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Physico-chemical and bacteriological studies of Benachi Pond, Dharwad Tq/Dist, India

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A B S T R A C T

Clean water to drink, pure air to breathe and natural soil to live are universal demands of man as their birth right. Due to population explosion, intensive agricultural practices and many other human activities, water becomes polluted. In the preset study, physico-chemical and bacteriological analysis of water were determined in Benachi pond, Dharwad Tq/Dist, India from March 2012 to February 2013. Physico-chemical parameters like water temperature, pH, TDS, TH, Cl, F, NO_3, PO_4, Alk, DO and bacteriological test i.e. MPN test were carried out. The value of physico-chemical parameters are almost present within the permissible limits of IS 10500-1991 except for some parameters like bacteriological MPN test carried out, the values are highest (1800) but recommended value is Nil to 10 (IS 10500-1991). However from the present investigation the pond water is not suitable for consumption, as MPN value is more as recommended.

Introduction

The availability of good quality of water is a necessary feature for prevailing diseases and improving quality of life (Oluduro and Aderiye, 2007). Water is a necessary element for endurance of living on earth which contains minerals essential for humans as well as for earth and aquatic life (Versari *et al.*, 2002). Water quality is a critical public health concern in India. About 95 percent of rural population living in India depends on ground water for domestic use (Moharir *et al.*, 2002). According to WHO estimate about 80 percent of water pollution in developing country like India is carried by domestic waste. In our country 70 percent of the water is seriously polluted and 75 percent of illness and 80 percent of the child mortality is attributed to water pollution (Zoeteman, 1980). The healthy nature of underground water has also altered (Dasgupta and Purohit, 2001). Thus, the estimation of water quality is very important for proper assessment of associated hazards (Warhate *et al.*, 2006). Recently, several important and useful species are dwindling, so to overcome their problems there is need

for application of oriented, limnological research so we can better utilize our natural resources.

Present study was aimed to analyse the physico-chemical and bacteriological properties of pond water, since there is no research work has been carried out on this pond water.

Materials and Methods

Benachi pond is located at 15° 24′ 10″ North and 74° 48′ 11″ East altitude of 655 MSL covering an area of about 10.4 acres in Dharwad taluk, Dharwad district. Water samples were collected in pre-cleaned polythene bottles from fixed locations of Benachi pond at monthly intervals between 6 am to 9 am from March 2012 to February 2013. Collected samples were brought to the laboratory within two hours for analysis. Temperature was noted down on the sampling spot with the help of thermometer. Rest of the parameters like pH, TDS, TH, Chloride, Fluoride, Phosphate, Nitrite, Alkalinity, Dissolved Oxygen are carried out in laboratory according to standard methods prescribed in the APHA 1998. Bacteriological test was also carried out in laboratory by MPN test using MacConkey media.

Physico-chemical and Microbial Parameters & their Methodology

Water Temperature⇒ Thermometer
Total Dissolved Solids (TDS)⇒Using digital pH meter
Total Hardness (TH)⇒Gravimetric method
Chloride (Cl) ⇒ By titration method
Fluoride (F) ⇒ By Spadns method using spectrophotometer
Nitrate (NO_3) ⇒ By spectrophotometer
Phosphate (PO_4) ⇒ By spectrophotometer
Alkalinity (Alk) ⇒ By titration
Dissolved Oxygen (DO) ⇒ Winkler method (Bacteriological Test)
MPN Test ⇒ Fermentation Technique tubes, using MacConkey broth

Bacteriological test (MPN Test) by multiple tube test

Measured volume of water and dilution of water were added to a series of tubes or bottles containing a liquid indicator growth medium. The media receiving one or more of the indicator bacteria shows growth and characteristic color change which is absent in those receiving an inoculums of water without indicator bacteria.

From the number of distribution of +ve and –ve reaction and the most probable number of indicator organisms in the sample (MPN) may be estimated by reference to the statistics taken. The indicator medium used has been MacConkey broth containing bromocresol purple.

The purple color changes to yellow, shows formation of acid from the lactose in the broth. An inverted Durham tube is placed in each bottle or tube of the medium. Bacteria capable of growth and production of acid and gas in the MacConkey broth were assumed to be coliform bacilli i.e. presumptive coliform.

Non-chlorinated water → MacConkey's media used (Pond water)

I Step: 5 tubes of double strength 10 ml media + 10 ml of water sample
II Step: 5 tubes of single strength media 5 ml media + 1 ml of water sample
III Step: 5 tubes of single strength media 5 ml media + 0.1 ml of water sample

Kept at 37°C for 48 hours for incubation.

Result ⇒ Observed for acid and gas formation, confirms positive for coliform test.

Values of MPN Test are recorded according to table of Medical Microbiology (By Robert Cruickshank) and probability tables (according to McCrady).

Physico-chemical parameters and MPN Test are carried out according to the standard procedures prescribed in APHA 1998.

Results and Discussion

The following results were obtained during present findings. These results were compared with the standards given by IS 10500-1991 as desirable and permissible limits. The examined physico-chemical parameters are almost within the permissible range prescribed by IS 10500-1991 but MPN test results showed higher values than what prescribed in IS 10500-1991. The observations are depicted in table-1.

Temperature: The water temperature was found in the range of 29°C to 30.2°C. The variations in the water temperature may be due to different timing of collection and influence of season (Jayaraman *et al.*, 2003). The temperature is important in controlling both the quantity and quality of plankton flora (Hutchinson, 1957).

pH: pH is an important factor which controls chemical changes in the water and also it influences aquatic life of any water body. The pH is generally affected by organic and inorganic solutes present in water. In present study pH ranges from 7.5 to 7.7. It was concluded that the pH of water were slightly alkaline and were within the maximum limit as prescribed by IS 10500-1991. High value of pH may result due to waste discharge, microbial decomposition of organic matter in the water body (Patil *et al.*, 2012).

TDS: Total dissolved solids in water body are due to the presence of dry leaves, mud sand particles and dissolved salts. Total suspended solids include the solids that are suspended in water bodies. They are organic and inorganic particles of immiscible liquids. In present study TDS ranged between 81 and 151. The values which we got in investigation are within the range prescribed by IS 10500-1991. The deterioration of the quality of water was mainly due to the concentration of the total dissolved solids (Agarwal and Kanan, 1986).

TH: In general hard water has no known effect on human health, but is unsuitable for domestic use. The permanent hardness caused by chlorides and sulphates (Roy and Kumar, 2002). In present study the hardness of water were ranged between 68 to 91 mg/l. It is within the desirable range prescribed by IS 10500-1991. The hardness of water increases in the polluted waters by the deposition of calcium and magnesium salts (Bhatt *et al.*, 1999).

Chloride: The main source of chloride in surface water and ground water is due to atmospheric precipitation, animal feeds, septic tanks, use of inorganic fertilizers and landfill leachate. Higher concentration of chlorides in water is an index of pollution. Chloride that dissolves easily in water is toxic to most aquatic organisms because it reacts quickly with other substances in water (Padmanabha and Belagali, 2001). In present study the chloride content of water is ranged between 10 to 17 mg/l. It is within the desirable range prescribed by IS 10500-1991.

Fluoride: The main source of Fluoride in water is weathering of fluoride bearing rocks (Gupta and Manvir Singh, 2005). In present study fluoride content of pond water is ranged between 0.1 and 0.3. The value is within the range prescribed by IS 10500-1991.

Nitrate: Nitrate concentration of ground water and surface water may be attributed to the biochemical and anthropogenic sources (McLay *et al.,* 2001), like fertilizers in agricultural practice. Nitrate is highly water soluble and tends to migrate from soil in to ground water ingested nitrate is reduced to nitrate which subsequently hinders the ability of blood to transport oxygen to body tissues (Gulis *et al.,* 2002; Johnson and Kross, 1990). In present study nitrate content of water is ranged between 1.2 and 3.1 mg/l. The value is within the range prescribed by IS 10500-1991.

Phosphate: Atmospheric deposition, agricultural practices impart from live stock, atmospheric nitrogen fixation and sewage are the main sources of nitrogen and phosphorus influx to a water course (Moreau *et al.,* 1998). Phosphate occurs as orthophosphates, condensed phosphates and naturally found phosphates. Their presence in water is due to detergents, used boiler water, fertilizers and due to biological processes. Phosphate occurs as detritus in the bodies of aquatic organisms. Inorganic phosphorous plays a dynamic role in aquatic ecosystems and it is one of the most important nutrients when present in low concentrations but in excess along with nitrate and potassium cause algal blooms (Ramachandra *et al.,* 2002). In present study phosphate content ranged between 0.2 and 0.3 mg/l.

Alkalinity: The usual reason for high amount of alkalinity in water is due to the waste water discharge from industries. The high value of alkalinity indicates the presence of weak and strong base such as carbonates, bicarbonates and hydroxides in the water body (Abassi *et al.,* 1991) and (Jain *et al.,* 1997). In present study alkalinity content ranged between 53 and 63 mg/l. The value is within the range prescribed by IS 10500-1991.

Dissolved Oxygen: DO levels between 5 and 8 mg/l are satisfactory for survival and growth of aquatic organisms. DO levels in surface water body indicate the ability to support aquatic life. The high DO values means the rate of oxygen replenishment in water is greater than the oxygen utilization. Adequate DO is necessary for good water quality. In present study the DO of water ranged between 7.1 and 7.6 mg/l. Depletion of dissolved oxygen content in indicative of the presence of considerable amount of biodegradable organic matter in water (Sharma *et al.,* 2004). The deficiency of oxygen in the water is shelter for bacteria and other pathogens, which are anaerobic and injurious to human health. The value which we got in our investigation are within the permissible limits of IS 10500-1991.

MPN test: The bacteriological analysis of water determines the probability of water. Generally total coliform bacteria refer to the entire coliform group. These bacteria are abundant in soil, decaying vegetation, animal fecal matter and raw surface water. In present study MPN Test values ranged between 260 and 1800. The reason for high number of bacterial colonies might be due to inadequate maintenance of water reservoir. The desirable limit of coliform in water is 10 MPN/100 ml according to IS 10500-1991. As this pond is in close vicinity of human settlements so the abundance of coliforms is imminent.

Table.1 Physico-chemical parameters of Benachi pond

Date	Water Temp.	pH	TDS	TH	Cl	F	NO_3	PO_4	Alk	DO	Bact
	C°		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	MPN/ 100ml
March 2012	30.0	7.5	100.0	72.0	13.0	0.3	1.8	0.20	53.0	7.5	260.0
April 2012	30.2	7.6	106.0	68.0	12.0	0.2	3.1	0.30	55.0	7.3	910.0
May 2012	29.8	7.5	106.0	73.0	12.0	0.1	1.8	0.30	56.0	7.6	490.0
June 2012	29.6	7.5	100.0	81.0	11.0	0.2	1.2	0.30	59.0	7.4	360.0
July 2012	29.4	7.5	111.0	81.0	12.0	0.2	1.9	0.20	57.0	7.3	290.0
Aug 2012	29.2	7.6	100.0	77.0	11.0	0.1	2.5	0.20	57.0	7.2	390.0
Sept 2012	29.0	7.6	81.0	77.0	10.0	0.1	3.0	0.20	59.0	7.1	460.0
Oct 2012	29.2	7.7	101.0	78.0	13.0	0.2	2.0	0.30	63.0	7.2	810.0
Nov 2012	29.4	7.6	121.0	78.0	17.0	0.2	1.2	0.30	61.0	7.4	1800.0
Dec 2012	29.6	7.7	131.0	85.0	13.0	0.3	1.9	0.30	63.0	7.3	560.0
Jan 2013	29.8	7.6	151.0	91.0	13.0	0.2	2.2	0.20	61.0	7.2	310.0
Feb 2013	29.8	7.6	121.0	81.0	11.0	0.1	2.0	0.20	56.0	7.3	510.0
Desirable Limit		7.0-8.5	500	300	200	1.0	45		200		NIL
Permissible Limit		6.5-8.5	2000	600	1000	1.5	100		600		10
As per IS 10500-1991											

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