Fish Disease and Health Management in Aquaculture Production

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**Abstract**

Disease issues are of great concern in aquaculture production. Production costs are increased through investment lost in dead cultured animals, cost of treatment, and decreased quality and quantity of yields. Likewise, health and environmental stability are threatened owing to public health hazards associated with disease occurrence and treatment involving synthetic drugs (especially antibiotics). And with these impacts and the fact that many diseases are still emerging; the aquaculture industry is finding it more challenging to guarantee its sustainable development. This study becomes necessary as there are various efforts to increase fish supply through aquaculture production to bridge the gap between the declining fish supply from capture fisheries and the increasing food fish demand. This study reviews the causes, significance, and control of fish diseases in aquaculture production to provide hands-on information on diseases and health management in aquaculture production, and create relevant awareness on cultured fisheries management and practices.

**Keywords:** Infectious Disease; Antibiotics; Aquaculture Development; Economic Loss

**Introduction**

The advent and anticipation of aquaculture is to enhance food production; more income generation and good health for the people. However, like other farming sectors, disease is a substantial source of constraint to aquaculture development and sustainability; from both social and economic points of view [1,2]. Production costs are increased through investment lost in dead cultured animals, cost of treatment, and decreased quality and quantity of yields [3]. Livelihood and standard of living are affected due to reduced products availability, loss of income and employments [4]. Likewise, health and environmental stability are also threatened owing to public health hazards associated with disease occurrence and treatment involving synthetic drugs (especially antibiotics) (Food and Agricultural Organization [5]. With these impacts and the fact that many diseases are still emerging [6]; the aquaculture industry is finding it more challenging to guarantee its sustainable development.

Disease is a condition in living organisms in which normal physiological functions are being impaired due to alteration in the body systems and typically manifested by distinguishing signs and symptoms (pathological symptoms) [7]. However, healthy fish have adequate resistance against diseases; they can adapt to reasonable environmental changes and in turn resist diseases [8,9]. Nonetheless, diseases occur in fish [3] but before an active fish disease is developed in a culture system pathologically linked factors are involved:

- Presence of environmental pathogens
- Low resistance of the fish
- Un favorable water environment

Development of an active disease in fish results from the effect of the association among these (pathologically linked) factors. In a pond, when the pathogen load increases due to external factors (environmental problems such as poor water supply, or other stressors), above what the natural resistance of the fish can cope with, fish become vulnerable to pathogenic infections and diseases. Also, external factors may cause drastic changes in water quality and lower fish resistance. When these happen, fish become susceptible to diseases, even the risks of fish kill is heightened.

**Forms of Fish Diseases**

There are two broad forms of diseases affecting fish

- **Infectious diseases**
- **Non-infection diseases**

**Infectious Diseases**

Infectious diseases are caused by living factors - pathogenic organisms (viruses, bacteria, fungi or parasites) present in the aquatic environment or carried by other fish. Fish become vulnerable to pathogenic infections when there are stressors (environmental abnormalities, water quality deterioration, unbalanced nutrition, or bodily injuries) which weaken fish natural resistance (immune system). Infectious diseases pose a unique problem of diagnosis [9]. Infections can occur internally and externally affecting tissues, organs and other fish body parts. They are mostly contagious diseases and some types of treatments may be necessary to control the disease outbreaks. The following are the type of infectious disease.

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**Sub Date:** February 17, 2017, **Acc Date:** February 27, 2017, **Pub Date:** February 28, 2017.

**Citation:** Idowu TA, HA Adedeji and OA Sogbesan (2017) Fish Disease and Health Management in Aquaculture Production. Int J Environ & Agri Sci 1: 002.

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Parasitic Diseases
Parasites of fish are not strictly pathogens, but they make a convenient classification as infectious disease of fish [10], as they are often accompanied or followed by secondary bacterial or fungal infections. Fish parasites infest the gills, skin, gut, or as a grub-like worms in fish muscle tissue causing irritation, impaired function, weight loss, and eventually fish kill [3]. Most protozoan infections are relatively easy to control using standard fishery chemicals such as copper sulphate, formalin, or potassium permanganate [3]. Examples of parasitic infections (Table 1) include Ichthyophthiriasis (White Spot Disease), Chilodonelliasis, Whirling Disease, Lernaeosis, Gyrodactylosis, Anchor Worm Infection and Copepods (commonly known as fish lice).

Bacterial Diseases
Bacteria are usually component of aquatic environment. They become problem when fish are exposed to stressors [11]. The actual role of bacteria in pond may vary from that of a primary pathogen to that of opportunist invader of a host rendered moribund by some other disease processes [10]. Bacterial infections are considered the major cause of mortality in aquaculture [9]. They can infect a single fish and multiply rapidly to cause a substantial fish kill in a few days or weeks. Bacterial diseases are often internal infections and usually require treatment (with antibiotics added to feeds or water). However, bacterial diseases can also be external which may result from rough handling or effects of parasitic infection. Among the common bacterial infections (Table 1) of fish are: Columnaris (Flexibacter columnaris), Furunculosis (Aeromonas salmonicida), Piscine tuberculos (Mycobacterium marinum) and Vibrios (Vibrio sp). Antibiotics are commonly used in the treatment of bacterial infection of fish. Various vaccines including bacterin and subunit vaccine have also been developed [12].

Viral Diseases
Viruses occur in particles and they are obligate pathogens. They depend on the synthesizing structure of the host cells for replication. Viral diseases of fish are difficult to diagnose and control with medications [3]. Lymphocystis has been reported in Africa Cichlids, including species of Tilapia, Oreochromis and Haplochromis [10,11]. Other fish diseases of viral origin include Infectious Pancreatic Necrosis (IPN), Infectious Haematopoietic Necrosis (IHN), Channel Catfish Virus Disease (CCVD), and Viral Haemorrhagic Septicaemia (VHS). The best control measure to viral infections is prevention. Vaccines seldom control viral disease of fish [13].

Fungal Diseases
Fungi are unavoidable and always present in pond but do not usually cause disease in healthy fish [3,9]. They often involve in secondary infections. They colonize damaged (or dead) tissues, on the external parts of fish which arise as a result of external parasite, bacterial infection, or injury by handling. The most significant fungal infection of fish is Saprolegniasis (Table 1). Formalin (concentrations range) is effective against most fungal infections. It is also of importance to address the original problem of fungal infections since fungi are usually secondary problem [3].

Non-Infectious Diseases
Non-infectious diseases (also referred to as systemic diseases) are caused by non-living factors. The diseases are either congenital (such as genetic anomalies or neo plastic conditions) or iatrogenic (induced by external conditions such as environmental or nutritional problems). Non-infectious diseases are not contagious and medications are generally not indicated for them [3]. However, iatrogenic condition can usually be reversed by removing (or adjusting) the cause (Leo G. M., https://seachem.com). Non-infectious diseases of fish include.

Environmental Diseases
Environmental diseases result from inadequacies in the physical and chemical characteristics of the pond water. They are the most important among the non-infectious diseases in commercial aquaculture [3]. Environmental problems (Table 1) include depletion of dissolved oxygen, extremes in pH, high ammonia, high nitrite, natural or man-made toxins, or mechanical trauma (caused by rough handling, overcrowding, low water levels, or predation). Proper water quality management and handling are necessary in preventing most environmental problems. Prompt disinfection of fish injuries with suitable disinfectants at recommended dosage is encouraged to prevent pathogen infestation.

Nutritional Diseases
Nutritional diseases are the resultant manifestations of excess or deficiency in fish nutritional requirements (carbohydrate, proteins, lipids, mineral salts and vitamins). Most nutritional diseases are difficult to diagnose because of their chronic nature, with the condition only manifesting over a long period of time [14]. Signs of nutritional disease can also be marked by secondary disease condition due to pathogens [1,14]. Examples of nutritional diseases in catfish include "broken back disease" caused by vitamin C deficiency (Table 1), and "no blood disease" related to folic acid deficiency [3]. Nutritional diseases can be avoided through proper feeding practices.

Neo plastic And Genetic Anomalies
Neo plastic fish disease refers to abnormal growth in any of the organs with resultant loss of structural and functional ability of the affected organ. The resultant growth may be lethal or mildly pathologic [14]. Malformations occurring in cultured fish or induced following hybridizations are of minimal significance; however, it is of importance to bring in unrelated fish for use as brood stock every few years to minimize inbreeding [3].

Significance of Fish Disease to Aquaculture Development
Economic impacts of aquatic animal diseases is almost a grey area in literature. However, as various countries start providing impacts estimates based on the frequency of occurrence, and magnitude of spread and effects; the available literatures so far reported fish disease impacts in socio-economic terms such as losses in production, income, employment, market access or market share, investment and consumer confidence; food shortages; industry
### Table 1: Some Common Fish Diseases, Causative Agents, Symptoms, and Treatment

<table>
<thead>
<tr>
<th>DISEASE</th>
<th>CAUSATIVE AGENT/FACTOR</th>
<th>SYMPTOMS</th>
<th>REMEDIAL ACTION/TREATMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INFECTIONOUS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Parasite Disease</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Ichthyophthiriasis (White</td>
<td>*Ichthyophthirius</td>
<td>White spots on fins, body surface then gills.</td>
<td>- Formaldehyde</td>
</tr>
<tr>
<td>Spot Disease</td>
<td><em>multifilis</em></td>
<td>Abnormal swimming, darkening of posterior part and skeletal deformation.</td>
<td></td>
</tr>
<tr>
<td>b) Whirling Disease</td>
<td><em>Myxosoma cerebralis</em></td>
<td>Small thread-like worm attaches to body surface (fin), anorexia (poor growth) and irritation</td>
<td></td>
</tr>
<tr>
<td>c) Lernaeosis</td>
<td>Anchor worm (<em>Lernae</em></td>
<td></td>
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</tr>
<tr>
<td></td>
<td><em>sp.</em>)</td>
<td></td>
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<tr>
<td>2. Bacterial Disease</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Columnaris</td>
<td><em>Flexibacter columnaris</em></td>
<td>Anorexia, whitish plaques eroding affected area (mouth, body surface, fin, gills), orange Lesions.</td>
<td>- A addition of nifurpirinol to pond</td>
</tr>
<tr>
<td>b) Furunculosis (Fin Rot)</td>
<td><em>Aeromonas salmonicida</em></td>
<td>Inflammation (intestine and anus), lesions and bloody coloured fluid in muscle and skin, fin rot</td>
<td>- Antibiotic treatment</td>
</tr>
<tr>
<td>c) General Septicemia</td>
<td><em>Aeromonas hydrophila</em></td>
<td>Ulceration of skin, distended abdomen, and inflamed fins and fin bases</td>
<td>- Vaccination</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Antibiotic treatment</td>
</tr>
<tr>
<td>3. Viral Disease</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Lymphocystis</td>
<td>Lymphocystis virus (*</td>
<td>Small, pearl-like tumefactions on skin, fins and tail, abnormal swimming or anorexia</td>
<td>- No specific treatment</td>
</tr>
<tr>
<td></td>
<td>Iridovirus*)</td>
<td></td>
<td>- Preventive measures</td>
</tr>
<tr>
<td>b) Viral Nervous Necrosis</td>
<td>Betanodavirus (*Nodavi-</td>
<td>Vacuolating necrosis of neural cells of the brain, retina and spinal cord (up to 100% mortality in young fish)</td>
<td>- No specific treatment</td>
</tr>
<tr>
<td></td>
<td>ridae*)</td>
<td></td>
<td>- Preventive measures</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Vaccination but not yet available commercially.</td>
</tr>
<tr>
<td>4. Fungal Disease</td>
<td><em>Saprolegnia</em></td>
<td>Grey-white patches on fish skin which have cotton wool-like appearance under water</td>
<td>- Reduce organic load</td>
</tr>
<tr>
<td>a) Saprolegniasis</td>
<td></td>
<td></td>
<td>- External disinfectant treatments – Salt formalin, copper sulphate,</td>
</tr>
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<td></td>
<td></td>
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</tr>
<tr>
<td><strong>NON INFECTIONOUS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Broken Back Disease</td>
<td>Vitamin C deficiency</td>
<td>Skeletal deformation.</td>
<td>- Preventive measures – Vitamin C added to feed.</td>
</tr>
<tr>
<td>b) Fatty Liver</td>
<td>High fat feed</td>
<td>Anorexia, bone defect or anaemia may occur.</td>
<td>- Improve feed quality and use suitable additives.</td>
</tr>
<tr>
<td>c) Asphyxia</td>
<td>Low DO</td>
<td>Fish gasping for air</td>
<td>- Aeration</td>
</tr>
</tbody>
</table>

Fish disease is a substantial source of loss to aquaculture industry as documented by authors including [3,15,16,17, 18]. These authors explained that fish disease impedes both economic and social development in many ways: directly, through production losses and increased operational costs and indirectly, through cost to society (social, welfare and environmental), adjustment in market shares and increase in price due to lower supply. They stressed further that fish diseases affect fish survival and growth rates resulting to poor yield (both in quality and quantity), the livelihood of people involved in the culture production and the community in which they occur through reduced food availability, loss of earnings/employments and recreation, apprehension of healthy environment, consumption and handling of sick fish. Invariably, fish culturists and consumers suffer hefty socio-economic losses. World Bank in 2006 reported global loss of about US $3billion per year to aquaculture production and trade due to disease [4,16]. Significance of fish diseases can also be in form of investment in disease research and control, along with health management programmes [15]. Reported on the financial implications incurred from fish disease control programmes and fish disease legislation by various countries. Moreover, discovery of pathogens and unapproved drugs in aquaculture products has also continued to generate issues including rejection of products, enforcement actions against involved trade parties (country, industry, importer, etc.), serious trade disruption and heavy financial losses [19].

Though, the economic impact of diseases in aquaculture production is still very much a grey area in the scientific literature, nonetheless, available data revealed high degree of impacts. However, in the foreseeable future, there will be increasing demand for such assessments in order to gain attention and continuous support from both the public and private sectors [15].

**Diagnosis and Treatments of Fish Diseases**

In most cases, healthy fish have ability to withstand considerable environmental changes and thus can resist diseases. Nonetheless, since most disease causing agents are usual component of pond water environment, disease problem is inevitable in aquaculture production [9]. However, the development of a disease problem in a culture system calls for a quick and effective response to detect and identify the cause of the disease at an early stage, for appropriate treatment and control of potential transmittable fish disease [8]. The first response of fish to disease is abnormal behaviour. A simple routine health check on fish stocks (especially their feeding and swimming behaviours) is essential (e.g., poor feeding activities, swimming near the water surface, darting or scratching on objects) for early detection of possible disease problem [7]. Also, check on pond fish body surface, eyes, fins scales and gills for distortion in forms and structures (such as discolouration, ulceration, protrusion, swollen, and disintegration), or present of surface parasites. Plate 1 highlighted the common bodily symptoms of fish diseases. When these symptoms are detected, the involvement of professional assistance is necessary for further follow up (laboratory or internal examination) on the situation and recommendation of appropriate remedial actions [7,8].

Of the appropriate (approved) remedial actions/treatments for fish diseases; a change in management is necessary in most cases, while in some other situations it is necessary to add antibiotics to the feed (for internal bacterial infections) or chemical to the water (usually for external parasite infestations) [7,20]. Table 1 indicated some remedial actions/treatments to some commonly encountered fish diseases in commercial aquaculture. However, it should again be emphasized that fish farmers should always endeavor to sort the assistance of professional (aquaculture health specialist) in undertaking remedial actions/treatment, and precautions/
Health management in aquaculture production describes the management practices put in place (designed) to prevent and control the occurrence of diseases [7]. The goals of fish health management should be to:

- Prevent introduction of disease to healthy fish.
- Prevent propagation of existing disease agents.
- Enhance the natural resistance of fish.
- Produce healthy, high quality fish.

Most diseases affecting fish are stress related, thus an effective disease prevention and control practices should center on good husbandry (management) practices; good water quality management, nutrition and sanitation [3, 8].

A relatively disease-free water supply is vital. Introduction of organic matter to the pond water must be controlled to limit. Proper and appropriate feeding schedule should be ensured. Maintaining a suitable stocking density is also necessary as overcrowding stress fish and eventually predispose them to infections. Also, proper handling of fish is necessary to reduce the risk of surface injuries. Fish feed should be hygienic and nutritious; fortified with necessary food nutrients in appropriate proportion. Fish are to be obtained healthy from a certified reputable source and quarantined before being released to culture ponds.

General hygiene practices are also essential in fish disease prevention and control. It is also of necessity to store feed properly (kept dry and stored in a cool, dry and covered place). Fungi such as *Aspergillus flavins* can grow on mouldy feedstuff and produce aflatoxins, which are responsible for Hepatoma (Liver cell carcinoma) in fish (a neo plastic condition with no known treatment) [14]. In a farm with many ponds (or recycling systems), it is advisable to have separate nets for ponds—a disease outbreak in one is prevented from being transferred to the others. Pond disinfection by fallowing and liming prevents diseases in pond from being carried over to subsequent culture year [8].

At regional (national) level the following highlighted strategies are applicable for proper and effective implementation of health management (disease prevention and control) practices in aquaculture production. As noted by [15], they are general strategies currently being implemented in the Asia Pacific region (but having applicability to other regions of the world), and apply to all infectious diseases.

- International codes (codes of practice and guidelines); example is OIE’s Aquatic Animal Health Code (OIE, 2003)
- Regional guidelines
- National strategies on aquatic animal health management
- Diagnostics, therapy and information technology
- Biosecurity
- Surveillance and reporting
- Research
- Institutional strengthening and manpower development (education, training and extension, diagnostic services)
- Emergency response to disease epizootics

### Conclusion

Addressing health issues with both proactive and reactive programmes has become a primary requirement for sustainable aquaculture production and its products trade [15,19]. However, the rural farmers are still the most involving in aquaculture production [21]. Most of them are with little or no knowledge of aquaculture health management and with inadequate opportunities to improve management skills and respond effectively to disease problems. Moreover, most of them do not understand the signs of diseases, to talk of treatments. As such, this has put the impacts of disease on fish production on a relatively more severe level. It is therefore of critical importance to focus efforts not only on the prevalence of diseases and pathogens but also on the development of farmer-oriented health management programmes. This includes, as noted by [15] capacity building of farmers and technical personnel (veterinarians, fisheries officers, laboratory staff, aqua culturist, farm attendants) on simple diagnostic procedure and effective remedial action, creation of awareness among farmers on fish health management and establishment of diagnostic centers. Health management is a shared responsibility, which calls for appropriate contributions from every stakeholder towards the actualization of the health management goals and in turn sustainable aquaculture production.

### References


