Print ISSN: 0976-2876 Online ISSN: 2250-0138

Available online at: http://www.ijsr.in

INDIAN JOURNAL OF SCIENTIFIC RESEARCH

DOI:10.32606/IJSR.V13.I2.00008

Received: 05-06-2022 Accepted: 08-11-2022 Publication: 31-01-2023

Indian J.Sci.Res. 13 (2): 53-58, 2023 Original Research Article

CHARACTERIZATION OF DRAIN WATER AT MARIAHU MUNICIPAL AREA JAUNPUR AND ITS PERIODIC VARIANCE IN THE CONTEXT OF BIODIVERSITY

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ABSTRACT

The effluents of drain water are seriously affected by soil, domestic and industrial wastes of the area. Such wastes in quality and quantity depend upon the rate of urbanisation, industrial growth, social changes and agro-revolutions. Under developed areas in India like one under such a phase. The effluents of drains at Mariahu Municipal Board, Jaunpur, have been periodically analysed for the physico-chemical parameters and their periodic variations have logically been explained with their effects on the bio-diversity of the ecosystem.

KEYWORDS: Effluents, Mariahu Municipal, Biodiversity

Alteration in physico-chemical and biological characteristics may cause harmful effects on human and aquatic biota by addition of excess of undesirable substance of water. Pollution reduces the number of species and destroys the balance of life in streams and is evidenced by the biological indices of community diversity (Chaudhuri, 1981).

Sewage is an excellent medium for the growth of pathogenic bacteria, viruses and protozoa (Wetzel, 2001). *Vibrio cholera* found in sewage caused cholera. *Salmonella typhosa* causes typhoid, while *Shigella dysentery* causes bacillary dysentery. Several photogenic micro-organisms (Kumar *et al.*, 2005) introduced into the water course deleterious effect and chronic diseases in man and animals. The protozoa bacteria and viruses may begin to grow on sewage under anaerobic condition. This may cause the spread of water borne diseases like viral hepatitis, polio, cholera, dysentery, typhoid, amoebiosis etc. Sewage containing oxidizable and fermentable matter causes depletion of dissolved oxygen in the receiving water bodies (W.M.F., 2003) (Ramakrishnaiah *et al.*, 2009) (Okeke and Igboanua, 2003) affecting the aquatic flora severely. Oxygen deficiency also leads to production of objectionable odours in water. Due to the evaluation of putrefied gases, the solid wastes are buoyed up by these gases resulting in offensive foul matters floating on water surface. Depletion of oxygen content of water is caused by biological oxidation by microbes in any unit volume of water. BOD value is proportional to the amount of organic waste (oxidisable organic matter) present in water. Hence it is used as a measure of the degree of water pollution and waste level. Since the population of *E.coli* (Bacterium) increases tremendously, these start consuming most of the dissolved oxygen. Hence the dissolved oxygen content of water further decrease. The number of *E.coli* in the unit volume of water is also an indicator for the degree of water pollution.

Accumulation of sewage and domestic wastes in water bodies retards the self regulatory capabilities of aquatic organisms. Self purifying ability of water is lost and it became unfit for domestic purposes. Moreover, the decomposition of wastes by aerobic microbes decreases due to the extreme pollution. In a balanced water ecosystem (Baig *et al.*, 2009) (Mian *et al.*, 2010) (Wang *et al.*, 2010), algae are found in small numbers. Most of these are beneficial because they enrich the oxygen content of water through the process the photosynthesis and are used as food also. When controlled quantity of domestic sewage is dumped into water, it becomes rich in nutrients (Bu *et al.*, 2010) (Carpenter *et al.*, 1998), especially phosphates and nitrate. Thus, the water bodies become highly productive, i.e., eutrophic and the phenomenon is called eutrophication. A large portion of nutrients come back into water either when still alive or after their death or decay. As a result of this, the algae flora is shifted to blue-green algae, whose blooms are produced and can be seen floating as scums or blankets on the top water. These blooms forming algae are not utilized as food either by zooplankton or by invertebrates. Hence, they become pollutants themselves, because they are left to decompose and release their organic and inorganic matter back into water. The algae blooms compete with other aquatic plants for light to perform the process of photosynthesis. Thus oxygen level in depleted and CO_2 level gets increased. As result, fish and other animals begin to die and the clean water body is turned into a sinking drain. Thus eutrophication is a limiting

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factor in the supply of clean drinking water, for fishing and navigation etc.

This paper reports physico-chemical characteristic, trace metal (Paul and Meyer, 2001) (Akio, 1992) (Friberg *et al.*, 1974) levels and phytoplankton composition in the reservoir. This is important because the reservoir serves as an alternative source of water supply to the municipal area in the dry season months (Jan-July) when there is water shortage.

MATERIALS AND METHODS

The important rural segments located between Jaunpur and Saint Ravidas Nagar (Bhadohi) named as Mariahu Municipality, has been undertaken for investigations. Three sampling sites were chosen: site A is a drain that received waste water from market and residential area and some time sewage from a damaged septitank nearby. Site B is at outflow of water containing animal wastes from dairy farm while site C is the source of chemical effluents and is located behind the laboratories of college. At this site, the water is usually reddish brown and sandy substratum has the same colouration.

Water samples were collected fortnightly in acid washed polythene containers in 2005. Temperature was determined with 0-50ºC thermometer while pH (Adetunde and Glover, 2010) and conductivity were determined using a portable canlab pH meter and WPA conductivity meter. D.O. was determined by Winkler's titrimetric method while ammonia-nitrogen and nitrate-nitrogen (Larry, 2006) (Steiner *et al.*, 2006) were analysed according to usual methods (Bansal, 2018) (Murali and Goel, 2014) (Atomic absorption spectrophotometer). Phytoplankton (John, 1989) were collected with a 64□m bolting silk plankton net and preserved in 4% formaline.

RESULTS

Table 1 shows the mean and ranges of physico-chemical parameters. D.O., pH, conductivity and ammonia-nitrogen showed wide variations during the study. The oxygen content of the reservoir is inadequate (mean 6.23±1.33 mgl^{-1}) and deoxygeneration of the water occurred periodically. The pH is neutral (mean 7.65±0.21) while conductivity recorded intermediate value (mean 245.32±75.25Scm^{-1}). Ammonia-nitrogen values were higher than nitrate-nitrogen values (Table 1). Iron is the most abundant trace metal in water (1.92±0.16 mgl^{-1}). Table 2 gives the composition and abundance of phytoplankton in the study area during the investigated period. The value obtained for Zn, Cu and Fe in the present study have been compared with WHO standards in Table 3. Generally, the blue-greeopns (Cynophyceae) dominated the community. There was a gradual increase in the abundance of Cynophytes from site A to C (Figure 1). Contrastingly, Bacillariophyceae and Desmidaceae decreased from site A to C. The green algae (Chlorophyceae) were second in order. Their abundance was relatively stable across site.

Table 1: Physico-chemical parameters in Mariahu Municipality (Mean values±SD, range in parenthesis) in 2015

Parameters	Mean and Ranges
Temperature (ºC)	25.3±1.59 (14.3-33.3)
Dissolved Oxygen (mgl^{-1})	6.23±1.33 (0.33-16.33)
pH	7.65±0.21 (6.3-8.9)
Conductivity (□Scm^{-1})	245.32±75.25 (46.93-949.93)
Ammonia-nitrogen (mgl^{-1})	0.61±0.16 (0.00-1.93)
Nitrate-nitrogen (mgl^{-1})	0.23±0.05 (0.00-0.39)
Zinc (mgl^{-1})	0.23±0.05 (0.09-0.65)
Copper (mgl^{-1})	0.36±0.05 (0.04-0.63)
Iron (mgl^{-1})	1.92±0.61 (0.45-2.37)

Table 2: Phytoplankton composition and abundance in Mariahu Municipality

Phytoplankton	Total Abundance per cm^{-3}	% Abundance
Cynophyceae	325000	77.4
Chlorophyceae	52000	12.4
Desmidaceae	30000	7.1
Bacillariophyceae	12000	2.8
Dinophyceae	1000	0.2

Table 3: Mean trace metal levels in Mariahu Municipal Area compared with WHO standards

Phytoplankton	Total Abundance per cm^{-3}	% Abundance
Zinc	0.23	5.00
Copper	0.36	1.00
Iron	1.92	0.30

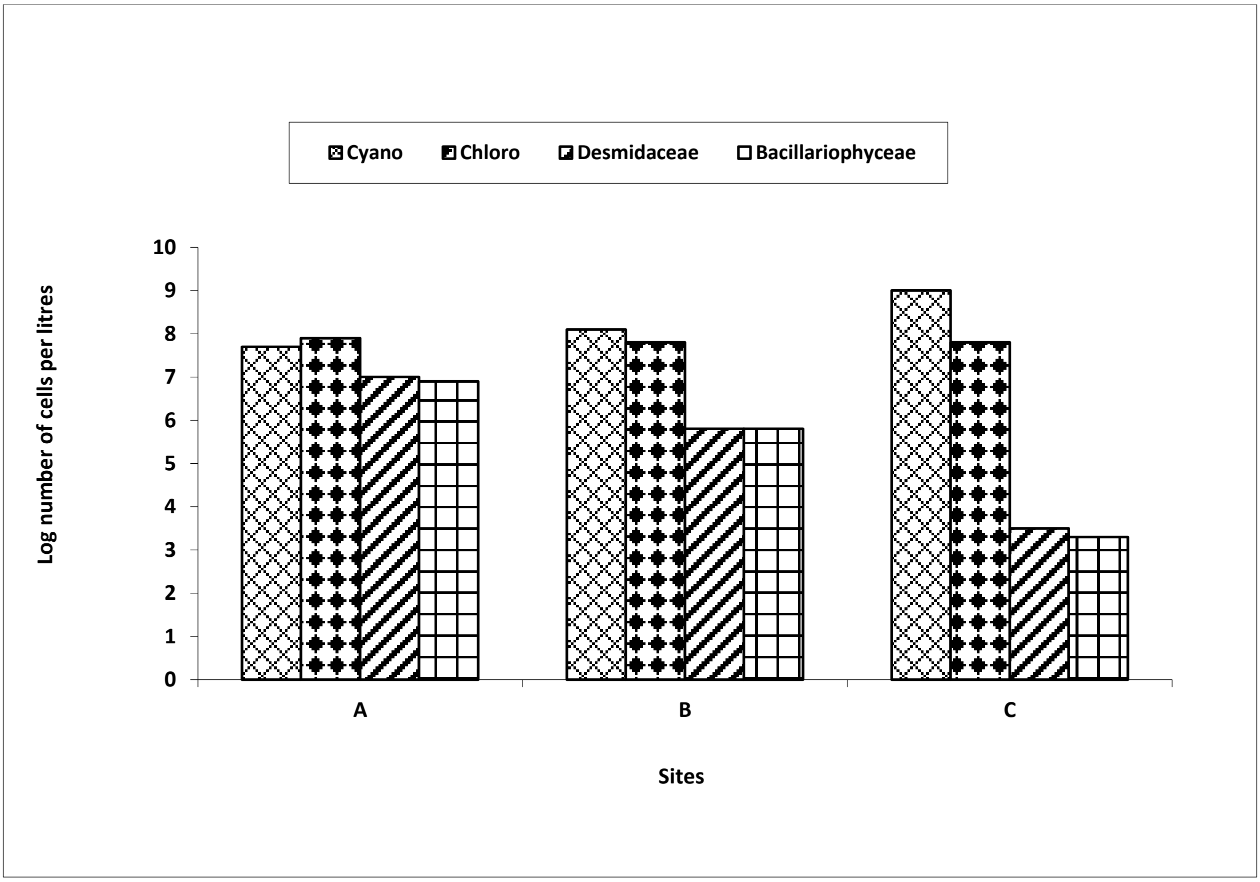

Figure 1: Mariahu Municipal Area showing sampling sites

DISCUSSION

The wide variations recorded in dissolved oxygen content, pH, conductivity and ammonia-nitrogen may be due to the fact that sampling took place during the late dry/rainy season periods. In tropical systems, marked variations in temperature and rainfall between seasons influence the physico-chemical characteristics of water bodies (Murali, 1995) (Kaushal et al., 2012). The conductivity of catchment area (Rida, 2017) can be recorded as being intermediate (Kennedy et al., 2001). The lower nitrate-nitrogen values recorded relative to ammonia-nitrogen values has significant implications for nutrient. In addition, the Principal Component Analysis (PCA) identified as trace metals are the most important factor responsible for variations observed in the data. Although the levels of Zn and Cu are still below the recommended limits, there is need for urgent action to prevent further increase. This is because trace metals act as micronutrients at low concentrations but at higher levels they become toxic depending on the prevalent chemical form (i.e., speciation) of trace element in water. Also bioaccumulation and food chain magnification of trace metals may occur (Mishra *et al.*, 2016).

However, the ferruginous nature of catchment area soils (Sharma *et al.*, 2017) may account for the levels of iron which exceeded recommended limits for drinking water quality. Cynobacteria have higher requirements for trace elements compared with eukaryotic phytoplankton (Yang, 2016) (Valtcho, 2002) (Aroroa *et al.*, 2002) (Balaji *et al.*, 2022), hence increased level favours their growth and physiology.

Although phytoplankton species composition and diversity changes with environmental conditions such as nutrients levels, temperature, light, predator pressure etc., the relative importance of these factors vary considerably among different taxa. Under conditions of nutrient enrichment or eutrophication, the blue-greens are known to proliferate and form noxious blooms in fresh water environments (Hassan, 2013) (Wang, 2020) (Ehsanul Kabir *et al.*, 2012).

Cynobacteria can produce both hepato toxic peptides which cause liver damage and are tumour-favouring e.g., microcytin as well as neurotoxic alkaloids that affect the nervous system e.g., aphonotoxin and anatoxin-a. Cyanophytes are thus recognised as potential toxic organisms and their blooms in drinkingwater are recreational reservoirs of great importance. Cyanobacterial toxins are contained within the living cells and are not released into surrounding water until senescene or death of the cells. Pre-chlorination during water treatment or the application of copper sulphate in controlling blooms (used in some European Countries) results in cells death and release of toxins into water (Raluca *et al.*, 2017) (Lakshmi *et al.*, 2022). In 1988 within 2-3 weeks of Cu treatment of the Goezalkowice reservoir, South Poland, the District Medical Officers recorded a rise in the number of cases of spastic bronchitis especially in children of this locality (Kumar *et al.*, 2005). Although there are no recorded cases of toxicosis in animals or humans (Prince *et al.*, 2020). Some abnormalities in the gonads of Telapiazillii and Oreochromisniloticus have been found in the reservoir. In T. zillii, abnormal ovaries were unusually shaped with very thin oocytes. However, in O. niloticus unequal ovarian lobes and the occurrence of two pairs of ovaries were observed. It was suggested that massive development of eggs could be due to break-down in nervous and hormonal co-ordination in fish during the breeding period. Since both species of fish are algae feeders it is possible that the abnormalities observed could be related to their diet (Lal, 1996).

In view of the use of reservoir for water supply, control measures aimed at preventing bloom formation such as reduction of nutrient load into the reservoir, artificial mixing of the water and biomanipulation of food-web components should be implemented in order to protect bio-diversity (Feng *et al.*, 2008) (Wang *et al.*, 2009) in India.

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