Immunological Control of Fish Diseases

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Abstract: Disease prevention by means of vaccination and immunostimulation of fish in aquaculture has been particularly successful against several bacterial diseases. There are several alternative strategies to the use of antimicrobial have been proposed. There are always trails for controlling and combating diseases by developments in control strategies. The developments have involved better husbandry and nutrition, vaccines and immunostimulants.
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The immune system of fish

During infection the fast but generally short-lived innate immune response proceeds the longer lasting more specific adaptive immune response. In fish this lag period can be as much as 10-12 weeks, which has to be kept in mind when considering vaccination as a prophylactic measure in fish aquaculture.

Innate Factors

The innate immune system is of prime importance in the immune defense of fish. It is commonly divided into 3 compartments: the epithelial/mucosal barrier, the humoral parameters and the cellular components.

Adaptive Factors

The key humoral parameter of the adaptive system is the immunoglobulins (antibodies), expressed either as Blymphocyte receptor or secreted in plasma. Effectively only one functional immunoglobulin class, a tetrameric IgM, is present in teleosts.

Inherent Factors that Affect the Immune System of Fish:

There are several inherent factors that can affect the immune system of fish resulting in variation in disease resistance between different species and between different individuals. These include evolutionary status, genetic variations, age, sex and maternal effects.

Evolutionary Lineage

The evolutionary lineage of present day teleosts goes back to Jurassic time separating the different orders of modern teleosts by up to 100-200 million years. Teleosts have also adapted to very varied environments and their feeding and breeding habits vary extensively. It follows that the selective pressures during evolution must vary considerably and influence their immune system and immune response. Comparing the immune response of the gadidae and salmonid species there are even indications that different lines of immune defence have been "tested out" through evolutionary time independently of the general physiological and anatomical progress of fish evolution [1].

Genetic Make- Up

Several studies have shown that the activity of different immune parameters can vary greatly between individual fish of the same species and that resistance to pathogens shows marked individual diversity. This diversity strengthens the survival of the species in its entirety especially under natural conditions. In aquaculture based primarily on out bred fish, this can cause problems of unpredictability in some research programmers, evaluation of husbandry practices or prophylactic methods. Selective breeding employed in aquaculture to select for favorable traits like disease resistance, has been problematic possibly due to the inherent diversity and often obscure correlation between immune parameters and disease resistance [2].

Age and Sex

Age and sexual maturation are important inherent factors that influence the immune system and immune response of fish. Considerable attention has been paid to the development of the immune system of fish from fertilized egg to a fully immuno-competent stage[3]. During ontogeny components of the innate system generally appear before adaptive immune parameters. Commonly present at hatching are phagocytes, lysozyme activity and complement proteins [4,5].

In general adaptive immune parameters appear later in marine species than in fresh water species but the order of appearance of the different organs and components of the immune system varies from one species to another. These variations play a crucial role in larviculture management and determine when vaccination is a valid prophylactic measure[6]. In fully developed fish, immune parameters can change with

increasing age and vary between males and females. For example, the immunoglobulin concentration in serum (and natural antibody activity) increases with increasing age. In some species, like the cod, this increase continues throughout life, in other species maximum level is reached at sexual maturation [7-9].

Interaction between the immune system and the endocrine system are well documented in fish. This interaction has been mainly studied with reference to stress hormones (see below) but male and female sex hormones, testosterone and estradiol-17β, have also been shown to effect immune parameters directly during sexual maturation and spawning [10]. Again, the effects vary depending on the fish species and the parameter studied. Suppression of plasma IgM levels was, for example, observed in rainbow trout following administration of sex hormones[11], while male and female sex hormones had different but not suppressive effects on phagocytic and complement activity and IgM levels in gilthead sea bream, Sparus aurata [12]. In aquaculture, measure are frequently taken to control, delay or impede sexual maturation and spawning to avoid threats to fish health during this period, for example, by inducing sterility through polyploidy[13-14] calves housed indoors in a temperature controlled environment with little added stressor may not benefit form probiotic feeding [15].

Medicinal Plant therapy:

The interest in medicinal plants has increased significantly in recent years not only to cure humans but also to cure animals. There are several medicinal plants to treat different illnesses in animals as presented in. One of them used as feed additives is *Nigella sativa (N. sativa).* The seed of *N. sativa* has been reported to have many biological properties including antibacterial [16] and anti-parasitic[17]. The oil fraction of *N. sativa* contains thymoquinone, which has immune-potentiating activities as well as anti-oxidative effect. Besides, *N. sativa* seeds provide relatively high amount of some essential nutrients such as carbohydrates fats, vitamins, mineral elements and proteins including eight of the nine essential amino acids that improve natural immune system activity. Dietary antioxidants from natural herbs such as *N. sativa* and organic multi nutrient-antioxidants (Zn-Met. And Vitamin E with Se enriched yeast) have potential for improvement of cellular immune responses. Moreover, it showed antimicrobial effect against some enteric pathogens by inhibition of the intestinal bacterial counts of *E.coli* and *C. Perfringens.*

Table (1): Some plants used in veterinary phytotherapy (Laudato and Capasso, 2013):

Scientific name	Used part	Use
Aloe ssp.	Latex, gel	Skin diseases, GI diseases, cancer
Arcostaphylos uva-ursi	Leaves	Urinary diseases
Capsella bursa-pastoris	Aerial parts	Haemorrhages, reproductive disorders
Eucalyptus globulus	Leaves, essential oil	Ectoparasites, respiratory diseases
Plantago major	Leaves	GI diseases, wounds
Thymus vulgaris	Flowers	Respiratory and GI diseases

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