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Review Article

Microbial and Parasitic Infection in Fish

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ABSTRACT

Major concerns in the fisheries business are parasitic fish and bacterial infections. When it comes to aquatic life microbes are a regular occurrence. The majority of microbes are naturally occurring in water. Because of poor environmental conditions, limited nutrition, and inefficient fish husbandry practices, they only cause diseases. Some microbial infections occur in fresh water fish (*Pseudomonas* infection, *Acinetobacter* infections, bacterial gill diseases), in marine water (*Vibriosis, Tenacibaculosis*, *streptococcal* infections, bacterial skin diseases) and in brackish water (Red sea bream iridoviral disease (RSID, Lymphocystis disease (LCD). All these infections affect fish differently. Parasitic illnesses can cause epidemics in fish that are overcrowded or under other unnatural situations. A large number of fish species have been severely impacted by parasite and bacterial species. Some parasitic infections of fresh water are Renal *Sphaerosporosis*, due to leeches and nematodes, isopods and Gill Monogeneans; in amarine water are *Microsporidiosis*, *Cryptocaryonosis* and *Brooklynelliosis* and in brackish water are *Diplostomum spathaceum metacercarial* infections. Some preventive actions are done to control this problem. In this review there is a complete detail about parasite and bacterial infections and how they can be prevented.

INTRODUCTION

Infectious illnesses are one of the most serious hazards to aquaculture's success. A great number of fish congregate in a compact region, creating an ideal habitat for infectious illness growth and dissemination. Fish are anxious and more prone to become ill in this crowded and rather artificial setting. Furthermore, the ocean and restricted water flow encourage infection spread among packed individuals. Pathogen virulence (ability to cause illness), host immunological, hereditary and metabolic factors, stressors, and population density all have a part in the development and intensity of illnesses after pathogenic infection. The potential of different strains of the same pathogen to cause illness can vary substantially. To put it another way, certain strains may infect the organism while generating clinical illness [1]. The density of fish populations is a very important element in the transmission of fish illnesses. Infections spread more easily in populated areas simply because sick fish are more likely to be linked with healthy fish. The actual development of the disease in fish populations and the associated severity of the disease are affected by the complex interaction of these variables related to pathogens, hosts, and the environment [2]. There are several historical examples of the appearance of diseases that significantly reduced the specific population of wild fish species, but generally does not play an important role in affecting the population of wild fish.

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However, the exact role is almost known among diseases by adjusting the population of wild fish. "Exotic" pathogens are probably the greatest threat to a group of wild fish[3].

Microbial Infections in Fishes

Microbial Infection in Freshwater

Other creatures than fish exist in water, especially various kinds of saprophyte bacteria that colonize sediments and vegetation, as well as Phyto and zooplankton. A few of them colonize the gills, digestive tracts, skin of fish, living as commensals and aiding digestion and the immune systems of these animals. Because these germs may endanger fish health they are classified as potentially harmful [4]. The development of a certain fish illness is heavily influenced by the climate conditions that predominate in a given zone, area, or nation. Fish with clinical indications of sickness frequently have the bacteria listed as *Stenotrophomonas maltophilia*, *Kocuria spp.*, *Acinetobacter spp.*, *Sphingomonas paucimobilis*, *Plesiomonas shigelloides*[5].

Pseudomonas Infection

An alternative name for the illness is Pneumonad hemorrhagic septicemia (PHS). There has only been one confirmed incidence of Epinephelus tauvina illness in Malaysia, which was found in a cage-cultured fish. The bacterium can harm grouper at any stage of development. As a result of the infection, infected fish suffer from severe hemorrhagic erosions. It is possible to see wounds on the skin, fins, and tails as well. Corneal opacity and exophthalmia are other typical symptoms of the illness[6]. Affected populations may have a mortality rate of 20 to 60 percent. The presence of secondary epibiont fouling may noticed as well. Hepatic and renal fragility can be seen internally, as well as multilocular dark red hepatic discolouration. The heart is affected by diffuse pericarditis and significant endocardial thrombosis and embolism. Hepatic vein thrombosis and embolism have also been recorded. There are a number of environmental factors that might lead to Pseudomonas infection in fish [7]. *Pseudomonas sp*. is the causal agent in this case. Ulcers can also be seen on the skin, fins, and tail. Exophthalmos and corneal opacity are two more prominent symptoms of the condition. Secondary treatment contamination on the surface can also be seen. There is renal fragility and a deep crimson multifocal liver discoloration on the inside [6]. When fish display recognizable clinical symptoms such as squashes, tissue impressions, or blood smears containing Gram-negative, motile rod-shaped bacteria, a preclinical illness is identified. [8]. When fish are exposed to environmental stresses such as severe variations in water temperature, overpopulation, poor water quality, and undernourishment, Pseudomonas bacteria can cause them[6].

Bacterial Gill Disease

Brunei Darussalam and Indonesia have both documented cases of bacterial gill illness in *Epinephelus malabaricus*. Fish in Brunei Darussalam are infected with *Cytophaga*, *Flexibacter*, and *Flavobacterium species*. When it came to *Plectropomus leopardus* in Indonesia, no bacteria were found to be infected. Histopathological investigation revealed rodlike bacteria present in the gills, which may have come from *Cytophaga*, *Flexibacter* or *Flavobacterium*. Bacteria that cause it include *Flexibacter sp.*, *Cytophaga sp.*, and *Flavobacterium sp*. Fingerlings are the most commonly impacted by the bacterium. They grow skinny and sluggish and have a darker hue[9]. There was evidence of secondary lamella fusion, rod-shaped bacteria in the gills on histological examination [10]. Water quality deteriorates after heavy rainfall, causing the illness to develop. During runoffs, silt and suspended organic particles can increase susceptibility to illness and irritate the gills. During illness epidemics, high levels of ammonia and low amounts of dissolved oxygen are common. During the grading process, fish become more vulnerable to germs [11]. *Cytophaga*, *Flexibacter*, and *Flavobacterium* species are the main cause. The affected fish became anorectic, lethargic and darkened. Injury to the gills can cause respiratory distress and the fish will eventually die [9, 10]. Maintain water quality, good sanitation, proper feed, and removal of weak or dead fish[11].

Acinetobacter Infections

Bacterial fish illnesses are often indicating a problem bacterium. *Acinetobacter spp*. is among them, and it is extensively distributed in nature, including the water habitats. These bacteria have been identified from trout and carp in Poland in recent years. Symptoms were followed by fatalities ranging from 5% to 20% [12]. Most *Acinetobacter spp*. infections are mixed with other bacterial infections, primarily from the genera *Aeromonas* or *Chryseobacterium spp*.; nevertheless, in bacteriological tests, the majority flora belonged to the genus Acinetobacter. It should be noted that *Acinetobacter spp*. are commonly thought to be carriers of antibiotic resistance genes. As a result, they may play a significant role in the propagation of antibiotic resistance in the environment[13].

Acinetobacter Infection in Fish

The major cause of illness is *Acinetobacter spp*. clinically, infected fish showed loss of scales, depigmentation of the skin, gill petechiae and exophthalmia with eye congestion. Infected carp had skin haemorrhages and gill congestion, and post-mortem investigation revealed inflammatory responses in both fish species. Identification was made in fish where illness signs were recognised at various times of the year, most often in May and September [12].

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Maintaining water quality, adequate cleanliness, correct feeding, and removing weak or dead fish are all important [11].

Microbial Infections in Marine Water

Vibriosis

As well as Vibrio hemorrhagic septicemia, the condition is commonly linked with Streptococcus spred.'s boil disease. *Epinephelus tauvina*, *Epinephelus malabaricus*, *Epinephelus coioides*, and *Epinephelus bleekeri* have all been shown to have the illness. Fish fry, fingerlings and juveniles may be affected by the bacterium, along with adults and broodstocks. Dietary anorexia or a lack of appetite is the first indication of the sickness, followed by a darkening of the fish's color [14]. There is a possibility that the fish is sluggish and swimming near the water surface. It is possible for affected fish to lose balance and display aberrant swimming behaviour. One of the symptoms of the illness is a bleeding body ulcer. Fin rot observations, which begins with erosive fin tip erosion and progresses to necrosis, are also possible. Another typical symptom of the illness is exophthalmia and corneal opacity. Internal bleeding can cause bloody discharges in the abdominal cavity. An enlarged gut filled with yellow fluid may be noticed in the *V. carchariae* case [14]., *Vibrio alginolyticus*, *Vibrio parahaemolyticus*, *Vibrio carchariae* and *Vibrio vulnificus* are the causal agents of vibriosis. Fish affected by classical vibriosis show signs of systemic sepsis, bleeding at the base of the fins, bulging eyeballs, and corneal opacity, usually anorexia [15]. A preliminary diagnosis is made by looking for motile, curved Gram-negative bacterial rods in marine fish spleen reduces or peripheral blood smears. [14]. By keeping optimal conditions at an aquaculture system is challenging, practices that are hazardous to health and the environment, such as the overuse of antibiotics and chemotherapeutants, should be avoided. We highly advise fish producers to utilize a good vaccination to prevent vibriosis since vaccines are more efficient and safer than antibiotics. Natural antimicrobial compounds can also be used[15].

Streptococcal Infection

Red boil disease is another name for the illness. In many cases, the illness is linked to vibriosis. Diseases of *Epinephelus malabaricus* and *Epinephelus bleekeri* have been documented from Brunei Darussalam to Thailand. All stages of grouper can be affected by Streptococcus sp. This disease causes weak and confused behavior in the affected fish [16]. Observed were exophthalmia and hemorrhages on the cornea, around the mouth, operculum, and the anus. The skin of infected fish is covered with red boils. Inflammatory lesions on the skin develop until they break and expose dead muscle tissue beneath, resulting in tiny ulcers that function as entrance points for additional germs. An infection that has no outward symptoms is another possibility. When young fish are infected, there is a 10 percent death rate, while adult fish are not impacted by the illness. Antibiotic-resistant strains of this bacteria have been discovered around the world [17]. *Streptococcus sp.* is the causal agent in this case. The clinical symptoms of streptococcal disease are similar to those caused via enterococci, with prominent bleeding eyeballs, opaque eyeballs, darkening of the skin, and petechiae in operculum, and pectoral fins congestion, tail, and mouth. Internally, congestion and hemorrhagic enteritis may be observed. Most prevalent adaptive fish bacteria show pink after Gram staining when examined under a high-powered microscope. Gram-negative bacteria are a kind of pink-staining bacteria. The majority of them are likewise rod-shaped. Maintain water quality and design medicines to overcome this problem. Proper sanitation also helps in this problem[16].

Tenacibaculosis

Tenacibaculosis, often referred to as oral erosion syndrome, slippery bacterial illness of marine fish, dark spot necrosis, and bacterial and saltwater columnar stomatitis, is a condition that affects marine fish. When the water temperature exceeds 15ºC, it will affect juveniles and adult fish. Its prevalence and severity are greater. Besides the temperature, it is also affected by the state of the skin and the stress of the fish. *Tenibaculum maritimum*, a gram-negative filamentous bacterium, which is slippery and is an absolute necessity for seawater; it cannot grow in a medium supplemented with NaCl. The temperature range for growth is 1534ºC, and the optimum temperature is 30ºC. The disease is caused by the seaweed tapeworm. Clinical signs include characteristic body surface lesions, ulcers, necrosis, oral erosion, fin wear and tail rot. This can become systemic and the erosion of the skin can be a gateway for other pathogens to enter. Tenacibaculosis diagnosis based on signs and symptoms of affected fish and microscopic observation of thin, long, anbundant rod shaped bacteria in in wet mounts and for gram staining prepareparations skin or gill leisions. Establish vaccination programs, proper sanitation and hygiene, avoid malnutrition[18].

Microbial Infections in Brackish Water

Red Sea Bream Iridoviral Disease (RSID)

An extremely harmful illness is brought on by the red sea bream iridovirus (RSID). It was found in cultured red seam bream for the first time in Japan, and it quickly spread across different Asian and East nations. [19]. Numerous more domesticated species of both sparid and non-sparid hosts, as well as those from China, Japan, Taiwan, Korea, Singapore, and Thailand, have been recorded as infected

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because to the wide host range. Fish can be vulnerable to various RSID strains in different ways. By ingesting contaminated water or sick tissues, horizontal contagion is used to spread the disease. When the water temperature is above 20°C, disease usually develops. Juveniles raised in cages are particularly vulnerable, although market-size fish have also been found to have significant mortalities. The virus belongs to the *Megalocytivirus* genus, a group that also comprises a variety of closely related and very cytopathogenic iridoviruses. Fish with the condition are anaemic, listless, and have splenomegaly and hemorrhagic petechiae in their gills. [20]. Polymerase chain reaction (PCR), Monoclonal antibodies, or loop-mediated isothermal amplification (LAMP) assays can be used to verify the diagnosis. It can also be confirmed by observing the icosahedral, and 200–240 nm virions in EM [19].

Lymphocystis Disease (LCD)

A very contagious illness with a global reach is lymphocystis. Numerous domesticated and brackish, wild freshwater, and marine fish have been identified as having it. Transmission is reportedly waterborne, with abrasions thought to be the point of entrance. Younger fish of any species are more vulnerable. Fibroblastic cells have a great affinity for lymphocystis viruses, which cause severe hypertrophy in these cells. Despite the fact that LCD viruses are primarily dermatotropic, they may also invade visceral organs, including the heart and spleen. [19]. A DNA virus from the *Iridoviridae* family is the cause of the sickness. It has a high host specificity. Fish that are affected develop macroscopic wart-like clusters of primarily fibroblasts from the dermal layer of the skin, which are often covered by skin and fin lesions. [20]. To establish the existence of large (130-380 nm), icosahedral virions, electron microscopy (EM) may be performed. Different fish cell lines can be cultured using the LCD virus. Polymerase chain reaction (PCR)-based molecular techniques have been developed for the accurate identification and characterization of the virus in fish that are asymptomatic as well. [21]. As there is no effective treatment, prompt culling of the fish that are most severely afflicted and a reduction in stock density are the only options.

Parasitic Infections

According to research, a large range of parasite species can seriously hamper grouper cultivation. Protozoa, particularly ciliates, are the primary cause of grouper parasite illnesses during the hatching and nursery stages. Grouper fry are vulnerable to handling and transportation challenges when they are moved to grow-out facilities. These fish often carry several types of ciliated protozoa, as well as powerful skin and bronchial monogenes. [22]. One of the most significant issues in the fishing industry is parasitic fish illnesses. The obligatory parasites of fish are spores, which mostly infect fish with economic value. They are blood-sucking, ape-like hermaphrodites that live in the fish's mouth, gills, or skin. These parasites prevent weight gain, stunt growth, and ultimately result in mortality. Large-scale fish epidemics in overcrowded settings and other unnatural situations are generated by pathological conditions brought on by parasite infections. [4]. It is reported that there are isopod parasites belonging to *Cymothoidae* in about 350 species of fish, and more than 80% of them are from tropical and subtropical waters the majority of Indo-Malay Islands. They feed on blood and are ectoparasites of marine, freshwater and saltwater fishIt has a single host during its whole life cycle (complete oxygen cycle). These parasitic isopods, which are often big, seriously injure the host fish [23]. A total of 10,000 species of copepods have been identified, and 2,000 of those are fish parasites. The Pennellidae family of copepod parasites are the most common and have reproductive organs in marine fish. All members of this family are known to have a two-host life cycle that depends on fish for larval development. [2]. Some of them just pierce the fish's flesh a short way, while others pierce all of its organs deeply in search of regions with an adequate blood supply. Most of these parasites affect nearby tissues locally and impair gonadal development. Various fish are allegedly parasitized by isopods and copepods in the coastal waters of Parangipettai, India. [24]. In this review infections caused by some major parasites like monogeneans, protozoans, nematodes, leeches, didymozoid digeneans and isopods are described.

Parasitic Infections in Freshwater

Infections Caused by Nematodes

Nematodes are parasites that live inside the body. They have un-segmented bodies that are generally 1-2 cm long. Nematodes are large enough to be seen with the naked eye when they reach adulthood. Naevi can influence the nursery, growth, and broodstock phases. Emaciation and decreased growth rates are likely results of parasite-induced malnutrition [25]. Transmission is horizontal and occurs when diseased intermediate hosts or garbage fish are fed to healthy intermediate hosts. Larvae hatch from nematodes that are released by the adult. Intermediate invertebrate eats this. Intermediate hosts, which are preyed upon by the final fish host, are where larvae grow. As a paratenic host for anisakid nematodes like *Anisakis sp.*, small fish might be a good choice. Aquatic mammalian hosts ingest infected cultured grouper larvae. According to reports from Indonesia, Malaysia and Thailand, nematodes infect *E. malabaricus* and *Epinephelus coioides*, *Plectropomus leopardus* and *Cromileptes altivelis*.. *Anisakis* species, *Philometra* species, and *Raphidascaris* species

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are the three most frequent parasite species found in groupers are main causes. Infected fish have reddish or black non-segmented roundworms adhering to fins, branchial cavity, muscles and parenchyma of digestive organs, as well as the male gonads and gonad tissue. Highly afflicted fish may have discolored and malnourished body surfaces [26]. By gross microscopic observations. Dissection of affected tissue is done for revealing parasite [25]. Don't feed them with affected trash fish, pond bottom should be dried regularly, filtered water used for rearing [26].

Epinephelus Coioide

Renal Sphaerosporosis

Fish organ cavities and tissues harbour tiny protozoans known as myxosporeans, which are parasites that are unable to live outside of their host. An Epinephelus malabaricus in Thailand was diagnosed with sphaerosporosis after being infected with the *Myxozoan, Sphaerospora epinepheli*, which can cause renal failure [27]. Rheumatoid Sphaerosporosis is caused by the pathogen *Sphaerospora epheli*, which has 8.7 by 8.2 micrometre spores and polar capsules with a spherical shape. Nursery, grow-out, and broodstock phases are all susceptible to parasites. Fish with hemorrhages in their swim bladder and an enlarged abdomen can be identified. When the parasite infects a host with its spores and pseudo plasmodia it destroys the organs and blood cells of that host. This makes them more vulnerable to other infections [28]. It's a renal infection is caused by a pathogenic endoparasite known as a myxosporean. The parasite infects the body and damages the kidney, liver, stomach, gall bladder, spleen, and blood cells with its spores and pseudo plasmodia. Necrotic renal corpuscles and tubular epithelium are present in the kidney [29]. The parasite can be identified by microscopic study of spores and developmental stages in affected tissue, such as kidney imprints [27]. Two preventative strategies are effective water changes and quarantine of new cattle. Infected water should not be utilized to produce fish. The infectious stage can be regulated by using UV light to treat the input water. Stock that has been tainted must be disposed of [29].

Infections due to Leeches

Leeches have been found to have an impact on the seedling, grow-out, and broodstock stages. The brownish-black parasites adhere in patches to the body, eyes, fins, brachial and other afflicted locations, mouth cavities. Affected fish's fins are ragged, and the connection and eating sites are swollen and hemorrhagic [30]. Low facility upkeep and poor sanitation are factors responsible. Horizontal transmission is used. Adult leeches leave the parent fish and place their cocoons on a solid substrate like rocks, shells, or plants. A cocoon contains an egg that can hatch into a baby leech. After then, the baby leech latches itself to its older host. After cocooning, leeches usually die. The leech has an extended cylinder that curves at the ends where the suction cups are located. Gross and microscopic inspection can reveal the distinctive oral (front) and tail (rear) suckers of leeches. These suction cups are securely adhered to the host in different directions. Mature leeches can grow to be 15 mm long [31]. In Malaysia the parasite has been found in *Epinephelus bleekeri*, *E. fuscoguttatus*, *E. coioides*, *Cromileptes altivelis*, *E. malabaricus*, *E. lanceolatus*. The causal agent is *Zeylanicobdella arugamensis*. Paleness, lethargy, redness and inflammation around affected place [23]. Researchers found that live leeches fix according to their specifications. Leeches can survive for some time even after closing them in a vial. If they are fixed use 70% ethanol and then relax them by methanol under glass slide [32]. They could be physically removed or antibiotic ointment may be used around affected area. Ponds, aquarium should be sanitized [31].

Gill Monogeneans

It is both fresh water and marine water infection. *Epinephelus bontoides*, *Epinephelus bleekeri*, *E. coioides*, *E. tauvina*. Nursery, growth-out and broodstock phases are typical for gill monogeneans. As a result, the fish exhibit aberrant swimming behavior near the water's surface, as well as a decrease in hunger [33]. Respiration is impaired when the gill epithelium is severely damaged. Overlap in fish generation is a major predisposing factor for transmission. Infection spreads quicker when there is a high density of stockings. Most monogeneans have elongated eggs with a helical filament that runs the length of the ovum. The oncomiracidium, a free-swimming larval stage, is produced after five days after egg hatching. Later, the larvae will connect their bodies and move to the fish's fins. 14 to 21 days are required to complete the life cycle [34]. *Pseudorhabdosynochus*, *Megalocotyloides* and *Diplectanum* are some common parasites that are the cause of this disease. Appetite loss, skin vary in color, respiratory disease, pale or swollen gills, extreme host irritation, grey patches on skin and open wounds. Examination of freshly died or live fish is best by performing mucus of gill, skin, fins biopsies by light microscope. Appropriate quarantine, proper hygiene, freshwater bath etc. [33].

Infections Caused by Isopods

In size, isopods range in size from 10 to 50 millimetres. In Indonesia and Thailand, the parasite has been found in *Epinephelus coioides* and *E. malabaricus*, respectively. It has been shown that *E. coioides* contains the isopod *Rhexanella spp*. Nursery, grow-out, and broodstock can be

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affected by the isopod's presence and activity. An infection occurs when a parasite infiltrates a person's mouth, nasal passages, and opercular cavity [35]. As a result of the lack of hunger, the fish's opercular movement is decreased, and their development rate is slowed. In order to avoid injury, the fish rubs its body against things. Isopods in the buccal cavity make fish feeble. Parasite pressure causes the host tissue to be damaged. Skin and gill filaments have necrosis. Affects swimming and eating habits during severe infection, juvenile fish die within 1-2 days. Prior to disposal, there should be enough of inventory. It's a horizontal transmission [36]. Because of isopods. Parasites may attach to the nasal cavity, body, mouth, loss of appetite, weakness, reduced movement. Microscopic and gross observations are done for diagnosis. Manually remove the parasite, freshwater bath treatment, disinfection [37].

Parasitic Infections in Marine Water

Microsporidiosis

This disease is caused by a parasitic fungus known as the microsporidian bacterium. As a protozoan intracellular parasite, microsporidians have sporoplasm and a spiralled polar filament in their spores, which range in size from 3 to 10 microns. In China and India, *Epinephelus tauvina* and *Epinephelus spp*. have been shown to be infected with the illness [38]. During microsporidiosis, pear-shaped spores develop tiny nodules in the afflicted tissue. According to reports, there are *Glugea* and *Pleistophora* species in grouper cultivation. The spores have a diameter of 6 microns. As a result, parasites can damage both the nursery and growth phases of the plant. Poor water quality and malnutrition are predisposing factors for the disease. The spores can be inhaled orally, resulting in horizontal transmission. The cycle of life is unknown [39]. This disease is caused by a parasitic fungus known as the microsporidian bacterium. Host mortality, Swollen abdomens are a sign of an infected fish. In adipose tissue and internal organs, brown to black nodules of varying sizes have been seen [40]. Microscopic and molecular diagnostic methods were used. Spores of microsporidian can determine in infected tissues wet mount preparations [41]. Some preventative measures include separation and disposal of sick fish, sterilization of culture systems with chlorine or iodine solutions, and prevention of feeding with highly contaminated fish [39].

Cryptocaryonosis

There are a few to many whitish or grey patches on the body surface and gills of infected fish, which are really parasite nests. Cryptocaryonosis is sometimes called white spot sickness. It's triggered by a ciliate that's on the go. In ciliates, locomotion is accomplished by small, thin cytoplasmic projections called cilia. They are 0.3-0.5 mm in size, round to spherical in form, and have cilia on the surface. Intensive culture systems are particularly susceptible to the disease's severe epizootic effects. Culture in the hatchery and nursery might be affected. There are white or grey patches on body surface and gills that indicate the presence of the parasite [42]. There are a variety of forms of tomites that may attach themselves to a host. Stocking density and water temperature are predisposing variables as well as a high organic load [43]. Through contaminated fish and water, it is possible to spread the virus horizontally [44]. The behaviour of infected fish might vary, possibly as a result of pruritus, and include fin tremors, hyperactivity, and abrupt darting movements. Fish with severe instances have ragged, opaque fins and ocular cloudiness as a result of skin sloughing, become sluggish, and hover just beneath the water's surface. The lamellae of the gills are frequently pallid and clumped together by extra mucus [43]. Only under a microscope can the continually rotating, pear-shaped ciliates of fresh fin or gill clips or skin scrapings be identified as cryptocaryonosis with certainty. The intricacy of *C. irritans*' life cycle, in particular the extended growth of some tomonts and the resulting asynchronous excystment of the infective theronts, makes it challenging to eradicate it from marine aquaria and mariculture systems. Chemicals are presently the mainstay of *C. irritans* management in aquarium systems [45].

Brooklynelliosis

Illness induced by the protozoan. *Epinephelus tauvina* cultivated in Singapore has been shown to be infected with the illness. These ciliates are kidney-shaped and may grow up to 60 microns in size. Fetuses and fingerlings may be affected. As a result, they brush their bodies against various objects [46]. As soon as this parasite attaches to the skin and gills, it causes severe skin injury and subcutaneous bleeding, which can lead to death. There are subcutaneous and pulmonary issues that are caused by the parasite Secondary bacterial infections can also occur in the hosts. A large number of people may also die. Stocking density, water quality and handling stress are all variables that might lead to extinction. Through contaminated fish and water, it is possible to spread the virus horizontally. *Epinephelus tauvina* attaches to the skin and gills, it causes severe skin injury. Respiratory issues, mass mortality and other secondary bacterial diseases, skin damage. Parasite diagnosed via microscopic examination of skin or gill wet mounts of fish that is affected. Fresh water bath daily for 3 days, proper aeration [47].

Skin Monogeneans

Epinephelus bleekeri, *Epinephelus coioides*, *E. fuscoguttatus*, *E. lanceolatus*, *E. malabaricus*, *Cromileptes altivelis* and *E. tauvina* have all been found to have skin monogeneans. They can impact the nursery, grow-out, and

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brood stock stages of poultry production. As a result, fish get infected with parasites that attach themselves to their eyes and gills. With flashing swimming behavior, the infected fish brush their bodies against things and congregate close to the source of oxygenation. Fish lose their appetite and become sedentary. A highly diseased fish's body surface is covered with hemorrhage, and its eyes are opaque [34]. If the eyes are infected, the parasite can cause blindness. Lesion sites are potential entrance points for subsequent bacterial infections. Cross-generational cultured fish overlaps as a predisposing factor. Infection of the fish host by the monogenean is more likely when there is a high stocking density of fish [48]. This species has tetrahedral eggs with long spiral filaments that are frequently stuck to tank walls or nets by their long filaments. A 4-day-old oncomiracidium larvae hatches from the egg. A suitable host is found and the larvae attach themselves to it, maturing seven days after hatching [49]. Monogeneans capsalids generate these illnesses. *Benedenia epinepheli* and *Benedenia spp*. are two species of Benedenia. Fish decrease their hunger and become sedentary. The skin surface and eyes of highly diseased fish are hemorrhagic. Fish that are afflicted brush their bodies against items [34]. After the death of fish monogeneans do not remain live for long time so we should use freshly dead fish for examination by performing biopsies of skin, gill or fin mucus [48]. Quarantine period for fish should be preferred. During treatment, strong aeration must be provided [49].

Parasitic Infections in Brackish Water

Diplostomum Spathaceum Metacercarial Infection

The Diplostomum spa thaceurn metacercariae eye fluke has indeed been found in fish from all over North America and Europe. It has produced serious issues in some regions for instance many of rainbow trout affected by the digenean are killed at a state fish farm in New Jersey. In Europe, the digenean creates comparable issues. *Diplostomuni sp*. had no impact on the surface epithelium or even other parts of the eye. The allergic response may have diminished when the parasites reached the lens. A number of alterations, involving retinal displacement and lens capsule breakage, were discovered in highly diseased rainbow trout. *D. spathaceum metacercariae* are frequent parasites of a variety of species of fish. Such parasites invade the eye's lens, whereupon they emit compounds that cause blindness and even dullness [50]. The quantity of light passing from the above and from the surrounds determines the degree of change in color in fish and is thus intimately related to blindness and vision sub mucosal cataract [51]. The quantity of light passing from above and from the surrounds determines the degree of change in color in fish, and is thus directly related to vision [50]. The eradication of the snail host appears to be the most successful method of managing the illness, and this may be accomplished by emptying and washing ponds, which is a labor-intensive operation, or by applying a molluscicide. Closure of spring-water sources, as well as the use of proper management procedures, are also advised. UV radiation has been utilized to destroy metacercariae in a few occasions [51].

CONCLUSIONS

Bacterial and parasitic diseases in fish is very serious is problem. Potentially all marine, freshwater and brackish water fish are susceptible to bacterial and parasitic infections. Some parasitic infections of fresh water (Renal Sphaerosporosis, due to leeches and nematodes, isopods, Gill Monogeneans) marine water (Microsporidiosis, Cryptocaryonosis, Brooklynelliosis) and brackish water (Diplostomum spathaceum metacercarial infection). Microbial infections which are common are fint rot, gill diseases, vibriosis, Pseudomonas infection, streptococcal infections, Red sea bream iridoviral disease, Lymphocystis disease that are caused by microbes. These parasitic diseases result in very serious issues that affect their kidneys, gills, fins, respiratory system and many other issues. Due to these infection fish population is declining very rapidly. Solution to this problem is preventive measures. Prevent pseudomonas infection by avoiding predisposing conditions such as severe water temperature fluctuations, overpopulation, poor water quality, and inadequate feeding. The parasite may be avoided by filtering of raising water or disinfection with ultraviolet irradiation. As a result of a freshwater bath, the parasites will be washed off of the skin and gills. Prevention is the best solution to this problem. In future there is a need of more practical research on fish infections and these infections can be controlled in a fast way for preventing our fish population.

Authors Contribution

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All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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