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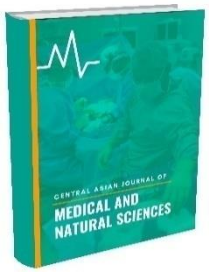

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Water Quality Assessment of Chandrasarovar Pond of Jhalawar (Rajasthan)

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Annotation: The occurrence of fungi in chandrasarovar pond water has received increased attention, and fungi are now generally accepted as drinking water contaminants. The knowledge about the occurrence and diversity of fungi in water has increased considerably from a low knowledge base. However, the relevance of waterborne fungi for water quality and human health is poorly understood and still conflicting. Scientific reports on effective treatment against fungi in water are also few.

Fungi are eukaryotic, heterotrophic organisms. Fungi include both single-celled yeasts and multi-cellular filamentous fungi. Many fungal species are able to survive in oligotrophic environments (which are areas relatively low in plant nutrients and containing abundant oxygen in the deeper parts). Fungi scavenge nutrients from the substrate that they colonize, or from the air or water in which they live. Fungi can produce secondary metabolites, some of which are toxins. Some fungal species and the metabolites they produce are human pathogens or allergens.

Keywords: fungi, Chandrasarovar, Jhalawar, pond, water, quality, assessment, report, toxins.

Introduction

Fungi are eukaryotic, heterotrophic organisms, including both single-celled yeasts and multi-cellular filamentous fungi. Many fungal species can survive in oligotrophic environments, through scavenging nutrients from the substrate which they colonise, or the air or water in which they live. Fungi also produce secondary metabolites, some of which are toxins. Some of the fungal species and the metabolites they produce are human pathogens or allergens. Fungi can enter Chandrasrovar pond water in Jhalawar through several contamination pathways, including treatment breakthrough, deficiencies in stored water facilities cross-connections, mains breaks and intrusions, and during mains installation and maintenance. Once introduced, fungal species can become established in pond water, including interaction and reaction, and biofilms, or can be suspended in the water. Water companies in Rajasthan have in place procedures to minimise the risk of microbial contamination in ponds of

different places. The results of sample analysis often reveal higher numbers of fungi than the analysis of samples following treatment. Such increases could be due to two reasons: i) the fungi that remain present after treatment multiply within the pond water or that fungi that were only partially inactivated later recover, and ii) fungi enter the pond via pathways of secondary contamination. [1,2]

Algae is not only a "catch-all" for unwanted aquatic plants, but it is also often looked at unfavorably by Chandrasarovar pond in Jhalawar, Rajasthan. For the most part, that would be accurate. Although algae plays a critical role in your pond health, an imbalance can be catastrophic to your overall pond ecosystem. An algae bloom is the rapid reproduction and spreading of algae when the conditions are right. They typically occur during the hot, sunny, calm part of summer. When an algae bloom takes place, the Chandrasarovar pond is covered with algae in a very short period of time.[3,4]

Algal bloom

When the bloom dies off, it adds a large amount of dead organic matter to Chandrasarovar pond. This organic matter is decomposed by microorganisms at the pond bottom. The added volume of organic matter causes the total amount of decomposition that occurs to increase. This can be detrimental because the decomposition process uses up oxygen and gives off carbon dioxide and even more harmful gases, such as methane and sulfur compounds. This causes two problems. First, lack of oxygen. When the oxygen in the Chandrasrovar pond is used to decompose the dead algae, it is not available for fish and other aquatic life. A crash can be so severe that the pond ecosystem starts to die off due to lack of oxygen. The larger the organism, the more oxygen it uses. Therefore, the larger fish that have been in Chandrasarovar pond for several years will be the first to die when oxygen is taken up.

The second problem with a large die off and increased organic matter is nutrients. When the algae die off and are decomposed, the carbon dioxide and nutrients are released back into the Chandrasarovar pond. The carbon dioxide and nutrients are then readily available for the generation of plant material to begin the cycle all over again.[5,6]

Another problem with excessive algae growth is that it can affect irrigation. Many farmers use Chandrasarovar pond as a holding area for irrigation water. Algae can clog the pump and the filters within it if the pond has an overabundance. In turn, this adds many hours of labor to the project. The

algae that passes through the pump will be distributed throughout the lawn or irrigated area. This leaves it unsightly and with foul odors as well.

However, Chandrasarovar pond can quickly come out of balance with an overabundance of algae, resulting in several harmful side effects. Regular monitoring and managing of the pond will ensure the best possible outcomes for algae.[7,8]

Discussion

There are many diseases caused by fungi isolated from Chandrasarovar pond. These are isolated from water samples cultured in laboratory and identified microscopically.

Table 1.11: Diseases caused by fungi

Name of the disease	*Causal organism*
Plant diseases	
Blast of Paddy	*Magnaporthe grisea*
Red rot of sugarcane	*Colletotrichum falcatum*
Anthracnose of Beans	*Colletotrichum lindemuthianum*
White rust of crucifers	*Albugo candida*
Peach leaf curl	*Taphrina deformans*
Rust of wheat	*Puccinia graminis tritici*
Human diseases	
Athlete's foot	*Epidermophyton floccosum*
Candidiasis	*Candida albicans*
Coccidioidomycosis	*Coccidioides immitis*
Aspergillosis	*Aspergillus fumigatus*

Pond is used for agricultural purposes. This causes plant diseases also. People using Chandrasarovar pond water are prone to many diseases. Hence it is necessary to build a treatment plant for purification of this pond water.

Algal toxins are organic molecules produced by a variety of algae in Chandrasarovar pond as well as on wet soils nearby. They are a problem when they are produced in sufficient quantities, with sufficient potency, to kill cultured fish, decrease feeding and growth rates, cause food safety issues, or adversely affect the quality of the product. We if want a fish culture in pond would be difficult as fish fauna would get destroyed by algal toxins. The production of algal toxins is normally associated with algal blooms, or the rapid growth and exceptionally dense accumulation of algae. The term Harmful Algal Bloom (HAB) is used to describe a proliferation of algae, or phytoplankton. Severe blooms of even non-toxic algae can spell disaster for cultured animals, because blooms deplete the oxygen in the shallow waters of many ponds. The number of HABs is increasing especially in Chandrasarovar which is now threatened, in some cases by more than one species of harmful algae. Scientists are unsure why this trend is occurring. [9,10]

HABs can affect public health and ecosystems when:

- filter-feeding shellfish feed on toxic phytoplankton and accumulate harmful toxins that are passed up the food chain;
- fish, shellfish, birds and even mammals are killed by eating organisms that have consumed algal toxins;
- light cannot penetrate the water, thus changing the function and structure of Chandrasarovar pond
- discoloration makes water aesthetically unpleasant;

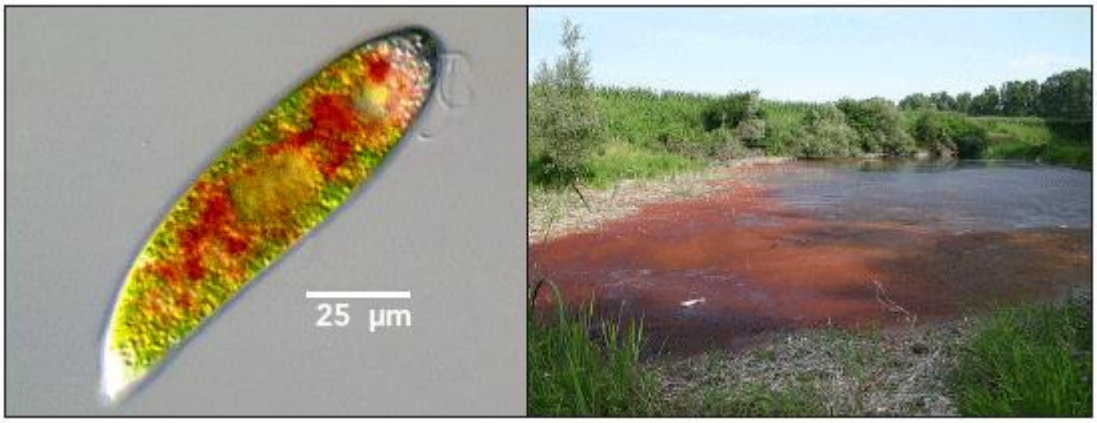
- the decaying biomass of a bloom depletes dissolved oxygen (especially critical in aquaculture); or blooms kill other algae important in the food web

The following algal species in Chandrasarovar pond water are identified by laboratory analysis.

Phylum	Common Name	Form	Locomotion	Pigment	Examples
Euglenophyta	Euglenoids	Unicellular	Two Flagella (one long & one Short)	Chl.a, Chl.b, Carotenoids	Euglena
Pyrrophyta	Dinoflagellates	Unicellular	Two Flagella	Chl.a, Chl.c, carotenes (including Fucoxanthin)	Gonyaulax, Ceratium
Chrysophyta	Diatoms	Usually Unicellular	Usually None	Chl.a, Chl.c, carotenes (including Fucoxanthin)	Diatoma, Frequilaria, Pinnularia
Phaeophyta	Brown Algae	Multicellular	Two Flagella (on reproductive cells)	Chl.a, Chl.c, carotenes (including Fucoxanthin)	Fucus, Macrocystis
Rhodophyta	Red Algae	Multicellular or Unicellular	None	Chl.a, Carotenes, Phycoerythrin	Chondrus, Polysiphonia
Chlorophyta	Green Algae	Unicellular, Colonial, Multicellular	Most have Flagella	Chl.a, Chl.b, Carotenes	Chlorella, Ulva, Acetabularia, Spirogyra

They are also destructive to the fish diversity and cause algal toxicity in pond. Relatively recent research has confirmed that Euglena species produce an ichthyotoxin in Chandrasarovar pond. The typical progression of symptoms from exposure to Euglena toxin begins with the fish going off feed. Fish exposed to *E. sanguinea* in culture or to filtrate from cultures were disoriented rapidly. Their respiration was accelerated and they lost the ability to maintain equilibrium. Although no distinct hemorrhaging was observed, gill tissue was reddened.[11,12]

Although *Euglena* sp. are normally very mobile, as a bloom progresses to the point that fish are disorientated, the algae seem to become concentrated in the downwind side of the pond.



Euglena

Mycotoxins or fungal toxins produce damages in the Chandrasarovar pond, with the consequent potential impact on human health. Mycotoxins are produced by fungi. Mycotoxins can accumulate in cereals, corn, peanuts, soybeans and spices, among others during water supply to agriculture. Consumption of mycotoxin-contaminated food or feed can cause acute or chronic toxicity in human and animals.

Molecular methods have been widely used since the 1990s to assess the presence of cyanobacteria and cyanotoxins in pond. They are based on the detection of genes present in cyanobacteria and those

related to the synthesis of their toxins. These methods include polymerase chain reaction (PCR) techniques such as the conventional PCR, multiplex PCR, terminal restriction fragment length polymorphism (T-RFLP), random amplified polymorphic DNA (RAPD), denaturing gradient gel electrophoresis (DGGE), real-time PCR and non-PCR-based techniques such as fluorescence in situ hybridization (FISH) and DNA microarrays. The PCR analysis is the most frequently used, consisting of the in vitro amplification of a DNA sequence by specific primers that target the DNA specific sequence. There are several sequences used in the investigation of cyanobacteria such as the amplification of the 16S ribosomal RNA (rRNA) gene, phycocyanin operon, internal transcribed spacer (ITS) region, and the RNA polymerase β subunit gene (rpoB) using taxon-specific primers.[13]

Results

When cyanobacteria can grow out of control, these freshwater blooms may look like scum, foam, mats or even paint floating atop the water. A warming climate and the growing use of fertilizers has upped the number of so-called algal blooms. There is anatoxin-a. Also known as ATX, it's the natural poison made by cyanobacteria.

Overgrowth of cyanobacteria — the blue-green algae coloring the water here — can release toxic pollution, making this pond water dangerous to animals and people.

Scientists knew ATX could poison pond water. Exposure to ATX can make someone sleepy or numb. Their muscles might twitch. It also could make it hard to breathe as it paralyzes the respiratory system. Birds, cows and dogs may even die after swallowing water tainted by blooms. ATX is deadly enough that it's often called Very Fast Death Factor.

Microcystis has gas vesicles that allow it to regulate buoyancy and migrate throughout the water column. Because of this the bloom can appear suddenly or scattered . Some species produce liver toxins, called microcystins, that can be lethal to livestock, fish and humans and have been linked to liver cancer. They can also cause skin irritation. The toxins are released when the cells lyse (break apart). At that time the bloom appears as a blue-green oily scum and has a pigpen odor. Under the microscope *Microcystis* consists of small round cells surrounded by a gelatinous envelope. The most common species *Microcystis aeruginosa* forms irregularly shaped colonies that appear almost black due to the optical effects of the gasfilled vesicles .

The *Anabaena* bloom may superficially resemble a *Microcystis* bloom as the pond may look like "pea-soup". However, *Anabaena* is a filamentous algae and the bloom is often less dispersed than *Microcystis* . The bloom does not migrate through the water column like *Microcystis* or *Aphanizomenon*. The pigpen odor may be present like with most Cyanobacterial blooms. Under the microscope Anabaena consists of chains of round or sometimes barrel-shaped cells with distinct heterocysts . Heterocysts are specialized cells that fix atmospheric Nitrogen. They have a thicker wall than the other cells and are not pigmented because Nitrogen fixation is not compatible with photosynthesis. The *Anabaena* chains can be straight or spiral. Many species of Anabaena are capable of producing toxins. Most produce anatoxin, which is a neurotoxin. A few produce both anatoxin and microcystin (the liver toxin). There have been many reports of deaths of pets, wildlife and livestock as a result of *Anabaena* blooms. The blooms occur in phosphorus-rich waters.

Hydrodictyon, known as water net, is also common in Chandrasarovar pond. It requires water with high alkalinity. The growth is light green and formed by filaments that are joined to form netshaped colonies. When the water is squeezed out it clearly appears like a net . Under the microscope the net arrangement of the cells is the most obvious feature that distinguishes *Hydrodictyon* from other algae.

Thus a series of algae, fungi and euglenoids get collected in Chandrasarovar pond releasing toxins affecting health of plants, animals and human.

Gram negative bacterial species: *Aeromonas hydrophila, Citrobacter freundii, Escherichia coli, Enterobacter aerogenes, Klebsiella* sp., *Pseudomonas* sp, *Vibrio anguillarum* and three Gram positive bacterial species: *Bacillus* sp., *Listeria* and *Staphylococcus* were found in the water of Chandrasarovar pond analysed by microscope in laboratory . Most bacteria are spherical or rod-shaped cells and some types are filamentous. They occur free-living in the water column, but they are more abundant on surfaces of suspended organic matter. They usually are present at their greatest abundance on organic matter at the pond bottom and in the underlying soil. Bacteria can be enumerated by plate counts and other microbiological methods, but the typical way of assessing the abundance of different types of bacteria is through measurements of the rates that they use nutrients for growth, consume oxygen in respiration, and release carbon dioxide and other metabolic wastes.[14,15]

The most important chemoautotrophic process in ponds is nitrification. In this process, bacteria of the genus *Nitrosomonas* oxidize ammonia to nitrite and bacteria of the genus Nitrobacter oxidize nitrite to nitrate. This process lessens the accumulation of potentially toxic ammonia in pond water, but it removes dissolved oxygen from the water and releases acidity (hydrogen ions) that neutralize alkalinity and lowers pH. Nitrification is one reason why ponds of naturally low alkalinity

Conclusions

It is necessary to treat Chandrasarovar pond water so that it may be useful for fish fauna, plants, animals and humans.

1. Maintenance of a healthy fish population

Excessive fish waste can cause an imbalance in pond water. Thus fish should be time to time taken out.

2. Creating a proper balance of plants

Too many plants can cause oxygen deficiencies at night due to the photosynthetic process, when the plants take in oxygen and give off carbon dioxide. The fish need the oxygen to survive.

3. Cleaning debris from pond before it has a chance to decay

4. Proper filtration for the Chandrasarovar pond

The pond's filter based on ideal circumstances,up-size the filter so that it can handle more than the capacity of pond and remember to clean filter according to instructions.There are two types of filters . A mechanical filter, also known as the skimmer, removes surface debris from pond water such as leaves and small sticks. The biological filter, or BioFalls filter, is positioned to create the beginning of the waterfall in pond. This filter uses bacteria to break down pond wastes, converting them into less harmful compounds that can be absorbed as fertilizer by aquatic plants.

5. Keep pond cool during the dog days of summer

When pond water exceeds 75º Fahrenheit, it has a difficult time retaining acceptable levels of dissolved oxygen, which is critical for the health of fish. This is why it's important to have the surface of pond shaded by aquatic plants to help keep pond water cool. Fish need oxygen to survive.[15]

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