World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

Check for updates

# Economically important freshwater fishes infected with fungi causes EUS

Podeti. Koteshwar Rao *

*Department of Zoology, Kakatiya University- 506 009, India.*

World Journal of Advanced Research and Reviews, 2023, 17(01), 605–609

Publication history: Received on 29 April 2022; revised on 19 January 2023; accepted on 22 January 2023

Article DOI: https://doi.org/10.30574/wjarr.2023.17.1.0397

## Abstract

The aim of this study was to investigate fungal infections in *Channa punctatus* and *Channa striatus* twenty specimens of each species were studied for the presence of fungal infections. Infected fish's shows clinical signs such as fungal growth on skin, fins, eyes, eroded fins and scales, hemorrhages on body surface and abdominal distension. The ability of aquatic fungi to cause diseases in fish is well known potentially all freshwater fishes their incubating eggs are susceptible to fungal infection. The most common fungal diseases of fish are saprolegniasis, disease caused by Achlya, branchiomycosis, epizootic ulcerative syndrome (EUS). Saprolegniasis is one of the most common infections of freshwater fishes in warm temperature and tropical waters; distributed throughout worldwide. Although there are many reports of different Achlya species infecting fish, there is no consistent and regularly observed clinical condition such as occurs with Saprolegnia. EUS is a seasonal epizootic condition of great importance in wild and farmed freshwater.

**Keywords:** *Channa punctatus*; Saprolegniasis; Branchiomycosis; EUS

## 1. Introduction

The Freshwater fishes are an important protein source for people of many countries [1-2]. However, globally fish from freshwater and marine sources are in severe decline, driven in large part by economic and human population growth [3]. Fish farming in various parts of the world has increased many folds in the last decade. As a result, fish culture has now become commercially an important industry worldwide. The aquatic animals are susceptible to a variety of pathogenic organisms, including fungi. In fact the first clinical report of a fungal infecting a fish [4]. The ability of aquatic fungi to cause diseases is encountered in eggs, fry, fingerling and adult fishes. Majority of the aquatic fungi are saprophytic and derive their nourishment by decomposed organic matter. They are primarily regarded as a secondary invader and are known to attack the host when it gets injured either mechanically or as a result of infection other than fungi [5]. Fungal infections of fish by Oomycetes, commonly known as water moulds, are widespread in fresh water and represent the most important fungal group affecting wild and cultured fish. The most important are the Saprolegniales. Although eight genera have been reported in naturally or artificially induced infections, Saprolegnia, Achlya, Aphanomyces, Calyptratheca, Thraustotheca, Leptolegnia, Pythiopsis and Leptomitus, only Saprolegnia, Achlya and Aphanomyces are significant in aquaculture [6-8]. On the other hand, the most common fungal diseases of fish, saprolegniasis, disease caused by Achlya, branchiomycosis, epizootic ulcerative syndrome (EUS). The behavioral changes appear as the infection progresses; fish becomes lethargic, irregular in swimming and equilibrium is lost. [9].

* Corresponding author: Podeti. Koteshwar Rao

## 2. Results and discussion

### 2.1. Saprolegniasis

Saprolegniasis is caused by fungus Saprolegnia sp. (that is why the disease is called saprolegniosis), one of the most important fish pathogen. Saprolegnia comes under family Saprolegniaceae, order Saprolegniales one of the four orders within the Oomycetes. Species mainly causing Saprolegniasis was defined as *Saprolegnia parasitica* by Coker [10] to accommodate all asexual isolates of Saprolegnia that were parasitising fish. *S. parasitica* and *Saprolegnia diclina* are probably the two species most commonly isolated from Saprolegniasis infected fish; they are closely related to each other and are often referred to as the *S. parasitica–S. diclina* complex [11-15]. Saprolegnia are filamentous producing a profusely branching as eptate vegetative mycelium. The life cycle of Saprolegnia was first described by Kanouse [15]. Saprolegnia development begins with a slight enlargement of the terminal portion of a hypha and cytoplasm and nuclei accumulate in the enlarged tip, called sporangium which produces masses of zoospores. The tip of sporangia rapture to release the primary zoospore has two flagella at the anterior end. They move for some time and encyst. The cyst after a period germination into hyphae or burst to release secondary zoospores which are reniform with two flagella laterally placed on the concave side. After swimming for some time, they encyst and finally germinate into hyphae. Sexual reproduction in Saprolegnia takes place by the sex organs developing at tip of the hyphae. The female organ oogonium is a globose body and the male organ antheridium is slender and sinuous. Sexual reproduction occurs by gametangia contact, resulting in the fusion of the haploid oosphere with nuclei to produce a zygote [17]. The zygote then transform into a sporangium where the protoplast divides into a number of the zoospores. From fertilization to germination into hyphae it takes nearly 3 months. Saprolegniasis is one of the most common infection of freshwater fish and also some estuarine fish in warm temperature and tropical waters, distributed worldwide. Saprolegnia are classical opportunists that normally feed saprophytically on dead organic matter. These infections in fish are often associated with immuno-suppression. Temperature has a significant effect on development of Saprolegnia infection and outbreak often occur when temperature are near the physiological low end for particular fish species. This may be due not only to lower immunity, but also to the fact that many oomycetes are more active in cooler months of the year [18].When saprolegniosis affects fish during cold temperature, it is often called winter kill.

The disease occurs when pond temperature drop below 15 °C. However stress of high temperature and poor oxygen levels may also induce Saprolegnia invasion [19]. Lesions are focal gray-white patches on the skin, have a cotton wool-like appearance where hyphal filaments extend out into the water. The early lesions are often almost circular and grow by radial extension around the periphery until lesions merge. At later stage, the oomycete patches are often dark grey or brown in color as the mycelium traps mud or silt. Skin and gill lesions are by far the most frequently observed, but there have been reports of infection of internal organs [5]. Saprolegnia are important pathogens of fish eggs. Infections most often begin in unfertilized or otherwise nonviable eggs. Once established, they can rapidly spread to healthy eggs, eventually resulting in complete loss of the brood [20- 21]. Among the four species of Achlya, A. Americana dominated even though all the Achlya species were perennial. Within the two Pythium species, *P. aphanidesmatum* occurred only during the rainy season while among the two species of Saprolegnia both were absent during the summer season. [22].

#### *2.1.1. Diagnosis*

Saprolegnia are more closely related to algae than to true fungi however hyphae of true fungi are septate while those of oomycetes are aseptate [21]. Observation of a cottony proliferative growth on the skin or gills is possible diagnosis of Saprolegnia infection. (Fig. 1)

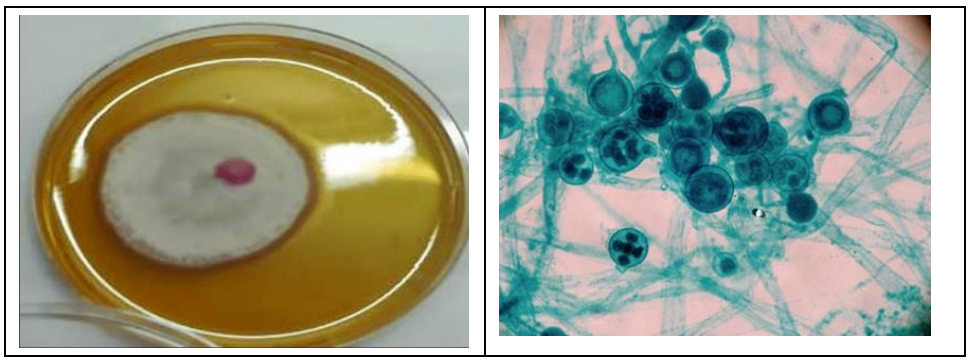

**Figure 1** Saprolegnia cultered images

*2.1.2. Treatment*

Saprolegnia are among the most difficult disease to treat. Prevention of the disease may be aided by maintaining fish under good husbandry condition. Correct feeding, the avoidance of overcrowded conditions and good water quality are essential. For treatment a variety of external disinfectant may be used, but except salt, most agents legally approved for food fish [24] are of limited effectiveness. Malachite green is highly effective for treating Saprolegnia infection, but it is not approved for food fish use in most countries because of its teratogenic and mutagenic properties. Saprolegnia infection are inhibited by even low prolonged immersion salt concentrations (>3ppt), which is probably why they do not affect marine fish in high salinities [25].

**2.2. Epizootic ulcerative syndrome (EUS)**

It is a seasonal epizootic condition of great importance in wild and farmed freshwater and estuarine fish. It has a complex infectious aetiology and is clinically characterized by the presence of invasive Aphanomyces invadans infection and necrotising ulcerative lesions, typically leading to a granulomatous response. EUS is also known as red spot disease (RSD), mycotic granulomatosis (MG) and ulcerative mycosis (UM). In 2005, scientists proposed that EUS should be named as epizootic granulomatous aphanomycosis or EGA [26]. However the term EUS has been used by most scientists. The oomycete that causes EUS is known as A. invadans. EUS has spread widely since the first outbreak in 1971 in Japan and to date only one genotype has been recorded. Parasites and rhabdoviruses have also been associated with particular outbreaks, and secondary Gram-negative bacteria invariably infect EUS lesions. *A. invadans* (Saprolegniales, Oomycetes) has an aseptate fungallike mycelia structure. This oomycete has two typical zoospore forms. The primary zoospore consists of round cells that develop inside the sporangium. The primary zoospore is released to the tip of the sporangium where it forms a spore cluster. It quickly transforms into the secondary zoospore, which is reniform with laterally biflagellate cells and can swim freely in the water. The secondary zoospore remains motile for a period that depends on the environmental conditions and presence of the fish host or substratum. Typically, the zoospore encysts and germinates to produce new hyphae, although further tertiary generations of zoospores may be released from cysts (polyplanetism) [27]. The EUS occurs mostly at water temperatures of 18— $22^0$C and after periods of heavy rainfall [28].

EUS is transmitted horizontally if the secondary zoospores cannot find the susceptible species or encounter unfavorable conditions, they can encyst in the pond environment. The cysts may wait for conditions that favor their transformation into tertiary generations of zoospores that are also in the free-swimming stage. The encysting property of the Aphanomyces pathogen may play an importance role in the cycle of outbreaks in endemic areas. EUS causes disease and mortality in farmed and wild fish, worldwide. Around 94 species of fish have been confirmed by histological diagnosis to be naturally affected by EUS. Suspect cases of natural infection with A. invadans in species other than those listed should be referred immediately to the appropriate OIE Reference Laboratory, whether or not clinical signs are associated with the findings. Some fish, such as common carp (Cyprinus capio), Nile tilapia (Oreochromis niloticus) and milk fish (Chanos chanos), have been considered to be naturally resistant to EUS. (Fig. 2 & 3).

**Figure 2** EUS infected *C. striatus*

**Figure 3** EUS infected *C. punctatus*

*2.2.1. Diagnosis*

EUS can be readily detected in diseased fish specimens collected from EUS-infected areas using histological techniques. However, Aphanomyces can be isolated only from fish with mild or moderate clinical signs of EUS, exhibiting red spots or small ulcers. Fish with severe clinical signs or large ulcers are not suitable for isolation. Fish skeletal muscle is the target organ and exhibits major EUS clinical signs with mycotic granulomas.

*2.2.2. Treatment*

There is no effective treatment for EUS-infected fish in the wild and in aquaculture ponds. To minimise fish losses in infected fish ponds water exchange should be stopped and lime or hydrated lime and / or salt should be applied. Attempts at using green water, ash, lime, and neem seeds or branches (Azadirachta indica) for prophylactic treatments of the EUS-infected fish in fish ponds gave variable results (Inland Aquatic Animal Health Research Institute, Thailand, internal report, 2001). In outbreaks occurring in small, closed water bodies or fish ponds, liming water with agricultural limes and improving water quality, together with removal of infected fish, is often effective in reducing mortalities and controlling the disease. Ensuring no leakage of water from EUS-infected areas into fish ponds is a normal practice that easily prevents the spread of EUS into farms. Sodium chloride or salt and agricultural lime are safe and effective chemicals for treating or preventing the spread of EUS.

## 3. Conclusion

Fungal diseases are often indicative of a more serious problem. Saprolegniasis is a common fungal disease which affects the external surfaces of fish. It can be eliminated easily after the primary cause of illness has been identified and corrected. On the other hand, Branchiomycosis has caused high mortalities in cultured fish, and is difficult to control. EUS causes disease and mortality in farmed and wild fish, worldwide, especially in the topical areas. The best control for all fungal infections is good management good water quality, good nutrition and proper handling.

## Compliance with ethical standards

*Acknowledgments*

Authors with to thanks Dr. P. Srinivas Plant Pathology and Microbiology laboratory, Department of Biotehnology, Kakatiya University, Warangal and Dr. G. Rajender Department of Zoology Kakatiya University, Warangal for their continuous support and inspiration and providing necessary facilities for the work.

## References

[1] Hussain SM, M Javed, A Javid, T Javid and N Hussain, Growthresponses of Catla catla, Labeo rohita and Cirrhina mrigala duringchronic exposure of iron. 2011.PakJAgricSci.48:225-230.

[2] Rubbani B, M Afzal, MS Mubarik, M Salim and SM Hussain, Estimation of apparent digestibility coefficients of soybean meal based diets with different protein levels for Labeo rohita. 2011. Pak J AgricSci, 48: 231-235.

[3] Limburg KE, RM Hughes, DC Jackson and CZ Brain, HumanPopulation Increase, Economic Growth, and Fish Conservation Collision course or Savvy Stewardship.2011Fisheries,36:27-34.

[4] Ainsworth GC an introduction to the history of mycology, 1976. Cambridge Univ Press, London.

[5] Roberts RJ Fish pathology. 4th edn, 2012. WileyBlackwell, USA.

[6] Aller GM Saprolegniosis en la trucha comun (Salmo trutta L.) de los rios de Leon (Espana). Medicina Veterinaria, 1987.

[7] 181—184. 4. Hatai K, Hoshiai GI Characteristics of two Saprolegnia species from coho salmon with saprolegniosis. J Aquatic Animal Hlth. 1993. 5: 115-118.

[8] Bly JE, Lawsos LA, Abdel-Aziz ES, and Clem LW) Channel catfish, Ictalurus punctatus, immunity to Saprolegnia sp. J Applied Aquac. 1994. 3: 35-50.

[9] Aqib Rehman Magray, Showkat Ahmad Lone, Bashir Ahmad Ganai, Fayaz Ahmad, Sabira Hafeez. The first detection and in vivo pathogenicity characterization of Saprolegnia delica from Kashmir Himalayas. Supplementary data to this article can be found online at https://doi. org/10.1016/j.aquaculture.542 (2021).736876.

[10] Coker WC. The Saprolegniaceae with notes on other water molds, Univ North Carolina Press, 1923.Chapel Hill, NC pp 201.

[11] Seymour RL, the genus Saprolegnia, 1970. Nova Hedwigia 19: 1-124.

[12] Willoughby LG. Saprolegniasis of salmonid fish Windermere, 1978. J Fish Dis 1: 51-57.

[13] Neish GA, Van as GC. Fungal diseases of fishes. Snieszko, SF, HR, Axelrod (eds). Diseases of fishes, 1980. Book 6. T.F.H. Publ Inc, LTD, Country pp 159.

[14] Noga EJ Water mold infections in freshwater fish: Recent advances. Annual Rev of Fish Disease ,1993. 3: 291-304.

[15] Johnson TW, Seymour RL, Padgett DE, 2002. Biology and systematises of theSaprolegniaceae, http://-dl.uncw.edu/digilib/biology/fungi/taxonomy%20and%- 0systematics/Padgett%20book/accessed April 2008.

[16] Kanouse BB A physiological and morphological study of Saprolegnia parasitica. Mycologia ,1932. 24: 431-452.

[17] Beakes GW, Gay JL Gametangial nuclear division and fertilization in Saprolegnia furcata as observed by light and electron microscope. Tran British Mycol Soc, 1977. 69: 459-471.

[18] Hughes GM. How fishes extract oxygen from water. New Scient, 1961.11: 346-348.

[19] Roth RR. Some factors contributing to the development of fungus infection in freshwater fish, 1972. J Wildl Dis 8: 24-28.

[20] Rand TG, Munden D. Involvement of zoospores of Saprolegnia diclina (Oomycotina : Saprolegniaceae) in the attachment to and invasion of eggs of brook trout under experimental conditions. J Aquatic Animal Hlth, 1993. 5: 233-239.

[21] Rand TG, Munden D. Chemotaxis of Saprolegnia diclina zoospore. J Aquatic Animal Health, 1993. 5: 240-245.

[22] K. Bharath Kumari and R. Sivakami An Analysis of Fungal Infection in Some Economically Important Freshwater Fishes of Mayanur Dam, Karur District, Tamil Nadu, India. Int.J.Curr.Microbiol.App.Sci, 2018. 7(1): 1062-1066.

[23] Latijnhouwers M, de Wit PJGM, Govers F Oomycetes and Fungi. Similar weaponry to attack plant. Trands in Micobiol, 2003. 11: 462-469.

[24] Schnick A, Meyer FP, Walsh DF. Status of fishery chemicals in 1985. Prog Fish Culturist, 1986. 27: 55-56.

[25] Baldock FC, Blazer V, Callinan R, Hatai K, Karunasagar I, Mohan CV, Bondad-Reantaso MG. Outcomes of a short expert consultation on epizootic ulcerative syndrome (EUS) : Re-examination of causal factors, case definition and nomenclature. In: Walker P, Laster R and Bondad-Reantaso MG (eds). Diseases in Asian aquaculture. Fish Health Section, Asian Fish Soc, Manila. Philippines, pp, 2005, 555-585.

[26] Lilley JH, Callinan RB, Chinabut S, Kanchanakhan S, Macrae IH, Phillips MJ, 1998. Epizootic ulcerative syndrome (EUS) technical handbook. Aquatic Animal Health Research Institute, Bangkok, Thailand.

[27] Bondad-Reantaso MG, Lumanlan SC, Natividad JM, Phillips MJ Environmental monitoring of the epizootic ulcerative syndrome (EUS) in fish from Munoz, Nueva Ecija in the Philippines. In: Shariff M, Subasinghe RP, Arthur JR (eds). Diseases in Asian Aquaculture1. Fish Health Section, Asian Fisheries Society, Manila, the Philippines, 1992. pp 475-490.

[28] Lumanlan-Mayo SC, Callinan RB, Paclibare JO, Catap ES, Fraser GC Epizootic ulcerative syndrome (EUS) in rice-fish culture systems : an overview of field experiments 1993—1995. In: Flegel TW, MacRae IH (eds). Diseases in Asian Aquaculture III. Fish Health Section, Asian Fisheries Society, Manila, Philippines, 1997 .pp 129-138.