

STUDY OF PHYSICO-CHEMICAL PARAMETERS FROM VISHNUPURI DAM, NANDED, MAHARASHTRA, INDIA

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ABSTRACT:

The present study was carried out from July 2006 to June 2008. During the study period water quality studied. Various quality parameters are measured including pH, air temperature, water temperature total solids, free CO₂, BOD, COD, total hardness, calcium, DO, total alkalinity, magnesium, chloride, and sulphate. All water parameters are within the permissible limit and suitable for biodiversity. The result indicated and discussed.

Key Words: Parameter, Vishhnupuri , Water Quality and biodiversity

Introduction: Water is an important resources for all living organisms. All the living organisms are depends on water for drinking, agriculture , food production , industries and very importance for waste disposal .The other biota is also depends on freshwater sources like river, dam well and lake etc. The condition of drinking water may be polluted with pathogen, toxic metal, chemical compounds such as pesticides, herbicides and other industrial waste becomes waterborne outbreaks , our main resources of freshwater is dams and from last two decade it will observed that our resources get polluted and hence the time comes to get reform and analysis the water quality of our near by dams. The present study was aimed at analyzing some important characteristics of water quality is of vital concern for the mankind because it related to human welfare.

Material and Methods

To study the water quality, which define as physical, chemical and biological characteristics of Water samples were collected monthly at 2 feet depth from the surface area of the water body from the two sampling points in between 7 to 11 am during the study period. The first sampling point (S₁) near the wall of the dam and second sampling site (S₂) at the river entry point and the distance between two sampling points were approximately 2 to 5 km.

The parameters studied were pH, air temperature, water temperature total solids, free CO₂, BOD, COD, total hardness, calcium, DO, total alkalinity, magnesium, chloride, and sulphate. Parameters like pH, air temperature and dissolved oxygen was measured at the site, and samples in 5 liter plastic cans were brought to the Fishery research laboratory, Department of Zoology, Rajarshi Shahu Art's, Commerce and Science College, Pathri

Aurangabad.for further estimation by using standard water analysis method described by APHA (1992), Kodarkar (1992), Trivedy and Goel (1986).

1.1 Morphometric Study

1.2 Study of physical parameters: Physical parameters such as air temperature, water temperature, total solids, total dissolved solids and total suspended solids were analyzed by the standard methods by Trivedy and Goel(1986), Kodarkar (1992).

i) pH (Hydrogen ion concentration): pH of water was recorded by field pH Meter Hanna –Model champ during study period on sampling site.

ii) Temperature: Water and air temperature of sampling site was recorded from June 2006 to May 2008. The temperature was recorded with a centigrade mercury thermometer (graduated from 0.0 °C to 110 °C) in the field.

iii) Total Solids, (TS), Total Dissolved Solids, (TDS) Total Suspended Solids (TSS). Total solids, total dissolved solids and total suspended solids were determined on monthly basis during the study period. Total dissolved solids (TDS) were determined in the laboratory as the residue left after evaporation of the filtered water sample while total suspended solids were determined by calculating the difference between total solids and total dissolved solids.

1.3 Study of Chemical parameters: Water samples from sampling site during the study period June 2006 to May 2008 were collected monthly and brought to the Fishery research laboratory, Department of Zoology, Dr Babasaheb Ambedkar Marathwada University, Aurangabad, for analysis of various chemical parameters. Chemical parameters like dissolved oxygen, free CO₂, BOD, COD total hardness, magnesium, calcium, total alkalinity, chlorides, and sulphate, were determined by standard methods as described by Trivedy and Goel (1986), Kodarkar (1992).

i) Total Alkalinity : Total alkalinity of water samples was estimated in laboratory by using standard method as described by Trivedy and Goel. (1986).

ii) Total Hardness: Total hardness of collected water samples was estimated by EDTA method in the laboratory as described by Trivedy and Goel. (1986).

iii) Magnesium (Mg⁺⁺) and Calcium (Ca⁺⁺): Calcium and Magnesium was determined in the laboratory by using titration method as described by Trivedy and Goel (1986).While magnesium was determined as the difference between the total titrant (Ca⁺⁺ + Mg⁺⁺) and the titrant for Ca⁺⁺.

iv) Sulphate:- Sulphate was estimated in the laboratory by using Gravimetric method as described by Trivedy and Goel (1986).

v) Dissolved oxygen :- Dissolved oxygen was estimated in the laboratory by using Winklers iodometric method as described by Trivedy and Goel (1986).

- vi) **Free Co₂ :-** Free Co₂ was estimated in the laboratory by using titration method as described by Trivedy and Goel (1986).
- vii) **Biological Oxygen Demand :-**BOD of water samples was estimated in the laboratory by the method described by APHA (1992).
- viii) **Chemical Oxygen Demand :-** COD of water samples was estimated in the laboratory by the method described by APHA (1992).
- ix) **Chloride :-** Chloride was estimated in the laboratory by using titration method as described by Trivedy and Goel (1986).

Table : 01

PHYSICO-CHEMICAL PARAMETERS OF VISHNUPURI DAM, 2006-2007

Parameters	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Air Temp.	24.5	26.25	26.5	26.75	23.55	23.95	22.5	22.1	24.65	26.1	28	29.02
Water Temp.	22.55	20.1	20.5	23.4	21.25	21.4	20.05	20.55	22.05	23.95	26.35	27.2
pH	7.85	8.0	8.05	7.9	8.05	7.85	7.55	8.0	8.2	8.15	8.0	8.15
TS	592.1	854	812.5	768.5	613.5	496	568	529.5	502.5	469	411.5	343.5
TDS	324.6	524	535	552	391	298	367.5	291	234.5	244.5	214.5	145.5
TSS	267.5	330	277.5	216.5	222.5	198	200.5	238.5	268	224.5	197	198
DO	5.0	5.05	5.0	5.55	8.05	7.3	6.05	5.65	5.0	4.6	3.5	3.7
CO ₂	5.85	6.85	6.5	6.4	3.1	3.3	3.4	3.35	4.35	6.0	6.75	7.35
Total Alkalinity	171.5	142	100.5	131	135.5	139.5	141	145.5	156	169	182	186.5
Chloride	53.75	39.05	38.5	29.6	26	39.5	45.5	41.75	42	57	65	71.65
Sulphate	8.2	9.35	8.85	9.65	7.9	6.75	7.5	7.2	7.8	9.25	10.3	11.75
BOD	4.6	3.4	3.65	4.85	5.5	5.65	6.45	7.55	7.75	8.4	9.05	10.4
COD	11	5.6	4.55	4.9	5.3	4.4	8.65	4.35	4.1	14.35	16.85	20.1
Hardness	155	115	130	135	152.5	150	149.5	151	154.2	169	177.5	195
Calcium	39	27	33	28.9	36.2	31.94	35.23	37.53	35.03	30	42.83	34.04
Magnesium	13.88	12.29	11.95	14.7	15.24	17.15	15.09	14.00	16.31	17.04	17.29	20.46

All values are expressed in mg/L except Temperature (°C) and pH.

Table : 02

PHYSICO-CHEMICAL PARAMETERS OF VISHNUPURI DAM, 2007-2008

Parameters	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Air Temp.	27.6	25.85	25.55	27	24.65	22.5	22.45	21.6	23.5	28.5	30.55	34.25
Water Temp.	24.05	22.15	21.85	22.1	21.6	20.15	18.2	18.65	20.5	26.3	29.2	29.95
pH	7.8	7.7	7.95	8.0	7.95	8.05	7.9	8.05	7.95	8.15	8.25	8.05
TS	603	629.5	449.5	670	946.5	601	735.5	434.5	408	461	382.5	417.5
TDS	203	329.5	237	345	481.5	419.5	534.5	237	223	246	203.5	225
TSS	400	300	212.5	325	465	181.5	201	197.5	185	215	179	192.5
DO	4.05	5.0	6.95	5.6	7.25	8.75	8.95	7.95	6.0	4.8	3.9	3.65
CO ₂	5.65	5.65	6.85	3.85	3.45	3.25	3.65	3.8	4.4	5.95	6.8	7.75
Total Alkalinity	165	134.5	131	142.5	144	150	145.5	164	167.5	173	195.5	203.5

Chloride	59.5	44	34.5	32	39	50.5	56.5	53	42	63.65	66.5	72.55
Sulphate	10	8.6	7.05	7.1	6.75	6.3	6.85	7.25	8.05	9.35	10.6	11.75
BOD	5.0	3.35	2.15	2.7	3.35	3.8	4.4	7.7	7.95	8.4	11.3	12.75
COD	10.75	7.35	4.1	4.55	6.1	4.1	4.8	4.65	10.02	14.15	19.9	23.56
Hardness	168.5	139	142	147.5	159.5	175.5	173	161	154.5	185.5	169.5	186
Calcium	43.5	34	29.15	25.5	25	53	50	30	35.5	45.5	38.5	46
Magnesium	14.62	13.19	16.97	21.97	22.15	10.54	11.76	21.185	16.07	17.53	17.9	17.34

All values are expressed in mg/L except Temperature ($^{\circ}\text{C}$) and pH.

RESULTS & DISCUSSION

1) AIR TEMPERATURE : In the study period from June 2006 to May 2008 it was observed that Vishnupuri Dam had air temperature ranging between 21.6°C and 34.25°C . The minimum air temperature was 22.1°C in January 2007 and 21.6°C in January 2008, and maximum was 29.02°C in May 2007 and 34.25°C in May 2008 (Table 01 & 02).

In the present investigation it was observed that air temperature is minimum in winter season and maximum in summer season. Salve and Hiware, (2006) reported air temperature range between 27.0°C to 35.0°C where minimum temperature was recorded in winter season and maximum temperature in summer season from Nagapur near Parli Vaijanath, Beed district. Mane and Pawar, (2007) reported similar results from Manar river, Nanded district, Sunkad and Patil, (2003) also reported minimum air temperature in winter season and maximum in summer season from Rakasakoppa reservoir of Belgaum, Karnataka. Air temperature was minimum in winter season and maximum in summer season during the study period June 2006 to May 2008. This change in temperature may be related to the photoperiod.

2) WATER TEMPERATURE : Recorded water temperature at Vishnupuri Dam from June 2006 to May 2008 ranged between 18.2°C and 29.95°C . The average minimum water temperature was 20.05°C in December 2006 and 18.2°C in December 2007, and maximum was 27.2°C in May 2007 and 29.95°C in May 2008 (Table 01 and 02). Results show that water temperature was minimum in winter season and maximum in summer season, Salve and Hiware (2006) reported water temperature range between 21°C and 31.1°C where the water temperature is lower than the atmospheric temperature by 1°C to 3.9°C . Mane and Pawar, (2007) from river Manar, Nanded district, Sunkad and Patil, (2003) from Rakasakoppa reservoir of Belgaum, Karnataka, have also reported similar findings. The water temperature was minimum in winter season and maximum in summer season this must be related to the air temperature.

3) pH : During study period from June 2006 to May 2008 it was observed that Vishnupuri Dam had pH ranging between 7.55 and 8.25. The average minimum pH was 7.55 in December 2006 and 7.7 in July 2007, and maximum was 8.2 in February 2007 and 8.25 in April 2008 (Table 01 and 02).

In the present investigation pH is alkaline in nature and ranges between 7.0 and 8.3. The high range of pH may be due to the biological activity and temperature changes. Significant changes in pH also occur due to disposal of drainages, seasonal variation may be due to variation in the photosynthetic activity which increases pH due to consumption of carbon dioxide in the photosynthetic process. These results are identical to those reported by Muley and Patil, (2006) from Pauna river, Pune district, Sharma and Shrestha, (2001) from Tinau

river Western Nepal. Tripathi Namrata Nath *et al.*, (2008) from Sikandrapur reservoir, Basti (U.P.), Shah Nawas *et al.*, (2009) from Bhadra rivers of western Ghats (India), Ashashree *et al.*, (2008), Korai *et al.*, (2008) from Keenjhar Lake district, Thatta, Sindh, Pakistan. According to Swingle, (1969) water pH within the range of 6.5 to 8.5 is most suitable for pond aquaculture. (Sinha, 2000; Singh, 2002) reported pH range between 7.0 to 8.6 in different water bodies of North Bihar, where fish production has been recorded to be maximum. The high range of pH indicates higher productivity of water, Khan and Khan, (1985).

4) T.S. (Total Solids) : During study period from June 2006 to May 2008 it was observed that Vishnupuri Dam had total solids ranging between 343.5 mg/L and 946.5 mg/L. The average minimum total solids was 343.5 mg/L in May 2007 and 382.5 mg/L in April 2008 and maximum was 854 mg/L in July 2006 and 946.5 mg/L in October 2007 (Table 01 and 02). Thus the results in the present investigation show that the T.S is within limits.

5) T.D.S. (Total Dissolved Solids) : During the study period from June 2006 to May 2008 it was observed that Vishnupuri Dam had total dissolved solids ranged between 145.5 mg/L and 552 mg/L. The average minimum total dissolved solids was 203 mg/L in June 2007 and 145.5 mg/L in May 2007 and maximum was 552 mg/L in September 2006 and 534.5 mg/L in December 2007 (Table 01 and 02).

In the present investigation the results shows that the TDS was maximum in monsoon season which may be due to an increased run off of bicarbonate and carbonate and minimum in summer season. In the present study it was observed that the TDS values are within safe limits. Similar result was observed by Jahangir *et al.*, (2000) from at Keenjhar and Haligi Lakes of district, Thatta, Sindh, Pakistan. Jayabhaye *et al.*, (2006) from minor reservoir Sawana, Hingoli district Maharashtra, Chandanshive *et al.*, (2008) from river Mula-Mutha at Pune district, Maharashtra, Dhimdhome and Ambhore (2004) from Siddheshwar dam, Parbhani district reported similar results. The permissible levels of T.D.S are 500 mg/liter in drinking water. The increase in T.D.S in winter as compared to rainy and summer is due to increase in salts containing carbonate, bicarbonate, chloride, sulphate, phosphate, nitrate, iron and manganese (Mittal. *et al.*, 1994, Gonzale *et al.*, 2004).

6) T.S.S. (Total Suspended Solids) : Concentration of total suspended solids at Vishnupuri Dam from June 2006 to May 2008 ranged between 179 mg/L and 465 mg/L. The average minimum total suspended solids was 197 mg/L in April 2007 and 179 mg/L in April 2008 and maximum was 330 mg/L in July 2006 and 465 mg/L in October 2007 (Table 01 and 02).

In the present investigation TSS was maximum in rainy season which may be due to increase in runoff of organic matter and results show that the total suspended solid are within safe limits. In the present investigation during the study period it was observed that TSS was maximum in rainy season and minimum in summer season. Similar results are observed by Jayabhaye *et al.*, (2008) from minor reservoir Sawana, Hingoli district Maharashtra, Chandanshive *et al.*, (2008) from river Mula-Mutha Pune, Maharashtra, Dhimdhome and Ambhore, (2004) from Siddheshwar dam Parbhani district. The suspended solids occur naturally in water, human activities can greatly increase their concentration (Gonzale, *et al.*, 2004).

7) Free CO₂ During the study period from June 2006 to May 2008 it was observed that Vishnupuri Dam had free CO₂ ranging between 3.1 mg/L and 7.75 mg/L. The average minimum free CO₂ was 3.1 mg/L in October 2006 and 3.25 mg/L in November 2007 maximum was 7.35 mg/L in May 2007 and 7.75 mg/L in May 2008 (Table 01 and 02). The free CO₂ concentration was minimum in winter, this might be due to high photosynthesis activity and maximum in summer which may be due to less photosynthetic activity because of low phytoplankton population. In the present investigation maximum carbon dioxide was observed in summer season and minimum in winter season.

Similar result have been recorded by Muley and Patil, (2006) from Pauna river, Pune district Maharashtra. Sharma and Shrestha, (2001) from river Tinau Western Nepal. Salve and Hiware, (2006) from Wanparakalpa Reservoir, Nagapur, near Parli-Vaijanth, district Beed, Marathwada, Ashashree *et al.*, (2008) from Savalanga pond Davangere district Karnataka. Dutta *et al.*, (2001) from river Basantar Chandigarh also reported similar results. The lower values of free carbon dioxide observed during rainy and winter season is due to complete utilization of free carbon dioxide by the phytoplankton's (Rawson, 1939).

8) DO (Dissolved Oxygen) : Concentration of dissolve oxygen at Vishnupuri Dam from June 2006 to May 2008 was between 3.5 mg/L and 8.95 mg/L. The average minimum DO was 3.5 mg/L in April 2007 and 3.65 mg/L in May 2008 and maximum was 8.05 mg/L in October 2006 and 8.95 mg/L in December 2007 (Table 01 and 02).

In the present investigation it was observed that dissolved oxygen is maximum in winter season and minimum in summer season. These results are identical to those reported by Mulay and Patil, (2006), Korai *et al.*, (2008); Sharma and Shrestha, (2001); Tripathi Namrata Nath *et al.*, (2008); Shahnawaz, (2009) from Bhadra River of western Ghats India, Martin, (2004) from South Indian River Tamiraparani, Munwar, (1970) from freshwater ponds of Hyderabad, Boyd, (1982) from water quality management of pond fish culture, Pandey *et al.*, (1999) studied Do from river Ramjan (Klshanganj) in relation to its impact on biological components. The 6 mg/L to 9 mg/L range of DO is supported for potability and aquaculture, Yogesh and Pendse, (2001).

9) BOD (Biological Oxygen Demand) : In the study period from June 2006 to May 2008 it was observed that Vishnupuri Dam had biological oxygen demand ranging between 2.15 mg/L and 12.75 mg/L. The average minimum biological oxygen demand was 3.4 mg/L in July 2006 and 2.15 mg/L in August 2007 and maximum was 10.4 mg/L in May 2007 and 12.75 mg/L in May 2008 (Table 01 and 02).

In the present investigation BOD had higher values in summer. This may be due to high rate of organic decomposition the gradual decline of BOD from rainy season to winter season which may be due to decrease in temperature which decreases the rate of organic decomposition. Similar results are reported by Salve and Hiware, (2006) from Waprakalpa, Nagapur near Parli Vaijanath in Beed district. Martin, (2004) from South Indian river Tamiraparani, Shahnawas *et al.*, (2009) from Bhadra river of western Ghats India and Muley and Patil, (2006) from river Pauna, Pune district, Maharashtra.

10) COD (Chemical Oxygen Demand) : During the study period from June 2006 to May 2008 it was observed that Vishnupuri Dam had chemical oxygen demand ranging between 4.1 mg/L and 23.56 mg/L. The average minimum chemical oxygen demand was 4.1 mg/L in February 2007, August 2007 and November 2007 and maximum was 20.1 mg/L in May 2007 and 23.56 mg/L in May 2008 (Table 01 and 02).

In the present investigation COD was maximum in summer which may be due to less quantity of water, depth and decay of aquatic flora and fauna and minimum values of COD in winter may be due to settlement and dilution effect. Similar results are reported by Salve and Hiware, (2006) from Waprakalpa, Nagapur near Parli Vaijanath in Beed district of Marathwada region, Maharashtra, India, Gyananath *et al.*, (2000) from river Godavari during holimela at Nanded, Mini *et al.*, (2003) from lotic ecosystem Vamanapuram river Thirvanathapuram, Kerala South India. Surve *et al.*, (2005) from Baral dam, district Nanded (M. S.) India. Pulle, (2000) recorded COD values in the range between 62 to 148 mg/L at Issapur dam. Deshmukh *et al.*, (1998) recorded COD values from Godavari river water, ranging from 22.0 to 30.0 mg/L, where maximum COD values are recorded in summer and minimum values in winter seasons.

According to Moyle, (1949) the COD values fluctuated between 33.55 and 60.33 mg/L, which are likely due to addition of sewage bringing in organic matter. The COD values of drinking water should not exceed more than 10 mg/L as per the guide lines of WHO.

11) Total Alkalinity

Concentration of total alkalinity at Vishnupuri Dam from June 2006 to May 2008 was between 100.5 mg/L and 203.5 mg/L. The average minimum total alkalinity was 100.5 mg/L in August 2006 and 131 mg/L in August 2006 and September 2007 and maximum was 186.5 mg/L in May 2007 and 203.5 mg/L in May 2008 (Table 01 and 02).

In the present investigation results show that the total alkalinity was low in rainy season and high in summer due to evaporation of water and increase in biological activity. Similar findings have been recorded by Muley and Patil, (2006); Korai *et al.*, (2008); Salve and Hiware, (2006); Singh, (2000); Mishra *et al.*, (1989); Jhingran, (1982); Sakhare and Joshi (2002); Surve *et al.*, (2005). Bhatt *et al.*, (1999) has mentioned lower range of total alkalinity during different seasons of Taudaha Lake in Nepal. Mohanta and Patra, (2000) recorded total alkalinity ranging from 37.35 to 87.25 mg/L in the river water Sanamachhanandana at Karphogarh. Deshmukh *et al.*, (2008) reported alkalinity ranging from 78 to 230 mg/L in the river Godavari.

Thus it shows that in the rainy season total alkalinity was low and high in summer season and the total alkalinity throughout the year is above 100 mg/L and within permissible limit these study site is highly productive and suitable for the growth of ichthyofauna.

12) Chloride: During the study period from June 2006 to May 2008 it was observed that Vishnupuri Dam had chloride ranging between 26 mg/L and 72.55 mg/L. The average minimum chloride was 26 mg/L in October 2006 and 32 mg/L in September 2007 and maximum was 71.65 mg/L in May 2007 to 72.55 mg/L in May 2008 (Table 01 and 02). The maximum values of chloride were recorded during summer season because of scanty

rain and high rate of evaporation. It has significant positive correlation with water temperature and electrical conductance. It was also observed that high level of chloride is an indication of higher degree of pollution and low level chloride content indicates absence of any substantial pollution.

Similar findings were reported by Muley and Patil (2006) from Pauna river Pune district. Korai *et al.*, (2008) from Keenjhar Lake district, Thatta, Sindh, Pakistan. Sakhre and Joshi, (2003) from minor wetland Tuljapur, Maharashtra. Sehgal, (1980) from Lake Sruinsar, Jammu and Kashmir. Adarsh Kumar *et al.*, (2006) from Ranjit Sagar reservoirs, Jammu & Kashmir. Mane and Pawar, (2007) from Manar River of Nanded district Maharashtra. According to Goal *et al.*, (1988) 250 mg/L of chloride in water makes water salty in taste, however a level up to 100 mg/L is safe for human consumption.

13) Sulphate : Concentration of sulphate at Vishnupuri Dam from June 2006 to May 2008 was between 6.3 mg/L and 11.75 mg/L. The average minimum sulphate was 6.75 mg/L in November 2006 and 6.3 mg/L in November 2007 and maximum was 11.75 mg/L in May 2007 and 2008 respectively (Table 01 and 02).

In the present investigation higher values of sulphate are recorded in summer and lower values are recorded in rainy season. The sulphate is used as source of oxygen by bacteria under an anaerobic condition, (Nath and De. D. K , 1998). The minimum and maximum sulphate concentration are within permissible limit, which are prescribed by WHO, (2004). Rajalakshmi and Sreelatha, (2005) reported similar results from river Goutami Godavari Yanam. Ajmal *et al.*, (1984) studied pollution in river Ganga and reported the similar findings. Similar result was observed by Mane and Pawar, (2007); Aher *et al.*, (2007) with maximum sulphate in summer season and minimum in rainy season. Ravikumar *et al.*, (2005) observed same trend in Ayyanakere tank Harapanahallitown, Davangre district of Karnataka.

14) Total Hardness: : During the study period from June 2006 to May 2008 it was observed that Vishnupuri Dam had total hardness ranging between 115 mg/L and 195 mg/L. The average minimum total hardness was 115 mg/L in July 2006 and 139 mg/L in July 2007 and maximum was 195 mg/L in May 2007 and 186 mg/L in May 2008 (Table 01 and 02).

In the present study it was found that low values of hardness were during rainy and winter season and higher values were observed during summer season. The total hardness is a contribution of calcium and magnesium salts dissolved in water. Normally these ions are not problematic but at higher concentration increases hardness. The high value of hardness in summer and low value in monsoon show that the water may be suitable for the growth of the fish. Hardness is more than 20 mg/L is satisfactory for the aquatic productivity and helps to protect fishes against harmful effects pH fluctuations, Das and Das, (1997). The high value of hardness in summer and low values in monsoon season was observed by Kannan, (1991). Rath *et al.*, (2000) reported similar results from Nandira Brahmani River, Angul-Talcher Belt Orissa, India. Muley and Patil, (2006) from Pauna river Pune district, Korai *et al.*, (2008) from Keenjhar lake, Thatta district, Sindh, Pakistan, Salve and Hiware, (2006) from Wanparkalpa reservoir, Nagapur Parli Vaijanath district, Beed, Marathwada region also reported similar results. Hiware and Jadhav, (2001) reported maximum total hardness in summer season and minimum in rainy season from Manjra river, near Kallam, district Osmanabad.

15) Calcium : During the study period from June 2006 to May 2008 it was observed that Vishnupuri Dam had calcium ranging between 25 mg/L and 53 mg/L. The minimum calcium was 27 mg/L in July 2006 and 25 mg/L in October 2007 and maximum was 42.83 mg/L in April 2007 and 53 mg/L in November 2008 (Table 01 and 02).

The desirable limits of calcium and magnesium for drinking water are 75 mg/L and 30 mg/L respectively (BIS, 1991). Calcium is helpful for the shell construction and bone building of aquatic organism the value of calcium is highest in summer season, lowest in monsoon season, Rajana *et al.*, (2002). Similar results are reported by Adarsh Kumar *et al.*, (2006) from Ranjit Sagar reservoirs, Jammu & Kashmir. Wagh, (1998) from Harsul Dam Aurangabad. Kulkarni *et al.*, (2002) from river Khushavali at Quepem Goa. Patil *et al.*, (2004) from Padmalaya lakes, Erondal at Jalgaon district. Zafar, (1964) from certain fish ponds of Hyderabad, India reported similar results. Singh and Swarup, (1979) reported that concentration of calcium promotes growth of microorganism.

16) Magnesium : Concentration of magnesium at Vishnupuri Dam from June 2006 to May 2008 ranged between 10.54 mg/L and 22.15 mg/L. The average minimum magnesium was 11.95 mg/L in August 2006 and 10.54 mg/L in November 2007 and maximum was 20.49 mg/L in May 2007 and 22.15 mg/L in October 2007 (Table 01 and 02).

In the present investigation it was observed that magnesium concentration was maximum in summer season and minimum in winter season. The magnesium concentration was within the permissible limit and helpful for the growth of fish. Magnesium occur in all kinds of natural water with calcium but its concentration remains generally lower than calcium because dissolution of magnesium reach minerals is a slow process and calcium is more abundant in earths crust, Dakshinini and Soni, (1997) .

Mohanta and Patra, (2002) reported maximum magnesium in summer season and minimum magnesium in winter season from river Sanamachhakandana at Keonijhar Garh Orissa, Gyananath *et al.*, (2000) studied river Godawari during holimela at Nanded. Shastri, (2000) studied river Mosam. Chawan *et al.*, (2004) from Manjara project reservoir in district Beed, Maharashtra reported similar results. Similar results were reported by Thilaga *et al.*, (2005) studied from Ooty Lake, Ooty. Jakher and Rawat, (2003) from tropical lake, Jodhpur Rajasthan, India, Jayabhaye *et al.*, (2006) from minor reservoir Sawana, Hingoli Maharashtra. Rath *et al.*, (2000) reported that the decrease value of magnesium may be due to plankton and algal uptake

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