protozoan parasitic infection of Fish and health problems resulting from outbreaks of parasitic diseases (Review)

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العدوى الطفيلية الأولية التي تصيب الأسماك والمشاكل الصحية الناتجة عن تفشي الأمراض الطفيلية

الملخص:

الأسماك هي مصدر حيوي لغذاء الإنسان يعتبر من أهم مصادر البروتينات عالية الجودة للإنسان، حوالي 16٪ من البروتين الحيواني الذي يتم استهلاكه من قبل سكان العالم. العديد من مشاكل الأسماك، سواءً كانت في المزارع السمكية أو في الطبيعة فإنها ناتجة عن الطفيليات الأولية المختلفة. أهم طفيليات الأوليات التي تصيب الأسماك مثل *Trichodina sp, Myxobolus sp Tetrahymena sp, Ichthyobodo necator*، *Chilodonella sp*، *Haemogregarina spp, Trypanosoma spp ,Cryptopia spp, Thelohania spp. Ichthyophthirius multifiliis Henneguya, spp Microsporidia spp*. تسبب الطفيليات الأولية خسائر فادحة في أحواض الأسماك فهي تمثل أحد التهديدات الخطيرة على صحة الأسماك بعد تفشي المرض، التعامل معقدًا مع المرض وإلى حد كبير يعتمد على اكتشاف العوامل الممرضة ومضيفيها وانتشارها وعلاجها والوقاية منها وإدارة الصحة العامة. تهدف هذه المراجعة إلى تسليط الضوء على العدوى الطفيلية الأولية للأسماك بالإضافة إلى معرفة المشكلات الصحية الناتجة عن تفشي الأمراض الطفيلية.

الكلمات المفتاحية: *العدوى الطفيلية الأولية، أمراض الأسماك.*

Abstract:

Fish is one of the most important sources of animal protein, it is a source of high-quality protein, and it provides 16% of the animal protein consumed by the world's population. Many fish disasters, both in nature and fish farms were caused by different protozoa parasites. Some most important protozoan parasites in fish such as *Trichodina sp, Tetrahymena sp., Chilodonella sp, Myxobolus spp, Ichthyophthirius multifiliis , Ichthyobodo necator, Haemogregarina spp. Trypanosoma spp. Cryptopia spp, Microsporidia spp,Henneguya spp, Thelohania spp.*Protozoan parasites cause dangerous losses in fishponds and wild in fish and occupy a very important sector as one of the serious threats to fish health after outbreak of disease. Disease manipulate is complex and relies largely on pathogen detection, their hosts, prevalence, treatment, prevention, and public health management. The aim of this review is highlight on protozoan parasitic infection of Fish in addition to knowing, health problems resulting from outbreaks of parasitic diseases.

Keywords: *Protozoan Parasitic Infection, Fish diseases.*

Introduction

Fish is a vital source of food for humans. It is the most important source of high-quality protein for humans, providing 16% of animal protein consumed by the world's population (Bilqees *et al,* 2003). Parasites are an important collection of pathogen reasons infection and sicknesses for fishes in freshwater and marine environments. With the increasing interests in aquaculture parasitic infections are getting threats for fish health management and aquatic crop production in the world. (Areerat *et al,* 1981). Protozoans are widespread parasites of both freshwater and marine fishes. To date, around 2420 species in 6 phyla of the protozoa group have been egistered infecting fish; more than 800 are found in marine fish (Lorn and Dykova, 1992).

The Phylum Protozoa gathers numerous organisms evolutionarily different which could act as ecto and endoparasites in fish (lom & dykova, 1992). Protozoa's are single-celled organisms, numerous of which are free-living in the aquatic environment. Typically, no intermediate host is needed for the parasite to reproduc (direct life cycle) (Ryan *et al,* 2019). In general protozoa are one of the main sectors of fish parasites that have been long overlooked due to its inherent difficulty instudying in comparison to other large parasites (Omeji *et al,* 2011).

Protozoans vary in form and size and live mostly on the gills, fins, and skin of fish. Nevertheless some, *including Cryptobia, Hexamita*, and *Myxozoa*, live in the internal organs (Roberts and Stepherd, 1997). *Apiosoma, Chilodonella, Balantidium, Epistylis, Ichthyophthirius multifiliis, Rhynchodinium paradoxum, Nyctotherus, Tetrahymena* and *Trichodinidae* are the major representatives. (EL-Tantawy *et al,* 2013). *Trichodina spp, Ichthyobodo necator* and *Ichthyophthirius multifiliis* are protozoan parasites that cause fish deaths (Durborow, 2003).

Parasitic illnesses are one of the most severe problems in fishes, though not of much concern among the wild fish stock because in most cases, no significant harm appears to have been done to them (Jithendran, 2014). Therefore, there are simplest. little reports of parasites causing death or intense damage to the fish populations, however this could be in large part due to the fact such effects pass unnoticed (Roberts, 2001). However, in times in which hosts are overcrowded consisting of in aquaria or in fish farms, parasitic illnesses can spread very unexpectedly causing excessive mortality (Imam and Dewu, 2010). Parasites are able to inflicting harm to the fish, either via damage to the tissues or organs in the process of burrowing or eating meals or the removal of digested food inside the gut of the fish in addition to the secretion of proteolytic enzymes (Moratal *et al,* 2020). Control of fish parasites requires knowledge of the parasites, their hosts, and their prevalence and distribution (Mitchum, 1995). The aim of this review is highlight on protozoan parasitic infection of fish in addition to knowing, health problems resulting from the spread of parasitic diseases.

protozoan parasitic infection

Most of the typically encountered fish parasites are protozoans. They are uncellular organisms, Lots of which are free-living within the aquatic surroundings. Their potential to multiply on or within their hosts makes them often very risky to fish (Chandra, 2004). Ectoparasitic ciliates represent one of the most hazardous threats to fish health (Pádua *et al.,* 2013). The ciliary protozoan, Ichthyophthirius multifiliis (Foquet), the causative agent of Ich or ichthyophthiriasis, is one of the maximum important pathogenic protozoan

parasites of cultured fish (Schäperclaus, 1991). And wild fish (Francis-Floyd & Reed ,1991).In general, the theronts foray, and penetrate the dermis of the fish and form cavities enclosed via epithelial cells where they settle and feed. This method is mediated through a combination of mechanical and enzymatic moves (Wang *et al.,* 2019).This process is mediated by a combination of mechanical and enzymatic actions (Wang *et al*., 2019). *Ichthyophthirius multifiliis* was the most common protozoan parasites found in *Clarias gariepinus*. These protozoan parasites comprise (37.08%) of the total parasites found in fish that live in the pond, and (42.51%) of wild fish (Omeji *et al*,2011). *Trichodina*, a genus of ciliate protists, belongs to the family Trichodinidae and is well known as the causative agent of trichodiniasis in numerous aquatic animals, especially both cultured and wild fish (Marcotegui, *et al,* 2018). The activities of Trichodina in infected fish damage epithelial cells and make pressure in the infected fish. Therefore, medical symptoms ininfected host vary from deat to asphyxia . (Valladao *et al.,* 2014). Those ectoparasites are regarded to be the motive of dying of mas fish larvae (Cyprinus carpio), mujair (Oreochromis mossambicus), tawes (Puntius javanius), nila (*Oreochromis niloticus*), betutu (*Oxyeleotris marmorata),* rainbow trout (*Salmo gairdneri*), salmon (*Salmo salar*), and gurami fish (*Osphronemus gourami*) (Anisah *et al.,* 2017). *Chilodonella spp*. is a cilium parasite that parasitizes integument and gills of several fresh water fish species (Pavanelli *et al,* 2008). and cause severe epizootic outbreaks in wild and farmed freshwater fishes (Lom & Dykova, 1992). *Chilodonella* is belonging to sobkingdom a protozoa , that may reason infected fish to secrete excessive mucus. Infected fish may flash and display similar clinical signs of inflammation and lots of fish die when infections turn out to be temperate (Abdel-Baki *et al.,* 2014). *chilodonella* species recorded from gills of *Oreochromus niloticus* and *Clarias gariepinus* (Hossin, 1992). *Tetrahymena spp.* are ubiquitous free-living hymenostome ciliates, that cause disease in a wide variety of fish, crustaceans, amphibians and turbellarians (Ponpornpisit *et al,* 2000). Tetrahymenosis has been reported in different species of ornamental and edible fish (Astrofsky *et al.,* 2002). Pathogenic characteristics of infected shes by *Tetrahymena spp*. Pathogenic characteristics of infected shes via *Tetrahymena spp*. Are analogous, : owning whitish lesions on the body surface, and affected organs involve, the pores and viscera, skin, musculature, eye socket and spinal cord; masses of ciliates can be detected in copious amount of mucus and between spaces in the damaged tissues (Lawhavinit *et al.,* 2002).

Ichthyobodo necator is An ectoparasite that belongs flagellate and infects the gills and skin of fishes. Flagellates identified as *I. necator* have repeatedly been implicated in diseases and mortalities among ornamental and farmed fishes (Woo,1994). variants have also been observed on captive marine fish (Beck *et al*,1996), The parasite has been found in the Pacific Ocean, Atlantic Ocean, and adjacent seas including Australian waters (Ueki *et al*, 1998) Large numbers of *I. necator* trophozoites can destroy the epithelial layer of the skin and gills, which in turn disrupts homeostasis, causing osmoregulatory stress and death (Noga, 1996).

Cryptobia species are flagellated protists, distantly associated with Spironucleus and Hexamita, however not almost as well understood. Like Hexamita and Spironucleus, Cryptobia spp. Are very small, (single-celled) organism and, therefore, may be difficult to identify and observed. There were 52 species of *Cryptobia* identified in fish (Floyd & Yanong, 1999). *Cryptobia* attachment via the flagellum does no induce result in any

pathological or even ultrastructural cellular damage (Lom, 1986). Contrary to reports of morbidities related to this parasite (Woo, 1987) Despite the fact that there are some of reports on bad condition and mortalities, specially of fry (Lightner *et al*, 1988).

The genus *Myxobolus* (family Myxobolidae) is certainly one of the utmost myxosporean groups and its members are significant pathogens of marine fish and freshwater in numerous geographical areas (Lom & Dyková, 2013). The traditionally classified with the protozoa due to their small size, it is now recognised that myxozoans are degenrate metazoans ,transmission is via an oligochaete alternate host. The Myxosporea are relationship to the Myxozoa ,a class of microscopic parasites.Species have been described from various tissues and organs, including gills (Azevedo *et al*, 2014), liver (Svobodova & Kolarova , 2004). Species have been described from various tissues and organs, including gills (Azevedo *et al*, 2014), liver (Carriero *et al*, 2013). Among the myosporean, species of the genus *myxobolus* are , so ,far the fo oremostunre markably found in fish, with about 856 known species throughout the world(Eiras *et al* ,2005). of them, about 12 species were described from *tilapias spp* (abdel-azeem *et al*, 2015) The most common symptoms of the disease are weakness, emaciation, scale protrusion, loss of scales, abnormal pigmentation Spores released from the infected and dead fishes remain viable for quite a long period in the pond bottom before they infect new hosts. (Kumar , 1992) .

The genus Henneguya Thélohan, 1892, in family Myxobolidae, is the third most speciose myxosporean genus after Myxidium and Myxobolus, with > 200 Henneguya species described (Székely *et al*, 2018) The type species, *H. psorospermica* was described by Thelohan(1895) from the gills of both pike and perch (Perca fluviatilis L.). Of them the pike, mentioned first by Thélohan, should be regarded as type host. Other pike-infecting Henneguya species were recorded from the gills (*H. lobosa* (Cohn, 1895). (Biance *et al*, 2003) described a new species of Myxosporea, called *Henneguya chydadea*, is parasitizing the gills of fish collected from a lake in state of Säo Paulo, Brazil. They recorded that about (88.3%) of examined fish had gills parasitized by Myxosporeans. The spread of the parasite ranged about (80%) inside the fall and spring seasons , (93%) during the summer season and (100%) during the winter season. Infections can purpose mortalities in fishes ,if parasites proliferate to high severity on the gills and reason breathing failure, , particularly in juvenile fish (Whitaker *et al* ,2005).

Microsporidia are common pathogens of numerous aquatic organisms, including crustaceans and amphipods, and members from some 18 genera of these parasites have been described in fishes (Lom & Nilsen, 2003). Among the microsporidian genera infecting species of freshwater crayfish, Thelohania is a serious pathogen in many countries (Evans & Edgerton, 2002). The first 'true' Thelohania with gene sequence data available, *T. butleri*, was identified from Canadian pink shrimp (Pandalus jordani) off the coast of British Columbia, Canada (Brown & Adamson, 2006). A dangerous protozoan pathogen overwhelmingly infests the black tiger shrimp, that leads to the cotton illness. *Thelohania sp.* is secluded from striated muscles, hepatopancreas, and intestine; these organs often degenerate (Prasertpol, 1989).

Haemogregarines are adeleorine that belonging to apicomplexan protists and live in the blood cells and tissues of differents of vertebrates and are especially prevalent in

marine fishes (Davies *et al*, 2004). Knowledge of marine fish haematozoans from South Africa is limited. Two species of haemogregarines, Haemogregarina (sensu lato) *bigemina* (Laveran & Mesnil, 1901) and Haemogregarina (sensu lato) *koppiensis* (Smit & Davies, 2005). Haemogregarina(sensu lato) bigemina Laveran and Mesnil (1901) having first been defined from intertidal blenniid fishes Lipophrys pholis and Coryphoblennius galerita (Linnaeus, 1758) in northern France in 1901 might be the most enigmatic of the marine fish haemogregarines (Laveran & Mesnil,1901). (Davies *et al*, 2004) reviewed past and current researches on the Haemogregarina bigemina, recorded from (96) species of fishes at Mesnil. The parasite undergoes intraerythrocytic binary fission finally forming mature paired gamonts.

Trypanosoma species are almost all heteroxenous and parasites of the blood of all classes of vertebrates, including marine and freshwater teleost and elasmobranch fish all over the world (Hayes *et al*, 2014). About 184 species that belonging Trypanosomatids in the genus Trypanosoma assigned to infect fish .Trypanosoma have a single flagellum and a single disc shaped kinetoplast. Infections in most species of fish are transmitted by leeches (Paperna, 1996). Despite most infected fish without clinical signs , fish trypanosomiasis can be acute at heavy parasitemias, and clinical signs include anaemia, leukocytosis, hypoglycemia and splenomegaly (Su *et al*, 2014). The haemoparasite belonging to the Genus Trypanosoma species were reported to appear,in Lake Victoria by way of Paperna (1996) in Esculenta (50%), *Oreochromis variabilis* (54%), O. *Clarias gariepinus* and *Bagrus spp* (Paperna, 1996).

Protozoa are common tropical and subtropical marine water fish parasites that affect public health and cause losses to fishes (Ahmed *et al*, 2021). In Libya Coasts (Ahmed *et al*, 2021) examined Mediterranean horse macherel (*Trachurus mediterraneus)* from Zliten coast were identified 7 species of parasitic protozoan particularly *Haemogregarina spp., Cryptopia spp Trypanosoma spp., Microsporidia spp .,Henneguya spp., Thelohania spp. and Ichthyophthirius multifiliis* .Among the examined fish, the high desnsity of parasitic infectious in internal organ was observed in kideny (0.375), liver (0.5), blood and spleen (0.25), respectively. in addation (SH & & RA, 2022) made general survey of protozoan parasites that infect Sawrow fish *(Trachurus mediterraneus*) from Zliten coast, Libya, The outcomes confirmed positive impact of *haemogregarina* inside the Sawrow Blood registered, highest dispersal and abundance amidst all of the different organs in Sawrow fish observed kideny, liver and spleen respectively.

(younis, 2012) made survey of protozoan parasites that infect *Tilapia zillii (*Gervais, 1852) and *Mugil cephalus* (Linnaeus, 1758) from Ain Ziana lagoon, Benghazi, Libya. the results confirmed that six species of ectoprotozoan parasites had been in the course of the examination of gills and skin these fishes. Theses parasites were *Tetrahymena sp, Chilodonella sp,Trichodina sp,Ichthyophthirius multifiliis Ichthyobodo necator, Myxobolus spp.* .

Conclusions

Fish is important to human; it is of importance in the diet of different countries. Infectious fish illnesses result from fungi, viruses, micro organism, and parasites. Parasites that affect fish include protozoans and metazoan. parasitic protozoans that affect fish include *Trichodina sp, Tetrahymena sp. , Chilodonella sp, Myxobolus spp , Ichthyophthirius multifiliis, Ichthyobodo necator, Haemogregarina spp. Trypanosoma spp.Cryptopia spp, Microsporidia spp,Henneguya spp, Thelohania spp. Ichthyophthirius*

*multifiliis.*Parasitic infestation repeatedly occurs in fish that lead retarded growth rate, consumer rejection, reduced production, low reproduction and collective mortality in fish. Parasites affect on the fish health through the affect the skin and gills of fishes. And through the tissues or organs damage and the appears of disease.

To overcome the consequences of parasitic infection on fish and public health, it's important to behave upon each health constraint based totally on scientifically verified and advocated in addition to locally applicable methods and additionally epidemiological procedures needed in maintaining aquatic animal fitness safe.

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