Physico-chemical properties of two village ponds of Surat District, Gujarat (India)

Ekhalak Ansari*[1], Mohini Gadhia[2] and Ranjana Surana[3]

Department of Aquatic Biology, Veer Narmad South Gujarat University, Surat, India

Abstract

Present study was conducted to assess the physico-chemical characteristics of the water of two village ponds of Kadiphadia (Dumas) and Piplod located in Surat District, Gujarat. Important water quality parameters *viz.,* air temperature, water temperature, turbidity, total solids, total dissolved solids, total suspended solids, pH, total hardness, calcium hardness, magnesium hardness, total alkalinity, dissolved oxygen (DO), bio-chemical oxygen demand (BOD), chloride, phosphate, silicate, nitrate, nitrite and ammonical nitrogen noted were 25.83ºC, 26.08ºC, 99.68 NTU, 972 mg/L, 632 mg/L, 255 mg/L, 8.7, 118 mg/L, 85.99 mg/L, 7.809 mg/L, 124 mg/L, 4.48 mg/L, 20.962 mg/L, 156.79 mg/L, 0.481 mg/L, 0.261 mg/L, 9.181 mg/L, 0.053 mg/L and 0.159 mg/L in Kadiphadia (Dumas) and 26.75ºC, 26.75ºC, 3.08 NTU, 17822 mg/L, 15390 mg/L, 91 mg/L, 7.6, 4235 mg/L, 2049.99 mg/L, 533.343 mg/L, 67.167 mg/L, 5.26 mg/L, 2.937 mg/L, 6901.61 mg/L, 0.521 mg/L, 0.181 mg/L, 2.244 mg/L, 0.006 mg/L and 0.157 mg/L in Piplod pond respectively. The values of various parameters were compared with water quality standards for aquaculture development. Higher values of total solids, total dissolved solids, total suspended solids and chloride concentrations were noted in both the pond water. High concentration in Kadiphadia (Dumas) may be due to leaching of brackishwater as the pond is located near to Arabian Sea while Piplod pond was fed with groundwater having high values.

Keywords: Village ponds, physico-chemical characteristics, aquaculture.

*Correspondence
Author: Ekhalak Ansari
Emails: aquatic44@yahoo.com

Introduction

Water quality is very important factor to understand the biological phenomenon completely, as the quality of water reveals about metabolism of the ecosystem and also explains the general hydro-biological interrelationship [1, 2]. Ponds are one of the most important sources of water for fish, wildlife and human being. However, the water of the ponds and other natural water bodies are polluted due to various anthropogenic activities *viz.,* discharge of waste water from residential areas, sewage outlets, solid wastes, detergents, automobile oil wastes, fishing industries and agricultural pesticides from farmlands [3, 4, 5]. Village ponds with high-quality water will produce more and healthier fish compare to ponds having poor quality water [6]. Monitoring the water quality of village ponds can quantify the scope and duration of aquaculture development. Early identification of water quality degradation in aquaculture ponds through routine monitoring permits aquaculturists to execute minor changes to correct the problems of water bodies [7]. Present study is an attempt to assess the water quality of two ponds of Surat District, Gujarat (India) for the sustainable scope of aquaculture development.

Experimental
Study Area

Surat is located on the bank of Tapi River in Gujarat, India. Two village ponds have been selected for the present investigation. First site Kadiphadia (Dumas) pond (lat 21°06'24.48"N, long 72°42'29.53"E) is located in Dumas village having 2.02 ha area whereas second site Piplod pond (lat 21°09'52.34"N, long 72°46'49.45"E) situated in Piplod having 1.21 ha area.

Materials and Methods

Water samples were collected monthly from the ponds in acid washed polythene bottles during morning hours between 7.00 a.m. to 9.00 a.m. Air temperature, water temperature and pH of water were noted down at the site. Samples for DO were fixed at the sampling sites. All the samples were analyzed in the laboratory of Department of Aquatic Biology, Veer Narmad South Gujarat University, Surat. Important water quality parameters *viz.,* air temperature, water temperature, turbidity, total solids, total dissolved solids, total suspended solids, pH, total hardness, calcium hardness, magnesium hardness, total alkalinity, dissolved oxygen (DO), bio-chemical oxygen demand (BOD), nitrate, nitrite [8] chloride, phosphate, silicate [9] and ammonical nitrogen [10] were done following the standard methods. Turbidity was measured by using digital turbidity meter (EQ-811, range, 0-2000). Photometric analysis was carried out by using UV- Spectrophotometer (Shimadzu-UV-1800). All the reagents used for the analysis were AR grade. Double distilled water was used for preparation of solutions. Mean and Standard deviation were also calculated.

Results and Discussion

Water quality of village ponds is given in **Table 1**.

Table 1 Water Quality of village ponds

Parameter	Minimum		Maximum		Mean Value		SD	
	PI	PII	PI	PII	PI	PII	PI	PII
Air temperature (°C)	17	21	31	30	25.83	26.75	4.66	2.56
Water temperature (°C)	20	21	31	31	26.08	26.75	3.72	2.86
Turbidity (NTU)	8.5	1	230	6	99.68	3.08	84.22	1.40
Total solids (mg/L)	220	6186	2030	30790	972	17822	709.80	8137.66
Total dissolved solids (mg/L)	154	485	1600	30700	632	15390	528.07	9269.53
Total suspended solids (mg/L)	20	40	560	120	255	91	212.99	24.00
pH	7.5	7.2	8.9	7.9	8.7	7.6	0.79	0.218
Total hardness (mg/L)	78	1670	178	5950	118	4235	34.31	1215.80
Calcium hardness (mg/L)	40	690	150	2909.98	85.99	2049.99	37.13	709.88
Magnesium (mg/L)	1.96	239.12	11.22	839.36	7.809	533.343	2.82	183.64
Total alkalinity (mg/L)	64	34	176	108	124	67.167	33.86	23.45
Dissolved oxygen (mg/L)	1.62	1.62	7.29	9.72	4.48	5.26	2.09	2.34
BOD (mg/L)	4.05	1.21	60.8	6.48	20.962	2.937	22.57	1.40
Chloride (mg/L)	42.6	83.07	461.5	12496	156.79	6901.61	150.99	4035.13
Phosphate (mg/L)	0.066	0.026	1.004	4.546	0.481	0.521	0.30	1.27
Silicate (mg/L)	0.036	0.06	0.646	0.378	0.261	0.181	0.18	0.10
Nitrate (mg/L)	1.679	0.614	20.708	6.056	9.181	2.244	7.03	1.80
Nitrite (mg/L)	0.006	0.003	0.163	0.012	0.053	0.006	0.05	0.00
Ammonical nitrogen (mg/L)	ND	0.027	0.494	0.39	0.159	0.157	0.164	0.12

PI= Kadiphadia (Dumas) pond, PII= Piplod pond, *ND= Not detected.

Air temperature recorded 25.83°C from PI while it was noted 26.75°C from PII. Similarly water temperature was 26.08°C from PI while 26.75°C was recorded from PII. Turbidity of water was found 99.68 NTU in PI and 3.08 NTU in PII. Total solids of pond noted 972 mg/L from PI and 17822 from PII. Similarly, total dissolved solids of pond

showed the value of 632 mg/L in PI and 15390 mg/L in PII. The values of total suspended solids of pond were from 255 from PI and 91 mg/L from PII. pH of pond water was alkaline during the study period. Total hardness was recorded as 118 mg/L from PI and 4235 mg/L from PII. Calcium hardness noted 85.99 mg/L in PI and 2049.99 mg/L in PII and magnesium hardness observed 7.809 mg/L from PI and 533.343 mg/L from PII respectively. Total alkalinity of PI was 124 mg/L where as it was 67.167 mg/L in PII. In the present study, DO was observed 4.48 mg/L from PI and 5.26 mg/L from PII. BOD observed 20.962 mg/L from PI and 2.937 mg/L from PII. The chloride was found 156.79 mg/L from PI and 6901.61 mg/L from PII. Nutrients like phosphate, silicate, nitrate, nitrite and ammonical nitrogen noted (0.481 mg/L), (0.261 mg/L), (9.181 mg/L), (0.053 mg/L), (0.159 mg/L) from PI and (0.521 mg/L), (0.181 mg/L), (2.244 mg/L), (0.006 mg/L) and (0.157 mg/L) in from PII respectively. Water quality influences the biological productivity of ponds and so the aquatic production. Temperature is one of the important factors affecting the activity of aquatic life. During the present investigation the air temperature of Kadiphadia (Dumas) pond (25.83ºC) and Piplod pond (26.75 ºC) was found suitable for aquaculture development prescribed by [11]. Higher value of turbidity was found in Kadiphadia (Dumas) pond (99.68 NTU) whereas it was lower in Piplod pond (3.08 NTU). Turbidity in the range of 20-30 NTU were found suitable for fish culture [12] but in present investigation village ponds crossed the limit. Higher values of total solids were observed in both the ponds. Similar higher range of total solids was noted by [13]. During present investigation the values of TDS measured from (632mg/L) in Kadiphadia (Dumas) pond whereas it was (15390 mg/L) in Piplod pond. High values of TDS in Kadiphadia (Dumas) pond could be due to addition of domestic wastewater, garbage and sewage *etc.* [14] while in Piplod pond high TDS was due to ground water impoundment. The value of TSS was (255 mg/L) in Kadiphadia (Dumas) pond whereas it was (91 mg/L) in Piplod pond. Total suspended solids in ponds water are found due to the substances that are found in suspension forms such as silt, clay and plankton *etc.* Values of total suspended solids for aquaculture were prescribed in the range of 30-200 mg/L [15]. It was slightly higher in Kadiphadia (Dumas) pond. The pH of both the ponds water was alkaline and suitable for fish culture [16]. Hardness of pond water is the measure of divalent cations such as calcium and magnesium [17]. Values of total hardness, calcium and magnesium from Kadiphadia (Dumas) pond were within the limit of aquaculture whereas it exceeded in Piplod pond [18]. Calcium and magnesium are essential for aquatic organisms as they contribute in various metabolic activities such as bone and scale formation. Total alkalinity is a measure of the concentration of bases in pond water and it is water's ability to resist changes in pH. The mean total alkalinity of 124 mg/L was observed in Kadiphadia (Dumas) pond while 67.167 mg/L was observed in Piplod pond. A total alkalinity of at least 20 mg/L is necessary for pond productivity. The values obtained in the present work are found within desirable range [18]. The mean value of dissolved oxygen 4.48 mg/L was noted in Kadiphadia (Dumas) pond whereas 5.26 mg/L was observed in Piplod pond. Dissolved oxygen is one of the important factors for the growth and body activities of the fish. The value of DO was slightly lower than the desirable range in Kadiphadia (Dumas) pond [16]. The value of low DO of present investigation was an agreement with the minimum DO of 5.0 mg/L reported for tropical fishes by [19]. BOD is the measure of oxygen required for decomposition of biodegradable organic matter by microorganism. The mean value of BOD (20.962 mg/L) was found in Kadiphadia (Dumas) pond while (2.937 mg/L) observed in Piplod pond. BOD of more than 35 mg/L is not suitable for aquaculture [20]. During present investigation the values of BOD was within desirable limits. Chloride found naturally as anion in all water bodies in varying concentrations. The source of chloride in surface water may be from weathering and leaching of sedimentary rocks, domestic, industrials and municipal wastes discharge *etc.* In the present investigation, the values of chloride recorded are as 156.79 mg/L in Kadiphadia (Dumas) pond while 6901.61 mg/L in Piplod pond. Phosphorus is one of the important parameter to predict the productivity of pond. It occurs naturally in rocks and other mineral deposits. During the process of weathering, the rocks gradually release the phosphorus as phosphate ions which are soluble in water. In the present investigation, phosphate recorded was 0.481 mg/L in Kadiphadia (Dumas) pond and 0.521 mg/L in Piplod pond. Silicate is important for the growth of diatoms in water bodies. The concentration of silica in natural water is found in the range of 1 to 30 ppm [9]. In present investigation the concentration of silicate was low. Nitrogen *viz.,* nitrate, nitrite and ammonical nitrogen were investigated (9.181 mg/L), (0.053 mg/L) and (0.159 mg/L) in Kadiphadia (Dumas) and (2.244 mg/L), (0.006 mg/L) and (0.157 mg/L) in Piplod pond respectively. These were almost suitable for aquatic biota [15, 16, 18].

Conclusions

Present study on water quality of two village ponds indicated that with scientific management and monitoring of ponds may be useful for aquaculture development.

Acknowledgement

References

[1]   Deshmukh, JU and Ambore, NE, J Aqua Biol, 2006, 21, 2, 93.
[2]   Patil, R, Anil and S Lohar Prakash, J Aqua Biol 2009, 24, 2, 1.
[3]   Srivastava, N, M Agrawal and A Tyagi, J. Environ Biol 2003, 24, 177-180.
[4]   Usha, R, Ramalingam, K and Bharathi Ramjam, UD, J. Environ. Biol. 2006, 27, 713-722.
[5]   Hasan, GO., Paul P. Mathisen and Don Pellegrino, J Environ Biol, 28, 2007, 493-502.
[6]   Boyd, CE, Res. and Develop., 1998, 43: 1-11.
[7]   Wisdom Solomon, GO, Olatunde, AA and Matur, BM, Global Advanced Research Journal of Agricultural Science 2013, 2, 1, 017-022.
[8]   APHA, Standard method for examination of water and waste water, 19th ed. American public health association, New York, 1995.
[9]   Trivedy PK and Goel RK, Chemical and Biological methods water pollution studies, Environmental publication Karad, India, 1986.
[10] Gupta, PK, Soil, plant, water and fertilizer analysis. Published by Agro Botanica, J.N. Vyas nagar, Bikaner, India, 1999.
[11] Gupta, SK and Gupta, PC, General and applied Ichthyology (Fish and fisheries). S. chand and company Ltd., New Delhi, 2006.
[12] Zweigh, RD, Hydrobiologia 1989, 171, 11-21.
[13] Parikh, AN and Mankodi, PC, Res. J. Recent Sci. 2012, 1, 1, 16-21.
[14] Verma, PU, Purohit, AR and Patel, NJ, IJERA 2012, 2, 1600-1606.
[15] CIFE, Training Manual on Recent Advances in Management of Water Quality Parameters in Aquaculture, Central Institute of Fisheries Education, ICAR, Versoa, Mumbai, 1997.
[16] CIFE, (2013). Management of Soil, Water and Fish Diseases in Aquaculture, Kolkata Centre, Central Institute of Fisheries Education, ICAR, Versoa, Mumbai, 2013.
[17] Ehiagbonare, JE and Ogunrinde, YO, African Journal of Biotechnology 2010, 9, 36, 5922-5928.
[18] Boyd, CE, Water quality in ponds for Aquaculture. Auburn University, Agric. Exptal. Sta., Auburn, Alabama, 1990.
[19] Saloom ME, Duncan RS, Fresh Water Biol. 2005, 50, 1233-1238.
[20] Pande, KS and Sharma, SD, Poll. Res. 1999, 18 (3), 327-333.