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Acanthocephalan infestation in fishes –A review

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Abstract

It has been estimated that Fisheries sector contributes to animal protein supply 63%, GDP 5.24% and foreign exchange earning 4.76% for the nation. For sustainable aquaculture production, it is therefore important to give proper attention to this essential area. Fish not only act as a host for different parasites but also serve as carrier of many larval parasitic forms that cause serious pathological disturbances in many vertebrates including man. Among different parasites, helminthes are the important parasites that cause a great threat for fish health management and aquatic crop production throughout the world. These helminth parasites of fishes cause decrease in growth rate, weight loss and emaciation, affect yield of fish products (liver oil etc), spread human and animal diseases, postpone sexual maturity of fish and cause mortalities in fish. Acanthocephalan is an important group of helminthes which infects and causes diseases in both freshwater and marine fishes. Keeping all this in view there is a need to explore the field to a high level so that fish could be used as a model in fisheries.

Keywords: Parasite, Acanthocephala, Helminth, Animal diseases, Larval parasitic

1. Introduction

Fish not only serve the function of food but also contributes a lot to meet the basic nutritional requirements and also plays a vital role in fulfilling the deficiencies of vitamins, proteins and minerals besides driving away the diet related diseases. Since fishes are utilized by the humans, it is thus important that they should be healthy and free of any kind of infection. Infections in fish are caused by viruses, bacteria and other parasites. Among different parasites, Helminth group is one of the major group of fish parasites which causes a severe loss in the fish production (Jha *et al.*[14]; Sobecka and Salmoniska [32]).

About 20,000 to 30,000 helminth species have been reported worldwide which cause heavy losses to the fish industry (Kime [19]). Dhar [9] reported 31 species of helminth parasites from Kashmir Valley which leads to severe damage to the fish production and population. Helminthes constitute of three major groups, the *Platyhelminthes* (flat worms that constitutes trematodes and cestodes), *Nematoda* (round worms) and *Acanthocephala* (spiny headed worms) that complete their life cycles through intermediate hosts like piscivorous birds (Schmidt [30]).

2. Acanthocephala: a diverse group

Acanthocephala is an important but a minor group of parasites that shows characteristics similar to that of rotifers. Adult members of this group are present and mostly feed on the intestinal walls of fresh and marine water fishes all over the world (Meyer [22]).

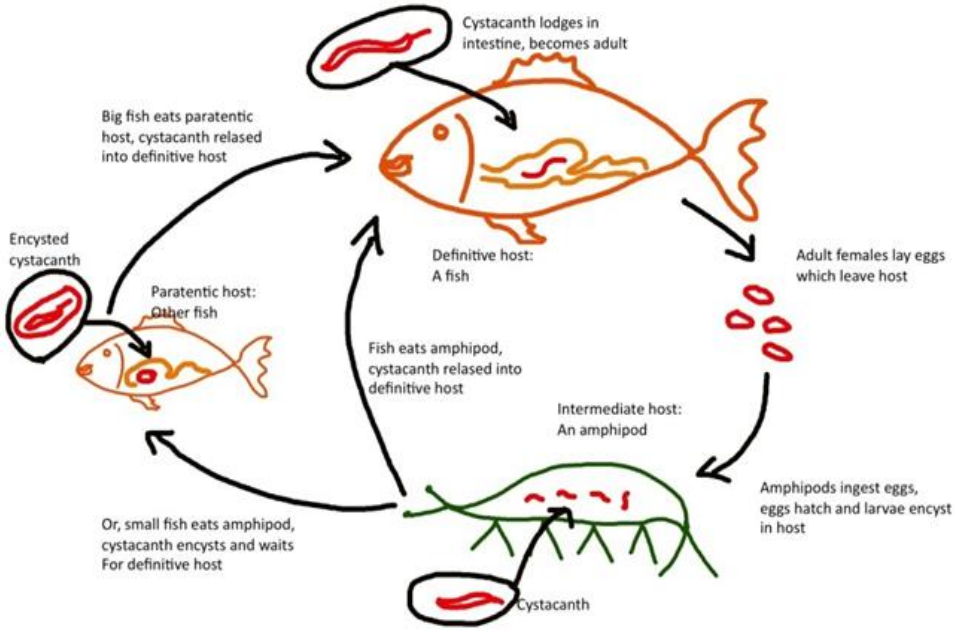
The distinguishing feature of acanthocephalans is the presence of hooked proboscis which is used by the worms to anchor to the intestinal wall of the vertebrate host. Acanthocephala are without a digestive tract and absorb nutrients directly from the lumen of the host intestine (Schmidt and Roberts [31]). Their body wall consists of numerous pores, canals and several structurally distinct layers, which performs both a protective and absorptive function (Lee [20]). Acanthocephalans are dioecious and most of trunk region consists of reproductive organs. Mating in acanthocephalans occur in the vertebrate host intestine. Acanthocephalan parasites of fishes are found either as adults in the intestine or as larvae (post-cystacanths) in fish tissues.

It is believed that approximately 1150 species of Acanthocephalan parasites exist within the four orders: Neoechinorhynchidea, Echinorhynchidea, Aporhynchidea and Gigantorhynchidea. The occurrences of Acanthocephalan parasites in fishes have been studied extensively throughout the world. There are different species of Acanthocephalans belonging to different genera (*Echinorhynchus, Neoechinorhynchus, Acanthocephalus, Corynosoma, Pallisentes, Rhabidorhynchus, Pseudorhadinorhynchus, Leptorhyncoides, Paragorgorhynchus, Acanthogyrus, etc*). Which are commonly found in both marine and freshwater fishes throughout the world (Jithendran and Kannappan [15]). *Pomphorhynchus laevis*, is an acanthocephalan parasite which is commonly found in several freshwater fishes (Bykhovskaya-Pavlovskaya [5]). This parasite is found to grow and attain maturity in only a small number of fish species (Hine. and Kennedy [11]). The existing literature on *Corynosma australe* indicates that this parasite is typically found in temperate as well as in subantarctic waters of the South Hemisphere, and its adult specimens sexually mature in several Otarid species (Zdzitowiecki [39, 40]). Its juvenile stages have been found encapsulated in the body cavity of several teleost species and they have been recorded in the Argentine Sea in *Micropogonias furnieri* (Zdzitowiecki [40]). Juveniles of acanthocephalan *Serrasentis sagittifer* were recovered from the intestine, pyloric caeca, body cavity, mesenteries and some internal organs of the four fish species (*Thunnus tonggol*, *Sphyraena barracuda*, *Pomadasys argenteus* and *Lutjanus gibbus*) from Al-Mehwat fish market, Hodeidah, Yemen with the prevalence of 11.7%, 11.9%, 24% and 4.4%, respectively. Encysted juveniles of *Gorgorhynchus sp*. were recovered from the intestinal mesenteries of *T. tonggol* only with a prevalence of 3.3% (Al-Zubaidy and Mhaisen [2]). *Acanthogyrus tilapiae, Paragorgorhynchus sp*. and *Tenuisentis* sp. were found in fishes of Warri River, Southern Nigeria (Wugo *et al.*[37]). Six species of acanthocephalans were found in fishes of Lake Biwa, the most ancient lake in Japan. The 3 most common species were *Acanthocephalus opsariichthydis* Yamaguti, 1935, *Echinorhynchus cotti* Yamaguti, 1935, and *Pseudorhadinorhynchus samegaiensis* (Nakajima and Egusa[24]). Two recently described species of *Acanthogyrus (Acanthosentis*) Verma and Datta, 1929. *Acanthogyrus* (*Acanthosentis*) *alternatspinus* Amin, 2005, and *Acanthogyrus (Acanthosentis) parareceptaclis* Amin, 2005 were also first collected in the course of this survey. *Neoechinorhynchus rutile* were recovered from *Clarias gariepinus* in Oba reservoir in Nigeria (Olumuyiwa *et al*.[26]). *Neoechinorynchus rutili* was found in the intestine of the fish and its prevalence was low. *Acanthogyrus (Acanthosentis) tilapiae* were found to infect three fishes, *Oreochromis niloticus 78%, Sarotherodon gallileus 46%, Tilapiae zilli 24%* (Bayoumy [3]). *Pomphorhynchus laevis* and *Acanthocephalus clavula* were present in *Salmo trutta* in Ireland (Byrne *et. al*. [6]). *Acanthocephalus minor* was found in the intestine of Goby fish *Cheanogobius annularis* and other fresh water fishes (Nagasawa *et al*. [23]). The biodiversity of acanthocephalan species in fish is largely unknown in India (Jithendran and Kannappan [15]).). There are some reports of the *Neoechinorhynchus sp* from Indian marine fishes (Tripathi [35]). Besides other acanthocephalan species, *Serrasentis nadakali* from *Rachycentron canadum* and *Tenuiproboscis sp.* were also recorded (George and Nadakal [10]). *Neoechinorhynchus agilis* has been recorded in a study on grey mullets from landing centre near Chennai, Tamil Nadu, India (Jithendran and Kannappan [15]). Yellow tuna which is one of the potential and most common food fish in India is infected with acanthocephalan parasites belonging to species Echinorhynchus *(*Sakhthivel *et al.* [29]). Fishes belonging to *Schizothorax sp.* of Dal Lake and River Jhelum in Kashmir are highly infested with acanthocephalan *Pomphorhynchus kashmirensis* (yousuf *et. al.* [38]; Ali *et. al.* [1]). Acanthocephalan species *Pallisentis* were also found in *Schizothorax species* (Khurshid and Ahmed [18]).The infection of *Pomphorhynchus kashmirensis* was also noticed in *schizothorax* sp.in Shallbugh Wetland (Khurshid and Ahmed [17]).

3. Life cycle

Due to involvement of a number of hosts, Acanthocephalans have complex life cycles, for both developmental and resting stages. Only in 25 species, complete life cycles have been worked out. For development to occur, the eggs when released from the female containing the acanthor are ingested by an arthropod, usually a crustacean. Inside the

intermediate host, the acanthor is released from the egg and transforms into an acanthella. Acanthella then penetrates the gut wall and transforms into the infective cystacanth stage (cyst) in the body cavity. This stage after eaten by a suitable final host develops into a mature adult, or by a paratenic host, in which the parasite again forms a cyst. When consumed by a suitable final host, a fish, the cycstacanth removes its cyst wall, everts its proboscis, pierces the gut wall and then feeds, grows and develops its sexual organs. After mating, adult male uses the excretions of its *cement glands* to plug the vagina of the female, to prevent subsequent matings from occurring. Embryos develop inside the female, and the life cycle repeats.



4. Pathogenecity:

Numerous reports are available on the pathological conditions caused by *Acanthocephalans* in fishes. Usually in acanthocephalan infections, pathology appears to be negligible when parasites are attached to the epithelial mucosa only but deeply embedded forms like *Pomphorhynchus spp*. can cause serious pathological conditions that result in extensive granuloma and subsequent fibrosis (McDonough and Gleason [21]). The hooked proboscis of acanthocephalans which is used to anchor the worm to the intestinal wall of the fish, can damage the host intestine, and can affect overall fish health (Schmidt and Roberts [31]). In some cases, hooks have been found to penetrate through the intestinal wall which lead to perforations, extensive inflammation, peritonitis and systemic clinical changes (Bullock [4]) that can be fatal (Schmidt and Roberts [31]). Extensive inflammation of the worm infested fish is dominated by granulocytes and macrophages, depending on the host species, and the structure of the proboscis hooks and tegument of the parasite (Reddy and Benarjee [28]). Acanthocephalan parasites have been found to cause occlusion of the gut and invasion/migration of the parasites into uncommon locations have also been reported (Nickol [25]). De Buron and Nickol [7], reported occlusion of gut in M.cephalus infected with the acanthocephalan *Neoechinorhynchus* sp. Also absorption of valuable nutrients, involvement of toxins and localized toxaemia in the host fish due to acanthocephalan infestation has also been reported by some authors (Holloway [13]) .The pathology of acanthocephalan parasites *Pomphorhynchus laevis* in fishes has been reported by (Wanstall *et. al*.[36]; Dezfuli [8]). Larval stages (cystacanths) of acanthocephalans leads to local changes in low to moderate infections in visceral organs (liver, spleen) while heavy infection, in juvenile fish in particular, led to extensive granuloma, fibrosis and ultimately atrophy of either a portion of or the entire organ (Paperna & Zwerner [27]).

According to Taraschewski [33] and Kabata [16] density of worms and depth of parasite penetration into the host tissues are the two main factors that determine the pathogenicity of acanthocephalans. Severe damage to the intestinal villi will hamper the normal digestive and absorptive functions of the animal by reducing the absorptive area while the damages associated with the tissue reactions in the wall of the intestine will alter the nature of the tissues, affecting its functional efficiency and the overall health status of the fish. Also absence of intestinal folds, loss of columnar appearance of

epithelial cells and formation of yellowish white fibrous nodules in the intestine is predominant in acanthocephalan infection. (Khurshid and Ahmed [18]). It has also been found by various workers that the number of acanthocephalans increases with the increase in the size of the host fish. (Jithendran and Kannappan [15]).

5. Diagnosis:

The diagnosis of acanthocephalan parasites infecting fish could be made possible by dissecting the individual fish and then stretching its intestine in normal saline and carefully opening by using needles. Adults can be identified based on the pattern of hooks on the proboscis, thus it is important that this portion of the worm is preserved and visible. If free floating forms of adult worms are not present, then the worms attached to the intestine should be carefully removed from its attachment site and placed in water which creates an osmotic turgor that detaches their proboscis from the intestine.

Feacal sedimentation techniques utilizing formalin-ethyl acetate are considered superior to flotation techniques for identifying acanthocephalan eggs as their eggs are large and heavy. The eggs of this group are also elongated with a thick outer wall and thin inner walls, often appearing to have 3 layers that cover the acanthor larva.

A positive identification of acanthocephalan can be made, if the spines at one end of the larva are visible. Eggs of acanthocephalans are usually clear but eggs of some species are brown due to fecal staining as they pass along of the intestinal tract of the host. Also feacal samples from the fish may be stained and viewed under objective x10 and x40 of the microscope for the detection of the larvae.

6. Control:

The need to assess the parasitic infection arises because the fish suffering from parasitic infection or disease result into severe damage to fisheries industry. For successful prevention and elimination of such infections, it is extremely important to achieve early and correct diagnosis of the larval stages of the parasites for which fish constitute the final host. In case of valuable fishes or brood stock fishes, individual fish treatment is preferred. Prevention involves proper hygiene to remove the infective host, regular checking of pond water to remove the crustaceans which serves as the intermediate host. Injection of Antihelmintic drugs like Febendazole or Oral administration through feed like Bithionol (2.2-thio bis (4, 6-dichlorophenol), in a dose of 0.2 g/kg fish are recommended for controlling acanthocephalan infections in fishes (HoffMan [12]). Feeds medicated with Di-N-butyl tin oxide are also potentially effective. Loperamid is recommended as the drug of choice for therapy of acanthocephalan infections in fish (Taraschewski *et al*. [34]).

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