Parasitic disease in Shellfish and Fin fish and their Zoonotic Impacts

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Abstract

Aquaculture, fisheries, and public health are all seriously threatened by parasitic infections in finfish and shellfish which can result in monetary losses and raise issues with food safety. Helminth, crustacean and protozoan parasites are the cause of these infections. They can spread indirectly through intermediate hosts or directly through the consumption of eggs or larvae. The main cause of morbidity in both humans and animals is parasitic diseases. Fish are intermediate hosts for many trematodes and a few nematodes and cestodes. Humans or their pets can become infected by eating raw, partially cooked, or undercooked fish that contains any of these helminth larvae.
Among the most common zoonotic parasite diseases are angiostrongyliasis (*Angiostrongylus cantonensis*), gnathostomiasis (*Gnathostoma spp.*), opisthorchiasis (*Opisthorchis spp.*), clonorchiasis (*Clonorchis sinensis*), anisakiasis (*Anisakis spp.*), and paragonimiasis (*Paragonimus spp.*). These diseases can cause gastrointestinal, neurological, hepatic, and respiratory issues in humans. This chapter provides a detailed analysis of life cycles, pathology, and routes of transmission of the major parasite diseases that affect finfish and shellfish. It also examines zoonotic consequences, food safety concerns, and effective prevention strategies such improved diagnostic techniques, biosecurity measures and regulatory initiatives.

Keywords: Parasite, Shellfish, Finfish, Zoonotic, Infection, Prevention

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Introduction

Aquaculture together accounted for 17% of all animal-source protein used for human consumption according to FAO (2020c) (Boyd et al., 2022). Aquaculture also involves the use of bait by fisherman, the preservation and reintroduction of rare, endangered and extinct species, the scientific research of aquaculture, and the production of specimens for sport fishing (Biondo & Burki, 2020). Due to rising fish consumption and the world's expanding population, seafood has become more in demand in recent years. Since seafood is one of the protein sources that the human body uses, the fisheries and aquaculture sectors, despite their sustainable growth on a worldwide scale, are not risk-free (Shamsi, 2019).

Numerous species found in aquatic environments are susceptible to parasite infections, including finfish and shellfish. These bacteria can harm people's health, cause infections, and pose a concern to the public by contaminating seafood (Madsen & Stauffer, 2024). For survival and reproduction, parasites rely on their host. Behind this simple concept is a complexity that reflects the level of virulence, reliance, or both, and how these vary over time and space. Dependency is a relative term rather than an absolute one (Turner et al., 2021). Water bodies and human life have been intertwined from ancient times, with many functions (Lynch et al., 2023). Aquatic biodiversity and water reservoirs are two biological components that are interdependent and have a close relationship (Irfan & Alatawi, 2019). Parasitic diseases in finfish and shellfish pose a significant threat to global aquaculture and fisheries, affecting public health, food security, and economic stability (Lõhmus & Björklund, 2015). Gastrointestinal parasite infections are among the parasitic infections that pose a serious threat to global health. It impacts both the nutritional status and overall health of the host. It results in several health problems, such as weight loss and malnutrition (Sarfaraz et al., 2025).

An infectious disease that is transmitted from other animal species to humans is called a zoonotic disease, also referred to as a pleural zoonotic disease (Han et al., 2016). Fish and shellfish parasites are dangerous for aquaculture as well as for public health worldwide. Numerous of these parasites are zoonotic, which means that people can contract them from animals. Concerns regarding these zoonotic parasites have increased along with the global increase in seafood consumption, especially of raw fish and shellfish (Han et al., 2016).

1. Zoonotic Parasite of Shellfish and fin fish

Fish are particularly vulnerable to parasite infection from a range of sources due to their aquatic lifestyle and cold-blooded physiology (Imran et al., 2021). Protozoans, helminths (including flatworms and roundworms) and crustaceans are among the many different types of fish parasites that can produce distinct illness symptoms (Rodriguez et al., 2024). Fish populations are seriously threatened by parasitic illnesses, which frequently result in mass mortality. Protozoa (ciliates, flagellates, microsporidians and myxozoans), platyhelminths (monogeneans, digeneans, and cestodes), nemathelminths, and acanthocephalans are important parasitic groups. Fish are susceptible to various illnesses due to their physiology which can have disastrous results. mortality (Lerssutthichawal et al., 2016) Fish intestinal helminths are serious parasites that cost the fish business a lot of money. These and other parasites live in fish and have a detrimental effect on food, metabolism, and the functioning of the digestive system. Fish population declines can result from these disturbances, which can cause serious neurological harm and reproductive dysfunction (Imran et al., 2021). Although humans can contract many of these fish parasites, some including those that cause gnathostomiasis and anisakiasis, are particularly dangerous because of the severe health issues they can cause (Herman & Chiodini, 2009). Seafood especially fish products, is frequently associated with foodborne diseases (Huss & Embarek, 2000). The significant variance and frequent insufficiency of food inspection standards among countries is one of the contributing factors (Williams et al., 2020). Import regulations for zoonotic parasites may be disregarded even by wealthy nations (Shamsi, 2016). The occurrence, geographic distribution, and frequency of zoonotic diseases spread by fish are on the rise due to climate change and rising consumer demand for raw, undercooked, and unusual foods (Lohmus & Bjorklund, 2015). For example, 45 million people are infected with freshwater fish liver flukes, which pose a hazard to 680 million people (Saijuntha et al., 2021). Some diseases caused by parasite in finfish and shellfish are mentioned in Table 1 and Table 2.

1.1. Protozoan Parasites of fish

Fish raised in intense aquaculture are seriously threatened by protozoan parasites including myxozoans, microsporidians, ciliates, and flagellates (Wang et al., 2019). Overcrowding exacerbates illnesses, leading to emaciation, weight loss, and death (Gomes et al., 2017). Anaemia, gallbladder thickening, tissue nodules, and tumour-like masses can all result from microsporidian infections (Maciel et al., 2018). Many fish species are infected by myxozoans, which create intricate parasite communities (Balta et al., 2019). Their effects on farmed fish include skeletal abnormalities, locomotory disorders, emaciation, sunken eyes, and circulatory problems due to histozoic (visible cysts, cartilage damage) and coelozoic infections (Manbe et al., 2020).

1.2. Helminthes

Helminthic parasites, particularly those found in tropical aquatic settings, are a substantial problem due to their prevalence and richness (Ogbeibu et al., 2014), with 268 species documented in 213 fish species in Vietnam (Nguyen et al., 2021). The parasite lifecycle is trophic since host transmission is dependent on the food system (Polley & Thompson, 2009). Edible teleost fish species are intermediate hosts for helminthic parasites, increasing the risk of infection with increasing host size (Tedesco et al., 2025). Over half a billion people's health may be at danger due to helminthic parasites, according to estimates (dos Santos & Howgate, 2011). From minor allergic reactions and gastrointestinal disorders like diarrhoea, indigestion, and abdominal pain to more serious conditions like brain haemorrhage, hemiparesis, and even cancer, fish-borne helminthic diseases can cause a variety of health problems (Cong & Elsheikha, 2021).

1.3. Trematodes

The trematodes, sometimes known as flukes, are the most problematic of the many helminths that humans can contract via fish and shellfish (Chai & Jung, 2022). Infections with fish-borne trematodes are common throughout Asia and a leading cause of mortality in Southeast Asia. Cholangiocarcinoma (CCA) is caused by Opisthorchis viverrini, which is especially common in northeastern Thailand and Laos (Homsana et al., 2024). Freshwater, brackish, and marine fish can harbour zoonotic trematodes (Cong & Elsheikha, 2021), and illnesses usually follow ingestion of uncooked freshwater fish or shellfish (Chai & Jung, 2022). The goal of the Parafish Control project is to slow the spread of zoonotic trematodes, particularly those from the Opisthorchiidae and Heterophyidae families, which humans might contract from fish raised in European aquaculture (Caffara et al., 2020). People who eat raw or undercooked freshwater crabs or crayfish that carry the fluke's metacercariae can get paragonimiasis, a lung fluke infection (Blair, 2020). Humans and animals are at risk from these fish-borne trematodes, which the WHO has designated as emerging infectious diseases, especially in aquaculture settings (Nguyen et al., 2024). *Haplorchis pumilio*, *C. sinensis*, *C. formosanus*, and *H. yokokawi* are important species that are known to infect humans (Clausen et al., 2012). Cats and dogs require monitoring and control measures because they can serve as reservoir hosts (El-Seify et al., 2021).

1.4. Cestodes

Cestodes, often known as tapeworms, are another prevalent class of parasitic fish. They can grow up to 20 meters in length, which is quite huge compared to trematodes. The Diphyllobothriidae order, which causes diphyllobothriosis, is one notable example (Scholz & Kuchta, 2016). Of the 50 species of Diphyllobothrium, about 14 are known to infect people (Jones, 2015). The most pathogenic species include *Diplogonoporus balaenopterae*, *Adenocephalus pacificus*, *D. dendriticum*, *D. nihonkaiense*, and *D. latum* (Schloz et al., 2009). Although some people may have diarrhoea, abdominal pain, anaemia, weight loss, and vitamin B12 insufficiency, diphyllobothriosis is usually moderate, non-life-threatening, and asymptomatic (Kristanti et al., 2022). Although human infection rates have decreased significantly, except for Japan and eastern Russia, an estimated 20 million people are infected globally (Ziarati et al., 2022).

1.5. Nematodes (round worms)

Consuming raw or undercooked fish or squid can expose humans to parasites, potentially fatal. However, research on this public health concern is limited, especially in South America, where zoonotic nematodes are found in freshwater and marine fish, with human infections documented in few nations (Ganucci et al., 2023). These infections are common in areas where seafood consumption is high, particularly the

western coast of South America (Eiras et al., 2018). It has been discovered that *Chrysophrys auratus*, a common food fish in Australia and New Zealand, harbours zoonotic nematodes belonging to the Anisakidae family. If consumed raw, as in sashimi or sushi, the presence of *Anisakis pegreffii* in this fish species poses a serious risk of infection to humans (Hossen et al., 2021). Furthermore, other zoonotically significant nematodes, including *Hysterothylacium* spp., *Anisakis* spp., and *Contracaecum* spp., have been discovered to be present in edible fish from Australia (Suthar & Shamsi, 2021). The most common fish-borne nematodes that are harmful to human health are *Anisakis* spp. 1 and *Pseudoterranova* spp., which cause anisakiasis, and members of the Gnathostomatidae family, which cause gnathostomiasis. These nematodes are very dangerous to human health both globally and locally (Safonova et al., 2021).

Table 1: Parasitic Diseases in Finfish

Diseases	Causative agent	Symptoms	Treatment	References
Cryptocaryoniasis	*Cryptocaryon irritans*	Lethargy, scratching, rapid breathing, loss of appetite. Pinhead-sized white nodules on gills and body, mucus hyperproduction, skin discoloration, corneal cloudiness, ragged fins, pale gills.	Sulfamethoxazole-trimethoprim, Sodium salinomycin	(Li et al., 2022)
Costia	*Ichthyobodo necator*	Lethargy, Disorientation, Dark body pigmentation, clamped fins, reddening at the base of the dorsal fin, Increased mucus, production, shedding of skin, Hyperplasia	5% Table salt solution, Formaldehyde	(Yulchiev, 2023)
Ichthyophthiriasis	*Ichthyophthirius multifiliis*	White spots on the skin of the infected fish. These are caused by the trophont stage of the parasite, which induces proliferation of epidermal cells.	Formalin, Copper sulphate	(Ohanu et al., 2024)
Capillariasis	*Capillaria philippinensis* (Nematodes)	Abdominal pain, Severe diarrhea, Malabsorption, Weight loss, Death (if untreated)	Mebendazole	(Tak, 2022)
Diphyllobothriasis	*Diphyllobothrium latum* (Cestodes)	Abdominal discomfort or pain, Diarrhea, Weight loss, Fatigue, Anemia	Praziquantel or Niclosamide	(Semenas et al., 2024)

Table 2: Parasitic diseases in Shellfish

Diseases	Causes	Symptoms	Treatment	References
Protozoa				
Haplosporidian Diseases	*Haplosporidium nelsoni*	Degraded oyster tissues and reduced oyster health, several mass mortalities	No cure	(Batchelor et al., 2023)
Marteiliosis	*Marteilia cochillia*	Emaciation, Discoloration of the digestive gland, Cessation of growth, sudden and severe cockle mortalities	No cure	(Villalba et al., 2023)
Perkinsosis	*Perkinsus olseni*	Increased mortality of host	No cure	(Scardua et al., 2017)
Helminths				
Bucephalosis	*Bucephalus spp.* (Trematodes)	Damage to the gonad tissues, Larvae can also affect the gills, digestive gland and adductor muscle.	No cure	(Guimarães Filho et al., 2024)

Table 3: Zoonotic Parasitic Diseases:

Diseases	Causes	Symptoms	Treatment	References
Protozoa				
Cryptosporidiosis	Protozoan parasite of the genus *Cryptosporidium*	Acute, self-limiting gastroenteritis, Diarrhea can be severe and chronic in immunocompromised individuals	No effective treatment present, Nitazoxanide and Halofuginone can be used	(Helmy & Hafez, 2022)
Trematodes				
Clonorchiasis	*Clonorchis sinensis*, *Opisthorchis viverrini*, or *Opisthorchis felineus*.	infections cause high infection rates and severe morbidity and mortality	Praziquantel, Albendazole, Tribendimidine	(Qian et al., 2024)
Fascioliasis	*Fasciola hepatica* or *Fasciola gigantica*	Nausea, vomiting, diarrhea, and abdominal pain. Acute cholecystitis, biliary obstruction, and liver abscessed, Liver fibrosis.	Triclabendazole	(Mas-Coma et al., 2023)
Nematodes				
Anisakiasis	*Anisakis simplex* and *Anisakis pegreffii*	Acute and severe epigastric pain, vomiting, nausea, ascites, low-grade fever, hematemesis	Freezing, Heating, High Hydrostatic Pressure, Salting, Pepsin Digestion, Garlic Oil can kill parasite in fishes	(Della-Morte et al., 2023)

2. Zoonotic parasitic infections associated with shellfish and finfish

2.1 Anisakiasis

A major public health concern that affects people is anisakiasis, a parasitic infection brought on by nematodes of the Anisakis genus (Suzuki et al., 2021).The parasite's third-stage larvae are found in marine fish and shellfish (Adroher-Auroux & Benítez-Rodríguez, 2020), with fish or

squid serving as paratenic hosts, marine mammals as definitive hosts, and crustaceans as intermediate hosts (Mattiucci & Nascetti, 2008). Eating raw or undercooked infected shellfish can infect humans, causing symptoms such as severe abdominal pain, nausea, vomiting, and gastrointestinal discomfort (Audicana & Kennedy, 2008). Allergic anisakiasis can range from moderate urticaria to severe, potentially fatal anaphylaxis within one to two hours of eating infected fish (Rahmati et al., 2020). Despite the use of various drugs, there is no single anthelminthic that works for all stages of anisakiasis (Shimamura et al., 2016). Diagnosing and treating stomach anisakiasis through endoscopy can result in quick recovery, often within hours (Ortiz et al., 2024). Zoonotic parasitic diseases are mentioned in Table 3.

2.2 Clonorchiasis and Opisthorchiasis

The liver flukes *Clonorchis sinensis*, *Opisthorchis felineus*, and *Opisthorchis viverrini* are the parasite causes of clonorchiasis and opisthorchiasis (Fedorova et al., 2020). Eating raw or undercooked freshwater fish that contain the larval metacercariae can expose humans to certain trematode diseases. Over 45 million people are thought to be affected, mostly in Asia (Pozio & Morales, 2022). These illnesses are prevalent in developing nations and are linked to cultural eating customs, poverty, pollution, and population expansion (Lim, 2011). Nonspecific symptoms such weakness (asthenia), exhaustion, nausea, indigestion, anorexia, diarrhoea, headache, and abdominal pain, especially in the right upper quadrant, are frequently seen in early infections (Traverso et al., 2012). Important physical symptoms include jaundice, icteric conjunctivae (yellowing of the conjunctivae), hepatomegaly (enlarged liver), and liver discomfort.

2.3 Gnathostomiasis

Human gnathostomiasis is a foodborne zoonotic disease caused by *Gnathostoma spp.* (L3) third-stage larvae (Liu et al., 2020). The virus infects humans when they eat raw or undercooked fish, frogs, snakes, or chicken (Pozio, 2018). The L3 virus needs one definitive host and two intermediate hosts, with fish, frogs, and shellfish being the second intermediate hosts. Eating raw or undercooked infected shellfish makes humans unintentional hosts (Liu et al., 2020). The disease can spread through sores on the skin, mouth, or placenta. Eating raw or undercooked meat from infected intermediate hosts is the main way to become infected (Ahmed et al., 2021). Pregnant women with severe *Gnathostoma* larval infections may develop transplacental infections (Waikagul & Chamacho, 2007). Clinical signs include cutaneous and visceral larva migrans, eosinophilia, and migrating cutaneous swellings. In extreme cases, L3 larvae can infiltrate internal organs and tissues, causing blindness, nerve pain, paralysis, coma, and even death (Bravo & Gontijo, 2018). Currently, no viable non-invasive treatment is available, with surgical removal being the most effective method (Herman et al., 2009).

2.4 Angiostrongyliasis

Angiostrongylus costaricensis and *Angiostrongylus cantonensis* are the two species of the Angiostrongylus genus that cause human angiostrongyliasis, a foodborne zoonotic disease. In many parts of the world, these species represent a serious threat to public health (da Silva & Morassutti, 2021). Once mostly found in Asia and Australia, foodborne infections caused by Angiostrongylus spp. have now been documented in the Americas, Caribbean, and even Europe (Federspiel et al., 2020). Ingestion of raw or undercooked gastropod intermediate hosts (slugs or snails) or paratenic hosts (freshwater shrimp, land crabs, frogs, toads or monitor lizards) can infect humans (Ortiz et al., 2024). Human angiostrongyliasis usually manifests as headaches, neck stiffness, paraesthesia, nausea, and vomiting in both adults and children (Wang et al., 2008). While nausea, vomiting, fever, somnolence, constipation, and abdominal discomfort are more common in children, neck stiffness and paraesthesia are less common in them. There are also uncommon, lethal encephalitic manifestations of the illness (Wang et al., 2010). Ocular infections or eosinophilic meningitis are two possible symptoms of angiostrongyliasis. Corticosteroids, antiparasitic drugs, and supportive treatment (such as lumbar puncture and pain management) are commonly used to treat meningitis (Wang et al., 2012). Ocular infections require surgical intervention. Although several herbal therapies have demonstrated potential in animal research, their applicability to humans has not yet been established (Thiangtrongjit et al., 2021).

2.5 Paragonimiasis

Paragonimiasis is a trematode caused by pulmonary flukes, which are primarily spread through eating raw or undercooked freshwater crustaceans (Keiser & Utzinger, 2009). The disease is transmitted through snails, crustaceans, and mammals, including humans. Metacercaria in infected shellfish excyst in the duodenum, pierce the intestinal wall, and develop into adult flukes in the lungs (Blair et al., 2018). Symptoms of pulmonary paragonimiasis include fever, chest discomfort, haemoptysis, and a persistent cough (Vijayan,2013). Ectopic paragonimiasis can affect organs like the brain, liver, or skin, causing serious consequences (Chai, 2013). The recommended medication is praziquantel, given over two to three days. Additional supportive care, including respiratory assistance, may be required in extreme situations (Resuh et al., 2024).

Praziquantel, administered over two to three days, is the suggested medication. In severe cases, more supportive care, such as respiratory support, might be needed (Resuh et al., 2024).

3. Prevention and Control Measures

A multifaceted strategy is needed to prevent zoonotic parasitic infections in finfish and shellfish, including public awareness campaigns, aquaculture biosecurity, seafood safety protocols, and regulatory enforcement (Loest et al., 2022). It is advised to cook at 63°C or freeze at -20°C for at least seven days in order to effectively eradicate the majority of zoonotic parasites (Galbreath et al., 2019). To reduce parasite burdens, aquaculture facilities must put biosecurity procedures in place, including routine health monitoring, water quality control, and antiparasitic treatments (Rahman et al., 2022). While stringent food safety laws and screening of imported seafood improve control measures, public education campaigns are essential in educating consumers about the dangers of consuming raw seafood (Hoque et al., 2022). Furthermore, early detection methods and integrated surveillance systems aid in reducing parasitic risks in the seafood sector, protecting public health and promoting sustainable aquaculture methods (Aly & Fathi, 2024).

Conclusion and Future Prospective

Numerous pathogens, including zoonotic ones that can infect humans, live in fish. Concern over the prevalence and spread of these pathogens is growing among the fishing and global health sectors. Nevertheless, there is a dearth of information regarding the morphological identification of these pathogens, which is essential for improved knowledge and awareness in the fields of biosecurity, medicine, and the food industry. Humans can contact the majority of parasitic tapeworms, roundworms, and flukes from fish by eating raw or poorly prepared fish or fish products. Preventive measures should be put in place and raw fish should be treated before consumption to lower the risk. Effective detection of these pathogens can be aided by sophisticated molecular diagnostic methods.

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