

Impact of Epizootic ulcerative syndrome

on small-scale fish farmers and its management

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*Epizootic Ulcerative Syndrome (EUS) caused by *Aphanomyces invadans* is one of the most destructive pathogens of freshwater fishes. The disease is a major problem in culture-based capture fisheries practiced mainly by small-scale farmers with limited resources. The losses due to the disease have significant impact on the livelihood particularly food and nutritional security. To date, there is no effective treatment for this disease. Therefore, there is a need to develop treatment measures which can be easily affordable for the farmers. ICAR-NBFGR under the All India Network Project on Fish Health has developed formulation which has been found to be quite effective in treatment of this disease.*

Keywords: *Aphanomyces invadans*, Epizootic Ulcerative Syndrome, Small-scale farmers, Treatment

EPIZOOTIC ulcerative syndrome (EUS) is a serious disease of freshwater and estuarine fish, and more than 160 fish species are known to be susceptible to this disease. It is the first disease which has spread internationally with major impacts, especially in the developing world. The disease has a complex infectious aetiology and it is clinically characterised by the presence of *Aphanomyces invadans* and necrotising ulcerative lesions leading to a pathognomonic granulomatous response. In early stages, the gross lesions are characterised by pinhead-sized red spots on the body surface including head and fins, caudal peduncle, dorsum or operculum with no noticeable haemorrhages or ulcers. In the intermediate stage, the lesions are represented by small (2–4 cm) dermal ulcers, with associated loss of scales and haemorrhages. In the advanced stage, lesions appear on other parts of body of the fishes and expand into large necrotic open ulcers; resulting eventually in death.

Given the wide geographical area, and the diverse range of habitats in which EUS-affected fish occur, a particularly diverse mix of

microbiological agents have been recovered from affected fish. Some of these agents may significantly contribute to the disease complex in a particular outbreak but it is important to distinguish them from the factor(s) essential in all EUS outbreaks. However, research works have confirmed that *Aphanomyces invadans* is the primary causative agent of the disease. In an expert consultation on Epizootic ulcerative syndrome (EUS) held during the Fifth Symposium on Diseases in Asian aquaculture, Australia in 2002, majority of the experts supported a new name for the disease i.e. Epizootic Granulomatous Aphanomycosis. However, as the old name epizootic ulcerative syndrome is familiar, till date the disease is called as EUS. It is important to note that the World Organization for Animal Health (OIE), in its Aquatic Animal Diagnostic Manual and Code mentions the disease as ‘Infection with *Aphanomyces invadans*’ like other OIE-listed diseases, suggesting that *A. invadans* is the causative agent.

A. invadans is a water mould (Omycete) which includes other important fish pathogens, such as

species of *Saprolegnia* and *Achlya*. This group of pathogens although look-like fungi but are not true fungi. Unlike fungi, oomycetes do not have chitin-based cell walls; instead their cell walls are composed of cellulosic compounds and glycan, and the nuclei within the filaments are diploid, rather than haploid as is the case in fungi. For this disease, secondary zoospores of *A. invadans* are considered as the infective stages that germinate upon attaching themselves to fish skin that has been damaged and subsequently leading to severe necrotising granulomatous lesions.

Impact of the disease

The most notable epidemiological characteristic of the disease is its vast host range which includes highest number of documented host aquatic animal species susceptible to clinical disease. As reported earlier, over 160 fish species are affected and they belong to 54 families under 16 orders. Such a wide host range has special relevance in the tropics and sub-tropics, where culture-based capture fishing is most common. It is important to mention that in one of



Fig. 1. Mortalities due to Epizootic Ulcerative Syndrome in culture-based capture fisheries in Lakhimpur Kheri district of Uttar Pradesh

the studies, it was observed that even after more than three decades of its first occurrence in the country in the year 1988, a prevalence of ~ 69% was recorded and 13 fish species were found to be infected in Lakhimpur Kheri district of Uttar Pradesh (Fig. 1). Interestingly, EUS was observed in seven new species for the first time in these natural outbreaks. In addition, there have been several reports of EUS from Northeast India where rice-fish culture is practised in some parts. Moreover, many cyprinids, the dominant human food species in India, are susceptible to EUS. Notably, fish has high concentrations of bio-available vitamins and minerals (such as vitamin B12, calcium, iron and zinc), essential fatty acids and animal protein. In addition, small indigenous fish species often caught by such farming communities are typically eaten whole and can make a significant contribution to the micronutrient intake of their families. Therefore, the importance of culture-based capture fisheries for the rural poor is much greater where fisheries are a key protein and nutrient source and occurrence of EUS can significantly affect fish catches. Hence, the potential impacts of the disease on fisheries, aquaculture and ecosystems can be serious.

Management of EUS

In the regions, where the disease is endemic, attempt should be made to eradicate *A. invadans* from an already

infected area. Removal of all susceptible fish from ponds prior to stocking, drying and liming of ponds, disinfection of contaminated equipments/nets could be considered for eradication programmes. Once eradicated, the pathogen from a culture facility, the goal should be to prevent its re-introduction. It is likely that infections may be spread by affected/carrier fish, contaminated water, equipment, net etc. Therefore, obtaining seed and brood from EUS-free farms, obtaining water from disease-free source, using screen to remove wild fish, treatment of water with disinfectants etc. can be considered under exclusion strategies. After eradication and preventing reintroduction, using the epidemiological evidences, intervention strategies and special management measures should be adopted during periods of high EUS risk. In one of the epidemiological studies undertaken in an Indo-UK research project in the Maharajganj district of Uttar Pradesh at ICAR-NBFGR, it has been observed that high stocking densities and poor water qualities are associated with fish mortalities during winter seasons which coincide with EUS season. Therefore, during high risk periods, keeping the stocking densities as low as possible, avoiding stress, maintaining good water quality, preventing skin damage caused by ectoparasites and bacteria, harvesting of susceptible fish before the high risk period are some of rational approaches. In addition,

the general health and the EUS status of susceptible fish should be monitored regularly. This will help to take appropriate actions if EUS is observed.

Although a number of chemicals have been evaluated for their efficacy for treatment of EUS but as on date, there is no effective treatment for EUS-infected fish. It may be noted that infection with *A. invadans* is usually observed in extensive aquaculture

systems which are practised mainly by small-scale farmers with limited resources. Therefore, there is a need to develop treatment measures which can be easily applied. Keeping the same in consideration, ICAR-NBFGR under All India Network Project on Fish Health funded by ICAR, carried out detailed investigation to determine the concentration-specific therapeutic efficacy of 11 compounds with antifungal properties against three different life-stages (zoospore production, germination of zoospores and growth of hyphae) of *A. invadans*. Based on the results of *in vitro* studies, two compounds were further evaluated in 38 farms at three different locations in Assam, West Bengal and Uttar Pradesh. The affected fishes in the above farms had typical lesions due to oomycete infection. Following single application of the formulation, the fishes in all the affected farms showed significant reduction in lesions. In addition, the formulation has also been used for treatment of 12 disease cases diagnosed with oomycete infection alone or co-infection with bacteria. In all the cases, the formulation also had significant effect in resolution of the lesions. This formulation would help in significantly reducing losses due to EUS and thereby helping the farmers to improve their food and nutritional security.

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