International Journal of Advanced Research in Biological Sciences
ISSN: 2348-8069
www.ijarbs.com
DOI: 10.22192/ijarbs Coden: IJARQG (USA) Volume 8, Issue 3 -2021

Research Article


DOI: http://dx.doi.org/10.22192/ijarbs.2021.08.03.004

# Physico-chemical characteristics of Akshar Vihar pond in Bareilly, U.P.

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## Abstract

The present paper deals with the monthly variations in physico-chemical parameters of Akshar Vihar pond, Bareilly, U.P., during July 2019 to June 2020. This pond is located at a distance of 2.5 km from Bareilly Junction in the cantonment area at latitude 28°20'19"N and longitude 79°25'39"E.Physico-chemical parameters were analysed using standard methods for water analysis. The ranges of monthly mean values were obtained after analysis of water samples in triplicates, for air temperature (17.03-36.03°C), water temperature (17.97-35.97°C), transparency (17.93-36.03 cm), pH (6.77-8.63), dissolved oxygen (6.40-9.97 mg/l), free $CO_2$ (0-18 mg/l),carbonate alkalinity (0-67 mg/l), bicarbonate alkalinity (155.58-433.13 mg/l),chloride (4.52-5.92 mg/l), calcium (65.76-82.34 mg/l), magnesium (158.60-538.83 mg/l), total hardness (380-480 mg/l), BOD (1.23-1.80 mg/l) and COD (3.97-8.83 mg/l). The data was subjected to various statistical analysis in order to investigate the significant relationship among these parameters. A positive relationship of air temperature with water temperature (0.864), dissolved oxygen with BOD (0.869), magnesium with both total hardness (0.915) and COD (0.866) was observed along with a negative relationship of water temperature and pH (-0.913).

**Keywords:** Akshar Vihar pond, Physico-chemical parameters, water quality.

## Introduction

The role of water in nature is inimitable from the human point of consideration, as well as the numerous organisms which make aquatic medium as their habitat. Understanding such aquatic life requires a thorough knowledge of water and other external influences that affect them. The physical and chemical properties of freshwater bodies are characterized by the climatic, geochemical, geomorphological and pollution conditions. The aquatic life depends on the quality of water. In order to utilize freshwater bodies successfully for abundant fish production, it is very significant to study the physicochemical characteristics which influence the biological productivity of the water body. Several studies have been made on the limnology of freshwater bodies in India during recent years (Kumar, 1992, 1995; Naganandini and Hosmani, 1998; Pandey *et. al.*, 2000; Patil and Tijare, 2001; Gupta and Shukla, 2006). While reviewing the literature, it seems that almost no study is conducted on physico-chemical aspects of Akshar Vihar pond in Bareilly. Hence, the present study is an attempt to work out the detailed information on important physico-chemical parameters of Akshar Vihar pond in Bareilly (U.P.).

## Materials and Methods

Akshar Vihar pond is located at a distance of 2.5 km from Bareilly junction in the cantonment area at latitude 28°20'19"N and longitude 79°25'39"E.Study was conducted from July 2019 to June 2020, except April 2020 due to COVID-19 pandemic constraint. Water samples were collected every month during morning hours, between 9.30 a.m. to 11.30 a.m. from three different sites in clean plastic cans and immediately transferred to the laboratories for analysis. Parameters such as transparency, pH and temperature were analysed on the spot itself, whereas the others were analysed in the laboratory following the standard methods of Trivedi and Goel (1986) and APHA (2005) and compared with standard values of aquaculture pond water (BIS, 1991). Various statistical analyses, applied to determine the relationship among different physico-chemical parameters and their correlation matrix, are given in Table-1 and Table-2, respectively.

## Results and Discussion

The pond water temperature is largely influenced by local climatic conditions. Water temperatureinfluences many abiotic and biotic components of aquatic ecosystem, directly as well as indirectly. It also reflects the dynamics of the living organisms such as metabolic and physiological behaviour of aquatic ecosystem. In the present study water temperature was found ranging between 17.97±0.15°C to 35.97±0.15°C, of which maximum value (35.97°C) was noticed in summer season during June 2020 and the minimum value (17.97°C) in winter season during December 2019. Maximum temperature of water in June may be attributed to the shallowness of pond, low macrophytic production and highest load of suspended matter (Kumar, 1990). Many workers observed similar trends while working on different water bodies (Reid and Wood, 1976; Dutta, 1978; Walia, 1983; Dwivedi and Pandey, 2002).

Transparency in the present study ranged between 17.93±0.31 to 36.03±0.45 cms of which higher value (36.03 cm) was reported in the month of February2020, while the lower value (17.93 cm) during June 2020. Similar conclusion was reported by Kamal *et al.* (2007).

Measurement of hydrogen ion concentration is represented as pH. It does not measure total acidity or alkalinity. The pH values ranged from 6.77±0.25 to 8.63±0.15 during the whole period of study. pH of water is considered as one of the most important chemical parameters since aquatic organisms are well adapted to specific pH range and do not withstand abrupt changes in it (George, 1997). pH also influences other factors like conductivity, bicarbonates, chloride, salinity, phosphate, hardness and magnesium.

The presence of dissolved oxygen is essential to maintain the higher forms of biological life and to keep proper balance of various pollutions thus making the water bodies healthy. The chemical and biochemical process undergoing in water body are largely dependent upon the presence of oxygen. Estimation of dissolved oxygen is a key test in water pollution and waste treatment process control. In the present investigation dissolved oxygen ranged from 6.40±0.10 to 9.97±0.55 mg/l. The permissible value recommended for DO is 5mg/L as per Indian standard. Winter increase in dissolved oxygen has also earlier been reported by many workers (Pennak, 1968; Vasisht and Sharma, 1975; Das and Pathani, 1978; Vasisht and Jindal, 1980; Kant and Raina, 1985). Increased levels of dissolved oxygen during winter months may be due to the increased solubility of oxygen at lower temperature. The relationship of dissolved oxygen with air and water temperature is depicted in Fig.-1.

Carbon dioxide is added to aquatic system as it is directly mixed from atmosphere. Free $CO_2$ in the present study varied from 0 to 18±2 mg/L. The highest value (18 mg/L) of free $CO_2$ was recorded in the month of October 2019. The increase in carbon dioxide level may be related to decay and decomposition of organic matter (Datta Munshi, 1995). This is strengthened by the observations of Joshi *et. al.* (1995) who have observed the addition of drainage was the main causal factor for increase in carbon dioxide in the water bodies. The relationship of free carbon dioxide with carbonate and bicarbonate alkalinity is presented in Fig.-2. Inverse relationship of dissolved oxygen and free $CO_2$ is well documented by Ganpati (1943), Kadlec (1962) and Patil *et al.* (1985).

The chlorides control the salinity of water and osmotic stress on biotic communities (Banerjee, 1967). The most important sources of chlorides in the fresh water is the discharge domestic and industrial sewage. The concentration of chlorides is thus the indicator of pollution (Pejaver and Gurav, 2008). The Chloride concentration in the study area ranged from 4.52±0.06

**Table-1: Descriptive statistics for various physicochemical parameters**

| | AT | WT | Tr. | pH | DO | $CO_2$ | $CO_3^{-2}$ | $HCO_3^-$ | $Cl^-$ | $Ca^{+2}$ | $Mg^{+2}$ | TH | BOD | COD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mean** | 27.82 | 26.00 | 26.28 | 7.90 | 8.08 | 4.70 | 29.91 | 271.73 | 5.13 | 75.07 | 58.35 | 427.85 | 1.48 | 6.43 |
| **Standard Error** | 1.52 | 1.75 | 1.53 | 0.18 | 0.36 | 2.22 | 8.53 | 39.62 | 0.15 | 1.52 | 2.25 | 9.35 | 0.05 | 0.49 |
| **Median** | 26.97 | 26.97 | 25.93 | 7.97 | 7.77 | 0.00 | 32.00 | 206.38 | 5.06 | 74.05 | 62.10 | 427.67 | 1.48 | 6.83 |
| **Standard Deviation** | 5.03 | 5.79 | 5.08 | 0.59 | 1.20 | 7.36 | 28.31 | 131.41 | 0.50 | 5.03 | 7.47 | 31.01 | 0.17 | 1.64 |
| **Sample Variance** | 25.35 | 33.52 | 25.80 | 0.35 | 1.45 | 54.17 | 801.29 | 17269.45 | 0.25 | 25.31 | 55.86 | 961.76 | 0.03 | 2.68 |
| **Kurtosis** | 1.29 | -0.64 | 0.25 | -0.48 | -1.22 | -0.51 | -1.56 | -0.10 | -1.40 | -0.06 | 0.36 | -0.58 | -0.27 | -0.98 |
| **Skewness** | -0.55 | 0.35 | 0.38 | -0.66 | 0.28 | 1.18 | 0.25 | 1.08 | 0.42 | 0.03 | -1.12 | 0.04 | 0.17 | -0.30 |
| **Range** | 19.00 | 18.00 | 18.10 | 1.86 | 3.57 | 18.00 | 72.00 | 380.23 | 1.40 | 16.58 | 23.70 | 100.00 | 0.57 | 4.86 |
| **Minimum** | 17.03 | 17.97 | 17.93 | 6.77 | 6.40 | 0.00 | 0.00 | 158.60 | 4.52 | 65.76 | 42.90 | 380.00 | 1.23 | 3.97 |
| **Maximum** | 36.03 | 35.97 | 36.03 | 8.63 | 9.97 | 18.00 | 72.00 | 538.83 | 5.92 | 82.34 | 66.60 | 480.00 | 1.80 | 8.83 |
| **Confidence Level (95%)** | 3.38 | 3.89 | 3.41 | 0.40 | 0.81 | 4.94 | 19.02 | 88.28 | 0.34 | 3.38 | 5.02 | 20.83 | 0.12 | 1.10 |

**Table-2: Correlation matrix for different physicochemical parameters**

| | AT | WT | Tr. | pH | DO | $CO_2$ | $CO_3^{-2}$ | $HCO_3^-$ | $Cl^-$ | $Ca^{+2}$ | $Mg^{+2}$ | TH | BOD | COD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AT | 1.000 | | | | | | | | | | | | | |
| WT | 0.864 | 1.000 | | | | | | | | | | | | |
| Tr. | -0.315 | -0.577 | 1.000 | | | | | | | | | | | |
| pH | -0.772 | -0.913 | 0.611 | 1.000 | | | | | | | | | | |
| DO | -0.477 | -0.609 | 0.502 | 0.607 | 1.000 | | | | | | | | | |
| $CO_2$ | -0.567 | -0.366 | -0.366 | 0.391 | 0.075 | 1.000 | | | | | | | | |
| $CO_3$ | 0.547 | 0.348 | 0.141 | -0.313 | 0.338 | -0.742 | 1.000 | | | | | | | |
| $HCO_3$ | 0.493 | 0.597 | -0.175 | -0.658 | 0.072 | -0.530 | 0.694 | 1.000 | | | | | | |
| $Cl^-$ | 0.391 | 0.167 | 0.564 | -0.133 | 0.224 | -0.681 | 0.624 | 0.512 | 1.000 | | | | | |
| $Ca^+$ | 0.033 | 0.266 | -0.485 | -0.370 | -0.203 | 0.170 | -0.191 | -0.033 | -0.566 | 1.000 | | | | |
| $Mg^+$ | -0.337 | -0.254 | -0.038 | 0.202 | 0.723 | 0.152 | 0.353 | 0.450 | 0.008 | -0.166 | 1.000 | | | |
| TH | -0.312 | -0.144 | -0.230 | 0.052 | 0.634 | 0.214 | 0.275 | 0.426 | -0.224 | 0.245 | 0.915 | 1.000 | | |
| BOD | -0.596 | -0.715 | 0.464 | 0.685 | 0.869 | 0.103 | 0.255 | -0.031 | 0.151 | -0.379 | 0.683 | 0.520 | 1.000 | |
| COD | 0.031 | 0.126 | -0.102 | -0.196 | 0.558 | -0.157 | 0.616 | 0.796 | 0.339 | -0.128 | 0.866 | 0.796 | 0.483 | 1.000 |

to 5.92±0.12 mg/l. The minimum value was recorded in the month of December and maximum in May. Present summer increase in chloride is in conformity with the observations of Munawar (1970), Harshey *et al.* (1982) and Kumar (1992).

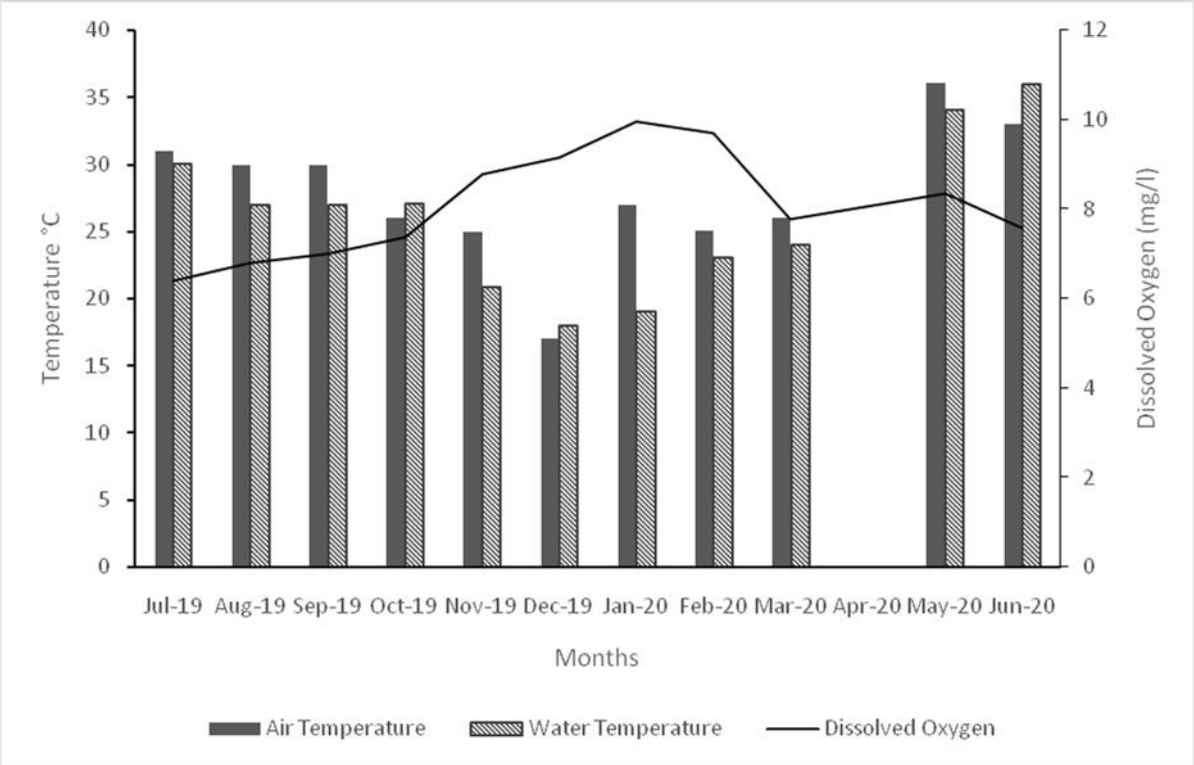


**Fig.1: Monthly variation in Dissolved Oxygen with respect to Air and Water temperatures**

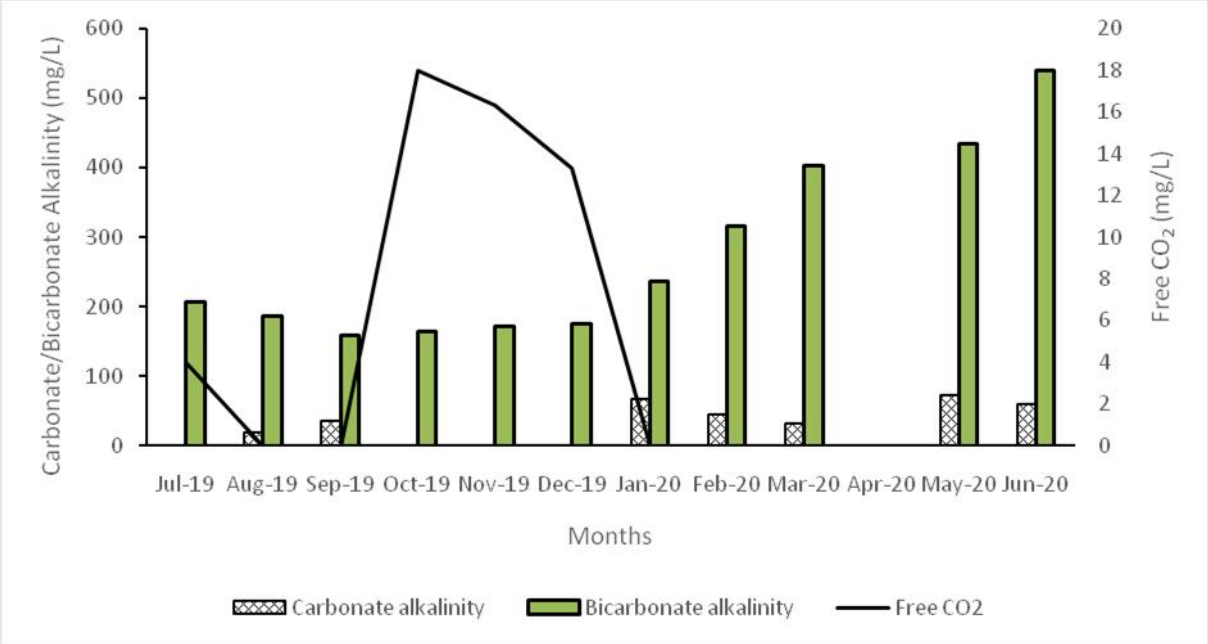


**Fig.2: Monthly variation in free $CO_2$ concentration with respect to Carbonate/Bicarbonate alkalinity**

Total hardness of water is a measure of its capacity to form precipitates with soap and scales with certain anions present in the water. It is not a pollution parameter but indicates water quality mainly in terms of $Ca^{2+}$ and $Mg^{2+}$ content. Total hardness values ranged from 380±15 to 480±15 mg/L in the study area. According to APHA (2005), the desirable limit for total hardness is 300 mg/l. As the value of total hardness is much more than the desirable limit, this water is not suitable for use in washing and cleaning. Calcium is an important nutrient for aquatic, organism and it is commonly present in all water bodies (Ansari and Prakash, 2000). In the present study, calcium concentration varied from 65.76±1.61 to 82.34±2.02 mg/L, while magnesium concentration ranged between 42.93±1.01 to 66.58±0.97 mg/l. The maximum permissible limit of calcium hardness is 30 mg/l (BIS, 1991). Magnesium is often associated with calcium in all kind of water, but its concentration remains generally lower than the calcium (Venkatasubramani and Meenambal, 2007). Fig-3 is showing the relationship of total hardness with calcium and magnesium concentrations.

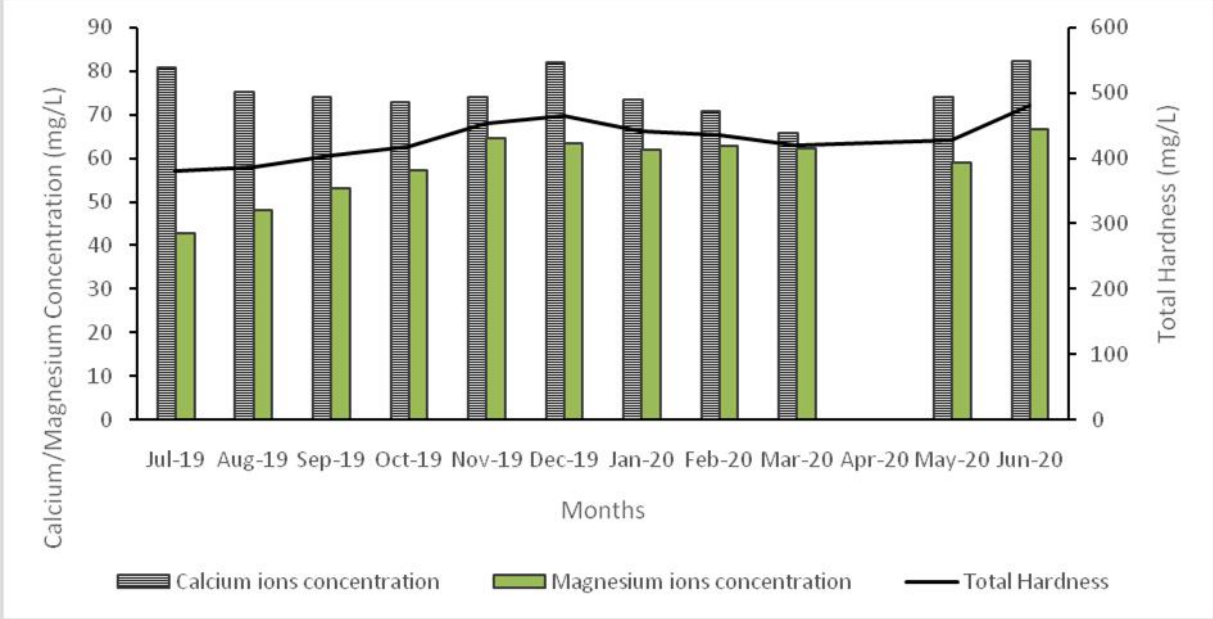


**Fig.3: Monthly variation in Calcium, Magnesium and total hardness concentration**

BOD is the measure of degradable organic matter present in water. The BOD and other microbial activities are generally increased by the introduction of sewage (Hynes, 1971). BOD values ranged from 1.23±0.06 to 1.80±0.10 mg/L. The minimum value of BOD was noticed in the month of July & August 2019 while maximum in January 2020 (Fig.-4). Lower values of BOD indicate the lower consumption of oxygen and lower population load in the pond water.

COD is the amount of oxygen consumed by reactions in a measured solution. It is useful for water quality to determine the effect of an effluent. The COD values ranged from 3.97±0.25 (August 2019) to 8.83±0.45 mg/L (June 2020). COD was positively correlated with magnesium (0.866, Table-2).

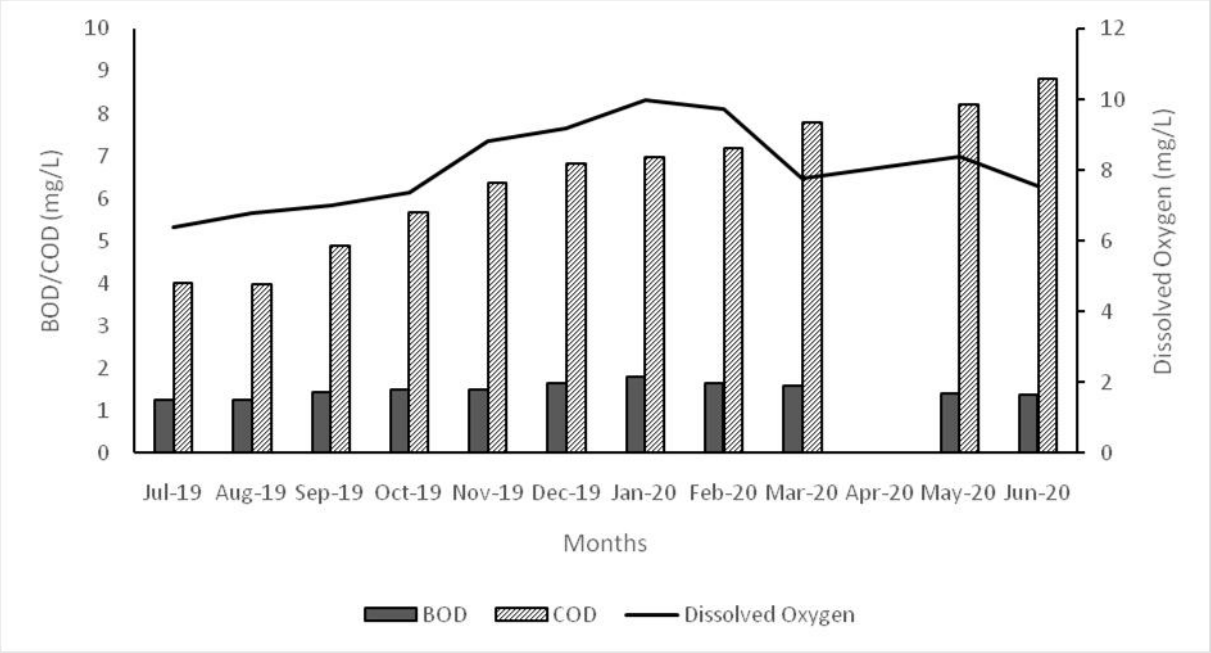


**Fig.4: Monthly variation in dissolved oxygen, BOD and COD**

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DOI:10.22192/ijarbs.2021.08.03.004

How to cite this article:
S. Kumar, V. Jain and S.K. Raghuvanshi. (2021). Physico-chemical characteristics of Akshar Vihar pond in Bareilly, U.P. Int. J. Adv. Res. Biol. Sci. 8(3): 30-36.
DOI: http://dx.doi.org/10.22192/ijarbs.2021.08.03.004