Chapter – 1

INTRODUCTION

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Chemically water is an oxide of hydrogen but biologically is the cradle where life originated. The water bodies have not only witnessed the whole drama of evolution of life, but also played a vital role in this whole drama. All the living organisms owe their existence to water as almost all living forms have 75–90% of water. Mother earth is also bestowed by water, as 2/3rd part of the land is covered with water in various forms i.e. glaciers, ocean, sea, rivers, lakes, ponds, streams, springs etc. Water is one of the basic necessities of life, nature has provided ample of water in various forms which sustain an array of life forms, ranging from unicellular bacteria, to multi cellular organisms. Fungi are of paramount importance among them; they act as decomposers and pathogens. In an aquatic ecosystem, fungi act as scavengers and help in mineral recycling

The great majority of fungi enjoy at some stage in their life an intimate relationship with plant tissues, that are either living or dead. Water has a critical role in this relationship, not just because it is the solvent for metabolic processes and a participant in many of them, but because it is essential for the transport of nutrients within and out side fungal thalli and plants. It has a vital skeletal function in both, and a key role in the behavior and spreading fungi.

Water is the medium in which and through which all of the intra-and-extra-cellular chemical reactions and solute transfers, necessary for life, take place. In addition, fungi require substantial amount of water for the volume increase responsible for extension growth. Some fungi also require water in order to eject reproductive propagules or to get their spores airborne (Ingold, 1971). Most require liquid water surrounding their spores before germination will takes place. Clark (1965) has noted that fungi in soil, unlike plants, do not compete for water as their water requirements are so low relative to that present in their immediate environment. However, where fungi are intimately associated with plants they will have to compete with the plant cells for water (Cook & Papendick, 1970). In spite of these conventional requirements of water some fungal communities inhabit niches with high osmotic stress or with widely fluctuating water regimes, and in such conditions it is likely that fungi do compete for water. Some fungi modify their niche in such a way that changes its water potential or retention ability, whilst others are adapted to germinate, grow and/or survive under conditions of low water potential.

Aquatic fungi contribute to the energy flow and productivity of an aquatic and semi aquatic ecosystem by their active role in the utilization and biodeterioration of organic materials. These fungi also possess the ability to parasitize aquatic plants and animals including fishes under certain conditions. Physiology, environmental needs and activity of these fungi vary with their morphological characters. The occurrence of these fungi in an aquatic system cannot remain static. The morphological variability of these species is ultimately linked to the genetic control of their characters.

Wurzbacher et al (2010) highlighted the presence and ecological roles of fungi in lakes, and aims to stimulate research in aquatic mycology. In the study of lentic systems, this field is more or less completely neglected topic and, if considered at all, has often been restricted to specific groups of fungi, such as yeasts, filamentous fungi (e.g. aquatic Hyphomycetes), or Phycomycetes (an obsolete taxonomic category that included various fungal-like organisms). They play potentially crucial roles in nutrient and carbon cycling and interact with other organisms, thereby influencing food web dynamics. The development and application of molecular methods have greatly increased the potential for unraveling the biodiversity and ecological roles of fungi in lake ecosystems.

The true Fungi, or Eumycota, are now restricted to five major groups, each of which is regarded as a phylum in the Kingdom Fungi. One of these groups is the Chytridiomycota or Chytrids. In some ways the Chytrids are similar to the Saprolegniales of the Oomycota therefore together are regarded as water molds. They feed on small organisms and debris in aquatic environments.

One of the most fundamental phylum of fungi is the Chytridiomycota which includes saprobes and parasitic fungi. Members of the Chytridiomycota may produce more than two hundred spores during reproduction. The fungi of this Phylum are fundamental elements to the stability of the environment. Not only do they provide themselves as an excellent food source to many life forms, but they also recycle key nutrients back to the environment. These fungi secrete extracellular enzymes outside their body to break down nutrients. After the nutrients have been broken down these fungi absorb them. This process of external-digestion helps to preserve vital nutrients by returning them back to the environment.

The true importance of the Chytridiomycotous fungi is in their evolution. They are the ancestors of today's most common fungi. The fungi found in our modern world are all derivatives of the ancient Chytridiomycota. They are originally aquatic however today they are both aquatic and terrestrial.

The Chytridiomycota is a ubiquitous, microscopic division of fungi. The synapomorphic feature of this division is that the asexual propagule is a posteriorly, uniflagellate zoospore. Thus these fungi, commonly known as Chytrids, thrive and reproduce in freshwater and marine environments, they can also be found commonly in habitats such as terrestrial soils where there need only be, a periodic film of surface water suitable for dissemination of zoospores. The 1,250 species of Chytrids that have been described so far are in five orders (Chytridales, Spizellomycetales, Neocallimastigales, Monoblepharidales, and Blastocladiales). These orders are distinguished primarily on zoospore features (Barr 2001) and are supported by molecular sequence data (James etal. 2000). Many Chytrids are determinate in their growth and require the production of zoospores for continuous growth. Many Chytrids are able to survive periods of desiccation and cold by the formation of resting sporangia. Sparrow (1960) and Karling (1977) are the two most comprehensive references on the Chytridiomycota. Sparrow's Aquatic Phycomycetes (1960) is monographic in nature, but omits, as we do here, the large plant parasitic Chytridious genera, *Synchytrium* (Karling 1964) and *Physoderma*, which together comprise 353 species. Long core et al. (1996) created an important bibliographic update for Chytridiomycetes. Since Sparrow's monograph, two new orders of the Chytridiomycetes have been named. Barr (1980) erected the Spizellomycetales, from the Chytridales based on ultra structural characteristics of zoospores.

A "Chytrid" is a type of fungus (Phylum Chytridiomycota) and there are approximately 1,000 different Chytrid oomycetous species that live exclusively in water or moist environments. The Chytrids are among the oldest (most primitive) types of fungi and until very recently were considered members of the Kingdom Protista (and therefore thought to be more closely related to single celled organisms like protozoa). Most Chytrids are saprobes, meaning that they feed on dead and rotting organic matter. The importance of Chytrids in aquatic habitats is only now becoming clear. Chytrids DNA is closely associated with processes of removal of Pico plankton in lakes and large water bodies. Some Chytrids are known to parasitize cyanobacteria and single celled algae. Thus, these poorly studied fungi appear to be potential biological control agents of important aquatic toxigenic microbes, and indicators of eutrophication.

Chytrids degrade a variety of substrates, such as chitin, cellulose, and keratin, including some of the most recalcitrant materials in the biological world such as lignin and sporopollenin. They act as saprotrophs or parasites on a wide array of hosts including algae, other fungi, plants, mosses, insects and invertebrates. More recently, the first Chytrid parasite of a vertebrate was described (Long core *et al.* 1999).

Chytrids are found throughout the world. But the majority (80%) harbours temperate regions of the world. and a smaller percentage (55%) is found on the Northern Temperate Region of the Western Hemisphere and European continent.

A considerable amount of taxonomic studies has been carried out by a number of mycologists all over the world. Water moulds have been studied extensively as they have been known since the middle ages, and ichthyologists fear them as parasites of fishes and their spawn. In the middle of the nineteenth century, chlorophyll-free micro plants with rhizoids and zoospores were discovered on several algae and substrates. They were called phycomycetes, a now obsolete category that included Chytridiomycetes, Hypochytridiomycetes, Plasmodiophoromycetes, Oomycetes, Zygomycetes, and Trichomycetes.

In the 1940s, C. T. Ingold isolated and described many filamentous fungi, whose spore morphologies were adapted to dispersal in running waters followed by attachment to plant detritus, such as leaves. They have become known as aquatic hyphomycetes or 'Ingoldian fungi'. During that time, phycomycetes were the focus of most investigators, including Ingold's many publications addressed the biodiversity and ecology of zoosporic fungi, and Sparrow (1960) published keys to all known species, together with ecological data, in his monograph 'Aquatic Phycomycetes'. Later Sparrow assembled the ecological knowledge of all aquatic fungi in a comprehensive review (Sparrow 1968). A detailed view on lower aquatic fungi was later provided by Jones (1976). Interest switched to aquatic hyphomycetes in lotic systems once they were identified as major participants in the food web. Lake Ecosystems, however, remained largely neglected.

Aquatic fungi, in the broadest sense, include fungi present transiently in water, terrestrial fungi that release spores which are dispersed in water, and species that function entirely within water. Water is found in transient pools after rain, swamps, estuaries, permanent rivers and oceans. Within a single environment, the water can have predictable characteristics. At the edge however, water bodies may contain soil and plant materials, and will be a changing environment.

Aquatic hyphomycetes are the major fungal decomposers of leaf litter entering into streams and are an important trophic link between decaying leaves and stream invertebrates Numerous studies have demonstrated that the distribution of aquatic hyphomycetes is affected by physical and chemical characteristics of the stream water and riparian vegetation. On a worldwide scale, temperature together with its influence on vegetation in different climatic regions is the main factor determining aquatic hyphomycete distribution, whereas within smaller areas the chemistry of stream water appears to be important. Altitude is also an important factor in structuring aquatic hyphomycete communities within a stream Several studies have reported that soft water streams show higher richness in aquatic hyphomycetous species than hard water stream The increase in nitrogen / phosphorus concentration in oligotrophic freshwaters has been reported to raise species richness that live on plants or invertebrate animals.

Occurrence of these aquatic fungi in systems depends upon various physical and chemical parameters. Their frequency and distribution in a system also fluctuate with seasons and water body to water body. The location chosen for the proposed study on group of fungi is Pipliyapala and Sirpur ponds of Indore (M.P.).

Indore is located in 22.2 - 23.05^0 North Latitude and 75.25 -76.16 East Longitude having an area of 3896 Sq Km of western region of Madhya

Pradesh, on the southern edge of the Malwa plateau , on the Saraswati and Khan rivers, which are tributaries of the Shipra River. Indore has an average elevation of 553 meter above mean sea level. It is located on an elevated plain, with the Vindhyas range to the south. Climate is moderately cool with an average annual rainfall of 35-40 inches. Indore has a long history of fresh water channels existing throughout the city. These channels end in a old static two perennial water bodies like Pipliyapala pond located on A.B road (NH3) on the left side in east-south of Indore having surface area of 96 hectare with 20ft depth and Sirpur pond located on the left side of Indore-Dhar road (NH59) with surface area of 20 sq.km having depth of 1-5 meters. These ponds harbor a wide variety of aquatic flora and fauna; fungi are integral part of this system. More so, the ponds have not been explored till date for aquatic fungi.

The proposed study on group of fungi give a complete scenario about seasonal fluctuations in occurrence of fungi in two important water bodies of Indore. These water bodies will also be investigated in terms of physico-chemical factors and impact of these parameters on the occurrence of aquatic fungi.