the vaccine to a large number of fish. Significant handling stress and due to small size fry cannot be vaccinated by means of injection (Fig. 2).

Fig. 2: Injection vaccination

2. **Immersion Vaccination:** Different types of immersion techniques are used as a commercial process. Like bath method, dip method and spray method. It is a hyperosmotic immersion technique were prior to immersion in antigen solution, fish are dipped for a short time in a hyperosmotic salt solution, which enhances the intake of antigens. Suitable for mass vaccination of all sizes of fish, lower labour costs. Major disadvantages are a large amount of vaccine required and lower level of protection and duration of immunity (Fig. 3).

Fig. 3: Immersion vaccination

Volume 3 – Issue 3
Online ISSN: 2582-368X
www.agriallis.com

3. **Oral Vaccination:** It is one of the easiest methods of mass vaccination of any size of fishes. Vaccine mixed with feed, different new approaches with microencapsulation, bio encapsulation or other ways of incorporation of antigens is promising. The main limitations of this method are large quantities of antigen required to obtain effective immunity, lower efficacy and protection generally weak and of short duration (Fig.4). (Komar et al., 2004)

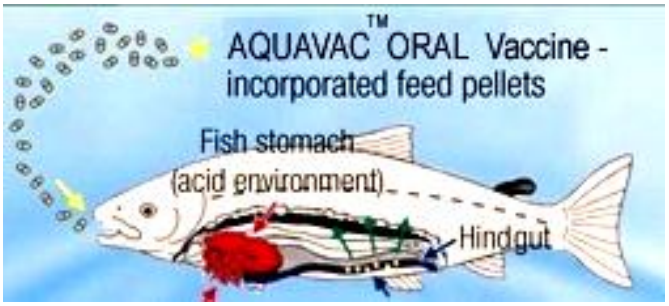

Fig. 4: Oral vaccination

Factors Affecting Response to Vaccine

- Species (age and size)
- Effects of preexisting disease
- Method of administration like for immersion vaccines the concentration, exposure time and use of any hyperosmotic infiltration procedure affect the response.
- For oral vaccines the method of incorporation in feed
- Farming technology (Handling, mechanisation)
- Environment (temperature, salinity)
- Stress factors, nutrition and cost benefit

Successful Vaccination

The major causative agents of infectious diseases in finfish aquaculture include fungi 3.1%, parasites 19.4%, viruses 22.6%, and bacteria 54.9%. There are several successful vaccines produced for bacterial diseases. In spite of the amount of research performed, both in commercial companies and in academic organizations, few viral vaccines are licensed. No parasite vaccines are commercially available.

In general, fish possess both humoral and cell-mediated defence mechanisms against many parasites, and there are many reports on immunity / increased resistance among fish

Volume 3 – Issue 3
Online ISSN: 2582-368X
www.agriallis.com

surviving natural parasitic infection. Cultivation of parasites for potential killed or live vaccine is even more expensive than virus cultivation.

Optimal effects of vaccines

Proper fish health management, including good hygiene and minimal stress, is important in the prophylaxis of infectious diseases and is also required for vaccines to work optimally. Using efficient vaccines and administering them correctly is not the only factors affecting the effects of vaccines. Proper fish management practices will help vaccines perform at their best. Optimal conditions and adequate nutrition are very important, and one must also strive to expose the fish to as little stress as possible. The efficiency of a vaccine largely depends on the condition of the immune system, and exposing fish to factors that might harm their immune system is therefore highly unadvisable.

Following is the list of some successful vaccines used in aquaculture-

Table1: List of Fish Vaccines Developed

Disease	Vaccine	Fish Species	Route of Administration
	1. Bacterial vaccines		
Furunculosis	*Aeromonas salmonicida* Bacterins	Atlantic salmon	**I, Im, O**
Vibriosis	*Vibrio salmonicida* Bacterin	Salmonids	**Ip**
Enteric septicaemia	*Edwardsiella ictaluri* Bacterin	Channel Catfish	**Im, O, I**
Columnaris	No commercial vaccines	Ictalurids, eels, Salmonids, cyprinids and ornamental fish like goldfish	**-**
Yersiniosis	*Yersinia ruckeri* Bacterin	Rainbow trout, Atlantic salmon	**I**
Bacterial kidney disease	*Renibacterium salmoninarum* bacterin	Salmonids	**I**
Mycobacteriosis	-	Freshwater and saltwater fishes	**No vaccines are available**
Dropsy	Biofilm and free-cell vaccines of *Aeromonas hydrophila*	IMC's	**I**
Streptococcosis	*Streptococcus agalactiae* (group B) vaccine	Tilapia	**I**

Volume 3 – Issue 3
Online ISSN: 2582-368X
www.agriallis.com

2. Viral Vaccines			
Infectious pancreatic necrosis (IPN)	Inactivated vaccines, DNA vaccine	Atlantic salmon	**I**
Spring viraemia of carp	Spring viraemia of carp virus	Common carp	**I**
Pancreas disease	Salmon pancreas disease vaccine	Salmonids	**I**
Koi herpes virus	Koi herpes virus (KHV)	Koi carp	**I**
3. Fish Vaccines against Parasites- No vaccines are available			

*Where, I-Injection, O-Oral route, Im-Immersion and Ip- Intra peritoneal

Conclusion

Vaccines are currently available for a range of economically significant bacterial and viral diseases. Vaccines for parasitic and fungal diseases, on the other hand, have yet to be generated. Major limitations in fish vaccine developments are less understanding of fish immunology, many vaccines unlicensed, not cost effective (expensive) and stressful on administration. Fish vaccination is still quite an infant stage, but innovative advances can be made. Vaccines are tools that can be used in conjunction with good health management and biosecurity plans to give aquaculture producers the most benefit. To be sustainable, aquaculture requires efficient and safe vaccines that can be converted into licensed products.

References

Komar, C., Enright, W. J,, Grisez, L. and Tan, Z. (2004). Understanding Fish Vaccination. Reprinted from Aquaculture Asia Specific Magazine, Intervet, Norbio Singapore pte, Iperahuroad, Singapore, pp: 27-29.

Plumb, J. A. (1999). Health maintenance and principal microbial diseases of cultured fishes. Iowa State University Press, 328 p.

Roy, P. E. (2011). Use of Vaccines in Finfish Aquaculture. School of Forest Resources and Conservation, Florida Cooperative extension service, institute of food and agricultural Sciences, University of Florida.

Seder, R. A. and Hill, A. V. S. (2000). Vaccines against intracellular infections requiring cellular immunity. Nature 406:793–797.

Volume 3 – Issue 3
Online ISSN: 2582-368X
www.agriallis.com

Tlaxca, J. L., Ellis, S. and Remmele, R. L. (2015). Live attenuated and inactivated viral vaccine formulation and nasal delivery: Potential and challenges. *Adv. Drug Deliv. Rev*. 93:56–78.