Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 7, No. 3, p. 201-206, 2015
http://www.innspub.net

INNSPUB
RESEARCH PAPER
OPEN ACCESS

Environmental chemistry and chemical ecology of microalgae effected by pH: Malakand as a case study

Fida Hussain[1,2*], Syed Zahir Shah[2], Muhammad Saleem Khan[2], Sardar Sikandar Hayat[2], Khalid Khan[2]

[1]*Faculty of Science, Qurtuba University of Science and Technology Peshawar, Pakistan*

[2]*Department of Botany, Islamia College Peshawar, Pakistan*

Article published on September 28, 2015

Key words: Microalgae, stagnant water, wastewater, running water, pH, ecology.

Abstract

Frequent variation in algal diversity with associated scum and unpleasant order is caused by changes in pH of the algal habitat. Among most important growth parameters; pH has a distinct role in the occurrence of microalgae in a specific habitat. The pH of different water bodies of the District Malakand were studied in detail and averages of these values were taken. These locations were studied for three types of water bodies. These were stagnant, running and waste water bodies. The pH recorded for stagnant water ranged between 6.8-8.8, while that of running water was 7-8.7 and that of wastewater was 6.4-8.5. The different seasons affected the pH factor and were highest in summer season for all the three habitats. pH favors the growth of most of the algae in fresh water bodies. pH was also one of the most promising factors which determined the better growth of these microalgae in stagnant water and warm temperature. Among most of the parameters studied for research locations pH has a great role in distribution of microalgae in these areas. Diverse habitat was observed in the research area with neutral pH. Spot with slight acidic or alkaline environment were found to be less diverse in algae.

***Corresponding Author:** Fida Hussain ✉ fidaicp@gmail.com

Introduction

Algal Taxonomy

A lot of taxonomic work has done throughout the world to classify and categorize algae. The most promising work done is on the fresh water red algae of the world (Kumano, 2002). A rich algal flora exists in Japan Ikoma *et al.* (1956) A hand book of British seaweeds was introduced by Newton (1931) while census of various freshwater bodies of new south Wales was presented by Playfair and Maiden (1917). Many marine algal species can be found in different marine habitat of France (Hoyt, 1920), similarly a systematic record of the algae from British freshwater bodies was presented by West and Fritsch (1927). An extensive work on the green algae of North America was done by Collins (1928), while (Smith, 1933, 1950) recorded the freshwater algae of United States. (Tiffany, 1934 and 1937) presented classified the collection of plankton algae and filamentous algae respectively from Lake Erie, USA. Catalogue of Illinois algae was developed by (Britton, 1944; Tiffany and Britton, 1952), while the marine algae of California was presented by Smith (1944) and that of Virginia was presented by Humm (1979).

Research Areas

The present research involved local bioprospecting of microalgae of freshwater bodies of District Malakand along its different localities. Bioprospecting of algae includes the collection; identification, nature of habitat and seasonality etc. The research study covering the following aquatic lines: the main river Swat enters district Malakand about 3 kilometers above Thana village (DCR, 1998). The summer is mildly hot while winter has sever occurrence which effect the geographical distribution of algae (Setchell, 1920) All the principal villages of the sub division Swat Ranizai are irrigated by this river.

Water bodies

The southern part of the district Malakand i.e. Sama Ranizai is also irrigated by its branched canal called upper Swat canal with head works at Amandara. The upper Swat canal along with irrigating a large portion of the district Malakand and Mardan provides falls for two Hydro Electric Power Stations in district Malakand, situated in Jabban and Dargai respectively (DCR, 1998). The main streams in subdivision Swat Ranizai which, during rain flow and falls into river Swat are Thana stream, Dehri Alladand Stream, Batkhela stream (Khowar), Chorbal stream, Munkar stream (piran killi), Hindosar stream of Malakand Dargai Jabban stream and Warter Dobandi stream (DCR, 1998). Similarly there are main streams in sub division Sama Ranizai flow in the rainy seasons which joins together near Sakhakot and flow down toward Jalala where these are connected with Kalpani in district Mardan (DCR, 1998).

Microalgae

Algae are not only an essential component of marine ecosystem(Setchell, 1917), but also the inhabitants of fresh water, salty water and damp haunt. Biologically they may be looked as water loving, autotrophic organisms having no sterile layer of jacket cells around their reproductive organs and lacking true embryogenesis (Shameel, 2003). Algae are also the inhabitant of areal habitat (Brown *et al.*, 1964) and marshy areas(Anderson, 1909). The algal flora was studied for their species composition and the important factors which determined the growth of these algae.

Four factors which are most important for algal growth and were found to be more promising were studied in detail. A monthly analysis was done for these factors. These were temperature, pH, total ammonia and total phosphates. Details about the effect of pH on algal ecology has been presented in this paper.

Material and methods

Regular monthly algal samplings were made (January 2012-January 2013) using the following methods.

Planktonic Net

Planktonic net is widely use to collect filamentous algae. in our study it was use for collection of thos

microalgae which were found in these filamentous colonies

Hand Picking and Scratching

The microalgae which is found attached to different stones and wooden bodies requires to be scratch from these bodies. The microalgae with larger size were scratched from these bodies with direct hand picking. And those which form a thin slippery layer were collected using sharp blade.

Sample collection

The sample of microalgae along with various materials in water, and taking water in bottles from the surface and at the depth of 2-3 meters below for the study of physico-chemical characteristics of water and identification of phytoplankton. Duplicate samples were also collected from each sampling spot at 10:00 am and 2:00 pm with a phytoplankton net of mesh size for the microalgae and estimation of different growth factors like pH, Temperature, ammonia and total phosphate. The following procedures were used to determine the physical and chemical parameters of the water. The pH of the water was determined at the time of collection by using PH-meter. The readings were further verified at PCSIR laboratory Peshawar.

Results and discussion

pH: The negative logarithm of the hydrogen ion concentration

pH is also one of the few major factors which determined the existence of microalgal species in a specific habitat. The pH of the present research area varied considerably with seasons and there was very little difference among the different locations of the studied area. The pH studies are divided into three parts on the basis of water bodies i.e. running water, stagnant water and waste water bodies. The running and stagnant water bodies showed slightly alkalinity in most part of the year the decrease in alkalinity to neutral pH was from warm to cold temperature. Similarly the waste water bodies were slightly acidic and were not favoring growth of most of the algae.

Research Spots

The pH of different water bodies of the present research areas were studied in detail and averages of these values were taken. All the research areas were studied for three types of water bodies. These were stagnant, running and waste water bodies. In the area of Thana the pH recorded for stagnant water ranged between 7.1-8.3, while that of running water was 7-8.1 and that of wastewater was 6.4-8.5. The different seasons affected the pH factor and were highest in summer season for all the three habitats.

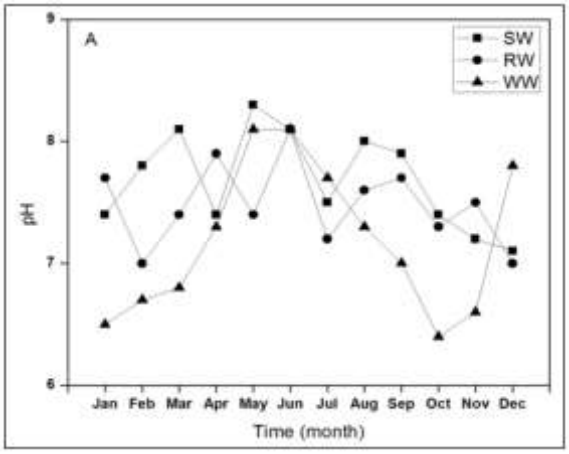

Fig. 6. Monthly pH variation in research location of Thana.

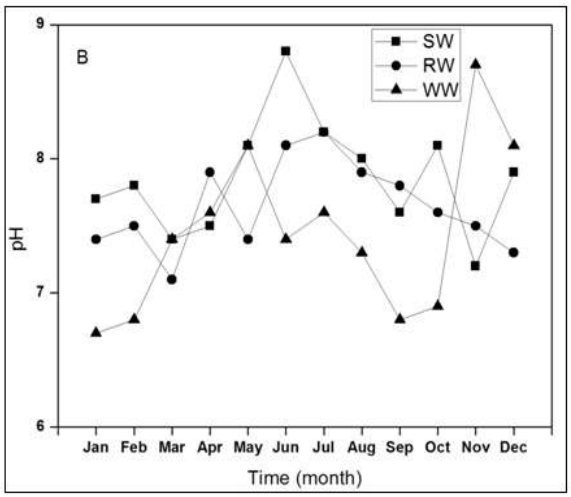

Fig. 7. Monthly pH variation in research location of Batkhela.

Apart from Thana, the next region studied was that of Batkhela. Here the pH of stagnant water was in the range of 7.2-8.8, while that of running water was 7.1 and 8.2 and that of wastewater was 6.7-8.7. The area of Malakand was reported to have 7.1-8.1 for stagnant

water, 7.3-7.9 for running water and 6.5-8.1 for wastewater bodies. Similarly Dargai region has pH reported as 7.4-8.1 for stagnant water, 7.1-8.1 for running water and that of waste water was 6.7-8.3. Shergarh area has also a number of stagnant water, running water and wastewater bodies. The pHs for these water bodies were 6.8-8.2, 7-8.7 and 6.7-7.6 respectively. The higher pH was recorded in summer seasons in all areas studied and the pH level decreased with decrease in temperature.

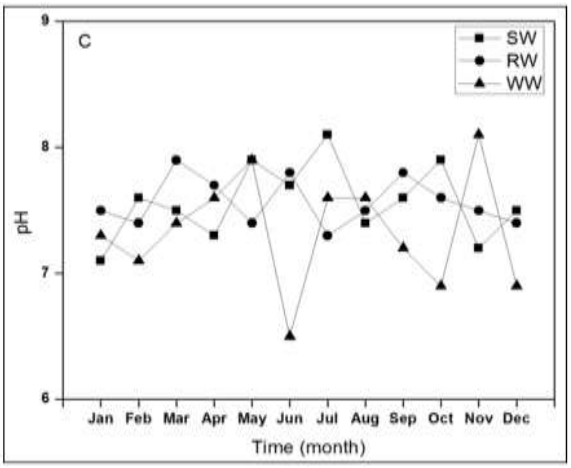

Fig. 8. Monthly pH variation in research location of Malakand.

Running water

The pH of running water ranged between 7.1 and 7.5 which were suitable for microalgae growth and this could not be responsible for the less variation in running water. As already mention the less variety of microalgal species was due to the total ammonia, total phosphates and fast flow of water.

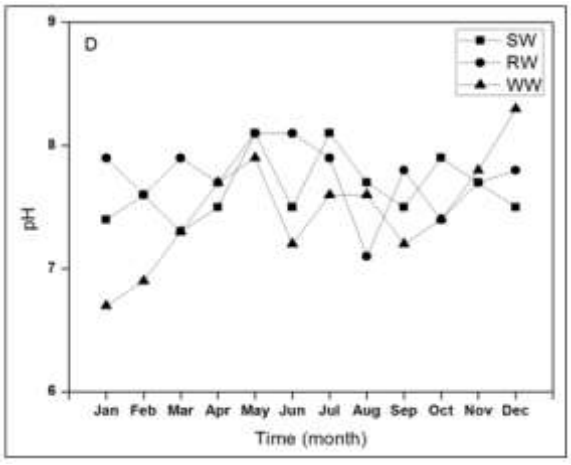

Fig. 9. Monthly pH variation in research location of Dargai.

Stagnant water

The stagnant water showed the pH ranged between 7.3 and 8.9. the highest pH observed was during the summer season which was due to the dissolution of organic and inorganic nutrient in the water bodies which made the water body more alkaline (Leghari *et al.*, 2001). This pH favors the growth of most of the algae in fresh water bodies. This could be concluded that along with other growth factors pH was also one of the most promising factors which determined the better growth of these microalgae in stagnant water in warm weather.

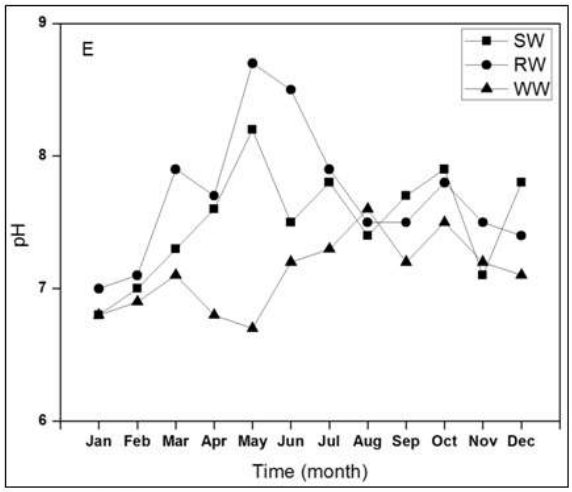

Fig. 10. Monthly pH variation in research location of Shergarh.

Wastewater

The specific algae grown in waste water was also determined by the pH along with the excessive amount of total ammonia and total phosphates etc. the pH of these water bodies were changed very slightly with seasons.

Conclusions

The overall research aimed to find out the effects of pH on the growth of microalgae in different habitat of district Malakand. Most of the water bodies studied were of neutral pH and showed a rich diversity in microalgae. the pH of water was effected by municipal waste in wastewater and break down of various salts in summer season which greatly effeted the diversity of these algal species. A more extensive work is

needed I n the present research area including other growth factors.

References

Britton ME. 1944. A catalog of Illinois algae. Northwestern university, Evanston,.

Brown RM, Jr Larson DA, Bold HC. 1964. Airborne Algae: Their Abundance and Heterogeneity. Science **143,** 583-585.

Collins FS. 1928. Green algae of North America. G.E. Stechert and Co., New York.

Cordero PA. 1980. Taxonomy and distribution of Philippine useful seaweeds. National Research Council of the Philippines, Bicutan, Tagig, Metro Manila, Philippines.

Karazina. 2007. Algal flora of Iran. V.N. Karazin Kharkiv National University, Kharkov, Ukraine.

Fritsen CH, Lytle VI, Ackley SF, Sullivan CW. 1994. Autumn bloom of antarctic pack-ice algae. Science **266**, 782-784.

Hoyt WD. 1920. Marine Algae of Beaufort, N. C., and adjacent regions. Govt. Print. Off., Washington,.

Humm HJ. 1979. The marine algae of Virginia. Published for the Virginia Institute of Marine Science by University Press of Virginia, Charlottesville.

Kumano S. 2002. Freshwater red algae of the world. Biopress, Bristol.

Lucas AHS. Perrin F. British Science Guild. South Australian Branch., 1936. The seaweeds of South Australia. F. Trigg, government printer, Adelaide.

Misra JN. 1966. Phaeophyceae in India. Indian Council of Agricultural Research, New Delhi,.

Newton L. 1931. A handbook of the British seaweeds. The trustees of the British museum, London,.

Okamura K. 1907. Icones of Japanese algae. Kazamashobo, Tokyo,.

Playfair GI, Maiden JH. 1917. Census of New South Wales fresh-water algae. W. Gullick, Govt. Printer, Sydney.

Prescott GW. 1951. Algae of the western Great Lakes area, exclusive of desmids and diatoms. Cranbrook Institute of Science, Bloomfield Hills, Mich.

Prescott GW. 1979. A checklist of algal species reported from Montana, 1891 to 1977. Montana Academy of Sciences, Montana.

Richardson WD. 1975. The marine algae of Trinidad, West Indies. British Museum (Natural History), London,.

Segawa S, Yamada Y. 1956. Coloured illustrations of the seaweeds of Japan. Hoikusha, Osaka,.

Silva PC, Moe RL, Meñez EG. 1987. Catalog of the benthic marine algae of the Philippines. Smithsonian Institution Press, Washington, D.C.

Smith GM. 1933. The fresh-water algae of the United States, 1st ed. McGraw-Hill Book Company, inc., New York, London,.

Smith GM. 1944. Marine algae of the Monterey Peninsula, California. Stanford University Press : Stanford University ; Oxford University Press : H. Milford, Stanford Calif. London.

Smith, GM. 1950. The fresh-water algae of the United States, 2d ed. McGraw-Hill, New York.

Tiffany LH. 1934. The plankton Algae of the west

end of lake Erie. The Ohio state university press, Columbus,.

Tiffany LH. 1937. The filamentous algae of the west end of Lake Erie. Ohio State University, Columbus.

Tiffany LH. Britton, M.E., 1952. The algae of Illinois. University of Chicago Press, Chicago,.

West GS, Fritsch FE. 1927. A treatise on the British freshwater Algae, in which are included all the pigmented Protophyta hitherto found in British freshwaters, New & rev. ed. The University Press, Cambridge Eng.

Womersley HBS. 1984. The marine benthic flora of southern Australia. D.J Woolman, Govt. Printer, Adelaide , S. Aust.