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AN ANALYSIS ON TREMATODE PARASITES OF FRESH WATER EDIBLE FISHES

1. Monabbar Ali Miah 2. Dr. Surya Prakash Mishra

Research Scholar CMJ University Jorabat[1] Research Guide CMJ University Jorabat[2]

ABSTRACT

Fish constitute one of the most important units of the animal kingdom by having the importance in solving the alarming situation of food problem in our country. Since last two decades, it has replaced the customary food items and has become the only source of food in some parts of our country. Besides, they are rich in proteins, vitamins and minerals and substantially improve the qualitative deficiencies in our dietary habits. However, majority of fishes cany heavy infections ofseveral parasites which create problems before fishculturists.

Keywords: Helminth parasites, fishes, trematodes

1. INTRODUCTION

Helminth parasites are one ofthem and are very important because they cause deterioration in food value of fishes. Many of them, particularly digenetic trematodes cause fish diseases and result their mortality. Presence of these parasites within the fish host reduces the growth, shorten the life-span and in some cases in accompany with secondary bacterial invaders, destroy the cornea and even the eye often killing the fish. Fish also acts as an intermediate host for transmitting helminthic or other diseases to man and other animals through eating fish infected with certain larval forms. Thus, helminthic infection has become a problem of deep concern.

Keeping in view the importance of fishes, our Government is paying attention towards the development offishery in our country, yet pathogenic effect of helminth parasites is one of the neglected field in fishery. This is only due to our ignorance about the occurance, morphology and taxonomy of these parasites. These aspects have been repeatedly emphasized by the helminthologists time to time. The variety and diversity have made this group of increased interest in studies of host-parasite relationship, speciation and phytogeny. Considerable work has been done, even then our knowledge is still imperfect with regard to the adult trematodes.

In recent years, an ecologic approach has been emphasized in order to understand the basic principles of parasitology, because the concepts of ecology in the study of parasites have been ignored in the past. This becomes especially important in the context that the relationship between the parasites and their hosts may be viewed as "ecological" because the host provides the environment in which the parasites lives, and as such the host‟s environment, the open sea or ocean, affects the parasites through its host. Furthermore, this becomes quite apparent to believe, rather confirm, that the parasite, be it an endo-parasite or ectoparasites, synthesizes its enzymes for digestion or other metabolic function from the constituents provided by the host‟s tissues, particularly the endo-parasitic digenetic trematodes and tapeworms. The food, pre-digested by the host, is absorbed via ultramicroscopic microvilli and other microscopic structures present on or immediately beneath the body surface of the Trematodes or Cestodes and used within their body.

Of course, the ecology of parasites is not only limited to meet their nutritional requirements but also equally interesting to study the ecologic factors that influence the distribution of parasites and the parasite density that is, in all, the parasite population dynamics.

2. LITERATURE REVIEW

Trematodiases are caused by digenetic flukes (Platyhelminthes: Trematoda) and are a major public health problem world wide. Food-borne trematodiasis (FBT) is an important group of neglected tropical diseases, which are zoonotic as they are transmitted by the consumption of raw or undercooked aquatic foods that harbour the metacercaria (i.e., infective larval stage) of the fluke. Over 100 species of FBTs are known to cause infections in humans (WHO 2009). FBTs are endemic in various parts of the world, particularly Southeast Asian regions (Dixon and Flohr 1997). As estimated, more than 750 million people are at risk of infections with food-borne trematodes (Keiser and Utzinger 2009). Fishes and crustaceans may harbour the infective metacercarial stage of a large number of trematodes, which are responsible for FBT (WHO 1995; Lun et al. 2005; Bullard and Overstreet 2008), thus serving as vector for some human helminthic diseases. In India, like most other tropical countries, parasitic infections play a major role in public health. Particularly in Manipur, Northeast India, the native people have similar food habits to those of the Southeast Asian neighbours of consuming raw or inadequately cooked fish or crabs that still sustain viable infective stages (i.e., metacercaria) of trematode flukes in their tissues (Mahanta 1990). Thus, trematode infections of the lung and intestine are especially significant as potential zoonoses in the region.

Freshwater fish harbour infections caused by various trematode species belonging to different families viz., Phyllodistomidae, Monorchiidae, Zoogonidae, Callodistomidae, Homalometridae, Opecoelidae, Microphallidae, Opisthorchiidae, Heterophyidae, Isoparorchiidae, Clinostomatidae, Diplostomidae etc. (Yamaguti 1971). A pioneering amount of literature is available on metacercariae of various digenetic trematodes from fishes all over the world (Malek and Mobedi 2001; Arafa et al. 2005; Silva-Souza and Ludwig 2005; Vianna et al. 2005; Rim et al. 2008; Han et al. 2008; Sohn 2009; Skov et al. 2009; Sohn et al. 2009; Gustinelli et al. 2010; Thuy et al. 2010; Gholami et al. 2011), including that from India (Kumari 1994; Jhansilakshmibai and Madhavi 1997; Singh et al. 2003; Vankara et al. 2011; Shareef and Abidi 2012).

The Crustacea-borne trematode infections are caused by fluke parasites belonging to families Paragonimidae, Microphallidae, Lecithodendriidae, Brachylaimidae etc. (Yamaguti 1971; Anantaraman and Subramoniam 1976; Janardanan et al. 1987). Among these infections, *Paragonimus* spp causing paragonimiasis pose a continuing public health problem (WHO 1995; Blair et al. 1999; Nakamura-Uchiyama et al. 2002). They occur in a number of countries in several regions of Asia, Africa and Latin America (Toscano et al. 1995). In context of India, the focal transmission of paragonimiasis has been documented in north-eastern states of the country, such as Arunachal Pradesh, Manipur and Nagaland (WHO 2009). Several species of *Paragonimus* have been reported to occur in the commonly edible crab species prevailing in the mountainous ranges of Northeast India (Singh 2002, 2003; Narain et al. 2003; Singh et al. 2006, 2007, 2009; Tandon et al. 2007; Devi et al. 2010). The regions, where crabs are commonly consumed as part of their traditional cuisine are suspected foci for human infection (Tandon et al. 2007). However, there is scanty information available on the metacercarial infection status in commonly edible freshwater fishes and crabs in the Manipur region of Northeast India. So, the present study was undertaken to ascertain the spectrum of metacercarial diversity in these common components of the traditional cuisine in Manipur state and to adjudge their zoonotic potential, if any.

As per the reports of WHO fish-borne trematode zoonoses are a serious health hazard (WHO 1995) and the subject has been recently reviewed (Chai et al. 2005). In the present study, among all the fish species studied, only the members of the family Channidae were found to harbour metacercariae. The channid fishes are reported to harbour metacercariae of several trematodes, e.g. *Atrophecaecum hindusthanensis, Clinostomum* sp., *E. heterostomum*, *Diplostomulum cerebralis*, *Neascus gussevi*, *Metaclinostomum srivastavi* and *Tetracotyl szidati*, to name a few (Chakrabarti 1974; Jhansilakshmibai and Madhavi 1997; Thapa et al. 2008; Vankara et al. 2011). Several species of *Euclinostomum* have been reported from India; these include *E. indicum* and *E. heptacaecum* from *C. punctatus* and *E. channi* from *C. marulius* (Bhalerao 1942; Jaiswal 1957). In the present study *E. heterostomum*, found encysted in the liver of *C. punctatus*, showed a low prevalence (0.25 %). In a similar study carried out in Meghalaya (another state in northeast India), *C. striatus* and *C. punctatus* also showed a low prevalence of *E. heterostomum* (1.44 and 0.74 %, respectively) (Thapa et al. 2008). Metacercarial infection of *Clinostomum* sp. that causes considerable damage to the viscera and muscles of many fish species has been reported from *C. punctatus* and *Heteropneustus fossilis* (Kalantan et al. 1987; Thapa et al. 2008; Vankara et al. 2011; Shareef and Abidi 2012). Besides affecting the nutritional value and/or mortality rates of the infected fish, infections by metacercariae of *Clinostomum* species are also important as potential fish-borne zoonoses (Kamo et al. 1962; Chung et al. 1995; Kitagawa et al. 2003; Dzikowski et al. 2004; Park et al. 2009). These parasites have been reported to cause laryngopharyngitis or even asphyxia and ocular parasitosis in human subjects (Eiras 1994; Tiewchaloern et al. 1999). However, in the present study, the *Clinostomum* infection was not detected in the fishes examined, though *C. punctatus* was found infected with three other types of metacercariae. Species of *Polylekithum* (= *Procreadium*) are known to occur in cyprinid fishes and have been reported from birds also (Verma 1936; Vidyarthi 1938; Jaiswal 1957; Kakaji 1969). It is for the first time that *Polylekithum* sp. infection has been reported from *C. punctatus* through the present study. The same host also harboured the metacercaria of *Posthodiplostomum* sp. as coinfection with *Polylekithum* sp. Many species of *Posthodiplostomum* (namely *P. austral*, *P. oblongum*, *P. opisthosicye*, *P. botauri*, *P. grayii* and *P. milvi*) have been reported from birds (Dubois 1937, 1969; Vidyarthi 1938; Verma 1936; Fotedar and Raina 1965); a few reports are there from crucian carp and common carp (Ishii 1951; Nagasawa et al. 1989) and from *Channa argus* as well (Nguyen et al. 2012). *Channa striata* also harbours metacercariae of *Haplorchis* sp., *Clinostomum complanatum* and *E. heterostomum* (Chakrabarti 1974; Thapa et al. 2008).

Potamiscus manipurensis, Alcomon superciliosum and *Barytelphusa lugubris* are identified as common potential second intermediate hosts for other *Paragonimus* species as well including *P. heterotremus, P. hueit'ungensis, and P. skrjabini* in Northeast India (Singh and Singh 1997; Singh 2002, 2003; Singh et al. 2006, 2007, 2009, 2012). In India *P. westermani* has been reported from various carnivorous mammalian hosts such palm civet cat, domestic dogs, panther, cat, tiger and mongoose (Rao 1935; Srivastava 1938; Dutta and Gupta 1978; Singh and Somvanshi 1978; Gaur et al. 1980; Parihar and Shrivastava 1988; Blair et al. 1999). An epidemiological survey carried out (during 1980s) in the Manipur region revealed the prevalence of paragonimiasis in human subjects in the region (Singh et al. 1993). In the present survey, *P. manipuriensis*, also harboured other metacercariae of the microphallid trematode genus—*Microphallus*, beside *P. heterotremus*. Metacercarial stages of *Microphallus* have been earlier reported from sand crabs and brackish-water prawns (Anantaraman and Subramoniam 1976; Jayasree et al. 2001). Metacercariae of *Microphallus indicus* have been reported from *B. lugubris* in Meghalaya (Goswami et al. 2013). However, the two microphallid metacercaria types recovered during the present study were morphologically very different from *M. indicus*. So far, from India only a few microphallid taxa have been identified, namely *Basantisia ramai*, *Levinseniella indica* and *Pseudospeloterma indicum* from birds (Lal 1936; Pande 1938; Murhar 1960), *Mehraformes jabalpurensis* and *M. indicus* from reptiles (Bharadwaj 1963; Mukherjee and Ghosh 1967), *Megalatriotrema hispidum* from the common frog (Rao 1969), and *Spelotrema narii* from jackals (Rao 1965).

The overall prevalence of metacercarial infections in the crustacean hosts was found to be optimally high (35.8 %). Among the crab species surveyed, *Barythelphusa* emerged as the potent vector and transmitter host for *P. westermani*, a high prevalence (25.04 %) of which was recorded in the region. Paragonimiasis caused by *P. westermani* is one of the medically important food-borne trematodiases in the tropical, subtropical, and some temperate countries (Miyazaki 1991; Blair et al. 1999).

3. HELMINTH PARASITES OF FISH

Fishes live in aquatic medium; many parasites are presence in this aquatic medium. So fish are infected with many parasites. These are typically divided into two groups: ectoparasites and endoparasites. Ectoparasites are live on the outside of a tropical fish host (including the gills, mouth, skin and fin surfaces); and endoparasites, which live in the tissues, blood and/or organs (Intestine, Air bladder, Liver, Muscles). Endoparasites or helminths parasite are multicellular, bilaterally symmetrical animals having three germ layers. Most helminth parasites carried by fishes are Nematodes, Acanthocephalans, Cestodes and Trematodes.

The Helminth parasitess, in the adult stage are usually found in vertebrate hosts, while the larval stage generally inhabit the invertebrate hosts. The parasite prevalence, density of infection and intensity infection depend on many factors like parasites and its life cycle, host and its feeding habits and the physical factors of water body where the fish inhabit. Population dynamics is necessary to provide data for the prophecy of integrated methods to achieve the regulation of numbers of harmful parasites.

Many trematodes attach themselves to superficial parts of the host as ectoparasites. But many others penetrate in to the body and settle down in one of the internal organs as endoparasites. Those flukes which remain confined to external surface of the body of fishes such as gills, skin, and fins and complete their life cycle on a single host called Monogenetic Trematodes. On the other hand, those flukes which are confined to internal organs like stomach, intestine, lever, gall bladder, heart etc. and complete their life cycle on two hosts or more hosts are called Digenetic Trematodes. Digenean are common, asympytomatic infections in fish. About 1700 species of adult digeneans infect fish. Metacercariae are even more common than adults. Digeneans are common in fish.

The nematodes are another important helminthic group infecting fishes. They have elongated bodies tapering at both ends and lack segmentations and suckers. Fish are either intermediate are final hosts for nematodes. About 650 species of Nematode parasitize fish as adults and many others use fish as intermediate hosts while Nematodes are common in fish. The adult form of nematode occur in almost all fishes, generally in the intestine while larval Nematodes may be found in connective tissues, body cavity or muscles. These Nematodes are very important as they cause pathological changes in fishes, due to which the production of fishes is effected through the increases in their mortality rate.

Tapeworms and their allies are invariably endoparasitic which lives in freshwater fish, and attain maturity only in the alimentary canal of the vertebrate animal. Adult Cestode is white flattened, segmented worms that inhabit the intestine. With a complex life cycle that required one are two intermediate hosts, Cestode are relatively more common in fish. Fish can be an intermediate host, definitive host or both. Some Cestodes are the most damaging parasites to viscera of fish and decrease nutritive value of fish, if present in muscles.

4. FISH DISEASE AND PARASITES

Like humans and other animals, fish suffer from diseases and parasites. Fish defences against disease are specific and non-specific. Non-specific defences include skin and scales, as well as the mucus layer secreted by the epidermis that traps microorganisms and inhibits their growth. If pathogens breach these defences, fish can develop inflammatory responses that increase the flow of blood to infected areas and deliver white blood cells that attempt to destroy the pathogens. Specific defences are specialised responses to particular pathogens recognised by the fish's body, that is adaptative immune responses. In recent years, vaccines have become widely used in aquaculture and ornamental fish, for example vaccines for furunculosis in farmed salmon and koi herpes virus in koi.

All fish carry pathogens and parasites. Usually this is at some cost to the fish. If the cost is sufficiently high, then the impacts can be characterised as a disease. However disease in fish is not understood well. What is known about fish disease often relates to aquaria fish, and more recently, to farmed fish.

Disease is a prime agent affecting fish mortality, especially when fish are young. Fish can limit the impacts of pathogens and parasites with behavioural or biochemical means, and such fish have reproductive advantages. Interacting factors result in low grade infection becoming fatal diseases. In particular, things that cause stress, such as natural droughts or pollution or predators, can precipitate outbreak of disease.

Disease can also be particularly problematic when pathogens and parasites carried by introduced species affect native species. An introduced species may find invading easier if potential predators and competitors have been decimated by disease.

Parasites in fish are a common natural occurrence. Parasites can provide information about host population ecology. In fisheries biology, for example, parasite communities can be used to distinguish distinct populations of the same fish species co-inhabiting a region. Additionally, parasites possess a variety of specialized traits and life-history strategies that enable them to colonize hosts. Understanding these aspects of parasite ecology, of interest in their own right, can illuminate parasite-avoidance strategies employed by hosts.

Usually parasites (and pathogens) need to avoid killing their hosts, since extinct hosts can mean extinct parasites. Evolutionary constraints may operate so parasites avoid killing their hosts, or the natural variability in host defensive strategies may suffice to keep host populations viable. Parasite infections can impair the courtship dance of male threespine sticklebacks. When that happens, the females reject them, suggesting a strong mechanism for the selection of parasite resistance."

However, not all parasites want to keep their hosts alive, and there are parasites with multistage life cycles who go to some trouble to kill their host. For example, some tapeworms make some fish behave in such a way that a predatory bird can catch it. The predatory bird is the next host for the parasite in the next stage of its life cycle. Specifically, the tapeworm *Schistocephalus solidus* turns infected threespine stickleback white, and then makes them more buoyant so that they splash along at the surface of the water, becoming easy to see and easy to catch for a passing bird.

Parasites can be internal (endoparasites) or external (ectoparasites). Some internal fish parasites are spectacular, such as the philometrid nematode *Philometra fasciati* which is parasitic in the ovary of female Blacktip grouper; the adult female parasite is a red worm which can reach up to 40 centimetres in length, for a diameter of only 1.6 millimetre; the males are tiny. Other internal parasites are found living inside fish gills, include encysted adult didymozoid trematodes, a few trichosomoidid nematodes of the genus *Huffmanela*, including *Huffmanela ossicola* which lives within the gill bone, and the encysted parasitic turbellarian *Paravortex*. Various protists and Myxosporea are also parasitic on gills, where they form cysts.

Fish gills are also the preferred habitat of many external parasites, attached to the gill but living out of it. The most common are monogeneans and certain groups of parasitic copepods, which can be extremely numerous. Other external parasites found on gills are leeches and, in seawater, larvae of gnathiid isopods. Isopod fish parasites are mostly external and feed on blood. The larvae of the Gnathiidae family and adult cymothoidids have piercing and sucking mouthparts and clawed limbs adapted for clinging onto their hosts. *Cymothoa exigua* is a parasite of various marine fish. It causes the tongue of the fish to atrophy and takes its place in what is believed to be the first instance discovered of a parasite functionally replacing a host structure in animals.

CONCLUSION

Although parasites are generally considered to be harmful, the eradication of all parasites would not necessarily be beneficial. Parasites account for as much as or more than half of life's diversity; they perform an important ecological role (by weakening prey) that ecosystems would take some time to adapt to; and without parasites organisms may eventually tend to asexual reproduction, diminishing the diversity of sexually dimorphic traits. Parasites provide an opportunity for the transfer of genetic material between species. On rare, but significant, occasions this may facilitate evolutionary changes that would not otherwise occur, or that would otherwise take even longer.

Other parasitic disorders, include *Gyrodactylus salaris*, *Ichthyophthirius multifiliis*, cryptocaryon, velvet disease, *Brooklynella hostilis*, Hole in the head, *Glugea*, *Ceratomyxa shasta*, *Kudoa thyrsites*, *Tetracapsuloides bryosalmonae*, *Cymothoa exigua*, leeches, nematode, flukes, carp lice and salmon lice.

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