MYCO-ALGAL FLORA OF THE AQUATIC ENVIRONMENT FROM VICINITY OF KARACHI

PHOOL B. ZAHID*
FATIMA S. MEHDI*

SUMMARY: The purpose of this research is to explore the correlation of algae and fungi which effect the productivity of the aquatic environment. About 200 water samples were screened from 58 localities of Karachi region. The dominating species of algae mostly belong to the Chlorophyceae and Cyanophyceae. Among the fungi, species of Alternaria, Aspergillus, Aureobasidium, Botrytis, Caetomium, Cladosporium, Fusarium, Penicillium and Trichodesmium showed positive cellulolytic activity and were found to be responsible in the decomposition of algal cellulose.

Key words: Myco-Algal flora, polluted water.

INTRODUCTION

In an aquatic environment, algae and fungi develop strong relationship. Most of the aquatic fungi play a significant role in the biological interaction in water and as a saprophyte take part in the degradation of organic matter. Frequency of occurrence of fungi become high in the late summer and early autumn which coincide with the decomposition of algae in the climate like Karachi Regarding the role of algae in aquatic environment, the polluted water is accomplished by bacteria whose activity is enhanced by the photosynthetic oxygen of associated algae.

Besides algae and fungi the biotic population of waste water include Bacteria, Nematodes, Protozoa, Insect larvae, snails and sludge worms (1). An extensive literature on the ecology of algae and fungi in polluted water has been reviewed by Tiegs (2), Curtis (3), termed as 'sewage algae' and 'sewage fungi'. Thus various workers have shown that organic detritus produced in lakes and rivers sooner or later are decomposed and mineralized through the metabolism of various organisms of which the fungi are considered to play a major role. Organic molecules in aquatic environment are converted into inorganic compounds which are later utilized as plant nutrients (4).

* From Botany Department, University of Karachi, Karachi 75270, Pakistan.

The ability to degrade cellulose has been reported for a few lower fungi by Hokins and Weston (5), Barr (6), in some aquatic hypomycetes by Jones and Eaton (7). Fungi as a rule re-synthesize into new plant material a larger percentage of the carbon of the decomposed organic material than do bacteria.

For this purpose a preliminary survey of the aquatic fungal and algal flora of Karachi region was undertaken, a total number of 45 species of fungi were recorded, 20 were isolated in pure culture. Out of which 6 were isolated by Hemp Bating Detritus technique from water samples, the rest of the species were isolated with the help of direct Plating technique. Regarding the algae, a total number of 50 species were studied, 22 were isolated in pure culture by plating and liquid culture techniques.

MATERIALS AND METHODS

Survey and collections from the polluted aquatic localities include oxidation ponds, sewerage lines showed, that fungi and algae were present in such habitats sometimes are in considerable numbers. Sampling was made during the period of November 1990-October 1991 from more than 50 places of 4 districts of Karachi viz East, West, Central and South regions to determine the composition of algal and fungal population of each designated station.

Fungal flora was studied by applying direct plating of detritus samples, baiting technique and plating of water samples. For the isolation of aquatic fungi, media utilized such as Cellulose agar, Siu (8), Cornmeal agar medium, Carrot agar medium, Cellulose agar medium, Czapek dextrose agar medium, Martins medium, Mineral agar medium, Potato dextrose agar medium, soil extract medium and Water agar medium. While algal cultures were prepared by using Chu (9) no. 10 medium, Hughes, Gogham (10) and Zehnder's medium and Bold (11) basal medium.

During water sampling temperature was estimated by centigrade thermometer. pH was estimated by pH apparatus model 607 Jenco. Conductivity and salinity was measured by conductivity meter, model H, 18033 Hanna.

RESULTS AND DISCUSSIONS

The quantity and quality of algal and fungal flora differ in different localities. The influence of Karachi Municipal Corporation treatment plant however is a mixture of domestic and industrial waste. Industrial waste carry heavy load of metallic pollutants, so the difference in the number of species may also be due to the quality and nature of water and selectivity of the medium.

During the period of studies, 30 genera and 50 species of algae were recorded from all over Karachi districts viz, 8 genera and 12 species of Chlorophyceae were followed by 12 genera and 25 species of Cyanophyceae, 5 genera and 10 species of Bacillariophyceae and 5 genera 5 species of Euglenophyceae. Species of Chlyamydomonas and Oscillatoria remained most dominant throughout the period of study. The number of species declining in the summer season and increased during the winter season (Figure 1). Diatom flora also flourished in this season. Water samples collected from Karachi East were dominated by Euglena, Phacus, Oscillatoria, Chlorella, colorless flagellates and some Diatoms remained throughout the period. Anjum *et al.* (12) reported the similar results.

On the whole, algal frequency remained maximum during summer season (Figure 1) which seems to be related to higher temperature, confirms Bristol and Roach's findings (13). During the summer season when temperature of Karachi ranged between 30-40°C Cyanophyceae showed its maximum growth (Figure 1). On the other hand the members of Chlorophyceae were widely distributed in all sampling sites. During winter season when temperature ranged from 10-25°C, frequency of Diatoms reached at its maximum, this is in accordance to Chapman (14) with this class of algae. *Moreover Oscillatoria Tenuis, O. limosa, Phacus sp., Euglena sp. Chlymydomonas sp.* and *Colorless flagellates observed* as the indicator organism of water pollution. This was also confirmed by Palmer (15).

The results obtained from direct plating of polluted water samples showed that a great variety of micro fungal species were found to be present in sewerage waters. Majority of the species belonging to *Aspergillus, Penicillium, Alternaria, Saprolegnia, Pilobolus, Chladosporium, Chytrids Rhizophidium planktonicum* occur as parasite on the algae *Asterionella*.

The highest number of fungal species were recorded from eastern zone of Karachi district. The total number of species were recorded was 16 during summer (March to October), while lesser number was 8 recorded during winter season (November to February). *Aspergillus, Trichoderma and Alternaria* species were dominant in every sampling sites.

During the study the species of *Alternaria, Aspergillus, Cladosporium, Fusarium* and *Penicillium* although found commonly as terrestrial fungi but frequently were isolated from sewage waters. This favors Park (16). He noticed that fungi which were recorded from aquatic

Figure 1: Showing monthly record of the Algal and fungal species.

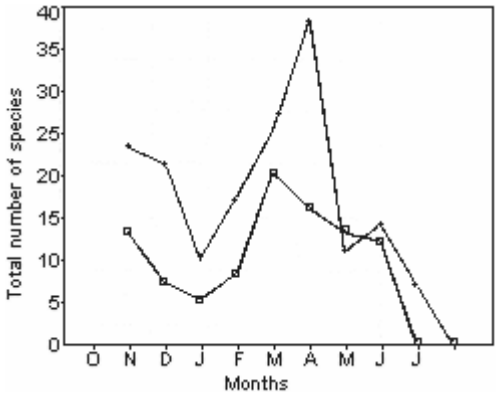

Table 1: Collection stations with species composition
(K.C : Karachi Central, K.S : Karachi South, K.E : Karachi East, K.W : Karachi West).

Date of collection	Statition Designated	Total Number of Sample	pH	Day Temp °C	Conductivity	Salinity	Fungal Species Isolated.	Algal Species Isolated
Nov. 1990	K.C	10	4.95 to 8.00	20-25	1	1.03-3.48	Aspergillus, Yeast Penicillium, Rhizopus, Alternaria	Chlamydomonas, Eudorina Volvox.
	K.S	15	7.45 to 8.65	11-20	1.00-4.14	1.0-1.04	Phoma, Yeast, Mucor, Tricho-derma, Rhozopus, Aspergillus, Phythium sp. Saprolagnia.	Euglena, Navicula sp.
	K.E	10	5.05 to 8.05	12-30	0.8-1.0	0.26-0.87	Aspergillus, Penicillium Tricho-derma, Rhizopus.	Staurastrum, Nitzschia, Chlyamy-domonas.
	K.W	15	16.45 t0 7.50	12-30	0.70-1.00	0.14-0.22	Yeast, Phoma Alternaria, Cla-dosporium, Aspergilluis	Ulothrix, Chlorococ-cum, Navicula.
Dec. 1990	K.E	12	7.55 to 8.55	10-18	0.25-0.90	0.32-0.44	Yeast, Mucor, Sordaria, Rhizopus.	Oscillatoria, Phormidum.
	K.W K.W	10 10	6.64 6.64 to 7.25	Same	0.27-0.9	0.32-0.42	Aspergillus, Rhizopus Aspergillus, Rhizopus	Desmids, Chlorella Desmids, Chlorella
	K.S	6	6.75 to 7.0	12-20	0.17-0.15	0.25-0.15	Penicilin, Trichoderma	Hormidum, Navicula.
	K.C	8	5.09 to 6.27	8-18	0.25-0.80	0.35-0.45	Aspergillus, Mucor	Ulothorix, Chlorococum
Jan. 1991	K.E	12	7.30 to 7.05	10-15	0.86-0.92	0.26-0.38	Asperhillus, Mucor, Penicillin, Trichoderma	Volvox, Ulothrix, Euglena
	K.W	12	7.30 to 7.75	10-18	0.86-0.85	0.26-0.38	Phoma, Aspegillus, Yeast, Trichoderma	Eudorina, Pandorina
	K.S	4	6.55 to 6.75	10-17	0.24-0.73	0.36-0.35	Phoma, Aspergillus, Yeast	Phacus, Pinnularia
	K.C	8	7.04 to 7.25	11-15	0.94-1.0	0.05-0.85	Yeast, Mucor, Sordaria.	Zygnema, Chlorella, Cosmerium.
Feb. 1991	K.W	4	6.25 to 7.26	12-25	0.22-0.75	0.44-0.54	Rhizopus, Yeast, Penicillum Aspegillus.	Chalymydomonas, Volvox Eudorina.
	K.S	10	5.24 to 6.75	12-23	0.25-0.26	0.38-0.65	Penicillium, Trichoderma, Aspegillus.	Hormidum, Ulothrix, Chlorella.
	K.E	10	4.23 to 6.25	12-23	0.24-0.25	0.35-0.89	Mucor, Aspegillus, Penicillium, Trichoderma.	Volvox, Ulothrix, Euglena
	K.C	10	4.25 to 5.26	10-20	0.28-0.29	0.25-0.90	Penicillium, Trichoderma, Yeast, Trichoderma	Phacus, Pinnularia, Eudorina
Mar. 1991	K.E	6	5.12 to 5.20	15-28	0.98-0.99	0.47-0.49	Alternaria, Yeast, Penicillium, Tri-choderma.	Spirulina, Bolrydium, Astasia.
	K.W	8	5.20 to 6.75	15-26	0.87-2.48	0.05-0.68	Rhizopus, Trichoderma, Yeast, Penicillium, Aspergillus.	Spirogyra, Botrydium, Merismopedia.
	K.S	6	5.30 to 8.54	18-32	0.73-0.77	0.35-0.41	Penicillin, Trichoderma, Aspergillus.	Nostoc, Merismope-dia, Oscillatoria, Spir-ulina
	K.C	9	7.10 to 7.30	18-32	0.35-0.84	0.17-0.41	Rhizopus, Alternaria Aspergillus, Mucor	Phocus, Navicula, Nitshia.
Apr. 1991	K.E	10	7.10 to 7.30	19-30	0.86-1.23	0.32-0.61	Yeast, Alternaria. Rhizopus, Aspergillus.	Staurastrum, Oscilla-toria.
	K.W	10	6.90 to 7.2	25-30	0.08-1.15	0.42-0.52	Aspergillus, Mucor, Trichoderma.	Chlymydomonas, Chlorella Scenedesmus.
	K.S	10	6.80 to 7.40	24-30	1.23-1.34	0.62-0.65	Trichoderma, Yeast, Aspergillus.	Phacus, Navicula, Chlamyromonas, Eudorina

May, 1991	K.C	10	6.70 to 7.83	24-40	1.25-1.45	0.52-0.64	Rhizopus, Alternatia, Penicillium.	Cuspidata, Navicula.
	K.E	12	5.22 to 6.30	20-30	0.16-1.16	1.07-2.31	Phoma, Yeast, Mucor, Tricho-derma, Rhozopos, Aspergillus.	Nostoc. Oscillatoria, Synedra.
	K.W	10	5.05 to 8.05	22-30	0.62-0.69	0.32-0.34	Aspergillus, Penicillium, Trichoderma, Rhizopus.	Euglena, Gonium, Chlyamydomonas.
	K.S	10	16.45 to 7.50	22-30	1.31-1.21	0.06-0.47	Yeast, Phoma, Alternaria, Cla-dosporium, Aspergillus. curvulara	Chrococcus, Spir-ogyra Eudorina.
	K.C	12	7.55 to 8.55	“	1.00-1.07	0.05-0.53	Yeast, Mucor, Sordaria, Rhizopus.	Oscillatoria, Cosmar-ium.
Jun. 1991	K.E	8	5.00 to 6.03	“	0.68-0.65	0.33-0.34	Aspergillus, Rhizopus chaetomium, Fusarium, Alternaria.	Spirulina, Pandorina.
	K.W	10	6.75 to 7.0	20-31	0.65-0.66	0.33-0.34	Penicillin, Trichoderma Alternaria, Rhizopus, Sordaria.	Scenedesmus, Phacus, Pinularia, Pyrobotrys
	K.S	10	5.09 to 6.27	25-30	0.55-0.65	0.22-0.24	Aspergillus, Mucor, Penicillium, Rhizopus.	Ulothorix, Chloro-cocum, Merismope-dia, Microcystis.
	K.C	10	7.30 to 7.05	25-31	0.56-0.78	0.21-0.23	Aspergillus, Mucor, Penicillin, Tri-choderma	Volvox, Ulothrix, Euglena
Jul. 1991	K.E	10	6.35 to 6.60	25-40	0.80-0.74	0.35-0.39	Penicillium, Aspergillus, Yeast, Tri-choderma.	Eudorina, Pandorina
	K.W	10	6.35 to 6.50	23-31	0.75-0.90	0.36-0.44	Phoma, Aspergillus, Yeast.	Phacus, Pinnularia
	K.S	12	7.10 to 7.20	23-30	0.56-0.72	0.26-0.30	Yeast, Mucor, Sordaria.	Zygnema, Chlorella, Cosmerium.
	K.C	12	6.90 to 6.97	22-31	0.64-0.67	0.30-0.32	Rhizopus, Alternaria, Penicillium.	Volvox, Eudorina, Chlymydomonas.
Aug. 1991	K.E	8	5.09 to 5.10	26-36	1.00-2.30	1.033.40	Phoma, Yeast, Mucor, Tricho-derma, Rhozopus, Aspergillus, Phythium sp. Saprolagnia.	Euglena, Navicula, Microcyctis.
	K.W	10	5.11 to 5.20	25-34	1.00-1.25	1.00-1.03	Aspergillus, Penicillium, Tricho-derma, Rhizopus.	Staurastrum, Nitzschia, Chlyamy-domonas.
	K.S	12	6.00 to 6.25	25-32	2.00-2.01	1.06-1.97	Yeast, Phoma, Alternaria, Cla-dosporium, Aspergillus.	Ulothrix, Chlorococ-cum, Navicula.
	K.C	10	6.00 to 6.99	26-37	2.00-2.09	1.29-1.46	Yeast, Mucor, Sordaria, Rhizopus.	Oscilatoria, Phormid-ium.
Sep. 1991	K.E	20	6.00 to 6.97	24-30	1.65-1.85	1.06-1.97	Aspergillus, Rhizopus	Desmids, Chlorella
	K.W	14	6.02 to 6.07	24-38	2.34-2.60	1.30-1.64	Penicillin, Trichoderma	Hormidium, Navicula,
	K.S	15	7.16 to 7.25	20-30	1.95-2.05	1.08-1.98	Aspergillus, Mucor	Ulothorix, Chloro-cocum
	K.C	20	7.66 to 7.88	21-31	1.09-1.95	1.90-1.97	Aspergillus, Mucor, Penicillin, Tri-choderma.	Volvox, Ulothrix., Euglena
Oct. 1991	K.E	8	5.24 to 5.29	22-32	2.56-2.66	1.33-1.37	Penicillium, Aspergillus, Yeast Tri-choderma	Eudorina, Pandorina
	K.W	12	5.24 to 5.29	“	1.75-1.80	1.07-1.22	Phoma, Aspergillus, Yeast	Phacus, Pinnularia
	K.S	16	6.33 to 6.37	“	1.75-1.85	1.31-1.39	Yeast, Mucor, Sordaria.	Zygnema, Chlorella, Cosmerium.
	K.C	10	7.01 to 7.23	25-33	2.00-2.08	1.30-2.00	Rhizopus, Alternaria	Volvox, Closterium, Cosmarium.

sites may or may not have originated there, but their existence may be regarded as immigrants in relation to water. Almost all the aquatic habitat was dominated by *Achlya* and *Saprolegnia*.

The distribution of Algae and Fungi is greatly influenced by the pH of the environment in which they grow (17, 18). Among algae, members Fogg, (19) Bacillariophyceae were mostly recorded from the localities with high pH. i.e. 7-8, while members belonging to Cyanophyceae were dominant in the localities with pH. 3.6 - 8.5. (Table 1). These were widely distributed throughout the study period. Lund (17) also found similar results in contrary the members of Chlorophyceae seem to prefer near about neutral pH. (Ranging 5-7) and the dominant species of this class were recorded in such a range of pH.

In case of Fungi species belonging to genera Mucor, Trichoderma, Penicillium, Aspergillus, Drescholera, Rhizopus, Botrytis were recorded in the waters having pH. 3-5, while higher pH. i.e. 6-8. appear most suitable for the growth of species belonging to the genera such as S*ordaria Alternaria, Fusarium, Curvularia, Pilobolus, Helminthospora, Yeast, Pythium, Cladosporium* and *Phoma.*

The Conductivity and Salinity of the polluted water remained directly proportional according to the rise and fall of the atmospheric temperature. The highest temperature recorded during the period of study was 35°C and the range of Conductivity was recorded 1.02-1.07 and the Salinity was in between the range of 0.50-0.53.

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REFERENCES

1. Cooke WB : Trickling filter ecology. Ecology, 40:273-291, 1959.

2. Tiegs E: Abwasserplize and wasser beschsffenfeit. Von Wass, 13:78-86, 1939.

3. Curtis EJC : Sewage Fungus: Its nature and effects. Review paper. Water Research Pergamon Press, 3:298-311, 1969.

4. Sorokin YI and Kadota H : Techniques for the assessment of microbial production and decomposition in fresh water. Blackwell Scientific Publication, Oxford, 1972.

5. Hokins RH and Weston WH : Studies in the lower Chytridiales. 1. Factors affecting pigmentation, growth, and metabolism of a strain of Kalingia (Rhizophylyctis) rosea. Ame J Bot, 37:739-750, 1950.

6. Barr DJS : Hypha Chytrium catenoides. A morphological and physiological study of north American isolates. Mycologia, 62:492-503, 1970.

7. Eaton RA and Jones EBG : The bio-deterioration of timber towers. 1. Fungal Ecology and the decay of wood at Connah's, Quay and Ince. Material and Organisms, 6:51-80, 1971.

8. Siu RGH : Microbial decomposition of cellulose. Rhineland Publishing Corp, New York, 1951.

9. Chu SP : The influence of the mineral composition of the medium on the growth of planktonic algae. I. Methods and culture media. J Ecol, 30:284-325, 1942.

10. Hughes EO and Gogham PR : Toxicity of a unialgal culture of Microcytic aeruginosa. Can J Microbiol, 4:236-255, 1958.

11. Bold HC : The Cultivation of Algae. Bot Rev, 8:69-138, 1942.

12. Anjum GF Hussain and Faridi MAF : Seasonal variation of algae in a polluted pond in Yar Hussain, Dist. Mardan, N.W.F.P. Pak J Bot, 17:253-256, 1988.

13. Bristol-Roach BM : On the algae of some normal English soils. J Agric Sci Camb, 17:563-588, 1927.

14. Chapman VJ and Chapman DJ : The algae. 2nd ed, The English language Book Society and MAC. Macmillan and Co, p 496, 1975.

15. Palmer CM : The effect of pollution on river algae. Ann N Y Acad Sci, 108:389-395, 1963.

16. Park D : Methods of decting fungi in organic detritus in water. Trans Brit Mycol Soc, 58:291-299, 1972.

17. Lund JWG : Observation on soil algae II. New Phytol, 46:35-60, 1947.

18. Lund JWG : Fungal diseases of plankton algae. In Biological aspects of the transmission of disease. Ed by C. Horton-Smith, pp 19-23, Oliver and Body, Edinburgh and London, 1947.

19. Fogg GE : "Algal culture and phytoplankton ecology". University of Wisconsin Press, Madison and Milwauker, 1965.

Correspondence:
Phool B. Zahid,
Department of Botany,
University of Karachi,
Karachi 75270,
PAKISTAN.