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MYCOTIC DIVERSITY OF EDIBLE FISHES IN RELATION TO PHYSCIO-CHEMICAL PROPERTIES OF WADALI LAKE, AMRAVATI (M.S.) INDIA

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ABSTRACT
In the present investigation an attempt was made for assessment of seasonal variation in physico-chemical properties due to fungal infection in healthy and infected fishes (*Channa punctatus* and *Clarias* sp.) were collected from Wadali Lake Amravati. Temperature has a huge effect on the growth of fungal infections. During the present study water pH was found to be alkaline throughout the investigation period. Dissolved oxygen exhibited marked fluctuation and no specific seasonal trend was observed. The range of free CO_2 in the water was found to be minimum in rainy season and maximum in winter. During the study period total hardness of water was within permissible limits. Clinical signs of fungal infection were more severe in the October, November, December and January, where as in the month of March and April most of the fishes were not infected and were healthy. Climate change, global warming and fungal infection has resulted into fluctuations in water temperature, pH, alkalinity and these affect the fish health leading to mortality and infection. Infected fishes exhibited eleven different fungal species infections.

KEYWORDS: Edible fishes, fungal incidence, Physico-chemical properties, Seasonal variation.

INTRODUCTION

Fresh water is a natural resource of fundamental importance. In many respects the properties of water are unique. Fish farmers often suffer heavy economic losses due to fish diseases. Fungi can become a problem, if fish are stressed by disease by poor environmental conditions, poor nutrition, and pressure of population and over exploitation. They can also adapt to reasonable environmental changes and in turn avoid diseases due to pathogenic infection. Fungal infections of freshwater fish are common and distributed worldwide and associated with immune suppression (Pickering and Willoughby, 1982). Fungal infection in fishes was first reported during mid-eighteenth century (Aderon, 1748; Spallanzani, 1777). Fungal infection is an important economic and limiting factor in intensive fish production microbial quality (Ogbonna, 1989) of formed fish is largely determined by the quality of water in which they were cultivated (Sati, 1991) fungal diseases are more acute in cold water.

Most of the fungal diseases on freshwater fishes mainly occurred during winter season. Stressors include high stock densities, poor habitat and poor water quality. As a result fish become more susceptible to diseases (Khulbe and Bhargava, 1977; Hossain and Paul, 1993; Muniruzzaman and Chowdhury, 2008). Muhsin (1977) isolated and identified 20 species of water moulds in river water in Iraq and found January as peak month for frequency and diversity of fungal species with the lowest frequency occurring in summer.

MATERIALS AND METHODS

Study area:

Wadali Lake is located at $20^0$93”N and 77075”E and at an elevation of 343 m in Amravati, Maharashtra (India). The water from the Lake is being used for the drinking purpose and fishery activities are carried out on commercial scale.

Assessment of Physico-chemical status of the Lake water:

Water samples were collected from Wadali Lake during 2011 to 2013. Monthly samples of sub-surface water in triplicate were collected during first week of each month in the early hours of the day (7 a.m. to 9 a.m.).The Physico-chemical parameters like water temperature, dissolved oxygen (DO), free carbandioxide (CO_2), pH and total hardness of water were analyzed seasonally during the study period. All the collected data were analyzed by standard methods given in APHA (1995).

Collection of fishes and Sampling techniques:
The healthy and infected *Channa punctatus* and *Clarias* sp.were collected randomly every week at regular interval from the study area with the help of fishermen. The infected fishes in catch were identified from red spot on their body, excess mucus secretions, damaged and infected gills and their sluggishness. For further investigations like isolation and culture of infective Fungi to know their morphotaxonomy the healthy as well as infected fishes were brought to the laboratory immediately after collection. They were acclimatized at laboratory condition in big aquaria (48x18x18) inches for 15 days.

Isolation of fungus:
Potato Dextrose Agar (PDA); Corn Meal Agar (CMA); Water Agar (WA) and Czapek Dox Agar (CDA) were used as a culture media for the isolation of the fungus. Infected fishes were cut in cross section; small block of muscle was removed from the lesion and transferred into the other set of Petri dishes. The Petri dishes were placed inverted in incubator at 25 °C for 3 days, until a circular fungal mat developed, which were used for subculture of the fungus. A suitable portion of culture of different colonies from PDA was taken out with the help of forceps or needle and put on a slide in 1 or 2 drops of cotton blue on clear slides and examined under a compound microscope.

Morphotaxonomy of Fungi:
Fungi from infected fishes were identified with help of characters and measurements of fruiting bodies, color, shape, size and attachments of conidia with the help of relevant literature (Barnett and Hunter, 1972).

RESULTS AND DISCUSSION
Water temperature is the most important factor next to Oxygen affecting the welfare of fish. Amongst the physicochemical characters water temperature plays an important role as water is a medium in which fishes lives, the water temperature has major role in regulation of different physiological reactions. During present investigation, the maximum temperature of water recorded was 33.50^0C during summer and minimum was recorded as 16.00^0C during winter (Table 1). The seasonal variation play an important role in spreading of the *Saprolegnia* infections in freshwater fish especially during late autumn, common in winter months and early spring where the temperature is comparatively low (Hughes,1962). Forbes (1935) and Waterhouse (1942) worked out the periodicity of water moulds and recorded the maximum field of water moulds during winter (December-February) and minimum during summer (May-June).

Table 1. Water analysis from Wadali Lake during study period.

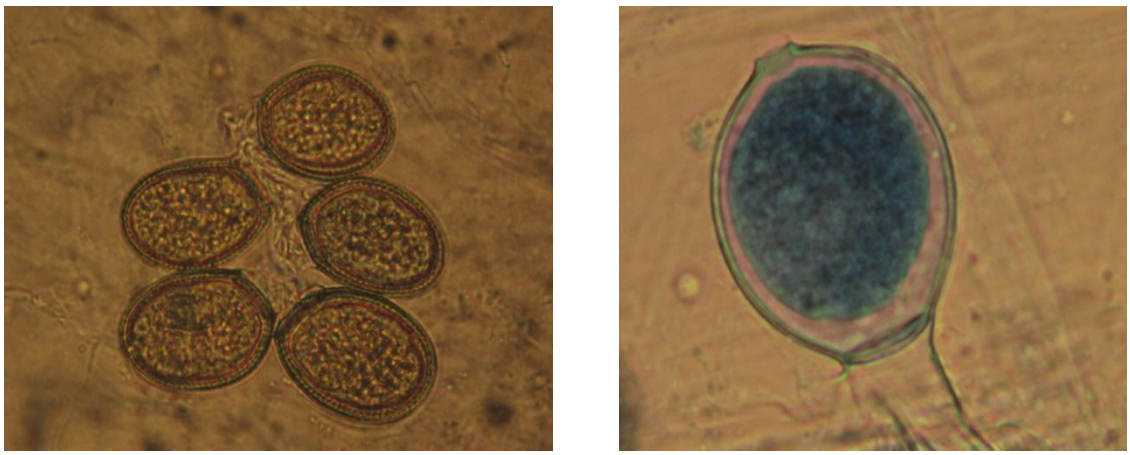
Water Parameters	Rainy Season		Winter season		Summer Season	
	Average	Range	Average	Range	Average	Range
Temperature ^{0}C	26.31	24^0C - 29^0C	18.74	16^0C- 20^0C	30.82	28^0C-33.50^0C
pH	9.15	8.90 - 9.50	8.70	8.60 - 8.90	8.90	8.70 - 9.40
Dissolved Oxygen(mg\ l)	5.88	5.80 - 6.10	8.75	8.60 – 9.00	7.00	6.60 - 7.60
Free CO_2 (mg\ l)	4.75	4.50 - 5.10	Nil	Nil	Nil	Nil
Total Hardness (mg\ l)	154.74	145.33-164.73	147.86	145-147.20	210.41	193.80-220

Low-dissolved Oxygen levels are responsible for fish death, than all other physicochemical properties. Small fish consume more Oxygen than large ones because of their higher metabolic rate (Meade, 1974). The range of Dissolved Oxygen in water samples of present study was between 5.8 and 9.00 mg/l. The fungal growth was observed maximum during the months of winter season, when the Dissolved Oxygen was found to be between 8.5 to 9 mg/l (Table 1). Dissolved Oxygen 8.5-9.5 mg/l was reported to be highly conducive for the growth of fungal species (Khulbe *et al*., 1995). Mohan and Shankar, (1994) also reported close relationship between DO and with distribution of aquatic Fungi.

Figures are average values of 4 months in each season. Rainy season- from June to September; winter season from October to January and summer season- from February to May.

Plate 1 . Showed Infected Fishes

a) Fungal infection on *Clarias* sp. b) Fungal infection on *Channa punctatus*



b) Oogonia in *Saprolegnia parasitica* d) Oospores in *Aphanomyces invadens*

During the present study free CO_2 was almost absent in Lake water during winter and summer which is almost below detectable limits. Absence of Free CO_2 in water bodies, has often been linked with its consumption in photosynthesis and for formation of carbonates as suggested by Hutchinson (1957), Cole (1975), Wetzel (1975), Jhingran (1982), Patil *et al.* (1985), Shardendu and Ambasht (1988), Puri (1989), Khajuria (1992) and Dalpatia (1998) in various water bodies in India and abroad. During the study the range of free CO_2 was between 4.5-5.1 mg/l indicating its non-utilization in photosynthesis and or production of more CO_2 through respiratory activities (Table 1).

During the present study hardness of water ranged between 145.00 and 220.00 mg/l. The maximum total hardness 217.32 mg/l was recorded in summer and minimum 140.20 mg/l was recorded during winter (Table 4.1, 4.2 and Fig: 4.2, 4.3). Similar observations were reported by Korai *et al.*, 2008. Interaction of physiochemical factors influences the diversity of water molds (Paliwal and Sati, 2009). In winter, zoospore production of *Saprolegnia* was at peak. The present results are in agreement with Khulbe and Bhargava (1977). They studied the distribution and seasonal

periodicity of water moulds in some Lakes in Nainital hills (India), reported maximum water moulds during summer (May - June) at 17.5 - 23.5^{0}C (average 20.5^{0}C). The most important consideration here is that the summer temperature of the hills corresponds with the winter temperature of the plains; therefore, a logical identity does exist among all these observations.

Barua (1994) reported maximum incidences of fungal infection in the fishes when the temperature was low and the intensity and frequency of infection was decreased as the temperature increased. Low value of pH and high amount of DO (Dissolved oxygen) also favored fungal growth.

Fungal infections are found to be more pronounced in the winter season when temperature range was between 18-35°C, pH between 7.4 to 7.5, DO 5.9-9.0 mg/l and total hardness 145-220 mg/l (Table 4.1 and 4.2). On comparing the fungal incidences, the highest prevalence of infection was in winter and the lowest during February to July. Chinabut (1994) also reported maximum disease outbreak every year during November to February in Thailand. These findings confirmed with the findings of Faruk *et al*., (2004) and Chauhan (2012) who reported that most of the infections mainly occurred during winter season with highest severity.

The infected fishes examined exhibited gross external and internal lesions. Infected fishes exhibited eleven different fungal infections. The fungal infected tissue was cultured on appropriate culture media and the microscopic observations showed the presence of fungal species like *Achyla hypogyna, Alternaria alternata, Aphanomyces invadans, Aspergillus flavus, Aspergillus niger, Cladosporium cladosporides, Curvularia lunata, Drechslera hawaiinsis, Fusarium oxysporum, , Mucor mucedo, Rhizopus stolonifer* and *Saprolegnia parasitica.* The fishes with pale appearance with lesions were considered for fungal isolation studies (Plate-I).
Recently because of climate change, and global warming possibilities of fungal infections to fishes has increased many fold and hence the present problem was undertaken to investigate the type of infective fungal species on the local edible fishes.

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