Journal of Research & Development, Vol. 4 (2004)
ISSN 0972-5407

A Preliminary Aquatic Mycological Study of Dal Lake

Sami-Ullah Bhat and Azra N. Kamili

P.G. Deptt. of Environmental Science, University of Kashmir, Srinagar, J&K, India, 190006

ABSTRACT

The present investigation on Dal lake was undertaken during June 2002 to January 2003 and deals with aquatic mycological study. The main aim of the study was to come up with the picture regarding the relationship of aquatic fungi with that of organic loading and pollution of the lake thereof. The investigation revealed that the lake harbours some members of Ascomycetes and to some extent Omycetes instead of Chytridiomycetes which are typically found in pure waters. The study showed that *Penicillium* spp. was found most abundant while as *Aspergillus* spp. , *Mucor* spp. and *Rhizopus* spp. showed larger fluctuations in their numbers during different seasons which might be attributed to the variation in temperature in different seasons besides the availability of organic matter.

Keywords: Aquatic fungi , Dal lake, pollution.

INTRODUCTION

Saprotrophs like aquatic fungi are distributed throughout the water but are especially abundant in the mud-water interface along bottom. A few saprotrophs are pathogenic causing disease among organisms(Agarwal, 1992; Cooke and Pipes 1970; Nardndra Babu and Manoharacharya 1992; Harbola & Khulbe, 1989)while most of them are harmless (more aptly useful) and they cause breakdown (mineralisation) of dead organic matter and release the nutrients for re-use in the material cycle of the system.(Cooke and Kenneth, 1997; Cooke, 1954; Curtis, 1972; Suzuki and Suzuki, 1962). The presence of large numbers of saprotrophs in the water indicates the abundance of organic matter(Khulbe and Durgapal, 1994).

In spring water, near the source, the number of fungal spores usually is minimal, unpolluted stream water has relatively large number of species representing the true aquatic fungi (species possessing the flagellated zoospores and gametes), aquatic hyphomycetes and soil fungi. Moderately polluted water may carry cells or spores of the these types however it has fewer true aquatic fungi and aquatic hyphomycetes and soil fungi are more numerous. Heavily polluted water has large number of soil fungi. The group designated as soil fungi also includes yeast like fungi many species of which have been isolated from polluted water(Tabak and Cooke, 1968; Niemi *et*

al., 1982, Rosenweig *et al.*, 1986). The association between fungal densities and organic loading suggests that fungi may be useful indicators of pollution (Khulbe and Durgapal, 1992, 1994).

There has been fairly good limnological work on the lakes of Kashmir valley especially the urban lakes,carried out by different researchers from time to time since the past few decades. The famous Dal Lake finds its place in the well-studied water bodies of the world. The studies conducted on these lakes are pertaining to the Physico-chemical and Biological parameters (plankton, periphyton, macrophytes, rotifers, algae etc.) but at the same time little attention has been paid to study the fungal flora of various lakes including Dal Lake. Present preliminary study on aquatic fungal flora of Dal lake is an attempt in this direction.

The primary objective and aim of the present study was to know the fungal diversity and density of two basins of Dal lake that is Hazratbal basin, site I and Nigeen basin, site II (Fig. 1) and their relation with the organic loading and other sources of pollution, the possible damage due to the abundance of potentially pathogenic species of fungi and the recreation value of the lake.

MATERIAL AND METHODS

Samples of water from two sites under consideration were collected in suitable plastic bottles, which were previously carefully cleaned, rinsed in clear water (distilled water). During collection of samples extreme care was exercised to avoid contamination of the parts of the bottle. The collected samples were immediately processed for fungal analysis.

All the glassware used in the cultivation of microorganisms were properly washed and sterilized in hot air oven at a temperature of 80°C for 3-4 hours. Instruments like inoculation needles, forceps etc. were sterilized before and after the process by flame sterilization method. Nutrient medium selected for culturing the fungi present in the water samples was Rose-bengal agar medium (Martin, 1950 c.f. Singh *et al.*, 1999).

All the constituents of medium were dissolved separately in distilled water and then the final volume was made by adding the distilled water. The pH of the medium was adjusted at 6.5.The medium was gelled with Agar (15g/l) and heated till boiling so that agar was completely dissolved.

The medium was dispensed into flasks (250 ml) which were tightly plugged with non-absorbent cotton. These medium laden flasks were subjected to sterilization by

Fig. 1 : Map showing two study sites in Dal Lake

autoclaving at 15lb pressure and at a temperature of 121 °C for 15-30 minutes.

Before performing the inoculation, the UV lamp of inoculation chamber was kept on for half an hour which was followed by putting the motor of the flow on to remove all the ozone generated by UV radiations. The floor of laminar flow was properly cleaned with 95% ethyl alcohol before dispensing the medium in petri plates and performing inoculations. The most frequently used method for the measurement of microbial populations is the Plate count which measures the number of viable cells. Pour plate technique (Koch, 1912) using serial dilution was followed for counting the number of colonies per ml of water sample.

The inoculated petri plates were incubated at a temperature of 25± 3°C in an

incubator in an inverted position. After seven days colony count and its morphology was studied with unaided eye as per the key given by Johnson and Case, 1995.

Pure cultures were obtained by platinum loop through streaking technique (APHA,1998) under laminar flow. Identification of colonies was made under the microscope on the basis of Conidiophores, Sporangiophores, Mycelia, Pigmentation, Spore structure etc. using lacto phenol and cotton blue stains.

RESULTS

The data was scored from each site on the seasonal basis i.e. summer, autumn and winter. Colonies were counted and their morphology was studied on the basis of key given by Johnson and Case, 1995. The number of colonies per ml of inoculum was calculated by dilution technique. A comparative assessment in the density of fungal colonies in three different seasons at two considered sites was made as depicted in Figs. 2 & 3. It appeared from the observation, on the basis of colony morphology, that most of the colonies were circular, entire and convex in appearance, margin and elevation respectively. However few colonies appeared as filamentous, undulate and irregular. After identification *Penicillium* spp. was found in summer and autumn seasons at both the sites while as *Aspergillus* spp. showed fluctuations in summer and autumn at these sites but was found present at both the sites in winter season. The *Rhizopus* spp. I was having only low frequency in summer and autumn at sites I & II respectively and was altogether absent in the winter season at both the sites. Similarly *Rhizopus* spp. II was usually found in autumn at site I and in summer and autumn at site II. *Mucor* spp. was found in higher numbers during autumn and low in summer at site II but were present during autumn at site I and totally absent during winter at both the sites. In addition to this unidentified yellow colonies were observed in small numbers during summer and autumn at site I but have shown the highest numbers during winter at site II (Figs. 2 & 3). Such colonies were also recovered during summer and autumn season at site II.

DISCUSSION

The increasing number of soil fungi usually indicate organic loading in water. Large number of similar fungi suggest excessive organic load while a highly diversified mycobiota indicates populations adjusted to the environmental organics (Awasthi and Khare, 1990, Cooke, 1960, Khulbe and Durgapal, 1992, 1994). Despite their wide occurrence, little attention has been given to the presence and ecological significance of fungi in aquatic habitats. The relevance of fungi and their activities in water is emphasized by increasing knowledge of their pathogenicity for humans,

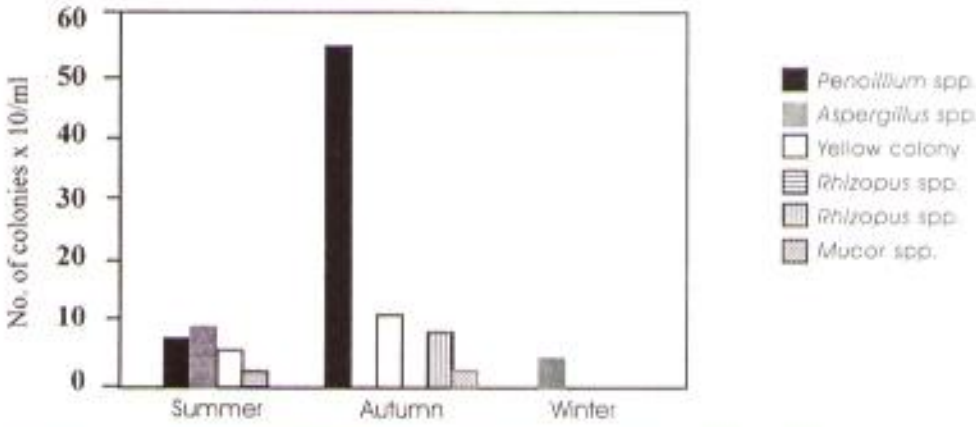

Fig. 2. Comparative assessement in density of fungal colonies x 10/ml in three different seasons (site I, Dal Lake)

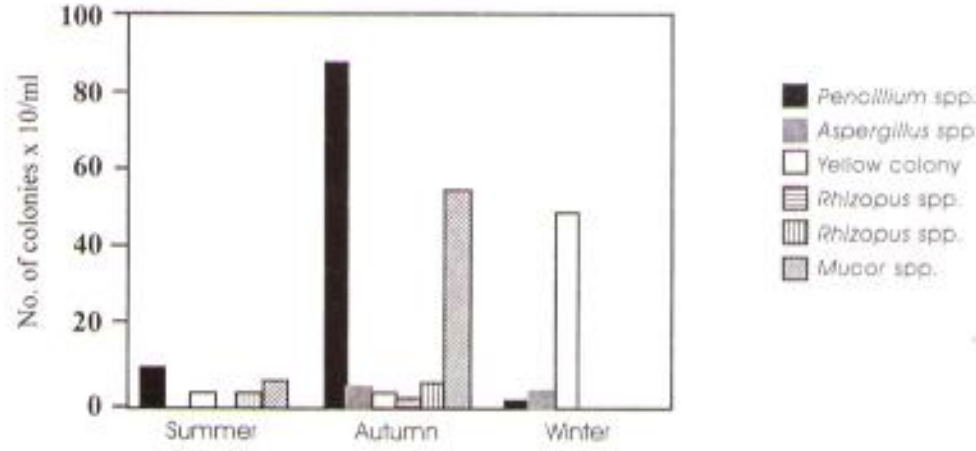

Fig. 3. Comparative assessement in density of fungal colonies x 10/ml in three different seasons (site II, Nigeen Lake)

animals and plants, their role as food for energy, their activity in natural purification processes, their exploitation for science and technological use (Cooke, 1954; Castllani, 1963; Curtis, 1972, Kishimoto and Baker, 1969, Suzuki and Suzuki, 1962).

The comparative study of observations of different investigators indicates that some species of aquatic fungi especially water molds show variation in their ecological requirement (Mer *et al.*, 1980). The fungal populations show variation with various chemical parameters such as at low pH (7.3-7.6) fungal populations observed higher and vice versa at high pH (8.7), higher density of fungi at greater conductivity and vice versa, dissolved oxygen in higher concentration decreased the fungal population and vice versa, high concentration of sulphates and nitrates shows low fungal populations and vice versa (Baradshaw *et al.*, 1973; Khulbe and Durgapal, 1994; Khulbe and Bhargava, 1983; Khulbe and Durgapal, 1981).

During the study the species of genus *Penicillium* and *Aspergillus* were isolated which are usually found in polluted lake waters and act as cellulose decomposers as opined by Kellermann and McBeth, 1912. The population of *Penicillium* spp. almost dominated quantitively and qualitatively in summer and autumn seasons and maximum was in summer because of high values for calcium, carbon dioxide, conductivity etc. (Zutshi and Vass, 1978; Khulbe and Durgapal, 1994; Ara *et al*, 2003). The *Penicillium* group especially *P. chrysogenum* thrives well within the temperature range of 9 °C to 23 °C and exhibits good ecological amplitude (Khulbe and Durgapal, 1992). Our observations for *Aspergillus* group were contrary to that of Khulbe and Durgapal, 1992 who reported that *Aspergillus* group as a whole was absent during their study in winter at Nainital lake but confessed at the same time that a very few species of *Aspergillus* group may also thrive well within the temperature range of 15- 23 °C. *Aspergillus* although small in number was also observed in winter during this study. *Mucor* spp. found although low in number in summer but compartively higher in no. at site II during autumn indicates that the species usually prefer moderate temperature of 15-23 °C as opined by Cooke (1960) and is also considered as pollution tolerant species (Khulbe and Durgapal, 1994).

All the three genera namely *Penicillium* , *Aspergillus* and *Mucor* fall in Lymaphiles (Cooke, 1960) which are able to tolerate a pollution habitat as a livable one. Further these genera also have been reported frequently from the drain waters with maximum densities during higher pollution (Khulbe and Durgapal, 1994). It can be therefore inferred from the observations that these species can act as good indicators of water pollution and there is every likelihood that these may be responsible for causing the various types of diseases to plants, animals besides human beings (Cooke, 1954; Harbola and Khulbe, 1989). The species of genus *Rhizopus* were usually found in

very small numbers especially in summer and autumn, thus giving an indication of exhibiting narrow ecological amplitude and do not tolerate the conditions of pollutions as also opined by Khulbe and Durgapal (1992).

The unidentified yellow colonies shows maximum number during winter may be that certain species thrive well at the temperature below 10 °C and were categorized as low temperature species (Khulbe and Durgapal, 1992).

The observations reflect that the two basins (Hazratbal and Nigeen) harbour the species of fungi which are typically found in polluted lake and drain waters. No species belonging to the Chytridiomycetes and Hyphochytridiomycetes were observed during the study from the water samples, which are typically found in pure waters. The water resources of Kashmir both lentic as well lotic have been facing tremendous threat from various types of pollutions. The need of the hour is thus to make the water resources pollution free through strict administration, law, proper scientific methods, regular public awareness, monitoring and coordination among government and non-government organizations.

ACKNOWLEDGEMENT

The authors are highly thankful to the Head, Department of Environmental Science for providing the necessary laboratory facilities to carry out this study which forms a part of the M.Sc. project work of the first author.

REFERENCES

APHA. 1998. *Standard Methods for Examination of Water and Waste water.* 20th edition. American Public Health Association, Washington D. C.

Ara, Showkat, Khan, M.A. and Zargar, M. Y. 2003. Physico-chemical characteristics of Dal lake water of Kashmir valley, India. *Indian J. Environ and Ecoplan.* 7(1): 47-50.

Awasthi, P. B. and Khare,A. K. 1990. Dynamics of fungal population in a polluted fresh water body at Bareilly, India-An ecological enumeration *Vegetas* **3**(1): 21-27.

Agarwal, G.P.1992. An outlook of certain opportunistic fungi in India emerging as potential human pathogens. *J. Ind. Bot. Soc.*, **71**(I-IV): 1-10.

Baradshaw, J. S.; Sunders, R. B.; White, D. A.; Barton, J. R.; Fuhriman, D. K.; Loveridge,E. L. and Pratt, D. R. 1973. Chemical response of Utah lake to nutrient inflow, *Jour. Wat. Pollut. Cont. Fed.* **45**(2) : 880-887.

Castllani, A., 1963. The cultivation of pathogenic fungi in sterile distilled water *commentarii* **1**(10):1.

Cooke, W. B. 1954. Fungi in polluted water and sewage I. *Literature review, Sewage and Industrial waters.* **26**: 661-674.

Cooke, W.B. 1960. *Pollution effects on fungus population of Stream Ecology* **42**(2) :1-18.

Cooke, W. B. and Kenneth, A. Bush 1997. Activity of cellulose decomposing fungi isloted from sewage, polluted waters *Sewage and Iindustrial wastes*, **29** (2).

Cooke, W. B. and Pipes ,W. O. 1970. The occurrence of fungi in activated sludge. *Mycopath, Mycol. Appl.*, **40**:249-270.

Curtis, E. J. C. 1972. Sewage fungus in rivers in the U.K. *Water Pollution Control* **71** : 673-685.

Harbola, P. and Khulbe, R. D. 1989. Studies on fungal diseases of Cabbage in relation to quality of water in Nainital area. In: *Perspectives in Aquatic Biology* (R. D. Khulbe, ed.). Papyrus Publising House, New Delhi.

Jhonson, Ted R. and Case, Christine, L. 1995. *A laboratory experiments in Microbiology* IV edition, The Benjamin/Cumming Publishing Company, Inc.

Kellermann, K. E. and McBeth, I. G. 1912. The Fermentation of Cellulose. *ZBI Bakt I Abs.* **34** : 485-494.

Khulbe, R. D. and Durgapal, A. 1981. Distribution of aquatic fungi in relation to some ecological factors, *Geobios* **8**: 214-216.

Khulbe, R. D. and Bhargava, K. S. 1983. Frequency of water molds in relation to Nitrate, Sulphate and Phosphate in some lakes of Nainital, India. *Trop. Ecol.* **24**: 180-187.

Khulbe, R. D. and Durgapal, A. 1992. Population Dynamics of Geofungi in a polluted fresh water body at Nainital, Kumaun Himalaya. *Poll. Res.* **11**(4); 213-219.

Khulbe, R. D. and Durgapal, A. 1994. Sewage mycoflora in relation to pollutants in Nainital, Kunaun Himalaya. *Poll. Res.* **13**(1): 53-58.

Kishimoto, R.A. and Baker. G.E. 1969. Pathogenic and potentially pathogenic fungi isolated from beach sands and selected soils of Oahu, Hawaii. *Mycologia*, **61**:539.

Koch, R.1912. Ueber die neuen untersuchungsmethoden Zum Nachweis. Der Microkosmen in Boden, Luft and Wasser. Reprinted in Ges. Werke Von R. Koch **1**: 274-284. Berlin.

Mer, G. S., Sati, S. C. and Khulbe, R. D. 1980. Occurrence , Distribution and Seasonal periodicity of some aquatic fungi of SAT-TAL(Nainital), India. *Hydrobiologia* **76**, 201-205.

Nardndra Babu, G. and Manoharacharya, C. 1992. Studies on the extra aquatic fungi associate with two polluted water bodies, Andhara Pradesh, India : *J Ind. Bot. Soc.* **71**:129-132.

Niemi, R.M., Kunth, S. and Lundstron, K. 1982. Actinomycetes and fungi in surface waters and potable waters. *Appl. Environ. Microbiol* . **43**:378.

Pandey, B.P. 1996. *College Botany*. Fifth edition S. Chand and company limited, New Delhi.

Park, D. 1972. Methods of detecting fungi in organic detritus in water. *Transactions of the British Mycological Society* **58**: 281-290.

Rosenweig, D.W; Minning, H.A. and Pipes, W.O. 1983. Chlorine demand and inactivation of fungal propagules. *Appl. Environ. Microbial.* **45**:182.

Singh, V., Panda P.C. and Jain, D.K. 1999. *A text book of Botany: Lower plants*. Rastogi and Company, Meerut, India.

Suzuki, S. and Suzuki, S. 1962. Fungi in polluted water and sewage. *Waste Water Research*. **2**: 146-148.

Tabak, H. and Cook, W.B. 1968. Growth and metabolism of fungi in an atmosphere of Nitrogen. *Mycologia*. **60**:115.

Zutshi, D. P. and Vass, K. 1978. Limnological studies on Dal lake-Chemical features. *Indian J. Ecol.* **5**:90-97.