DISEASE CHALLENGES AND THEIR MANAGEMENT IN INTENSIVE FISH FARMING

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1. INTRODUCTION

Intensive fish farming is becoming an important and rapidly expanding enterprise throughout the world because of its enhanced unit value and resultant economic returns. Fish is still considered as the best source of animal protein and hence much emphasis is given by developing countries like India to culture it to combat the malnutrition and under-nutrition problems.

Although intensive fish farming is a lucrative venture, the success of it depends solely on the health of fish. Fish health is in turn determined by the various biotic including the disease causing organisms and abiotic parameters present in the culture system. However, fish diseases are given due attention, only when they result in large scale mortalities concomitantly reducing the production to an alarming extent. The recent outbreak of dreaded Epizootic Ulcerative Syndrome (EUS) in Asia can be taken as the best example in this regard.

In general, the intensive fish culture technique involves high density stocking of fish young ones (fry/fingerling) per unit area and feed them with artificial feed. Large quantities of fertilizers and manure are applied to the culture system to enhance the primary productivity. This practice of high density stocking and application of feed and manure cause stress to fish and together with other adverse environmental factors prevailing in the culture system induce the growth of disease causing pathogens also. Under ideal conditions (like density of pathogens, virulence of pathogens and susceptibility of host) the delicate balance is tilted favourably towards parasites/pathogens, resulting in disease manifestation. Such influence of diseases in aquaculture and the loss due to them are not fully studied mainly due to lack of technical expertise and know-how in this important area.

2. ROLE OF ENVIRONMENTAL FACTORS

As noted earlier, many a time, sudden epizootics result from the combined action of the biotic factors and adverse environmental factor/s prevailing in the culture system. The diseases thus caused can be called as "Stress - mediated diseases". Figure 1 gives an idea of the manifestation of stress-mediated disease in fishes.

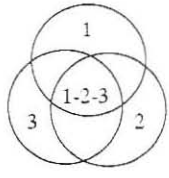

Fig. 1. Frequently a fish population (1) must interact with a pathogen (2) in an unfavourable environment (3) for an epizootic to occur (1-2-3) (Snieszko, 1974).

Table 1 lists the 9 stress - mediated fish diseases which are recorded from India.

Table 1. Stress - mediated diseases in fishes from India

Disease	Environmental factor associated with the disease
Bacterial gill disease	Crowding; low D.O.; high ammonia in water (0.1 ppm of NH_3-N)
Aeromnad and Pseudomonad Septicaemia (Haemorrhagic)	Prior infection by Protozoa; increased bacterial load in the culture system; crowding; low D.O.; bad handling of fish; chronic sublethal exposure to heavy metals, pesticides or PCB's
Dropsy of carps and catfishes	Crowding; chronic exposure to low level of D.O., accumulation of organic load in water
Catarrhact of *Catla catla*	Continuous exposure to poor sanitary conditions
Tumours of *Anabas testudineus*	Crowding; chronic exposure to low levels of D.O; accumulation of organic matter in ambient in water
Reddish blotches of silver carp, *Hypothalamichthyx molitrix*	Chronic exposure to low level of D.O; crowding; accumulation of organic load in water
Vibriosis	Handling; low levels of D.O.
Tail and fin rot	Crowding; improper deit; ambient temperature
Gas bubble disease	Supersaturation of D.O; N_2 (131.0%) and CO_2 in water

3. NUTRITIONAL FACTORS

Nutritional diseases are usually caused by feed imbalance, like deficiencies. Although it is rare for a single deficiency to exist, there are other reasons like absolute starvation, protein deficiency, lipid deficiency and vitamin deficiency symptoms which are easily noticed. These deficiencies can be corrected by incorporating the relevant feed component.

4. BIOTIC FACTORS

Large scale mortalities in the fish culture systems are often caused by parasites and microbes which are generally termed as 'biotic factors'.

4.1. Microbial Diseases

The microbial diseases caused by viruses, bacteria, fungi and protozoans are considered as very important as these agents infect the fishes and bring down production to an alarming extent.

The studies on fish diseases caused by microbial agents are conducted in 4 stages in the laboratory:

Stage 1: Recording of visible external and internal symptoms.

Stage 2: Isolation, characterization and maintenance of the causative organisms.

Stage 3: Artificial infection of the healthy fishes with the pathogen to study pathogenecity.

Stage 4: Screening relevant microbicidal drug for application in culture system with epizootics.

The fish pathogenic bacteria and fungi are known to produce toxins, which are consid-

ered as virulence factors. Many of the toxins are known to be proteins, and symptoms of the diseases can be experimentally induced by injecting very low quantity of these toxins.

A few of the common external visible symptoms of diseased fishes which can be observed inthe field conditions include:

1. affected fishes become lethargic and refuse to feed
2. affected fishes frequent the water surface to breathe
3. in some cases, eruptions on the body surface
4. excessive mucus secretions
5. blood accumulation at the base of fins and around anus
6. tumours and in some cases exopthalmic conditions
7. cotton wool like growth in the case of fungal diseases

In India about 10 Research Institutes and Universities are presently engaged in fish disease investigations.

4.2. Bacterial Diseases

In India 13 species of bacteria belonging to 8 genera are associated with fish diseases. A summary of the bacterial diseases in Inland aquaculture is given in Table 2.

In the estuarine and marine fin fish culture, very little information is available about bacterial diseases. In these culture systems, it is observed that *Vibrio* species cause high mortalities. In addition, *Alcaligenes, Bacillus, E. coli, Klebsiella, Mycobacterium, Proteus* and *Pseudomonas* sp. were reported to be causative agents.

Table 2. Bacterial diseases of inland fish culture system

Disease	Host	Associated bacteria
Eye disease	Catla	*Aeromonas liqueifaciens**
Haemorrhages	Major carps	*Aeromonas punctata**
Dropsy	Major carps	*Aeromonas* spp.
Hemolytic	Rohu	*Aeromonas hydrophila**
Abscess	Catfish	*Alcaligenes falcalis*
Flexibacter	Rohu	*Flexibacter columnaris*
Ulcer	Rohu	*Haemophilus piscium*
Skin lesion	Catfish	*Pseudomonas aeruginosa*
Eye disease	Murrels	*Staphylococcus aureus*

* These are now classified as Aeromonas hydrophila

4.3. Fungal disease in fishes

A perusal of literature indicates that 27 species of fungi are associated with freshwater fish diseases from India. The major group of fungi involved belong to *Acbyla, Aphanomyces, Branchiomyces, Dictyuchus, Fusarium, Leptomities, Pythinum* and *Saprolegnia*. Among these *Saproleginia* is considered as a dreaded one since it affects almost all the species of fish and even fish eggs. Usually fungal diseases occur as secondary infections, the primary being a bacterial attack, virus attack or due to bruises caused by handling the fishes. Some of the common fungi, associated with fish diseases are listed in Table 3.

4.4. Protozoan diseases

Ciliates, Mastigophora and Myxosporidia falling under Protozoa are recorded to affect

Table 3. Common fish pathogenic fungi recorded from culturable species of fish

Species	Host fish
Achlya americana	mrigal, *Cirrhina mrigala*
A. diffusa	catla, *Catla catla*
A. hypogna	perch, *Anabas testudineus*
A. orion	grass carp *Ctenopharyngodon idella*
Achyla sp.	murrel, *Channa marulius* Common carp, *Cyprinus carpio*
Aphanomyces levis	mrigal, *Cirrhina mrigala*
Branchiomyces sanguinis	murrel, *Channa marulins*
Dictyuchus anomalous	murrel, *C. punctatus*
Fusarium sp.	Tilapia *Oreochromis mossambica*
Leptomitus liberatae	Fry of Indian major carps
Saprolegnia diclina	Common carp, *Cyprinus carpo*
S. parasitica	Indian major carp eggs, fry, fingerlings and adults
Saprolegnia sp.	Catfish, *Heteropneustes fossilis* murrel, *Channa gachua*

the culturable freshwater fishes. Among the Ciliates, *Ichthypthiris muffifillis* is recorded to cause large scale mortalities. Its counter part, *Cryptocaryon irritans* is of marine origin and causes severe mortalities among the marine ornamental and other commercial fishes. Some of the cilitate, mastigophoran and myxosporidian pathogens of fishes are given in Table 4.

5. MANAGEMENT OF MICROBIAL DISEASES

In the intensive fish culture systems disease prevention (Prophylaxis) and treatment (therapy) are equally important to combat the microbial disease.

5.1. Diseases prevention (prophylaxis)

Disease prevention emphazises procedures that prevent infection eventhough the pathogenic organisms are present in the environment. The principles involved in prevention of disease include: (i) avoidance, (ii) increased host resistance, (iii) environmental

Table 4. Common Ciliata, Mastigophora and Myxosporidian parasites of fishes

Parasite species	Host fish	Site of infection
Ciliates		
Icthyopthirius multifilis	Indian major carps, murrels	body surface
Scyphidia pyriformis	Indian major carps	skin, fins and gills
Trichodina indica	Indian major caprs, murrels	gills and skin
Mastigophora		
Bodomonas rebae	Indian major carps	gills
Trypanosoma sp.	Indian major carps, catfishes, murrrels	blood
Myxosporidia		
Myxosoma sp.	murrels	Intestine, fins, liver, kidney
Myxobolus sp.	Indian major carps, catfishes, murrels	gills, gall bladder, liver
Henneguya sp.	murrels	gills, viscera
Thelohanellus sp.	Indian major carps	gills
Unicauda sp.	murrels	buccal cavity, gills

modifications and (iv) chemopro-phylaxis. Fish health experts are of the opinion that disease inspection and certification are important steps so that suitable laws and regulations for import of fish, fish eggs and fish products are enacted. Even hatchery produced seeds for inland use within the country require legalisation, so as to avoid the onset and spread of some of the communicable diseases (like EUS).

Breeding for resistance to diseases is a new line of thinking as has been experienced in the case of trouts against furunculosis disease in Europe. In fact more of genetic work has to be carried out to understand the disease resistance pattern of fishes.

Immunization of fishes is another successful step against disease prevention. Vaccines and immunostimulants are being tried against fish pathogenic microbes. A number of methods are evolved to administer these into fishes. However this remains a nascent field in the Indian aquaculture scenario.

Likewise chemopophylaxis could be successfully employed by using antimicrobial compounds in the culture system. However care must be taken to use the recommended chemical at the recommended concentrations.

5.2. Disease treatment

It is a known fact that the occurrence of infectious diseases will be minimal if fish are maintained in a perfectly balanced environment. However, regardless of preventive steps, fish diseases do develop to some degree. In the fish culture system, diseases are to be considered on a population basis unlike those to domesticated animals or humans, which can be carried out on individual basis.

Treatment/Therapy for controlling fish diseases are usually given by administering chemical (chemotherapy). A chemical or antimicrobial compound reduces the level of infection, prevents the reproduction of replication of pathogen or retards the growth of pathogens so that the host's defensive mechanism can develop and the fish can overcome the disease. According to Plumb (1992) four 'K's' must be studied before starting the treatment: i) Know the water, ii) Know the fish, iii) Know the chemical and iv) Know the disease.

i. Know the water

Before initiating treatment the volume of water present in the culture system should be accurately known. Chemical parameters such as alkalinity, pH and temperature should be studied as these factors influence the efficacy and toxicity of some chemicals to fish.

ii. Know the fish

Different species or ages/stages of fish are affected differently by some chemicals. It is advisable to carry out a test 'bioassay' before initiating the treatment. This can be performed by treating a few fish in a small vessel containing the water to be treated and observing the effects of chemicals on fish.

iii. Know the chemical

As noted earlier the toxicity of chemical to be used must be determined. It is known that some chemicals are neutralised by sunlight, PH and temperature. Some chemicals are toxic to phytoplankton and plants which in turn result in oxygen depletion or chemical removal of oxygen from water.

iv. Know the disease

The disease to be treated should be understood fully. In some instances, multiple

infections involving two or more pathogens case disease at the time. For such cases, a sequence of treatments should be prescribed

5.2.1 Methods of treatment

The therapy can be effected by:

i. external treatment like dip, flush, prolonged and indefinite.

ii. systemic treatment via diet (including bioencapsulation)or injections.

Some of the recommended chemicals and their application procedure are given in Table 5.

allowing it to flush through without interrupting the water flow. It is usually recommended in hatcheries as well as for treating fungus infections on eggs.

Prolonged:

The chemical is added and the fish are exposed for a comparatively short-term bath for a specified period of time. This involves a higher concentration of the chemical than the indefinite method.

Indefinite:

In the 'indefinite' treatment, low concentration of chemical or drug is used in ponds

Table 5. Recommended chemicals to control microbial diseases of fishes

Chemical	Pattern of use	Effective concenration
Acriflavin	Antibacterial	2 ppm (I) 10 ppm (P)
Chloramine T	Antibacterial	8 - 10 ppm (P)
Copper sulphate	Antimicrobial	0.25 - 1.0 ppm (I)
Erythromycin	Antibacterial	100 mg/kg feed
Furanace	Antibacterial	20 - 100 ppm (P)
Malachite green	Fungicide on fish eggs	5 ppm (P), 0.1 ppm (I)
Oxytetracycline	Antibacterial	50 mg/kg feed
Potassium permanganate	Antibacterial	2 - 4 ppm (I)
Oxolinic acid	Antibacterial	10 - 50 mg/kg feed
Sodium chloride	Osmoregulator	0.3 - 10.0% (I), 3.0% (D & P)
Sulphur drugs (Sulphamerazine)	Antibacterial	100 mg/kg feed

(D) - Dip; (I) - Indefinite; (P) - Prolonged

i. External Treatment

Dip:

A strong solution of the chemical to be used is prepared and fish are immersed (dipped) in the solution for 15 to 60 seconds. As a precaution, it is advisable to treat a few infected fish to determine their reaction before treating the entire stock.

Flush:

A specific amount of chemical is added to a trough, aquarium, tank or raceway and

or tanks for an undetermined length of time. This treatment is considered as safe.

ii. Systemic Treatment

Feeding

Feeding is effective in treating systemic bacterial infections and intestinal parasites. The drugs are incorporated into the feed at a concentration that delivers a desired dose per unit of fish weight per day when the fish are fed at a specific feeding rate (percentage of body weight).

Injection

Injections can be administered as intraperitonealy (IP) or intramusculary (IM). The doses are measured in either international units or micrograms of active drug per kilogram of fish.

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