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Fish-borne parasitic zoonoses: status and issues in India

K. P. JITHENDRAN

Food-borne parasitic zoonoses (FBPZs) are human and animal diseases caused by helminthes and protozoans though the consumption of infected or contaminated meat, fish, plants and/or water. They pose great public health significance and socioeconomic problems in many countries and play great role in the transmission through food webs. In aquatic ecosystem, marine mammals, birds and fish act as reservoirs of potentially zoonotic pathogens to the human beings by way of contact and/or consumption of infectious pathogens.

Traditionally, fish-borne parasitic helminths (viz., *Chlonorchis, Opisthorchis, Metorchis, Diphyllobothrium, Anisakis* etc.) associated with the human consumption of fish products containing infective form of pathogens resulting in zoonotic diseases 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.

The growing incidence of *Giardia, Encephalitozoon* and *Cryptosporidium* in fish and other marine animals is a recent phenomenon associated with growing urbanization and increased human activities. They may have been acquired via contamination of coastal waters by sewage, run off and agricultural and biomedical wastes. These indicate that organisms that can pose human health risks are widespread in marine vertebrates. Long distance migration, foraging of these animals, live and frozen fish trade and transboundary movement etc. are factors that favor transmission of disease across geographical boundaries. The intensification of aquaculture and globalization of the seafood trade have led to remarkable developments in the aquaculture industry accompanied with deterioration in environmental and health conditions. To understand the nature of health risks for marine animals and humans, increased attention is needed to establish the source of these zoonotic pathogens in marine environment. Awareness programme is needed to highlight the food-borne parasitic infections with public health hazards and food safety issues of seafood (fish and shellfish), which is a major export commodity in India.

Parasitic zoonoses of fish origin

About 18 million people are affected by fish-borne trematodes alone and are geographically confined to population living in low and middle income countries called as 'hot spots' of fish-borne zoonoses. They show a further expanding geographical limits and population at risk due to the growing international markets, improved transportation system, demographic changes etc. though the meat-borne zoonoses were more common in developed country and fish-borne zoonoses in developing country. Fish, shell fish and mollusc-borne parasitic zoonoses are clonorchiasis, opisthorchiasis, paragonimiasis, echinostomiasis, anisakiasis, angiostrongyliasis etc.

The major exposure routes include ingestion and introduction of organisms through open wounds or abrasions. More specifically, ingestion includes consumption of raw or under-cooked infected fish tissue, ingestion of fish tissue contaminated with faeces from infected fish, and ingestion of water harboring infectious organisms. Dermal exposure includes introduction of infectious agents into open wounds or abrasions through handling infected fish or infected water. As far as aquatic environment is concerned, fish-borne zoonoses can be classified under – (i) Fish-borne zoonoses: parasite undergoes some stages of development in fish/shell fish, (ii) Crustacean-borne zoonoses: parasite undergoes some stages of development in crustaceans and, (iii) Vegetable-borne/water-borne zoonoses: mainly by mechanical contamination of infective parasitic stages

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on vegetation (weeds, lotus stem etc).

The zoonotic parasites of fish origin also vary from freshwater, brackish water and marine ecosystem; host species etc. to a large extent. There is complete lack of priority for parasites of zoonotic significance, though some parts of the country face these problems. Food safety issue is a growing concern especially in export sector as majority of the fish products are being exported as frozen items. A single factor responsible for fish-born zoonoses could be lack of hygiene (poverty, lack of personal hygiene, scarcity of potable water, consumption of raw or undercooked food) and/or favourable climatic condition for parasite growth and transmission. Many zoonotic parasites enter human by way of consumption of raw aquatic vegetation/tubers etc. In India, food-borne zoonosis in general, especially the fish-borne in particular, are comparatively very less prevalent than in South East and Far East countries mainly because of the traditional culture of cooking and serving. However, eating raw or undercooked fish, crustacean, snail etc. is a delicacy in certain communities, and people. The incidence of helminthozoonosis can be minimized substantially, if people are provided with clean drinking water and hygienic living conditions. Besides, people need to be made aware and educated of risks of infection by way of undercooked fish / crab. Anisakis occur in the visceral cavity and surrounding tissues of many marine fish species. Human consumption of fish products containing these parasites can result in the zoonotic diseases anisakiasis.

The future impact of these fish-borne zoonotic parasites may be linked closely to the expected growth of aquaculture in Asia. However, there is disagreement on the relative importance of pond cultured fish versus wild caught fish in the epidemiology of human infection.

Plant and water borne parasitic zoonoses

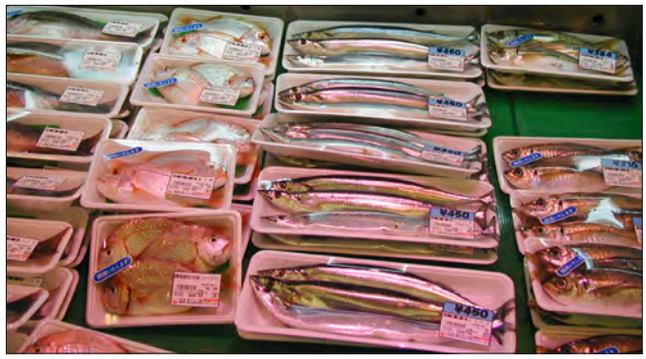
Plant and water-borne parasitic zoonosees are fasciolopsiasis, fascioliasis, schistosomiasis, cryptosporidiosis and giardiosis. *Cryptosporidium* is typically a water-borne disease and the survival in seawater and the role of invertebrate as reservoir has been demonstrated.

Emerging fish-borne parasitic zoonoses

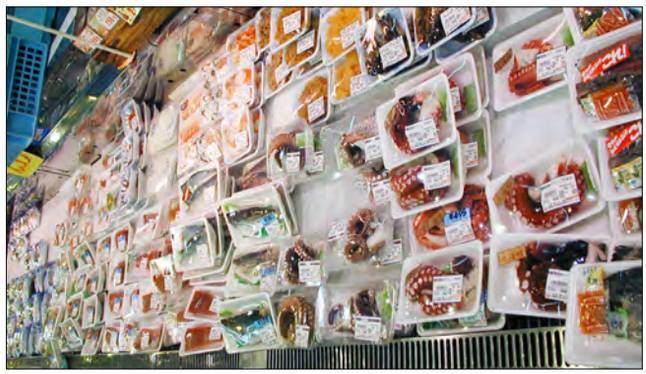
Some of the emerging FBPZs are *Heterophyes, Gnathostoma, Entamoeba,Balantidium* and microsporidium (*Encephalitozoon*) infection. Both marine mammals and birds act as reservoir for many potentially zoonotic protozoans infections (*Giardia, Cryptosporidium, Encephlitozoon* and *Entamoeba*).

Role of food habits

Fish-borne and meat-borne parasitic zoonoses are also endemic in many Asian countries that have related traditional cooking styles. In addition, an array of freshwater and brackish-water fish and wild animal



Ready to eat fish and other aquatic animal products in super market outlets



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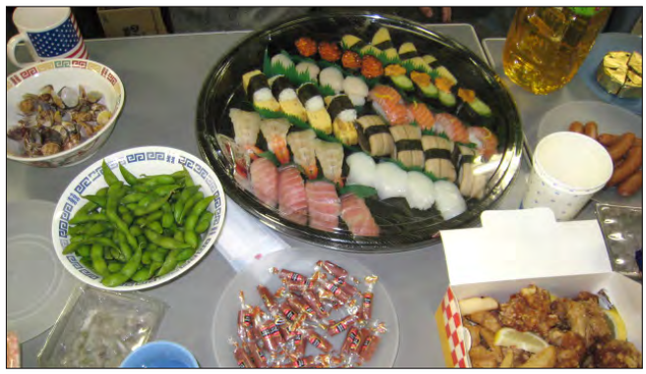

Largely raw or semi-cooked/processed delicacies like 'sushi' and other meat products on dining table

meats, which are important sources of infection with zoonotic parasites, are served as *sushi* and *sashimi*

in rural areas of Japan (Fig. 1-3). Despite the recent increase in the number of travellers to areas where these zoonoses are endemic, travellers and even infectious disease specialists are unaware of the risk of infection associated with eating exotic ethnic dishes. Because of the worldwide popularization of Japanese cuisine, the traditional Japanese fish dishes *sushi* and *sashimi* that are served in Japanese restaurants and sushi bars have been suspected of causing fish-borne parasitic zoonoses, especially anisakiasis.

Ligula intestinalis: The plerocercoid of the pseudophyllidean cestodes *Ligula* and *Schistocephalus* occur in the body cavity of freshwater fish commonly roach (*Rustilus*) and sticklebacks (*Gasterosteus*) respectively. Adults are found in the intestine of piscivorous birds. Compared with the mass of the fish plerocercoid tissue may be massive. Echinostomes are naturally occurring parasites in the intestine of a variety of mammalian and avian hosts. Humans are accidental hosts, the acquisition of echinostomiasis being associated with the food habits of consumption of raw or inadequately cooked mollusks, fishes etc. Many of these diseases are also zoonoses, some major and others potential.

Role of aquatic organisms

Marine zoonotic infections in humans result from consumption of contaminated edible tissues or products of seafood or, to a lesser extent, from physical contact with contaminated seafood. Across the world, over 50 species of helminth parasites from fishes, crabs, crayfishes, snails, and bivalves are known to produce human infections.

Most helminth zoonoses are rare and invoke only slight to moderate injury; however, some are more prevalent and pose serious potential health hazards. Most of the seafood zoonoses across the world occur along coastal regions, where seafood products are commonly consumed. Continuing improvements in transportation, technology, and food handling, however, allow fresh seafood to be shipped throughout the world; thus, the potential for acquisition of parasitic infections from marine products is not limited to coastal populations.

Although the number of documented cases continues to increase, the overall risk of human infection is slight. The increasing exploitation of the marine environment by humans, changing dietary habits incorporating "natural" seafood dishes (eg, sushi and sashimi), and tendency to reduce cooking time when preparing seafood products – all are factors that increase the chances of becoming infected with these parasites. Also, an influx in international trade of food items, particularly of the crustaceans, fishes etc., which may be contaminated with the infective stages of the trematodes, from the disease endemic countries to distant continents may contribute a potential health hazard for the population living in the 'sanitized' world.

Role of immigrants

Paragonimiasis is endemic in Aisa, African and South American countries and about 300 million people are at risk. In Japan the disease is re-emerging since 1980, due to the increased number of immigrants.

Role of migratory animals

Considerable evidence indicates that migratory birds and animals can contribute to the global spread of infectious agents in a spatial manner analogous to humans traveling in aircraft. Water fowls usually occur in large numbers, can migrate long distances, frequently graze and defecate in water, and are in fact protected by environmental laws in many regions where they have unlimited access to the surface waters used as drinking water.

Perspectives for control

Even after 60 years after Stoll wrote about "This wormy world", the prevalence of intestinal worms in human populations remain virtually unchanged. Helminth diseases, in general, are diseases of poverty, and are associated poor sanitation. These infections tend to decline with increased economic development.

> CONTROL OF ZOONOTIC FISH PARASITES IS A MULTIFACETED TASK DUE TO COMPLEX NATURE OF THE INTERACTION BETWEEN HOST, PATHOGEN AND ENVIRONMENT IN AQUATIC ECOSYSTEM.

Any approach towards effective control measures against meat/fish-borne zoonotic parasite should focus on the knowledge of various factors responsible for transmission and occurrence. Control of zoonotic fish parasites is a multifaceted task due to complex

nature of the interaction between host, pathogen and environment in aquatic ecosystem.

A central point towards the control of fish-borne zoonoses is overall hygiene and continued awareness among people about these infections. Proper education, hygienic living conditions, adoption of strict self-hygiene, habit of eating properly cooked food, use of clean water for drinking and bath particularly those whose trades compel them to be in constant and close contact with fish and shell fish, viz., fishing, culture, trading and processing activities etc. are important.

There is no strong and recent database on the fish-borne parasitic zoonoses in India though many text books on zoonoses have been published over a period of two decades. Hence the endemic areas of zoonotic infections of fish origin should be revisited to update the present status of each disease in both fish as well as man. Apart from lung flukes of human in North Eastern Hill (NEH) region, most other diseases need reappraisal. More importantly, culture of fish and shell fish in hygienic environment and free from sewage is also necessity to ensure food safety for fish and fishery products.

Strategies for prevention and control

Trends in the global parasitic infections soil-transmitted nematode infections show a decline over the last couple of decades as against the food borne parasitic zoonoses. The majority of human cases of fish borne or other food borne parasitic infections can, generally, be easily be treated by anthelmintic drugs after an accurate and early diagnosis has been established. Hence the challenge for helminth-control programmes today is more operational than medical and will depend on its ability to reach the poorest and often least accessible sections of the community.

TRENDS IN THE GLOBAL PARASITIC INFECTIONS SOIL-TRANSMITTED NEMATODE INFECTIONS SHOW A DECLINE OVER THE LAST COUPLE OF DECADES AS AGAINST THE FOOD BORNE PARASITIC ZOONOSES.

There is complete lack of priority for parasites of zoonotic significance, though some parts of the country face these problems. Food safety issue is a growing concern especially in export sector as majority of the fish products are being exported as frozen items.

The US Food and Drug Administration (USFDA) recommend preserving fish for raw consumption by storing it at less than -35˚C for 15 h or at less than -20˚C for 7 days. Similarly, according to the European Union Hazard Analysis and Critical Control Points (HACCP), marine fish for raw consumption should be frozen at less than -20˚C for more than 24 hrs.

The risk of infection by eating aquatic products is higher in countries where such legal regulations have not been implemented. For example, a country like China has 1.3 billion peoples of about 56 nationalities. So the task of controlling zoonotic disease is gigantic.

However, regular epidemiological survey, enhancement of food safety by implementing strict quarantine techniques and detectable methods for pathogens at production, processing, distribution and marketing stages. Change of peoples unhealthy eating habits particularly for some ethnic groups need to be addressed.

Conclusion

Parasitologists are confronted with complex problems of parasitic diseases in a rapidly changing world. Changes in human ecology and the impact of global climatic changes on parasitic systems have raised a serious voice of concern all over the world. Added to that, the food-borne parasitic zoonoses have emerged as a major public health problem in many countries, posing serious threat to human and animal health.

Increased thrust is required to control parasitic infections both in conventional slaughter animals and in aquatic animals/sea food in view of the increased production of cultured fish, and the need for hygienic aquaculture practice and processing of fish and fish products for human consumption.

Further, there is also a need for the establishment of a national network of aquatic parasitologists and a national surveillance system for parasite zoonoses of fish origin and their distribution in the country.

Establishment of national surveillance system for parasitic zoonoses of fish origin could be considered for addressing food safety issues and augmenting the research programme in this direction.