



Comprehensive Review on Fish Diseases and Health Management in Aquaculture Systems

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Fish health is one of the most critical pillars of sustainable aquaculture. A healthy fish population ensures optimal growth, high feed conversion efficiency (FCR), and improved production performance, directly influencing the profitability of aquaculture enterprises. Moreover, fish contribute significantly to global food and nutritional security, providing high-quality animal protein, essential fatty acids, and micronutrients to millions of people. Therefore, maintaining fish health is as vital as managing feed, genetics, and water quality in any aquaculture system.

Fish live in constant interaction with their aquatic environment, where even minor fluctuations in physicochemical parameters can influence their physiological and immune responses. Poor water quality such as low dissolved oxygen (DO), high ammonia (NH₃) levels, or extreme pH variations acts as a primary stressor in culture systems. Chronic stress suppresses the immune competence of fish by affecting the hypothalamic pituitary interrenal (HPI) axis, thereby increasing their susceptibility to opportunistic pathogens including bacteria, fungi, and parasites.

Overstocking, accumulation of organic matter, and thermal stress also create favourable conditions for pathogen proliferation. The carrying capacity of aquaculture ponds, when exceeded, leads to oxygen depletion, high organic load, and enhanced microbial activity, which compromise fish health. Inadequate sanitation, irregular pond preparation, and lack of quarantine for new stock further elevate the risk of disease transmission within the culture system.

Aquatic diseases are multifactorial in origin, often resulting from an interplay between host susceptibility, pathogen virulence, and environmental stressors a relationship described by the disease triad concept. Understanding this triad is crucial for effective disease prevention and health management.

Thus, maintaining fish health requires a preventive and ecosystem-based approach rather than a reactive one. Key strategies include:

- Regular monitoring of water quality parameters (temperature, pH, DO, ammonia, nitrite, hardness, alkalinity).
- Maintaining optimum stocking density to reduce competition and stress.
- Adopting biosecurity measures such as disinfection of ponds, proper waste management, and quarantine of broodstock and fingerlings.
- Ensuring nutritionally balanced feed enriched with probiotics, vitamins, and minerals to enhance immune response.
- Periodic health surveillance and observation of fish behaviour for early detection of abnormalities.

A holistic approach that integrates environmental monitoring, good aquaculture practices (GAP), and scientific health management can significantly minimize disease risks and ensure sustainable fish production for future generations.

Fish Diseases: Causes, Symptoms, and Control Measures

Fish diseases are among the major constraints in aquaculture production. They affect fish health, growth, and survival, resulting in significant economic losses. Understanding the types of diseases, their symptoms, and suitable control measures is essential for maintaining a healthy and profitable aquaculture system.

Fish diseases can be broadly classified into three major groups: bacterial, viral, and parasitic diseases.

A. Bacterial Diseases

1. Aeromonas Septicemia (Caused by *Aeromonas hydrophila*)

- **Symptoms:** Hemorrhages on skin, ulcers, swollen abdomen, lethargy, mass mortality.
- **Control:** Maintain pond hygiene, proper feeding, reduce stress, avoid overcrowding.
- **Treatment:** Administer antibiotics like oxytetracycline or sulfonamides under veterinary guidance.

2. Columnaris Disease (Caused by *Flavobacterium columnare*)

- **Symptoms:** White or grayish patches on skin and gills, frayed fins, lethargy, slow growth.
- **Control:** Improve water quality, avoid overcrowding.
- **Treatment:** Antibiotic treatment (oxytetracycline, kanamycin) and topical antiseptics.

3. Fin Rot (Caused by *Aeromonas* or *Pseudomonas* sp.)

- **Symptoms:** Frayed or decaying fins, secondary infections, slow growth.
- **Control:** Maintain water quality, remove infected fish.
- **Treatment:** Antibiotics (oxytetracycline, erythromycin) and antiseptic baths.

4. Dropsy / Edema (Caused by *Aeromonas* sp. or poor water quality)

- **Symptoms:** Swollen body, fluid accumulation, bulging eyes, lethargy.
- **Control:** Improve water quality, reduce stress.
- **Treatment:** Antibiotics (oxytetracycline, trimethoprim-sulfamethoxazole) and supportive care.

B. Viral Diseases

1. Viral Hemorrhagic Septicemia (VHS) (Caused by VHS virus)

- **Symptoms:** Hemorrhages in eyes, skin, gills; bulging eyes; lethargy; high mortality.
- **Control:** Use disease-free seed, maintain biosecurity, avoid infected fish.
- **Treatment:** No specific antiviral drug; supportive care, maintain water quality, quarantine infected fish.

2. Infectious Pancreatic Necrosis (IPN) (Caused by IPN virus)

- **Symptoms:** Darkening of skin, abdominal swelling, erratic swimming, high mortality in fry.
- **Control:** Use virus-free seed, disinfect equipment.
- **Treatment:** No antiviral drug; supportive care, reduce stress, maintain optimal water quality.

C. Fungal Diseases

1. Epizootic Ulcerative Syndrome (EUS) (Caused by *Aphanomyces invadans*)

- **Symptoms:** Reddening of skin, ulcer formation, hemorrhages, high mortality.
- **Control:** Maintain good water quality, avoid stress, quarantine new fish.
- **Treatment:** Topical antifungal agents, salt or formalin baths, and supportive care.

2. Gill Rot / Branchiomycosis (Caused by *Branchiomyces* sp.)

- **Symptoms:** Necrosis of gills, breathing difficulty, lethargy.
- **Control:** Maintain aeration, disinfect ponds, avoid high organic load.
- **Treatment:** Improve water circulation, apply approved antifungal treatments, copper sulfate dips if recommended.

D. Parasitic Diseases

1. Myxoboliasis (Caused by *Myxobolus* sp.)

- **Symptoms:** Formation of cysts in gills and body muscles; difficulty in respiration; reduced growth.

- **Control:** Use healthy seed, disinfect ponds, avoid mixed stocking with wild fish.
 - **Treatment:** No effective chemical treatment; remove heavily infected fish, improve pond hygiene.
- 2. White Spot Disease / Ichthyophthiriasis (Caused by *Ichthyophthirius multifiliis*)**
- **Symptoms:** Small white spots on skin and gills, rubbing against objects, respiratory distress.
 - **Control:** Quarantine new fish, increase water temperature gradually.
 - **Treatment:** Formalin or malachite green baths, potassium permanganate treatment as per dosage.
- 3. Lernaea Infestation (Caused by *Lernaea* sp.)**
- **Symptoms:** Visible worms on skin or fins, skin irritation, ulcers, reduced growth.
 - **Control:** Avoid introducing infected fish.
 - **Treatment:** Manually remove parasites, apply organophosphate dips or approved anti-parasitic chemicals.
- 4. Trichodiniasis (Caused by *Trichodina* sp.)**
- **Symptoms:** Excess mucus on skin and gills, rubbing against surfaces, respiratory distress.
 - **Control:** Improve water quality.
 - **Treatment:** Freshwater dips, formalin or potassium permanganate baths as per guidelines.
- 5. Costiasis (Caused by *Costia* sp.)**
- **Symptoms:** Slime coating on body, lethargy, rapid gill movement.
 - **Control:** Maintain water hygiene.
 - **Treatment:** Salt baths, formalin treatment, or approved anti-parasitic agents.

General Preventive Measures

- Maintain **optimum water quality** (pH: 7–8, DO: >5 mg/L, low ammonia).
- Avoid **overfeeding** and accumulation of organic matter.
- Stock only **certified healthy fingerlings**.
- **Quarantine** new fish before introducing them into the main pond.
- Use **lime (CaCO₃ or CaO)** and **salt** periodically to control pathogens.
- Ensure **regular health monitoring** and seek expert help for disease diagnosis.

Conclusion

Fish health management is the cornerstone of sustainable and profitable aquaculture. The occurrence of diseases in fish is often a result of multiple interacting factors involving the host, pathogen, and environment. Therefore, understanding the causative agents bacterial, viral, fungal, and parasitic and their respective control and treatment measures is essential for minimizing losses and maintaining productivity. Preventive strategies such as maintaining good water quality, adopting proper biosecurity measures, and ensuring the use of healthy seed are far more effective and economical than curative approaches. A proactive health management plan that includes regular monitoring of physicochemical parameters, timely diagnosis, and appropriate treatment not only enhances fish survival and growth but also ensures the sustainability of aquaculture systems. Farmers must be educated and encouraged to follow good aquaculture practices (GAP), including disinfection, proper stocking density, and balanced feeding. Moreover, integrating modern diagnostic tools and eco-friendly treatments such as probiotics and herbal immunostimulants can further strengthen fish resilience against diseases. In conclusion, maintaining fish health is not merely about disease control it is about building a resilient and sustainable aquaculture ecosystem where environmental management, preventive care, and scientific intervention work together to ensure higher productivity, profitability, and long-term ecological balance.