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## Fish borne ichthyozoonoses: A review

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### Abstract

The fish borne ichthyozoonoses in human being occurs due to consumption of raw or undercooked fish and fish products. Some parasites, bacteria and virus found in fish may infect human beings as non-traditional hosts. Moreover, people consume a large number of marine organisms that produce toxic substances which causes illness and even death in man. A numbers of clinical signs and symptoms like gastroenteritis, diarrhoea, abdominal pain, fever, nausea and vomiting, weight loss, fatigue, pneumonia etc. are arisen in man due to fish borne ichthyozoonoses. The prevention principles of fish borne ichthyozoonoses includes avoidance of consumption of raw or undercooked fish and fish products, adopting good hygiene practices among fish producers, conducting awareness programme among public about the prevalence of the fish borne diseases reduce the risk of infections, adopting precautionary measures as wearing gloves when handling fish, thoroughly cleaning all cuts and injuries caused by marine with antiseptics and keeping them dry. In this review, prominence parasitic, bacterial, viral ichthyozoonoses along with harmful effects of toxin present in fish and shellfish has been discussed.

**Keywords:** Fish, ichthyozoonoses, parasites, bacteria, virus

### 1. Introduction

Fish, a very delicious dietary item which rich in vitamins and minerals are a high-protein, low-fat food that provides a range of health benefits including neurologic development during gestation and infancy and reduced risk of heart diseases [1]. White-fleshed fish, in particular, is lower in fat than any other source of animal protein, and oily fish are high in omega-3 fatty acids, or the "good" fats [2]. Since the human body can't make significant amounts of these essential nutrients, fish are an important part of the diet. Unfortunately fish also poses a great threat to the public health as it may be a source for a number of diseases for the humans are called ichthyozoonoses [3]. Zoonotic diseases have been defined by the World Health Organization [4] as those diseases or infectious agents, which are generally transmitted between animals and men. Transmission of zoonoses from animals to man may occur through various vectors like insects, mosquitoes, flies, fleas etc. and consumption of fish, milk and meat. Moreover, humans may get the infections through ingestion of infected tissue of fish or aquarium water or by contamination of lacerated or abraded skin [3]. India ranked second in world in fish production contributing 8.5% of global fish production [5] as has a very vast area of water bodies besides commercial artificial ponds including natural water resources used for the extensive and intensive fish farming. Under these changing circumstances ichthyozoonoses are likely to emerge as major problems both for the consumers and the producers. The fish farmer suffers the economic losses by the way of rejection of the produce while as the consumers suffer from the ill health due the consumption of the fish borne pathogens or the toxins [6]. There is need for creating awareness among the fisheries students, fish farmers and general public about the fish borne diseases communicable to man. Therefore, in this review, emphasis has been placed on parasitic, bacterial, viral ichthyozoonoses along with harmful effects of toxin present in fish and shellfish.

### 2. Types of ichthyozoonoses

#### 2.1 Parasitic Ichthyozoonoses

The fish-borne parasitic zoonoses caused by trematodes, cestodes and nematodes have been limited for the most part to populations living in low and middle-income countries, but the geographical limits and populations at risk are expanding because of growing international markets, improved transportation systems, and demographic changes such as population

Movements [7]. Worldwide, numerous parasitic food borne zoonoses are transmitted from freshwater, brackish and marine fish to human causing gastroenteritis and other health problems [8].

### 2.1.1 Nematodes

The fish-borne nematodosis in humans are common in some countries where people have a traditional custom of consuming live, raw, smoked, lightly cooked or marinated fish and/or squid [9]. This assumes that, i) the fish or squid must harbour infective stages of nematodes and, ii) they must be ingested in such conditions that live worms can reach the digestive tract of humans. Not only live worms but also dead worms can cause allergic reaction, sometimes with serious consequences including anaphylactic shock [10]. Several species of nematodes are transmitted to human and causes nematodosis: *Anisakis*, *Pseudoterranova*, *Contracaecum* and *Hysterothylacium* spp. (family-Anisakidae); *Gnathostoma* spp. (family- Gnathostomatidae); *Capillaria philippinensis* (family-Capillariidae) and *Eustrongylides* spp. and *Dioctophyme renale* (family-Dioctophymatidae) which are a fish-borne pathogen capable of causing severe, sometimes fatal, diarrhea, urinary tract infections in the Philippines and Thailand, and sporadic cases have been reported from Taiwan, Japan and Korea [11].

#### 2.1.1.1 Anisakiasis

It is one of the most important diseases of humans acquired from fish infected with larval stages of *Anisakis simplex* [12]. There is no report of anisakiasis in human due to adult worm. Humans acquire larval *A. simplex* by eating raw, inadequately cooked, poorly salted, pickled or smoked herring (*Clupea harengus*), cod (*Gadus* spp.), mackerel (*Scomber* spp.), salmon (*Oncorhynchus* spp.) or squid (*Todarodes* spp.). It is a major source of traditional preparations like raw herring, lomi lomi and salmon [13, 14]. Anisakid larvae have been shown repeatedly to be responsible for severe gastrointestinal disease [13]. The symptoms of the disease include severe abdominal pain, fever, nausea and vomiting.

#### 2.1.1.2 Dioctophymiasis

The dioctophymiasis occurs in human due to ingestion of undercooked fresh water fish containing infective larvae of *Dioctophyme renale* [14]. The symptom includes renal colic haematuria, pyuria and retention of urine due to the presence of parasite in the urinary system.

### 2.1.2 Trematodes

Liver and intestinal trematodes are major fish-borne zoonotic parasites of humans. A number of fish-borne zoonotic liver flukes, with currently more than 45 million people estimated to be infected [15] due to consumption of raw, marinated or improperly cooked fish, crustacean or mollusks. *Paragonimus westermanii*, *Metagonimus yokogawai*, *Clonorchis sinensis*, *Opisthorchis tenuicollis*, *Heterophyes heterophyes* are frequently reported from human infections in the Middle East and Asia, especially the Philippines, Indonesia, Thailand, the People's Republic of China, Japan and the Republic of Korea [14]. Fish act as a second intermediate host where the free swimming cercariae leave the snail (first intermediate host) and penetrate fresh water fish to develop metacercariae [16]. Of these fish-borne trematodes, *C. sinensis*, *O. felineus* and *O. viverrini* are not only the most important but provide an interesting zoonotic

perspective [17]. *O. felineus* is a parasite predominantly of carnivores throughout much of its range, only occasionally causing human disease [18], where prevalence in humans can be high and poor sanitary conditions make the spread of eggs via human faeces possible [19]. The accumulation of large numbers of these parasites in the small intestine may cause inflammation, ulceration and necrosis. In chronic cases most of these trematodes are responsible to cause cholangio-sarcoma [6].

### 2.1.3 Cestodes

#### 2.1.3.1 Diphylobothriosis

*Diphyllobothrium latum*, the broad tapeworm of fish lives in small intestine of man and produces gastrointestinal illness and anaemia is transmitted through the ingestion of infective larvae (plerocercoid) in raw or insufficiently cooked freshwater fish [17, 20]. World-wide, at least 13 species of *Diphyllobothrium* have been reported from humans, with infections by *D. latum* and *D. dendriticum* being the most prevalent [21]. The symptoms are generally mild which include diarrhoea, abdominal pain, vomiting, weight loss, fatigue, sometimes constipation and discomfort. In small number of cases it leads to the severe vitamin B<sub>12</sub> deficiency, megaloblastic anemia and neurological symptoms [12, 16].

### 2.2 Bacterial Ichthyozoonoses

Human infections and intoxications have been recorded due to consumption of contaminated fish or contact with the contaminated fish with *Clostridium botulinum*, *Vibrio* spp., *Erysipelothrix rhusiopathiae*, *Escherichia coli*, *Aeromonas* spp., *Salmonella* spp., *Staphylococcus aureus*, *Listeria monocytogenes*, *Mycobacterium* spp., *Streptococcus iniae*, *Plesiomonas shigelloides* etc. [22, 23, 24]. Some of the potential fish borne bacterial ichthyozoonoses are highlighted below:

#### 2.2.1 Botulism

The botulism, characterized by an acute, symmetric, descending flaccid paralysis is occurred due to consumption of canned fish and other seafood preparations contaminated with the several types of potent neurotoxins elaborated by the *Clostridium botulinum* [6]. The *C. botulinum* type E is more psychotropic than other types and can reproduce even during refrigeration. Early symptoms of the disease often include cranial nerve palsies with diplopia, ptosis, slurred speech, and often difficulty swallowing progressing to descending weakness and paralysis [25].

#### 2.2.2 Erysepelosis

Erysepelosis or *Erysipelothrix* infection, an occupational hazard of the fishermen, anglers and workers in the fish processing plants is caused by *Erysepelothrix insidiosa* and *E. musioopathiae*. The symptoms include itching, tingling and burning sensation of the site of infection. Erythema, edema, arthralgia, lymphangitis, septicemia, endocarditis, anemia and meningitis are also seen [26].

#### 2.2.3 Listeriosis

Fish get the infection from contaminated water, where *Listeria monocytogenes* infects a wide range of animals and fish and produce disease in man. The organisms survive in frozen, raw, cooked, smoked or fermented fish [27]. So, ingestion of infected undercooked/raw fish and fish products cause listeriosis in man with various symptoms like septicemia, abortion, meningitis, glandular granulomatosis,

conjunctivitis, pneumonia, urethritis, endocarditis and hydrocephalus [6, 27].

#### 2.2.4 Salmonellosis

Salmonellosis occurs in human due to ingestion of contaminated or uncooked fish and fish products with 2500 serotypes of the *Salmonella* present in man, birds and fishes [24, 25, 27]. Fish grown in the dirty waters may be the source of infection. Additionally the fish and other sea food can become contaminated with *Salmonella* during storage and processing [30]. Septicemia, sudden onset of abdominal pain, diarrhoea, nausea, vomiting and fever are the symptoms [6, 27].

#### 2.2.5 Vibriosis

It is caused by consumption of contaminated undercooked fish or fish shell, raw oysters and cooked crabs. The common causative organisms are *Vibrio parahaemolyticus*, *V. cholerae* and *V. vulnificus* [28, 29]. Among the different *Vibrio* species *V. parahaemolyticus* is one of the major bacteria causing gastroenteritis in man mainly in coastal areas where sea food consumed lavishly. The symptoms are of acute gastroenteritis, diarrhoea, vomiting, fever and headache and chills [1]. The symptoms last from 1-8 days and usually are of self-limiting nature. Pre-existing liver diseases, alcoholism and other immuno-compromising status make an individual more susceptible [6, 27].

#### 2.2.6 Tularemia

It is caused by *Francisella tularensis* contaminated with infected fish and its symptoms in man include chills and sudden onset of fever, erythematous papules, pustules, ulcers, anorexia, headache, nausea and gut disturbances [31].

#### 2.2.7 Aeromonas infection

In human the fish borne diarrhoeal illness occurs through open wound contaminated with the *Aeromonas hydrophila* bacteria infected fish or by ingestion of contaminated fish and fish products [27]. The common symptoms are gastroenteritis and localized wound infections.

#### 2.2.8 Escherichi coli infection

Gastroenteritis due to consumption of contaminated or uncooked fish tissues infected with *E. coli* occurs in human beings [27].

#### 2.2.9 Shigellosis

The *Shigella* species is an incidental food borne bacterial pathogen. Ingestion of finfish, shrimp and raw oyster the shigellosis occurs in man. Diarrhoea is the main symptom [6, 27, 32].

#### 2.2.10 Plesiomonas shigelloides infection

The food poisoning occurs in human when infected with *Plesiomonas shigelloides* [31]. The self-limiting nature of infection occurs in human through ingestion of the uncooked or shell fish [27].

#### 2.2.11 Mycobacteriosis

Mycobacteriosis, a chronic progressive disease spread all over the world occurs in sea, brackish and fresh water fish kept as in aquacultures, as in aquariums and free nature [33, 34]. Human gets infection through ingestion of infected fish. Emaciation, ascites, exophthalmos and keratitis and pigmentation and ulcerations in skin are the common symptoms [34].

#### 2.2.12 Streptococcus iniae infection

*Streptococcus iniae* an emerging human pathogen associated with injury while preparing fresh aqua cultured fish infected with these bacteria which causes meningioencephalitis and death in cultured fish [35]. The symptoms may be accompanied by cellulitis, endocarditis, meningitis, and probable septic arthritis [36].

#### 2.3 Viral Ichthyozoonoses

Shell fishes like oysters, mussels and clams are the common sources of the viral agents like Hepatitis A, Norwalk like virus and Enteroviruses like Polio virus which are infected with sea water contaminated with human sewage. The common diseases associated with these viruses include aseptic meningitis, respiratory illness, myocarditis, fever, diarrhoea, nephritis etc. [36].

#### 2.4 Toxin in fish and shell fish

A large number of marine organisms produce toxic substances that can cause illness and even death in man.

##### 2.4.1 Ciguatera poisoning

It is caused by eating certain species of reef fish like grouper, kingfish, barracuda snapper and moray eels contaminated with toxins originally produced by dinoflagellates-*Gambierdiscus toxicus* adhered to coral, algae and sea weed [6]. The toxins include ciguatoxin, maitotoxin, scaritoxin and palytoxin. Ciguatoxin laden fish is not detoxified by the conventional cooking [37]. The symptoms of this disease are gastrointestinal and neurological where patient suffers from nausea, vomiting, diarrhoea, headache, muscle ache, paresthesia, numbness, ataxia, vertigo and hallucination. Cold sensitivity of the mouth and extremities is the significant characteristic feature of this poisoning [38].

##### 2.4.2 Diarrhoetic shellfish poisoning

Diarrhoetic shellfish poisoning (DSP) causes gastrointestinal disturbances with abdominal cramps in human beings. DSP is the result of vocadic acid production by dinoflagellates concentrated in mussel: oyster and scallop tissues [6].

##### 2.4.3 Minamata disease

It is caused due to ingestion of the fish caught in the Minamata Bay and Shiranu Sea polluted by the industrial waste water with methyl-mercury [39]. The symptoms of the disease include ataxia, numbness in the hands and feet, general muscle weakness, narrowing of the field of vision and the speech, and in extreme cases paralysis, coma and death in few weeks. It may be congenital and may affect the fetus.

##### 2.4.4 Paralytic shellfish poisoning

Paralytic shellfish poisoning is a serious illness which leads to neurological symptoms including paralysis terminating some times in fatality. Outbreaks mainly occurred from consumption of cooked shellfish especially mussels, cockles, clams, and scallops contaminated with Dinoflagellates which produce 20 derivatives of saxitoxin and accumulated in shellfish [3, 6].

##### 2.4.5 Puffer fish poisoning

This disease occurs as a result of consumption of puffer fish that contains tetrad toxin which is a potent neurotoxin. This toxin inhibits firing action potential after binding with voltage gated sodium channels and inhibits passage of sodium [40].

### 2.4.6 Scombroid or histamine poisoning

It is caused by eating spoiled or decayed fish. Poorly refrigerated fish like tuna and blue fish are the main sources of bacterial contamination like *Klebsiella* and *Proteus* which break down the histidine into histamine during storage [41]. Histamine may accumulate toxic levels if contaminated fish are left unrefrigerated for as little as 3-4 hours. Symptoms include flushing of skin, headache, redness of eyes, abdominal cramps, nausea, diarrhoea and other allergic reactions [42].

### 3. Prevention and control

Prevention of fish borne ichthyozoonoses requires an understanding not only of the etiologic agents and the type of fish and other marine animals involved but also the mechanisms of the contamination that are amenable to the control. Defining the problem areas, which relies on the surveillance of the food associated infections through outbreak and case reporting, can lead to targeted research and help to guide control efforts. Following points may be followed in day-to-day life to control these diseases;

- Avoid eating raw and insufficiently cooked freshwater fish.
- Fish should be thoroughly cooked, brined or frozen before consumption.
- Preventing parasitic eggs reaching to water resources by providing adequate sanitary latrines.
- Governments programs and attention should be devoted for safety aquaculture product.
- Implementation of Hazard analysis critical control point (HACCP) and good management practices.
- Creation of laboratory facilities for rapid identification of illnesses.
- Greater awareness among the public health personal about fish borne diseases by conducting periodical seminars, training programs and other communication methods.
- Educating the population at risk about the prevalence of the diseases in the area.

### 4. Conclusion

Eating of raw or partially cooked fish is the main risk factor for these diseases. If fish consumption enhances globally as is expected, the importance of ichthyozoonoses may increase. Accumulation of large numbers of parasites, bacteria, viruses etc. in the small intestine may cause various symptoms. Good hygiene practices and educating the public as well as fish producers about the prevalence of the fish borne diseases reduces the risk of ichthyozoonoses.

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