

“A Study For prediction of Water Quality of Non-Reserved Ponds of Bhilai-Durg Regions for Various Purpose”

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Abstract

Water supports life on earth and around which the entire fabric of life is woven. Ponds, as sources of water, are of fundamental importance to man. However pond may have been natural water sources exploited by man at different time to meet different needs or may have been created for a multitude of different purposes. The increased demand for water as a consequence of population growth, agriculture and industrial development has usurped environmentalists to determine the chemical, physical and biological characteristics of natural water resources.

In present study the physicochemical (taste, odor, color, pH, temperature, electrical conductivity, alkalinity, total dissolved solids, chemical oxygen demand, biological oxygen demand, chloride, total hardness, calcium, magnesium) and microbial parameters of collecting sample from non-reserved ponds water samples. Studies of physiological parameters were done by APHA standard methods (1975) and microbiological analysis were done by isolation of bacteria through serial dilution of water samples than collected isolates were identified by morphological studies and biochemical tests. Results of physiochemical parameters were compared with limits prescribed by WHO standard (1984) and analyzed higher than the give standard value of the WHO whereas dissolved oxygen for both ponds, chloride and total hardness for NR1 pond were under range of standard value of WHO.

Studies of microbial flora of non-reserved ponds were observed NR1-five and NR2- four colonies. The Morphological characteristics of the isolates obtained completed coliform test showed a positively completely confirmed test for all the water samples. The Biochemical characteristics of the isolates obtained from these water samples were shown some specific test for *Salmonella Typhii* (Salmonella agar), *S. aureus* (Enrich media) and coli form (MPN, EMB agar) were performed given positive results. The isolated bacteria species were identified to with reference to Bergey's Manual of Determinative Bacteriology (Buchanan and Gibbon, 1974). These identified isolates include *Staphylococcus aureus*, *Salmonella* species, *Escherchia coli*, *Pseudomonasaerugionosa*, *Bacillus* species, *Proteus* species, *Klebsiella* species.

In this present investigation it was found that the maximum parameters were exceed at the level of pollution except few parameters. So both ponds water not satisfy the requirement for the use in various purposes like domestic, agricultural, industrial etc. But the study of nonresrved pond water indicated that the community ponds are highly polluted and unsafe for human use.

KEYWORDS: Physicochemical, Morphological characteristics, Total dissolved solids, Chemical oxygen demand, Biological oxygen demand,

INTRODUCTION

Water the life's matter and matrix and without it life cannot exist. It given us the evolution and functions of universe on the Earth hence water is "Mother of all living world". Majority of water available on the earth is saline in the nature; only small quality exists as fresh water. Fresh water has become a scare commode due to over exploitation and pollution^[1,2,3,4]. Industrial, sewage and municipal wastes are being continuously added to water reservoirs affect physiochemical quality of water making them unfit for use of livestock and other organisms^[5,6].

Ponds, as sources of water, are of fundamental importance to man. However pond may have been natural water sources exploited by man at different time to meet different needs or may have been created for a multitude of different purposes^[7].

Many of the physical and chemical properties of water must be considered in its management. Some of these properties are temperature, pH, hardness, dissolved oxygen, source of the water in the pond, uses made of the water, and where it goes if it flows from the pond. It can be concluded that these characteristics of water bodies are influenced by seasonal variations. It is recommended that the proper maintenance of the water bodies is necessary. Proper sanitation measures and environmental education to public care essential to keep these water bodies clean and safe. A good knowledge of the chemical qualities of raw water is necessary so as to guide its suitability for use. Thus, regular physico-chemical analysis of water at source must be carried out to determine or check the effectiveness of treatment process.^[8]

Physico-chemical parameters were studied an important criterion for evaluating the suitability of water for irrigation and drinking purposes. The water samples were analyzed for Bacteriological Screening, temperature, pH, electrical conductivity, alkalinity, salinity, phosphate, hardness, dissolved oxygen and biological oxygen demand. The zooplankton population shows positive significant correlation with higher value physico-chemical parameters like, temperature, alkalinity, phosphate, hardness and biological oxygen demand, whereas negatively correlated with rainfall and salinity. Bacterial isolates were isolated from all studied ponds and they were identified as *S.aureus*, *Salmonella* sp., *E. coli*., *P. aeruginosa*, *E.aerogenes*, *Bacillus* sp., *Proteus* sp., *Klebsiellasp.*, *Flavobacteriumsp.*, *Acinetobactersp.*^[9].

Seasonal temperature variation could account for some of the bacterial population variation. *Aeromonashydrophila*, *Shewanellaputrefaciens*, *Corynebacteriumurealyticum*, *Escherichia coli*, *Pseudomonas* sp., *Vibrio cholera* and, *Cellulomonassp.* were the common species in all the bacterial populations of different seasons where the first four bacterial species made up most cultural assemblage. *Flavobacteriumsp.*, *Micrococcus* sp., *Streptococcus* sp., *Burkholderiaglumae* and *Pasteurellasp.* were present in some seasons of the year. *Pseudomonas fluorescens* and *Salmonella* sp. were present only in winter, where *Pasteurellapneumotropica* was found only in summer^[10].

The present investigation attempts to find out the Comparative analysis of physico-chemical parameters and microbial flora of non-reserved ponds.

MATERIALS AND METHODS

In present studies physicochemical and microbial analysis of two non-reserved pond Talpuri and Shitla Talab water were done.

Physico - Chemical Analysis of Ponds Water Samples

Physicochemical studies (Odor, Test, Temperature, pH, Total Alkali, Free CO₂, Total Hardness, Calcium and Magnesium, Nitrate Nitrogen, Nitrate, Total Phosphate) were done for collected pond samples according to APHA standard methods (1975)^[11].

Study of Microbial Flora of Non Reserved Pond

Isolation of microorganisms was done by serial dilution method using water sample of non-reserved (Talpuri, Shitla Talab) ponds. The pure cultures of the bacterial isolates were subjected to various morphological study, differential staining (Gram's and endospore) and biochemical characterization tests (catalase test, starch hydrolysis, Indole, MR-VP, simmon's citrate agar, fermentation, H₂S production, nitrate reduction, urease, casein hydrolysis, gelatin hydrolysis) to determine the identity of the bacteria isolates with reference to Bergey's Manual of Determinative Bacteriology^[12].

RESULTS AND DISCUSSIONS

In present study the physicochemical and microbial parameters of non-reserved ponds water samples were done and the results were compared with limits prescribed by WHO standard (1984)^[13].

The taste, odor, color, pH, temperature, electrical conductivity, alkalinity, total dissolved solids, chemical oxygen demand, biological oxygen demand, chloride, total hardness, calcium, magnesium of the non-reserved ponds water samples were analyzed higher than the give standard value of the WHO whereas dissolved oxygen for both ponds, chloride and total hardness for NR1 pond were under range of standard value of WHO shown in Table-I.

Microbial flora of non-reserved ponds water samples were isolated through serial dilution. In NR1-five and NR2- four colonies were observed. The Morphological characteristics of the isolates obtained from the water samples on Nutrient Agar (NA) and Eosin Methylene blue (EMB) agar is shown in (Table-II, Fig-I).

The completed coliform test showed a positively completely confirmed test for all the water samples. The gram's reaction and endospores staining reaction for the characterization of isolates obtained are also shown on Table-2. The Biochemical characteristics of the isolates obtained from these water samples is shown in Table-3. Some specific test for *Salmonella typhi* (Salmonella agar), *S. aureus* (Enrich media) and coli form (MPN, EMB agar) were performed given positive results. The isolated bacteria species were identified to with reference to Bergey's Manual of Determinative Bacteriology^[12]. These identified isolates include *Staphylococcus aureus*, *Salmonella* species, *Escherchia coli*, *Pseudomonasaerugionosa*, *Bacillus* species, *Proteus* species, *Klebsiella* species, (Table IV).

The study non-reserved pond water were carried out by taking certain important parameters and microbial flora revealed that

Temperature: The temperature of the non-reserved ponds water samples were analyzed Shown in Table-I, found to be in the range between 30.5 to 34.0°C during study. The higher value of water temperature observed in the present study could be attributed to the early summer months prevailed during the period of investigation^[13]. **pH:** The pH of the non-reserved ponds water samples analyzed were within the desirable limit of 6.69 – 7.2 Given by WHO and most of the samples were slightly alkaline in nature while deviation from the neutral 7.0 is as a result of the CO₂/bicarbonate/carbonate equilibrium. The pH of brackish water bodies stated by^[15] ranged from 6.5 - 7.4.pH is considered as an important ecological factor and provides information in many types of geochemical equilibrium or solubility calculation. pH is an important parameter in water body since most of the aquatic organisms are adapted to an average pH and do not withstand abrupt changes^[16]. **Electrical Conductivity:** WHO limit of electrical conductivity was 1800 (mmho, cm⁻¹) and nonreserved ponds sample NR1 showed 2410 (mmho,cm⁻¹) which was higher than limit.

Total Alkalinity: The standard desirable limit of alkalinity in potable water is 100 mg/L. The maximum permissible level is 600 mg/L. The alkalinity of NR1 and NR2 (Table I) which exceeded the desirable limit. The value of alkalinity in water provides an idea of natural salts present in water. The cause of alkalinity is the minerals which dissolve in water from soil. The various ionic species that contribute to alkalinity include bicarbonate, hydroxide, phosphate, borate and organic acids. **Total Dissolved Solid (TDS):** In water, total dissolved solids are composed mainly of carbonates, bicarbonates, chlorides, phosphates and nitrates of calcium, magnesium, sodium, potassium and manganese, organic matter, salt and other particles. NR1 and NR2 exceed limit WHO limit (500mg/L) respectively. In the maximum value of TDS was recorded which reflects the pollution of NR1 and NR2. **Dissolved Oxygen (DO):** The dissolved oxygen of non-reserved ponds water ranged from 2.4-4.5 mg/lit respectively. The minimum value of DO was recorded in NR2 pond, might be due to the high rate of oxygen consumption by oxidisable mater. The higher level of nutrient load and other factors caused lower level of DO in NR2. **Chemical Oxygen Demand (COD):** The COD value of NR2 was found to be maximum i.e. 884.0 mg/lit. COD values convey the amount of dissolved oxidisable organic matter including the non-biodegradable matters present in it. While the maximum value in NR2 respectively might be due to high concentration of pollutants and organic matter. **Biological Oxygen Demand (BOD):** BOD of non-reserved ponds was found to be maximum for NR2 was found 137.3 mg/lit. Both non reserved ponds were exceed WHO limit (6mg/L) respectively indicate that high biological demand of living organisms. **Chlorides:** Chlorides are important in detecting the contamination of ground water by waste water. The permissible limit of chloride in drinking water is 250 mg/L. The values of chloride observed in NR1 were low *i.e.* within the permissible limit, whereas the chloride value observed in NR2 (Table I) was well above the standard desirable limits prescribed by WHO (1984). The presence of chloride in slightly higher amounts in NR2 may be due to natural processes such as the passage of water through natural salt formations in the earth or it may be an indication of pollution from industrial or domestic use. The higher content of chloride in ponds may be due to animal origin like human faces and sewage inflow. Chloride increases with the increasing degree of

eutrophication. The maximum chloride was found in NR2 which indicates that amount of pollutants present in the pond. **Total Hardness:** WHO has specified the total hardness to be within 500 mg/L of CaCO₃. Regarding total hardness fluctuating trends in its value were observed in all ponds. The observed total hardness value of NR1 were well within the limits. NR2 has comparatively high TH value (524.0 mg/L) than other. **Calcium and Magnesium:** Calcium and magnesium concentrations were found to vary from 77.5 to 210 mg/L and 12.87 to 96.71 mg/L. The upper limit of calcium and magnesium concentration for drinking water is specified as 75 mg/L and to 50 mg/L (WHO, 1984). The calcium and magnesium hardness observed in all ponds was exceeding the desirable limits.

A investigation was carried out to study the ground water as well as surface water quality, nutrient status and physico-chemical characteristic of Bargarh district of Orissa, India. Attempts were made to study and analyze the physico-chemical characteristics of the water. Various parameters like Temperature, pH, Total suspended solids, and Total dissolved solids, Alkalinity, Dissolved oxygen, Chemical Oxygen Demand, Nitrate, Chloride, Sodium, Potassium, Phosphate, Fluoride, Total Coli forms (Pond water) etc. give a picture of quality parameter in both dug well and bore well water were portable whereas pond water of the town exceed who limit of drinking water and highly polluted [17].

In previous studied on water characteristics and bacterial population in high yield Kajola Fish Pond, Ibadan, Oyo State, Nigeria. The bacterial population of the pond soil was composed of six species and one fungus. The bacteria are *Escherichia coli*, which occurred in two ponds, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Streptococcus faecalis*, *Actinomycetesspecies* and *Bacillus cereus*, while the fungus is *Cladoporiumspecies*. *B.cereus* population was significantly higher ($P < 0.5$) than the rest species population. The presence of these organisms was attributed to the human activities in and around the pond [18]. Collected samples of tap, well, stream, and wastewaters from Abeokuta and Ojota (both in Nigeria) state and analyzed microbiologically and physico-chemically using standard methods. The Isolated organisms were identified to be *Staphylococcus aureus*, *Salmonella* species, *Escherichia coli*, *Pseudomonas aeruginosa*, *Enterobacteraerogenes*, *Bacillus* species, *Proteus* species, *Klebsiellasppecies*, *Flavobacteriumspecies* and *Acinetobacterspecies* [8]. Plankton diversity and physico-chemical parameters were studied an important criterion for evaluating the suitability of water for irrigation and drinking purposes. In this study total 17 bacterial isolates were isolated from all three study station and they were identified as *S.aureus*, *Salmonella* sp., *E. coli*, *P. aeruginosa*, *E.aerogenes*, *Bacillus* sp., *Proteus* sp., *Klebsiellasp.*, *Flavobacteriumsp.*, *Acinetobactersp.* [9]. Previous studies supported to the present studies.

CONCLUSION

In present study of physiochemical and microbial parameter of non-reserved ponds were done. In this present investigation it was found that the maximum parameters were exceed at the level of pollution except few parameters. So both ponds water not satisfy the requirement for the use in various purposes like domestic, agricultural, industrial etc.

But the study of non-reserved pond water indicated that the community ponds are highly polluted and unsafe for human use. So for the protection of ponds some human activities like washing, bathing and effluent discharge in the pond should be avoided.

The presence of bacteria is helpful for many ways such as biodegradation of degradable material etc. But in non-reserved ponds some harmful bacteria were seen. The pathogenic organic and the indicator organisms present in all the water samples render them unfit for human consumption though they can be used for other purposes. Water should meet different quality specifications depending on the particular uses. Thus, potable and domestic water should be harmless for the health of man and should have proper organoleptic properties and should be suitable for domestic use. Water quality should be controlled in order to minimize acute problem of water related diseases, which are endemic to the health of man.

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Table-I: Physicochemical analysis of Non-reserved ponds with respect to Std. Value given by WHO

Table-II: No. of colonies isolated from different sample sites

Sample Sites	NR1	NR2
No. of Colonies	5- C1, C2, C3, C4, C5	4- D1, D2, D3, D4

Table-III: Shown morphological characteristic of isolated microbes from pond samples

S.No	Physicochemical Tests	NR1 Talpu	NR2	Standard
1.	Total Dissolved Solid (TDS) (mg l^{-1})	525.00	704.00	500
2.	Biochemical oxygen demand (B.O.D) (128.60	137.30	6.0
3.	Chemical oxygen demand (C.O.D) (800.80	884.80	255
4.	Dissolved oxygen (D.O) (mg l^{-1})	3.0	2.4	5.0
5.	Chloride estimation (mg l^{-1})	113.46	255.20	250
6.	Total Hardness (mg l^{-1})	446.00	524.00	500
7.	Total Calcium (mg l^{-1})	210.00	126.00	75
8.	Total Magnesium (mg l^{-1})	96.71	57.34	50
9.	Electrical Conductivity (mmho, cm^{-1})	1612.00	2410.00	1800
10.	Total alkalinity (mg l^{-1})	400.00	360.00	100
11.	Temperature ($^{\circ}\text{C}$)	31.0	34.0	30
12.	pH	7.4	8.1	6.5-8.5
13.	Colour	Colourless	Colourless	
14.	Odour	Odourless	Odourless	agreeable
15.	Taste	Tasteless	Tasteless	

Table IV: Shown biochemical test for identification of isolated Bacteria from ponds

Isolates	Morphological Characteristics	Organisms
D4	Non-spore forming and non-motile, Gram positive cocci, circular, low convex with entire margin, smooth, medium, opaque, golden yellow colony on Nutrient Agar,	<i>S. aureus</i>
C1, D1	Gram negative, circular, low convex, with entire margin, mucoid, opaque, small, non-endospores forming rod shaped, pinkish glistening with metallic sheen colony on Eosin Methylene Blue (EMB) Agar; grown at pH 7, 37 and 45°C	<i>E. coli</i>
C3, D3	Non-spore forming, Gram negative short rods, colourless colony on Nutrient Agar, grown at 4 and 42°C	<i>P. aeruginosa</i>
C2, D2	Spore forming, Gram positive rods, creamy white colony on Nutrient Agar entire margin	<i>Bacillus</i> sp.
C4	Non-spore forming and non-motile gram negative rod colony on Nutrient Agar that appeared translucent with serrated or feather-like margins	<i>Proteus</i> sp.
C5	Gram negative rods on Nutrient Agar	<i>Klebsiella</i> sp.

samples.

S. No.	Biochemical test	NR1					NR2			
		C1	C2	C3	C4	C5	D1	D2	D3	D4
1.	Motility test	-	+	+	-	-	-	+	+	-
2.	Catalase test	+	+	-	+	+	+	+	-	+
3.	6.5% NaCl	+	-	ND	-	-	+	-	ND	-
4.	Glucose fermentation	A	A/G	A/G	A	A	A	A/G	A/G	A
5.	Lactose fermentation	A	A	A/G	-	-	A	A	A/G	-
6.	Sucrose fermentation	A	A/G	A/G	A/G	A/G	A	A/G	A/G	A
7.	Starch Hydrolysis test	-	-	-	-	+	-	-	-	-
8.	Indole test	+	-	-	+	-	+	-	-	-
9.	MR Test	+	-	-	+	-	+	-	-	-
10.	VP Test	-	+	+	-	+	-	+	+	+
11.	Citrate test	-	-	+	-	+	-	-	+	-
12.	Urease test	-	-	-	+	+	-	-	-	+
13.	Gelatin Hydrolysis	-	+	+	+	(+)	-	+	+	-
14.	H ₂ S Production Test	ND	+	+	-	-	ND	+	+	ND
15.	Nitrate Utilization	+	+	-	+	+	+	+	-	-

Note: ND-Not Determined, A -Acid, A/G-Acid/Gas, + =Positive, - =Negative, (+) =Late Positive

Figure I:- Shown Morphological Characteristics of Isolated Microbes from PondSamples NR1 and NR2

