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PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 3 (11): 1973-1975, 2000

Studies on the Fresh Water Poisonous Planktonic Cyanobacteria (Blue Green Algae) of Manchar Lake Dadu, Sindh, Pakistan

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Abstract: Manchar Lake is the largest fresh water lake and a vital source of potable water for thousands of families in Dadu District. The lake water quality has deteriorated due to increase in electrical conductivity, total dissolved solids, salinity, chlorides hardness and phosphates. Due to increase in the physico-chemical parameters of water a large number of micro organisms including a variety of Cyanobacterial toxic species, have been observed. These organisms are responsible for gastrointestinal illness, most often mentioned symptoms were vomiting, diarrhea, thirst, choking with wheezing and even frank foamy discharges from the nostrils, by drinking the lake water. In Manchar Lake the process of eutrophication is at its extreme due to shallowness of the basin, but the whole range of chemical parameters has gone up beyond the permissible limits.

Key words: Toxicity, Cyanobactaria, Algae, Manchar Lake

Introduction

Manchar lake being the largest fresh water lake of southern region of Pakistan is supported by the supply of water from river indus, and rainy water from hill torrents of "Khirthar Mountain" range. The peripheral population (approx: 20,000) of different villages around the lake, viz. Bubak bund, Danister Miani, Nohani village, Shaikhani Aral, Hadi Shah village, Lalchatta Drib, Channi, Shah Hassan, Shaikh Daman. Tehni, Kot barocho, Dabri, Mashakh, Pirsoomer and Bozdar Jo Thallo. The lake region being old and comparatively back ward is favored by economically weaker section of the society. Population of the area uses water which is untreated, unhygienic having lot of algal, fungal and bacterial Contamination. The presence of cyanobacterial toxins in drinking water supply is being recognized as a potential hazard to the health of the human population. Out breaks of cyanobacterial blooms in water storage ponds, lakes, reservoirs and rivers used as drinking water sources are increasingly reported (National River Authority, United Kingdom, 1990, Blue green Algae Task Force, NSW, Australia, 1992; Carmichael, 1992). Retrospective epidemiological studies are being applied to search out short term injury associated with known exposure to Cyanobacterial contaminated water (Soong *et al.*, 1992).

This study provides the information about the water quality, which has deteriorated due to presence of toxic chemicals and pathogenic micro organisms. It also reveals the detailed identification of the impurities and exposes their effects on the local consumers. The species of Cyanophyta (Cyanobacterial) have been recorded first time from Manchar lake, since no detailed published information is so far available regarding the poisonous algal flora of this lake and their effect on human life.

Materials and Methods

Water and algal samples from Manchar lake were collected in plastic bottles at monthly intervals during1998-2000. Temperature of water, depth and transparency were recorded in the field. In laboratory pH of water was measured with Orion Modle 420 pH meter, electrical conductivity, total dissolved solids and salinity of water were measured with WTW 320 conductivity meter, total alkalinity, total hardness and chlorides were determined by titremetery and orthophosphate was determined by spectrophotometery by reaction with acid ammonium molybedate, followed by the reduction with ascorbic acid to molybdenum blue. All these methods were according to APHA (1981).

Samples for planktonic cyanobacterial species were collected by plankton net 55 μm size and were preserved in 4% formaline solution. Identification of Cyanobacteria was done according to taxonomic keys of Desikachary (1959) and Prescott (1962) drawing of the specimen was made by camera Lucida under binocular microscope.

Results and Discussion

The result of physico-chemical analysis is summarized in table (1). The water in the lake was observed from colourless to brown at different stations. The temperature of water at the time of collection varied within range 17-34°C.

The transparency values ranged between 23-65 inches. The pH and total alkalinity values were observed between 7.4-8.7 and 141-240 mg/l. The hardness was recorded between 614-934 mg/l. Salinity, conductivity and TDS were within the ranges 1.8-3.1 g/L 3.6-6.41 mS/cm and 2270-4865 mg/l, chloride ions also varied within 700-1536 mg/l and orthophosphate ranged 0.11-0.36 mg/l.

The physico-chemical variable of Manchar lake when compared with other lakes of Sindh, such as Keenjhar lake (chloride 38.9 mg/l, salinity 0.05, alkalinity 200 mg/l, Khuhawar *et al.*, 1998). Haleji Lake, alkalinity 525 mg/l, chlorides 75 mg/l TDS 338 mg/l (Khuhawar *et al.*, 1998). Hamal lake, hardness 670 mg/l, chloride 1750mg/l, alkalinity 550 mg/l (Khuhawar *et al.*, 1998) and Hub dam, transparency 2.1-3.3 m, pH 6.8-7.5, dissolved oxygen 3.1-5.3 mg/l, salinity 0.15-0.24 ppt dissolved solids 502 ppm,, (Iqbal, 1988), indicated that all these lakes still keep the typical fresh water characterstics despite progressive eutrophication. The whole range of chemical parameters of the Manchar lake water has gone up beyond the permissible

Table 1: Physico-chemical variables of Manchar lake

Parameters	1999							2000				
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Temp. °C of water	32.00	29.00	34.00	30.00	24.00	19.00	18.00	17.00	19.00	25.00	29.00	32.00
Visibility/ inches	23.00	23.00	26.00	27.00	28.00	28.00	46.00	55.00	38.00	65.00	42.00	45.00
Depth / feet	7.50	6.40	7.90	8.50	10.50	11.00	11.00	10.50	10.00	6.50	7.0	5.00
Dissolved Oxygen/mg/l	4.90	4.76	5.14	4.30	4.80	7.30	6.50	7.20	8.42	4.82	5.90	6.52
pH	8.02	7.97	8.07	7.40	7.40	7.60	8.10	8.70	7.90	7.40	8.5	7.68
Total Alkalinity: mg/l ($CaCo_3$)	186.00	184.00	219.00	173.00	158.00	160.00	221.00	240.00	213.00	141.00	146.00	155.00
Hardness/ mg/l (Ca mg)	934.00	918.00	750.00	715.00	614.00	648.00	768.00	714.00	827.00	832.00	844.00	902.00
Orthophosphate: mg/l	0.35	0.36	0.26	0.27	0.12	0.11	0.12	0.19	0.27	0.26	0.27	0.31
TDS: mg/l	4865.00	3216.00	2996.00	3072.00	2239.00	2270.00	2516.00	2963.00	3588.00	3677.00	3825.00	4486.00
Chloride: mg/l	1536.00	1673.00	1063.00	850.00	716.00	765.00	700.00	700.00	818.00	1293.00	1205.00	1329.00
Salinity : g/l	3.90	2.90	2.70	2.40	1.80	1.80	1.80	2.4	2.8	2.7	2.8	3.1
Conductivity: mS/cm	7.89	5.38	4.83	4.95	3.61	3.67	3.90	4.56	5.60	5.98	5.90	6.41

Table 2:

Division:	Cyanophyta
Order:	Chroococcales
Family:	Chroococcaceae
1.	*Chroococcus minor* (Kutz) Nag.
2.	*Chroococcus pallidus* Nag.
3.	*Chroococcus minutus* (kutz) Nag.
4.	*Chroococcus tenax* (Kirchn) Hieron.
5.	*Chroococcus dispersus* Lemm.
6.	*Coelosphaerium pallidum* Lemm.
7.	*Coelosphaerium* kuetzingianum Nag.
9.	*Coelosphaerium* sp.
9.	*Gloeocapsa magma* (Breb) Kutz.
10	*Gloecapsa stegophila* Rab.
11	*Microcystis flos-aquae* (wittr) Kirch.
12.	*Microcystis incerta* Lemm.
13.	*Microcystis elabens* (Kutz)
14.	*Microcystis aeruginosa* Kutz.
15.	*Microcystis pulverea* (Wood) Forti.
16.	*Microcystis holsatica* Lemm.
17.	*Microcystis grevillei* Hass
18.	*Merismopedia minima* (Beck)
19.	*Merismopedia glauca* (Ehrenb)
20.	*Merismopedia punctata* (Lemm)
21.	*Merismopedia tenuissima* (Lemm)
22.	*Aphanocapsa grevillei* (Hass) Rab.
23.	*Synechocystis pevalekii* (Ercegevic).
Order:	Nostocales
Family:	Nostocaceae
24.	*Nostoc ellipsosporum* Rab.
25.	*Nostoc hatei* Dixit.
26.	*Nostoc punctiforme* (Kutz) Hario.
27.	*Nostoc* sp
28.	*Anabaena aphanizomenoides* Forti.
29.	*Anabaena planctonica* (Brummthea)
30.	*Anabaena variabilis* (kutz)
31.	*Anabaena bergii* (Osten)
32.	*Anabaena sigmoidag* (Nyga)
33.	*Anabaena tonericaulis* (Nyga)
34.	*Anabaena circinalis* (Kutz) Hnsg.
35.	*Anabaena flos-acquae* (Lyngb) Breb.
36.	*Anabaenopsis raciborskii* (wol)
37.	*Aulosira prolifica* Bharadw
38.	*Aulosira fertilissima* Ghose
39.	*Cylindrospermum muscicola* Kutz.
40.	*Cylindrospermum stagnale* Kutz.
41.	*Cylindrospermum majus* Kutz.
Order:	Oscillatoriales
Family:	Oscillatoriaceae
42.	*Oscillatoria sancta* (kutz) Gom.
43.	*Oscillatoria simplicissima* Gom.
44.	*Oscillatoria amoena* Gom.
45.	*Oscillatoria limosa* Ag.
46.	*Oscillatoria claricentrosa* (Gardner)
47.	*Oscillatoria jasorvensis* Vouk.
48.	*Oscillatoria vizagapatensis*(Rao)
49.	*Oscillatoria princeps* Vaucher.
50.	*Spirulina nordstedtii* Gom.
51.	*Spirulina gigantea* Schmidle.
52.	*Arthrospira platensis* (Nordst) Gom.
53.	*Arthrospira gomontiana* Setchell.
54.	*Arthrospira* sp
55.	*Lyngbya hieronymusii* (Lemm)
56.	*Lyngbya martensiana* (Menegh)

limits, recommended by the WHO (1984). The Manchar lake is eutrophic which possesses the luxurious growth of algal flora. Fifty six species have been identified, belonging to genera *Chroococcus, Coelosphaerium, Gloecapsa, Microcystis, Merismopedia, Anabaena, Anabaenopsis, Nostoc, Oscillatoria, Spirulina, Arthrospira* and *Lyngbya* (Table 2). These species are considered toxic and are responsible for gastro intestinal illness. Most often mentioned illnesses are vomiting, diarrhea, thirst, dyspnea, cyanosis, choking with wheezing and even frank foamy discharges, from the nostrils (Schwimmer and David Schwimmer, 1968).

In April to May 1999 15 people were affected accidentlly within 40 days due to the symptoms of Gastro intestinal illness through drinking untreated algal (cyanobacterial) contaminated water which was taken from Manchar lake. Eight children near 5-8 years old died within 4-12 hours due to bathing and swimming in Manchar lake. According to the statement of their parents, before bathing they were quite healthy, after taking water during bath they were unable to talk, frank foamy liquid was discharging from their nostrils. (Pers. Comm: Dr. Asif Mirza, Medical Officer, Bubak).

Reports of human illness resulting from accidental ingestion of toxic cyanobacteria during water sports, have been reported the most recent being of army trainees under taking a canoeing exercise in the United Kingdom. In this case, both gastro intestinal and pulmonary illness were recorded (Turner *et al.*, 1990). Lake Vesijarvi Finland, (Hindersson, 1933), 40 animals (live stock) suddenly became ill after drinking algal genus Anabaena contaminated water, develops labored breathing, rapid

pulse, occasional diarrhea, extreme weakness, falling, and death. Three cows died shortly after drinking *Microcystis* and *Anabaena* species contaminateted water from lake Mc Guire (Fitch *et al.*, 1934). Hendersson and Steward (1950) reported. *Microcystis incerta, Microcystis flosaquae, M. aeruginosa* and *Anabaena* sp. as contaminants of water killed 16 Cows. Symptoms were observed as muscular twitching weakness, sunkon and glassy eyes.

The toxic substance appeared to act rapidly, the time between ingestion of water and death being less than one hour in several cases. Davidson (1959) has reported that by drinking the water of a heavy accumulation of *Nostoc,* the wild and domestic animals become ill and finally died. Numerous dead fish and frogs were observed along the water line of pond. Gorham (1960) recorded in Echo Lake, Canada. *Microcystis* sp. *Anabeana* sp. and *Coelosphaerium* sp, Dogs died after swimming in the lake. Many large fish were found dead along the lake shores. Dogs became visibly uncomfortable shortly after leaving the water, lied down, starting retching and convulsive movements and soon showed foam at the mouth and then had diarrhea. They were, within half to one hour, unable to rise and would not respond to water or food. Death followed after a short period of laboured breathing, interrupted by convulsions.

It was observed that *Microcystis, Anabaena, Merismopedia* and *Oscillatoria* remained most abundant species through out the study. Chemical analyses of water samples from Manchar lake indicate that all the parameters, show values towards higher side for a typical fresh water lake. More research work is required for an assessment of human gastro-intestinal cancers with chronic consumption of Cyanobacteria in drinking water.

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