Comparative Study on the Quality of Water from Two villages in Ernakulam District of Kerala

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ABSTRACT

In this project water samples were collected from, two villages in Ernakulam District of Kerala State in India, namely *Cherukadappuram* and *Nettoor*. The water samples included river water, bore well water and well water from *Cherukadapuram.* The water samples from *Nettoor* included pond water and well water. The analysis of the water quality parameter of different water samples were found to be similar in case of Dissolved Oxygen while it was highly varying in other parameters of study. Pond water sample collected from *Nettoor* has a salinity of 63.93 PPT Dissolved chloride ions was found to be 34.84 mg/l . It has comparatively high amount of sulphate and nitrite. Therefore among the collected samples pond water sample collected from *Nettoor* was the most polluted one. In the study, river water sample collected from *Cherukadapuram* is also polluted . The salinity was found to be 130.32PPT .The dissolved chloride ions were estimated to be 71.02mg/l. It contains highest amount of sulphate as well as nitrite. Bore well water is mainly used for house hold purposes. The sample had a pH of 7.15 and normal salinity. But the sulphate content is high with low nitrite content. So it is not suggested for consumption without proper treatment. The well water samples collected from *Cherukadapuram* and *Nettoor* is found to be less polluted. Sulphate and nitrite are absent in both the water samples.

Introduction

Water is an essential commodity. Water has the property to dissolve many substances in it. Therefore it can easily get polluted. It is a pity that many of the rivers flowing through densely populated areas and industrial belts in developed counters have turned into sewage canals or chemical drains. Pure water, the elixir of life, is now a precious commodity *et al.,* 2012) [1]. Water quality is a term used to describe the condition of the water, including its chemical, physical and biological characteristics, usually with respect to its suitability for a particular purpose. Water quality is also affected by substances like pesticides or fertilizers that can negatively affect marine life when present in certain concentrations generally certain parameters are used to determine the water quality including chlorinity, salinity, BOD, COD, estimation of free CO_2 etc.(Dalela *et al.,* 1977) [2]. In this project water samples were collected from, two villages in Ernakulam District of Kerala State in India, namely *Cherukadappuram* and *Nettoor*. The water samples included river water, bore well water and well water from *Cherukadapuram.* The water samples from *Nettoor* included pond water and well water. The objectives of the present work were to study the quality of water samples collected from different sources. Sampling was done from selected locations]. The samples were analyzed to quantify the following parameters:

- Free Carbondioxide
- Dissolved chloride ions
- Salinity
- Sulphate ions
- Nitrite ions
- Dissolved oxygen
- pH

Materials and methods

In order to evaluate the various physical and chemical aspects of water, sampling was done from different water sources and they were collected in clean bottles of one liter each.

Cherukdapuram

1. Bore Well Water
2. Well Water
3. River Water

Nettoor

4. Pond Water
5. Well Water

Analysis was carried out for various quality parameters such as free Carbon dioxide, dissolved chloride ions, salinity, dissolved oxygen, sulphate ions, nitrate ions and pH.

Reagents used for the estimation of CO2 in water sample.

1. Phenolphthalein indicator
2. NaOH Solution [0.01N]

Reagents used for the estimation of dissolved chloride ion content..

1. 0.02 N silver nitrate solutions
2. Potassium chromate [5%] indicator

Reagents used for the estimation of dissolves oxygen in the water sample by Winkler method.

1. Winkler solution A- prepared by dissolving 48g of MnSO4 in 100ml of distilled water.
2. Winkler solution B-prepared by dissolving 10g of KOH in 1% g of KL in 100 ml of distilled water.

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3. Standard sodium thiosulphate solution [$Na_2S_2O_2$]

A stock of standard 1 N $Na_2S_2O_2$ is prepared by dissolving $Na_2S_2O_2$ in 100 ml of distilled water and diluted to the required normality before use.

4. Conc. H_2SO_4

5. Starch solution prepared by dissolving 5g of starch in 100ml of distilled water, boiled and diluted to 11 1.25 g of salicylic acid or a few drops of Toluene or a preservative is added to it.

Reagents used for the estimation of CO2 in water sample

1. Phenolphthalein indicator

2. Standard NaOH solution [0.01N]

Dissolved 40 gms of NaOH pellets in 1 liters of water

Reagents used for the estimation of salinity of water sample

1. 0.02 N silver nitrate solution

Dissolved 3.4 gms of pre-dried $AgNO_3$ (A.R) in distilled water to prepare 1 liter of solution. Keep in a dark glass bottle.

2. Potassium chromate [5%] indicator

Dissolved 5 gm of K2CrO4 in 100ml of distilled water.

Reagents used for estimation of sulphate ions

1. Conditioning reagent

Mixed 75 gms of NaCl, 15ml concentrated HCl, 100 ml of alcohol in 300ml of distilled water. Add 50 ml glycerol to this solution and mix thoroughly.

2. Barium chloride

Fine crystals of barium chloride crystals were taken and dried.

Reagents for Nitrite ion estimation.

1. Sulfanilamide solution

2. N ethylene diamine dihydro chloride

1. Estimation of free carbon dioxide in water sample

Free carbon dioxide content in a water sample was determined by simple titration.

Procedure

50 ml of water sample was taken in a clean conical flask; and 2 drops of phenolphthalein was added as an indicator. The water sample was titrated against 0.01 N NaOH solution taken in the burette. The end point was the appearance of a light pink color. The titration was repeated till a concordant value is obtained.

Weight of CO_2 per liter in the given sample=V_1N_1 x 44 x 1000/V_2

Where,

V_1=Volume of NaOH used

V_2=Volume of water

N_1=Normality of NaOH

2. Estimation of dissolved chloride ions in water sample.

Most of the chlorides are soluble in water and can be determined by direct titration using silver nitrate and potassium chromate as indicator.

Procedure

50 ml of sample was taken in a conical flask and 2 drops of potassium chromate solution was added. The content was titrated against 0.02 N silver nitrate until a persistent reddish brown tinge appeared.

Chloride per liter of water sample=V_1N_1*35.5*1000/V_2

Where,

V_1=Volume of Silver nitrate

V_2=Volume of water

N_1=Normality of Silver nitrate

3 Estimation of the salinity of water sample.

Procedure water sample the salinity of the water can be calculated using More Knudson equation.

Salinity=0.03+(1.805*chlorosity per liter)

4. Estimation of dissolved oxygen in the water sample by Winkler method.

The Winkler method involves the oxidation of $MnSO_4$ in a highly alkaline solution, on acidification in the presence of KI.$Mn(OH)_3$ dissolved and iodine is liberated in an amount equal to the oxygen dissolved in the water sample.

Procedure

Water was collected in a BOD bottle without air bubbles. The stopper was removed and 1 ml of $MnSO_4$ solution (Winkler solution A) was added into it. 1 ml of KI solution (Winkler solution B) was added to the bottom of the bottle using a separate pipette. The bottle was shaken vigorously for half a minute and the bottle was kept undisturbed for 5 minutes in order to settle down the precipitate. 1 ml of Conc.H_2SO_4 Was added along the sides of the bottle. The bottle was inverted 2-3 times till a dark straw color appeared.

5 . Estimation of the sulphate ions of the water sample

Procedure

To 100 ml of clear sample 50 ml of conditioning reagent was added. This was added to each sample just prior to further processing. Stirred the sample on a magnetic stirrer and during stirring added a spoon full of barium chloride.

After the stirring was over , the optical density was read on a calorimeter and found the concentration of the sulphate from the standard curve.

Estimation Of The Nitrite Ions Of The Water Sample

Procedure

To 50 ml of clear sample , added 1 ml of sulphanilamide solution, allowed the reagent to react about 2-8 minute. Added 1 ml N(1-Naphthyl)-ethylene diamine dihydro chloride solution and mix immediately and not the absorbance at 543nm.

Estimation of pH of water sample

pH of the water sample was determined using digital pH meter MK VI.

Observations

Free Carbondioxide [Table 1]

Free CO_2 in well water (N) was found to be 1.76 mg/l

Free CO_2 In pond water (N)was found to be 2.2 mg/l

Free CO_2 in well water (C) was found to be1.76 mg/l

Free CO_2 in bore well water (C) was found to be 3.52mg/l

Free CO_2 in river water (C) was found to be 2.64mg/l

Table 1. Estimated free Co2 content in the water sample.

Sl.No.	WATER SAMPLE	FREE CO_2
1.	WELL WATER (N)	1.74mg/l
2.	POND WATER (N)	2.2mg/l
3.	WELL WATER (C)	2.64mg/l
4.	BOREWELL WATER (C)	3.52mg/l
5.	RIVER WATER (C)	1.76mg/l

N= Water sample from Nettoor

C= Water sample from Cherukadapuram

Dissolved Chloride Ions [Table 2]

In well water (N)the estimated dissolved chloride ions was 30.82mg/l

In pond water (N) the estimated dissolved chloride ions was34.84 mg/l

In well water (C)the estimated dissolved chloride ions was 29.48mg/l

In bore well water (C) the estimated dissolved chloride ions was33.5mg/l

In river water (C)the estimated dissolved chloride ions was71.02mg/l

Table 2 . Estimated dissolved chloride ions content.

Sl.No.	WATER SAMPLE	DISSOLVED CHLORIDE
1.	WELL WATER (N)	30.82mg/l
2.	POND WATER (N)	34.84mg/l
3.	WELL WATER (C)	29.48mg/l
4.	BOREWELL WATER (C)	33.5mg/l
5.	RIVER WATER (C)	71.02mg/l

N= Water sample from Nettoor

C= Water sample from Cherukadapuram

Salinity [Table 3]

Salinity of well water (N) was found to be 56.55 PPT

Salinity of pond water (N) was found to be 63.93 PPT

Salinity of well water (C)was found to be 54.09 PPT

Salinity of bore well water (C) was found to be 61.47PPT

Salinity of river water (C) was found to be 130.32 PPT

Where,

Table 3 . Estimated salinity of the water sample.

Sl.No.	WATER SAMPLE	SALINITY
1.	WELL WATER (N)	56.55PPT
2.	POND WATER (N)	63.93PPT
3.	WELL WATER (C)	54.09PPT
4.	BOREWELL WATER (C)	61.47PPT
5.	RIVER WATER (C)	130.32PPT

N= Water sample from Nettoor

C= Water sample from Cherukadapuram

Nitrite Ions [Table 4]

In well water (N) the estimated nitrite ions was 0μ mol/l

In pond water (N) the estimated nitrite ions was 0.3μ mol/l

In well water (C) the estimated nitrite ions was 0μ mol/l

In bore well water (C)the estimated nitrite ions was 0.1μ mol/l

In river water (C)the estimated nitrite ions was 0.2μ mol/l

Table 4. Estimated nitrite ions of water sample.

Sl.No.	WATER SAMPLE	NITRITE IONS
1.	WELL WATER (N)	0 μ mol/l
2.	POND WATER (N)	0.3μ mol/l
3.	WELL WATER (C)	0 μ mol/l
4.	BOREWELL WATER (C)	0.1μ mol/l
5.	RIVER WATER (C)	0.2μ mol/l

N= Water sample from Nettoor

C= Water sample from Cherukadapuram

Sulphate Ions [Table 5]

50 ml of sample water was taken in a conical flask. 2 ml of 5 % potassium chromate solution was added. The content was titrated against 0.02 N silver nitrate until a persistent reddish brown tinge appeared. From the value chloride (mg/l) of the

In well water (N) the estimated sulphate ions was 0 μ mol/l

In pond water (N)the estimated sulphate ions was 1.5μ mol/l

In well water (C) the estimated sulphate ions was 0μ mol/l

In bore well water (C) the estimated sulphate ions was 1.0μ mol/l

In river water (C) the estimated sulphate ions was 1.0μ mol/l

Table 5 .Estimated sulphate ions of water sample.

Sl.No.	WATER SAMPLE	SULPHATE IONS
1.	WELL WATER (N)	0 μ mol/l
2.	POND WATER (N)	1.5 μ mol/l
3.	WELL WATER (C)	0 μ mol/l
4.	BOREWELL WATER (C)	1.0 mol/l
5.	RIVER WATER (C)	0 μ mol/l

N= Water sample from Nettoor

C= Water sample from Cherukadapuram

Dissolved Oxygen [Table 6]

In well water (N) the dissolved oxygen was estimated to be 6.4 mg/l

In pond water (N) the dissolved oxygen was estimated to be 6.4 mg/l

In well water (C) the dissolved oxygen was estimated to be 6.4 mg/l

In bore well water (C) the dissolved oxygen was estimated to be 6.4 mg/l

In river water (C) the dissolved oxygen was estimated to be 6.4 mg/l

Where,

Table 6. Estimated dissolved oxygen in the water sample.

Sl.No.	WATER SAMPLE	DISSOLVED OXYGEN
1.	WELL WATER (N)	6.4 mg/l
2.	POND WATER (N)	6.4 mg/l
3.	WELL WATER (C)	6.4 mg/l
4.	BOREWELL WATER (C)	6.4 mg/l
5.	RIVER WATER (C)	6.4 mg/l

N= Water sample from *Nettoor*

C= Water sample from *Cherukadapuram*

pH of The Water Sample [Table 7]

pH of well water (N) sample was found to be 6.89

pH of pond water (N) sample was found to be 6.25

pH of well water (C) sample was found to be 6.55

pH of bore well water (C) sample was found to be 7.15

pH of river water (C) sample was found to be 7.49

Where,

N= Water sample from *Nettoor*

C= Water sample from *Cherukadapuram*

N= Water sample from Nettoor

C= Water sample from Cherukadapuram

Table 7 . pH of the water sample.

Sl.No.	WATER SAMPLE	pH
1.	WELL WATER (N)	6.89
2.	POND WATER (N)	6.25
3.	WELL WATER (C)	6.55
4.	BOREWELL WATER (C)	7.15
5.	RIVER WATER (C)	7.49

N = Water sample from Nettoor

C = Water sample from Cherukadapuram

Discussion

The study reveals that the free CO_2 in bore well water sample and well water sample collected from *Cherukadapuram* had the highest value . Surface water normally contains 10 ppm free carbon dioxide. Carbon dioxide is readily soluble in water. Increased amount of carbon dioxide makes it acidic and it leads to increase in the pH of water. River water collected from *Cherukadapuram* has the lowest free carbon dioxide amount. Water samples collected from *Nettoor* showed only slight variation in free carbon dioxide amount. Chloride enters in to the surface water from natural sources like atmospheric deposition of oceanic aerosols and weathering of rocks salts. Anthropogenic sources are industrial domestic sewage effluents and run off from agricultural fields through fertilizers. The chloride content ranges from 29.48 to 71.02 , from well water sample of *Cherukadapuram* and river water sample of *Cherukadapuram* respectively. Among all the water samples, river water sample of *Cherukadapuram* has the highest chloride value. Presence of chloride ions imparts salty taste to water. Salinity is the quantitative measure of dissolved mineral ions in water.

The lowest recorded salinity is from the well water sample of *Cherukadapuram* (54.09 PPT) and highest is recorded from river water sample of *Cherukadapuram*(130.32 PPT) . In a study on physiochemical analysis of pond water of Surguja district , revealed that the salinity of 10 pond water samples ranged from a minimum of 5.13 PPT to a maximum of 6.27 PPT [3], where as the salinity of pond water in the present study was estimated to be 63.93 PPT. The concentration of sulphate ranged between 0 to 1.5 μmol/l , showing maximum in river water and bore well water collected from *Cherukadapuram* and minimum in the *Nettoor* well water. High concentration of sulphate along with sodium and magnesium in drinking water can lead to gastro intestinal irritation and respiratory illness. The high concentration in drinking water causes adverse effects since it is a strong oxidizing agent and it can react with secondary amines present in human body to form nitrosamines. Biological oxidation of nitrogenous substances and bacterial action from sewage is the main source of nitrite. The concentration of nitrite ranges from 0 to 0.3μmol/l. In the present study , *Nettoor* pond had high sulphate and nitrite content and thus makes the river polluted. One of the main reasons for the pollution is the dumping of biological wastes and direct sanitary outlets to the pond. This leads to a condition called eutrophication.

Dissolved oxygen in the water sample was found to be same for all the water samples. In a study done estimated amount of dissolved oxygen was found to be different for all the water samples [4]. Generally, tropical waters tend to have low pH. Lower values in pH are indicators at high acidity which can be caused by the deposition of acid forming substances in precipitation. pH values recorded in the river water are in agreement with the pH values reported for other fresh water systems of *Thiruvananthapuram* [5] and elsewhere in Kerala [6]. In the present study pH of water samples ranges from 6.25 to 7.49 for samples from *Nettoor* well water and *Cherukadapuram* river water. Two of the water samples have pH lower than the B15 prescribed limit of 6.5 to 8.5.

From the study it is seen that of the two water samples collected from *Nettoor*, pond water is found to be highly polluted. It contains high amount of sulphate and nitrite. Dissolved chloride ions, salinity, free carbon dioxide and pH were within the permissible limit. The presence of sulphate and nitrite may be due to the adding up of fertilizers and biological wastes. The chance for pond water to get polluted is very high. Because it is an open water body. By analyzing all the water samples collected from *Cherukadapuram*, river

water sample is found to be highly polluted. It contains sulphate and nitrite. Salinity and dissolved chloride ions were found to be the highest in this river water sample while comparing with all the water samples studied in this project. River water is always exposed to the pollutants present in nearby agricultural fields and the disposal of biological as well as chemical pollutants. By conducting this study, the pond water sample from *Nettoor* was found to be the most polluted. It may be due to the dumping of biological waste and the direct sanitary outlets to pond. It has the highest sulphate and nitrite value. More studies are needed in this direction. The pH of all water samples were within the permissible limits. The water sample from *Cherukadapuram river* was also found to be polluted due to the presence of sulphate and nitrite. The reason may be the adding up of fertilizers from nearby agricultural lands. Bore well water was also polluted. Comparatively well water from *Cherukadapuram* and *Nettoor* were slightly polluted but it can be preferred for drinking, house hold and industrial purposes after proper treatments

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