PROJECT REPORT

ON

"COMPARATIVE STUDY ON WELL WATER, TAP WATER, RIVER WATER IN CORPORATION, MUNICIPALITY AND PANCHAYAT OF ERNAKULAM DISTRICT"

Submitted by

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In partial fulfilment for the award of the

Bachelor's Degree in Chemistry

DEPARTMENT OF CHEMISTRY AND CENTRE FOR RESEARCH
ST. TERESA'S COLLEGE (AUTONOMOUS)
ERNAKULAM

2022-2023

DEPARTMENT OF CHEMISTRY AND CENTRE FOR RESEARCH
ST. TERESA'S COLLEGE (AUTONOMOUS)

ERNAKULAM

B.Sc. CHEMISTRY PROJECT REPORT

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Register Number : **AB20CHE001, AB20CHE007, AB20CHE031**

Year of Work : **2022-2023**

This is to certify that the project "COMPARATIVE STUDY ON WELL WATER, TAP WATER, RIVER WATER IN CORPORATION, MUNICIPALITY AND PANCHAYAT OF ERNAKULAM DISTRICT "is the work done by AKSHAYA KUNJMON, BLESSY BIJU & SREELAKSHMY K R

ST. TERESA'S COLLEGE (AUTONOMOUS) DEPARTMENT OF CHEMISTRY

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Date: 06/03/23

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DEPARTMENT OF CHEMISTRY AND CENTRE FOR RESEARCH

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CERTIFICATE

This is to certify that the project work entitled "COMPARATIVE STUDY ON WELL WATER, TAP WATER, RIVER WATER IN CORPORATION, MUNICIPALITY AND PANCHAYAT OF ERNAKULAM DISTRICT "is the work done by AKSHAYA KUNJMON, BLESSY BIJU & SREELAKSHMY K R under my guidance in the partial fulfilment of the award of the Degree of Bachelor of Science in Chemistry at St. Teresa's College (Autonomous), Ernakulam affiliated to Mahatma Gandhi University, Kottayam.

PROJECT GUIDE

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DECLARATION

I hereby declare that the project work entitled "COMPARATIVE STUDY ON WELL WATER, TAP WATER, RIVER WATER IN CORPORATION, MUNICIPALITY AND PANCHAYAT OF ERNAKULAM DISTRICT" submitted to Department of Chemistry and Centre for Research, St. Teresa's College (Autonomous) affiliated to Mahatma Gandhi University, Kottayam, is a record of an original work done by me under the guidance of Dr. ANNU RAJU (Asst. Professor Department of Chemistry and Centre for Research, St. Teresa's College (Autonomous), Ernakulam) and this project work is submitted in the partial fulfilment of the requirements for the award of the Degree of Bachelor of Science in Chemistry.

AKSHAYAKUNJMON
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SREELAKSHMY K.R

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Chapter 1

Introduction

Water is an inorganic, transparent, tasteless, odorless and nearly colorless chemical substance, with chemical formula H2O, which is the main constituent of life. Water covers about 71% of the Earth's surface, with seas and oceans making up most of the water volume i.e., about 96.5%. Small portions of water occur as ground water and some as ice caps and glaciers. Only a small amount of water is there for human purposes. So, conservation of clean, useful water is very important.

Nowadays the rate of water pollution is increasing rapidly. This is a widespread problem affecting our health and day to day life. Water pollution may cause many deadly diseases. Toxic substances from farms, towns and factories readily dissolve into and mix with water bodies easily, which causes water pollution. Safe drinking water is a basic need for good health, and it is also a basic right of humans. Fresh water is already a limiting resource in many parts of the world. In the next century, it will become even more limiting due to increased population, urbanization, and climate.

Due to these severe issues, analysis of water is very important. In water analysis, the demand of monitoring systems with the ability of operating as stand-alone measurement systems becomes more important. It is carried out to identify and quantify the chemical components and properties of water samples. Drinking water polluted with microorganisms is a major cause of diarrhea, cholera, dysentery, typhoid, and other diseases that affect large populations worldwide. Water quality is an index of health and wellbeing of a society. Industrialization, urbanization and modern agriculture practices have direct impact on the water resources. These factors influence the water resources quantitatively and qualitatively. Laboratory methods are used to assess the quality of the water. There are three different ways to measure water quality characteristics. These include the physical (color, turbidity, odor, taste, etc.), chemical (ph., hardness, DO, BOD, COD, chlorine, metals, etc.), and biological (turbidity, DO, BOD, COD, etc.) Characteristics (presence of virus, algae etc.). The criteria of the evaluated water quality must meet local government norms, which are frequently affected by international standards established by business or water quality organizations like the World Health Organization.[1][2][3]

1.1Water quality parameters

1.1.1 pH

pH is a measure of how acidic/basic water is. The range goes from 0 to 14, with 7 being neutral. pHs of less than 7 indicate acidity, whereas a pH of greater than 7 indicates a base. The pH of water is a very important measurement concerning water quality. EPA guidelines state that the pH of tap water should be between 6.5 and 8.5. High pH causes a bitter taste, water pipes and water-using appliances become encrusted with deposits, and it depresses the effectiveness of the disinfection of chlorine, thereby causing the need for additional chlorine when pH is high. Low-pH water will corrode or dissolve metals and other substances. If the pH of water is too high or too low, the aquatic organisms living within it will die. pH can also affect the solubility and toxicity of chemicals and heavy metals in the water. The majority of aquatic creatures prefer a pH range of 6.5-9.0, though some can live in water with pH levels outside of this range. pH values above 11 and below 4 can cause eye irritations in human beings.

pH meters are used to measure pH level in water. pH meters are a more accurate type of measurement and they are widely used.[4]

1.1.2 Hardness of Water

Hardness of water is due to the presence of soluble bicarbonate, chloride and sulphate of calcium and magnesium. Hardness is an important water quality parameter to determine the suitability of the water for use in different purposes. This water would not give lather with soap. It can also be defined as the soap consuming capacity of water.

It is expressed in parts per million that is the weight of calcium carbonate in milligram equivalent to all hardness causing substance in one million milligrams of water. It can also be expressed in weight of calcium carbonate in milligram equivalent to all hardness causing substance in one liter of water. Therefore, the unit is ppm or mg/L. Hard water with the hardness of 60-100 ppm is recommended for drinking. Water with hardness 0-75 ppm is called soft water and hardness from 75-150 is medium hard water and hardness form 150-300 is hard water and over 300 is very hard water.[5]

The major differences of hard water from soft water are that it does not readily lather with the soap and forms an insoluble scum thus affecting the cleaning action of soap. And it does not contain dissolved salts of calcium and magnesium. Hardness is further classified into two

1)Temporary Hardness

2)Permanent Hardness

•**Temporary Hardness**

The presence of magnesium and calcium carbonate in water makes it temporarily hard. Here the hardness can be removed by boiling the water. During boiling the sodium bicarbonates get converted to insoluble carbonates which is further removed by filtration. Another method for this purpose is Clark's method using Clark's reagent 'calcium hydroxide'. Calcium hydroxides convert bicarbonates into carbonates and this removes the hardness.

• **Permanent Hardness**

When the soluble salts of magnesium and calcium are present in the form of chlorides and sulphides in water, we call it permanent hardness because this hardness cannot be removed by boiling. We can remove this hardness by treating the water with washing soda. Insoluble carbonates are formed when washing soda reacts with the sulphide and chloride salts of magnesium and calcium and thus, hard water is converted to soft water. Other methods for removing permanent hardness include Gan's Permutt Method, Calgon's method, and the Ion exchange resin method.

Advantages and disadvantages of Hard water

Advantages

1. Hard water contains high content of minerals which is one of its best advantages. Calcium present in water helps in growth of bones and teeth.

2. It acts as a dietary supplement and has proven to improve bowel movements and reduce constipation.

3. Hard water has a sweeter taste because of the presence of cations.

Disadvantages

1)Scale and sludge formation in boilers of industries which can result in wastage of fuel, choking of pipes and lowering the safety boilers and also boiler corrosion.

2)It decreases the cleansing action of soap.

3)Wastage of soap and detergents

4)Stains in kitchen utensils and bathroom fitting.

5)Drinking hard water for a long period leads to stomach disorders, especially water containing magnesium sulphate weakens the stomach permanently.

6)Damage of clothes.

Certain chemicals like sodium hydrogen carbonate, Calcium hydroxide, sodium hydroxide, sodium trioxocarbonate (IV), borax etc. are capable of removing hardness.

1.1.3 Total Alkalinity

Alkalinity is the water's capacity to resist changes in pH. That would make the water more acidic. It also helps protect your health and piping when it comes to drinking water. The term "buffering capacity" usually denotes this capacity. Alkalinity also refers to the capability of the water to neutralize the acid. This is true that it has buffering capacity. A buffer is a solution in which acid can be added without changing the concentration of available H+ ions. It absorbs the excessive H+ ions and protects the water from fluctuations in pH.

The pH and the alkalinity level of the well water can be affected by various factors such as acidic sanitizers, rain, fill water, and other product applications that can change the alkalinity level over time. The majority of alkalinity in the surface water is from calcium carbonate, $CaCO_3$, leached from soil and rocks.

Alkalinity is important in the treatment of wastewater and drinking water. It can influence the treatment processes such as anaerobic digestion. Water can also become unsuitable for irrigation if it is higher than the natural level of alkalinity in the soil. The use of alkaline drinking water Is controversial. Some health experts claim that there is not enough research to back up the health claims provided by the sellers and users. Meanwhile, there are differences in research findings related to the type of alkaline water studies.

According to experts, regular water is still the best for people. There are no studies to verify the claims made by alkaline water supporters fully. But some studies show that alkaline water can be helpful for certain medical conditions. For example, a study done in 2012 found out that drinking naturally carbonated artesian-well alkaline water with a pH level of 8.8 may help deactivate pepsin. This is the main enzyme that causes acid reflux. Moreover, drinking alkaline ionized water can positively benefit the body, especially for those who have high blood pressure, high cholesterol levels, and diabetes.[6][7]

Factors Affecting Alkalinity

•Geology and Soils

The water system accumulates carbonates if the water passes through soil and rock containing carbonate minerals, such as calcite ($CaCO_3$). Waters with limestone and sedimentary rocks and carbonate-rich soils are high in alkalinity. The Eastern part of the Boulder Creek watershed is one example. Waters with igneous rocks (such as granite) and carbonate-poor solids are low in alkalinity. One example is the western part of the Boulder Creek watershed.

•Changes in pH

Since pH and alkalinity are closely related, changes in pH can also affect alkalinity. This is true, especially in a poorly buffered stream.

•Sewage Outflow

The effluent from Wastewater Treatment Plants (WWTPs) can increase alkalinity to a stream. The wastewater from our houses also contains bicarbonate and carbonate from the cleaning agents and food residue that we put down our drains.

Risk of alkaline drinking water

In general, drinking alkaline water is safe. However, it can still cause side effects on the human body. Some of the side effects can include lowering the acidity level of the stomach. With this, it can help kill the bacteria in the body. It can expel unwanted pathogens in the bloodstream.

In addition, excessive alkalinity in the human body can cause skin irritations. It can also lead to gastrointestinal issues. Furthermore, it can agitate the normal pH level of the body. This can lead to metabolic alkalosis, a health condition that can cause symptoms like vomiting, nausea, muscle twitching, hand tremors, confusion, and tingling in the face. Metabolic alkalosis can lead to a decrease in calcium levels in the body. As such, it can damage bone health. But the most common cause of hypocalcemia is not because of drinking alkaline water. It has an under-active parathyroid gland.

Measurement of Alkalinity

Titration is the process that measures alkalinity. The 'titrant' is an acid of known strength added to a volume of a treated sample of water. The volume of acid needed to bring the samples to a specific pH level reflects the alkalinity of the sample. A color change indicates the pH endpoint. The unit that expresses the alkalinity is milligrams per litre (mg/l) of $CaCO_3$ (calcium carbonate).

1.1.4 Residual Chlorine

Chlorine is a greenish yellow gas that dissolves easily in water. It has a pungent, noxious odor that some people can smell at concentration above 0.3 parts per million. Because chlorine is an excellent disinfectant, it is commonly added to most drinking water supplies I. In parts of the world where chlorine is not added to drinking water, thousands of people die each day from waterborne diseases like typhoid and cholera.

Chlorine is also used as a disinfectant in wastewater treatment plants and swimming pools. It is widely used as a bleaching agent in textile factories and paper mills, and it's an important ingredient in many laundry bleaches. Free chlorine is toxic to fish and aquatic organisms, even in very small amounts. However, its dangers are relatively short lived compared to the dangers of most other highly poisonous substances. That is because chlorine reacts quickly with other substances in water or dissipates as a gas into the atmosphere. The free chlorine test measures only the amount of free or dissolved chlorine in water. The total chlorine test measures both free and combined forms of chlorine.

If water contains a lot of decaying materials, free chlorine can combine with them to form compounds called trihalomethanes or THMs. Some THMs in high concentration are carcinogenic to people. Unlike free chlorine, THMs are persistent and can pose a health threat to living things for a long time. People who are adding chlorine to water for disinfection must be careful for two reasons:

Chlorine gas even at low concentration can irritate eyes, nasal passage and lungs. It can even kill in a few breaths. The formation of THM compounds must be minimized because of the long-term health effects. Less than one half (0.5) mg/L of free chlorine is needed to kill bacteria without causing water to smell or taste unpleasant. Most people can't detect the presence of chlorine in water at double (1.0) mg/L. Although 1.0 mg/L chlorine is not harmful to people, it does cause problems for fish if they are exposed to it over a long period of time.

Effects of chlorine on industrial process:

Chlorine may cause canned or frozen food to taste “funny”. It also may affect the smoothness or brightness of plated metals. Chlorine levels as low 0.3 mg/L can spoil the quality of high-grade paper during the manufacturing process.

Effects of chlorine in water used for irrigation:

The concentration of chlorine in city water or treated wastewater rarely reaches 1.0 mg/L. So, chlorine usually is not a problem to farmers and gardeners using either city water or wastewater to irrigate their crops.

Effects of chlorine on fish and aquatic life:

0.006 mg/L of total chlorine kills trout fry in two days and 0.01 mg/L of total chlorine is recommended maximum for all fish and aquatic life. It is important to realize chlorine becomes more toxic as the pH level of the water drops. And it becomes even more toxic when it is combined with other toxic substances such as cyanide, phenols, and ammonia.

Phenols are organic chemicals produced when coal and wood are distilled and when oil is refined. Phenols are found in a number of products (from organic waste to sheep dip). Although phenols are very toxic, dilute solutions of a phenol (carbolic acid) are used as disinfectants.[8][9]

1.1.5 Ammonium

Ammonium (NH_4^+) is one of the most commonly produced industrial chemicals. It is formed by the protonation of ammonia (NH_3). Ammonium is an important nutrient in primary production; however, high ammonium loads can cause eutrophication of natural waterways, contributing to undesirable changes in water quality and ecosystem structure. While ammonium pollution comes from diffuse agricultural sources, making control difficult, industrial or municipal point sources such as wastewater treatment plants also contribute significantly to overall ammonium pollution. It is used in industry and commerce, and also exists naturally in humans and in the environment. Ammonia is essential for many biological processes and serves as a precursor for amino acid and nucleotide synthesis.

Sources

About 80% of the ammonia produced by industry is used in agriculture as fertilizer. Ammonia is also used as a refrigerant gas, for purification of water supplies, and in the manufacture of plastics, explosives, textiles, pesticides, dyes and other chemicals.

Effects

Ammonia is toxic to some fish and other aquatic organisms at concentrations below 1 mg/l (ppm) in water. Human beings and higher animals are less sensitive to ammonia in water, but long-term ingestion of water containing more than 1 mg/l (ppm) ammonia may be damaging to internal organ systems.[10]

1.1.6 E. coli

Escherichia coli also known as E. coli is a Gram-negative, facultative anaerobic, rod-shaped, coliform bacteria of the genus Escherichia that is commonly found in the lower intestine of warm-blooded organisms. Human and animal stool may pollute ground and surface water, including streams, rivers, lakes and water used to irrigate crops. Although public water systems use chlorine, ultraviolet light or ozone to kill E. coli, some E. coli outbreaks have been linked to contaminated municipal water supplies. Private water wells are a greater cause for concern because many don’t have a way to disinfect water. Rural water supplies are the most likely to be contaminated. Some people also have been infected with E. coli after swimming in pools or lakes contaminated with stool.[11]

Effects of E. coli

E. coli can affect anyone who is exposed to the bacteria. But some people are more likely to develop problems than others.

People who have weakened immune systems, from AIDS or from drugs to treat cancer or prevent the rejection of organ transplants are more likely to become ill from ingesting. E. coli. Young children and older adults are at higher risk of experiencing illness caused by E. coli and more-serious complications from the infection.

Prevention

No vaccine or medication can protect you from E. coli-based illness, though researchers are investigating potential vaccines. To reduce your chance of being exposed to E. coli, avoid swallowing water from lakes or pools, wash your hands often, avoid risky foods, and watch out for cross-contamination.

We tried to analyze water from different Panchayats, municipalities and divisions of the Kochi Corporation. Kochi is one of the largest municipal corporations in Kerala which consists of 13 Municipalities, 7 taluks, 14 Block Panchayats, 82 Grama Panchayats and 124 villages. Out of this we took 4 Municipalities, 4 grama panchayats and 5 divisions from Kochi Corporation. Every day Ernakulam district is suffering from different types of pollution, mainly water pollution, so the necessity of analyzing water in these areas is very important.[12]

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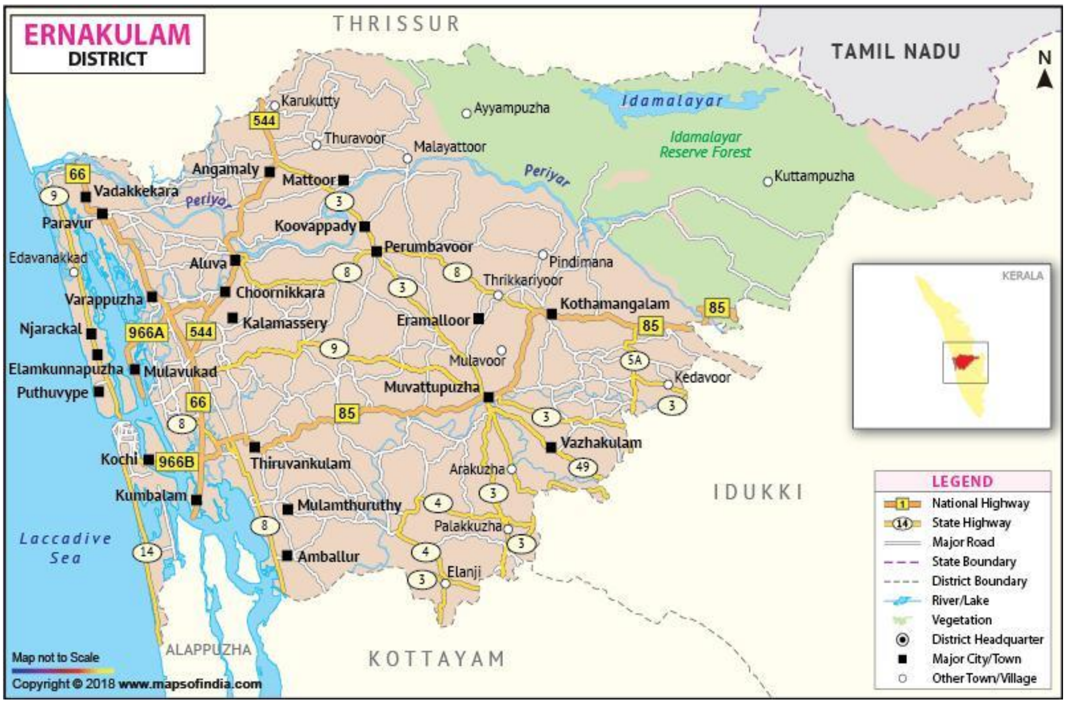
Kochi (9.9312° N, 76.2673° E) is one of the largest municipal corporations in Kerala which consists of 13 Municipalities, 7 taluks, 14 Block Panchayats, 82 Grama Panchayats and 124 villages. Out of this we took 4 Municipalities, 4 grama panchayats and 5 divisions from Kochi

Corporation. Every day Ernakulam district is suffering from different types of pollution, mainly water pollution, so the necessity of analyzing water in these areas is very important. Kochi is one of the fastest-growing cities in the country and the business capital of Kerala. As of 2011 national population census, it has a corporation limit population of 677,381 within an area of 94.88 km^2 and a total urban population of more than of 2.1 million within an area of 440 km^2, making it the largest and the most populous metropolitan area in Kerala. The corporation is the most densely populated one in the state and faces many challenges in the water sector, ranging from inadequate water distribution network, depleting groundwater quantity and quality to increasing water pollution, population growth and changing land use patterns that result in loss or depletion of water resources. Above all the main issue is the less availability of clean and safe drinking water. To make sure the quality of water, analysis is very important.



Map of Ernakulam district

1.2 Literature Survey

Many studies have been conducted to analyze the quality of drinking water. Some of them are listed below:

Susan.D. Richardson (2009) studied about water analysis and its emerging contaminants and current issues. (Analytical chemistry 81 (12), 4645-4677, 2009) This biennial review covers developments in water analysis for emerging environmental contaminants over the period of 2007-2008

Amrita Pal, Karina Yew-Hoong Gin, Angela Yu-Chen Lin, Martin Reinhard (2010) studied impacts of emerging organic contaminants on freshwater resources: review of recent occurrences, sources, fate and effects. (Science of the total environment 408 (24), 6062-6069, 2010)

R. M. Khan, M. J. Jadhav, I. R. Ustad (2011) have Explained, in order to understand the water quality Of Triveni Lake, Physio-chemical parameters were Studied and analyzed for the period of one year i.e., December 2010 to November 2011. Various Physicochemical parameters, such as water Temperature, air temperature, pH, humidity, Conductivity, free Co2, total solid, dissolved Oxygen, Total alkalinity, Total hardness, caco3, Ca^{2+}, mg^{2+} were studied. The results revealed that There was significant seasonal variation in some. Physicochemical parameters and most of the Parameters were in normal range and indicated better quality of lake water. It has been found that the water is best for drinking purposes in winter and summer seasons.

R. W. Gaikwad, V. V. Sasane has explained, the present work is aimed at assessing the water quality of the groundwater in and around Lonar Lake. Water quality has been determined by collecting groundwater samples and subjecting the Samples to a comprehensive physicochemical Analysis. For assessing water quality, pH, total Hardness, calcium, magnesium, bicarbonate, Chloride, nitrate, sulphate, total dissolved solids, iron, manganese and fluorides have been considered. The higher values have been found to be mainly for Iron, Total hardness, chloride, fluoride, Calcium and magnesium, many literatures shows that groundwater quality in Lonar Taluka has been badly affected by nitrate contamination. The analysis reveals that the groundwater of the area needs some degree of treatment before consumption, and it also needs to be protected from the perils of contamination. Many different options are now in progress for treatment of water locally. Various community-based programs have been tried in the past, but only few of these purely community run plants are successful. The future lies in providing safe drinking water in rural areas with a mixture of these options so that the objectives of providing safe water at low cost for sustaining over a long time and reaching to maximum number of people is achieved.

S.P.Gorde,M. V. Jadhav (2013) studied on Assessment of Water Quality Parameters in lake water in India. For the assessment of water pollution status of the water bodies, the following water quality parameters were analyzed: (1) pH (2) Specific Conductance (3) Temperature (4) Total dissolved solid (TDS) (5) Total Solids (TS) (6) Total Alkalinity (7) Dissolved oxygen (DO) (8) Chemical oxygen demand (COD) (9) Biochemical oxygen demand (BOD) (10) Total Hardness. And they came to the conclusion that the seasonal values of WQI indicate that during summer, lake water is more affected than during winter. This could be due to the fact that the microbial activity gets reduced due to low temperature, thereby keeping DO level at a very satisfactory range during the entire winter season. The suggested measures to improve the lake water quality includes total ban on the activities that cause pollution. Result of the water quality assessment clearly showed that most of the water quality parameters are slightly higher in the wet season than in the dry season. Water quality is dependent on the type of the pollutant added and the nature of self-purification of water.

Arivoli Appavu, Sathiamoorthi Thangavelu, Satheeshkumar Muthukannan, Joseph Sahayarayan Jesudoss and Boomi Pandi (2016) studied water quality parameters of Cauvery River water in the eroded region and Following physio-chemical properties were studied. Total dissolved solid (TDS) of water and fixed residue was measured by evaporation method. Dissolved oxygen(DO) and biochemical oxygen demand (BOD) of water was measured by sodium thiosulphate titration method. Chemical oxygen demand (COD) was measured by titration of potassium dichromate and sodium thiosulphate (APHA. 2005).

1.3 Objectives

Main objectives of the project are

- To find out the quality of drinking water from different areas of Kochi.
- To establish the importance of water quality analysis.
- To ensure clean and safe drinking water.

Chapter 2

Materials and Methods

This chapter gives a brief description of the materials and experimental procedures adopted for the present investigation.

2.1 MATERIALS

Water samples were collected from different panchayats (Cheranalloor (10.1768°N, 76.4751°E), Kadamakkudy (10.0540°N, 76.2537°E), Chellanam (9.8394°N, 76.2740°E), Ellamkunnapuzha (10.0268°N, 76.2233°E) municipalities (Kalamassery (10.0531°N, 76.3528°E), Thrikkakara (10.0327°N, 76.3319°E), Maradu (9.9368°N, 76.3180°E) Tripunithura (9.9487°N, 76.3464° E) and cooperation (Cochin corporation divisions- 34,27,8,13,53) of Ernakulam district.

Other materials used were ammonium, residual chlorine, total alkalinity, total hardness, pH and e coli testing kits.

2.2 EXPERIMENTAL METHODS

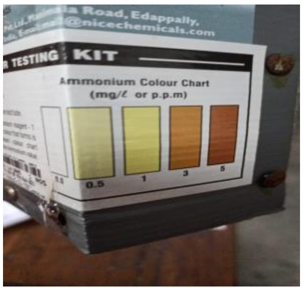
2.2.1 Ammonium

1.Take 5 ml of water sample in the test tube.

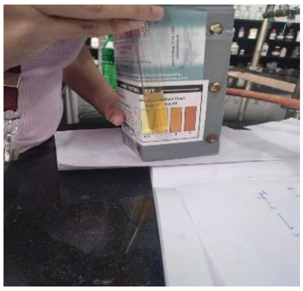
2. Add 5 drops of Ammonium reagent-1 (NH-1- Nessler's Reagent) and mix well. The color that formed is Compared with the Ammonium color chart immediately and records the ammonium value.

$$2K_2\,[HgI_4] + 3KOH + NH_3 \rightarrow [OHg_2.NH_2\,]I + 7KI + 2H_2O$$

The product formed after the reaction of ammonia and Nessler's reagent is brown in color.



Ammonium Color Chart

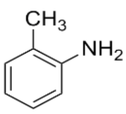


Comparison of color formed with given chart

2.2.2 Residual Chlorine

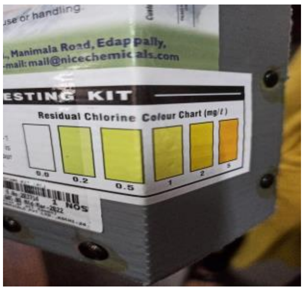
1.Take 5 ml of water sample in the test tube.

2. Add 5 drops of Residual chlorine reagent-1 (RC-1- Orthotoludine) and mix well. The color that forms is compared with the Residual chlorine color chart and records the Residual chlorine value.



+ Cl_2 ⟶ Holoquinone of orthotoludine (yellow color)

Orthotoludine



Residual chlorine color chart

Comparison of color formed

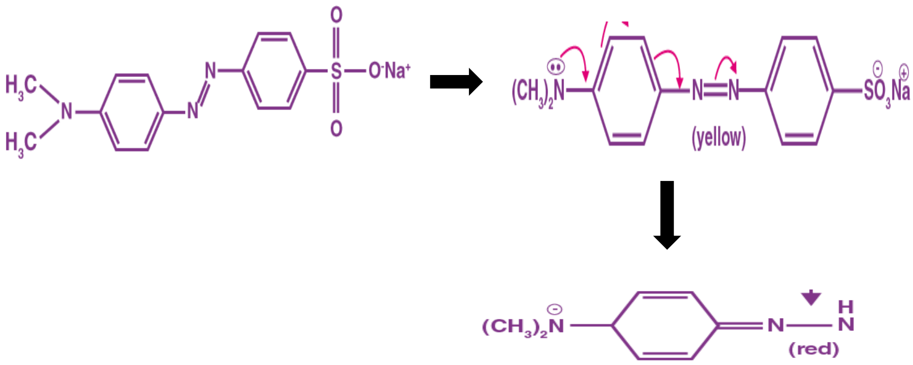
2.2.3 Total Alkalinity

1.Take 25 ml of water sample in the test bottle.

2. Add 4-5 drops of Total Alkalinity Reagent-2 (TA-2- methyl orange) and mix until an orange yellow color develops.

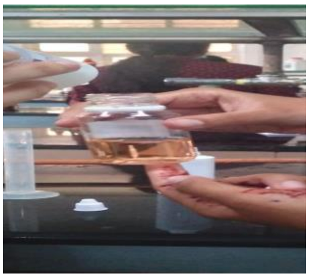
3. Add Total Alkalinity Reagent-1 (TA-1- dil HCl), shake well after each drop until the color changes from orange yellow to orange red. Count the no. of drops of TA-1 required for color change.

Total Alkalinity = (p.p.m in terms of $CaCO_3$) = no. of drops x5



Methyl orange react with base to form orange yellow complex and again react with acid to form orange red complex

Orange yellow color



Orange red color

2.2.4 Total Hardness

1. Take 25 ml of water sample in the test bottle (No-1)
2. Add 10 drops of Total Hardness reagent - 2 (TH-2- buffer) and mix.
3. Add a few specs of Total Hardness reagent 1(TH-1-Eriochrome Black-T) and mix until a distinct pink color develops.
4. For Hard water, add Total Hardness reagent - 3 (TH-3- EDTA), shake well after each drop until the color changes from pink to blue. Count the no. of drops required for color change.

Total Hardness = (p.p.m. in terms of $CaCO_3$) = no. of drops of TH-3 x 5

5. For soft water, add Total Hardness reagent - 4 (TH-4-EDTA), shake well after each drop until the color changes from pink to blue. Count the no. of drops of TH-4 required for color change.

Total Hardness = (p.p.m. in terms of $CaCO_3$) = no. of drops of TH-4 x 2

6. For very hard water (Borewell water, sea water) add Total Hardness reagent - 5 (TH-5-EDTA), Shake well after each drop, until the color changes from pink to blue. Count the no. of drops of TH-5 required for color change.

Total Hardness= (p.p.m. in terms of $CaCO_3$) = no. of drops of TH-5 x 50

Buffer and salts of Mg or Ca react with eriochrome black T to form Ca or Mg ion complex which is in pink colour and then EDTA react with it and give blue coloured complex

Formation of pink color

Formation of blue color

2.2.5 pH

1. Take 10 ml of water sample in the test bottle (No-1) 2. Add 3-4 drops of pH Reagent-1 (pH-1-Universal Indicator) and mix well.
The color that forms is compared with the pH color chart.

Universal indicator composed of 300ml water, 1-propanol, sodium bisulfite, 0.36g phenolphthalein, 0.1M sodium hydroxide, 0.18g methyl red, 0.43g bromothymol blue and thymol blue.

pH chart

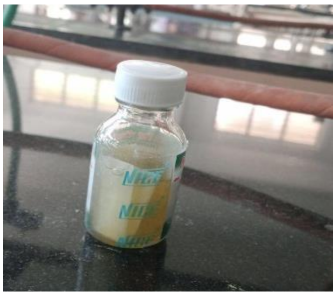
pH = 7

pH = 8

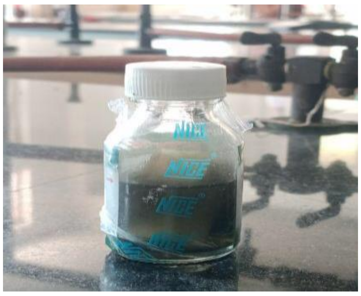
2.2.6 E. coli

1. Fill the water sample to be tested for fecal pollution into the bottle, the arrow mark, screw the cap and shake gently.
2. Keep the bottle at room temperature (Preferably at 30-37°C) for 24-48 hours.
3. Observe the change in color of the medium against the color chart.
4. Add a few drops of some disinfectant (Dettol, (Presence of Coliform/E.coli) (Absence of Coliform/E.coli) Phenyl or Lysol I.P.) and discard the solution.

Bile Esculin Agar (Bile + Sodium azide + esculin) + E. coli $\rightarrow$ *Esculetin* $\rightarrow$ *(presence of ferric citrate) Phenolic iron complex (black colour)*



Sample without E. coli



Sample with E. coli

Chapter 3

Results and discussion

3.1 Observation

3.1.1 Analysis of Tap Water collected from different Panchayats.

a. Determination of Alkalinity and Hardness

Panchayat	Sample	Ward	Alkalinity		Hardness	
			Drops	Value	Drops	Value
Chellanam	T_1	10	5	25	3	15
Cheranalloor	T_{2a}	17	5	25	5	25
	T_{2b}	11	5	25	4	20
	T_{2c}	01	5	25	4	20
Ellamkunnapuzha	T_{3a}	11	4	20	3	15
	T_{3b}	12	7	35	2	10
Kadamakudy	T_{4a}	07	4	20	8	16
	T_{4b}	06	3	15	6	30
	T_{4c}	05	5	25	3	15

b. Determination of pH, Ammonia and Chlorine

Panchayat	Sample	Ward	pH	Ammonia	Chlorine
Chellanam	T_1	10	5	0	0
Cheranalloor	T_{2a}	17	7	0	0
	T_{2b}	11	8	0	0
	T_{2c}	01	8	0	0
Ellamkunnapuzha	T_{3a}	11	7	0	0
	T_{3b}	12	7	0	0
Kadamakudy	T_{4a}	07	5	0	0
	T_{4b}	06	7	0	0.1
	T_{4c}	05	8	0	0

3.1.2Analysis of Well Water collected from different Panchayats.

a. Determination of Alkalinity and Hardness

Panchayat	Sample	Ward	Alkalinity		Hardness	
			Drops	Value	Drops	Value
Chellanam	W_1	10	61	305	17	85
Cheranalloor	W_{2a}	17	41	205	35	175
	W_{2b}	11	4	20	2	10
	W_{2c}	01	17	85	5	25
Ellamkunnapuzha	W_{3a}	11	3	15	1	5
Kadamakudy	W_{4a}	7	22	110	16	70
	W_{4b}	6	11	55	15	30
	B_{4a}	7	19	95	3	15
	W_{4c}	5	61	305	17	85

b. Determination of pH, Ammonia and Chlorine

Panchayat	Sample	Ward	pH	Ammonia	Chlorine
Chellanam	W_1	10	7	0	0
Cheranalloor	W_{2a}	17	7	0	0
	W_{2b}	11	5	0	0
	W_{2c}	01	8	0	0
Ellamkunnapuzha	W_{3a}	11	6	0	0
Kadamakudy	W_{4a}	7	6	0	0
	W_{4b}	6	6	0	0
	B_{4a}	7	6	0	0
	W_{4c}	5	8	0	0

3.1.3 Analysis of River Water collected from different Panchayats.

a. Determination of Alkalinity and Hardness

Panchayat	Sample	Alkalinity		Hardness	
		Drops	Value	Drops	Value
Cheranalloor	R_{2b}	9	45	2	100
Kadamakudy	R_{4a}	4	20	3	15
Kuzhuppilly	R_3	27	135	35	1750

b. Determination of pH, Ammonia and Chlorine

Panchayat	Sample	pH	Ammonia	Chlorine
Cheranalloor	R_{2b}	7	0	0.1
Kadamakudy	R_{4a}	7	0	0
Kuzhuppilly	R_3	10	0.5	0

3.1.4 Analysis of Tap Water collected from different Municipalities

a. Determination of Alkalinity and Hardness

Municipality	Sample	Division	Alkalinity		Hardness	
			Drops	Value	Drops	Value
Kalamassery	T_5	6	4	20	3	15
Maradu	T_{6a}	26	5	25	16	80
	T_{6b}	30	8	40	20	100
Thrikkakara	T_{7a}	27	4	20	7	14
	T_{7b}	43	5	25	7	14
Tripunithura	T_7	45	6	30	4	20

b. Determination of pH, Ammonia and Chlorine

Municipality	Sample	Division	pH	Ammonia	Chlorine
Kalamassery	T_5	6	7	0	0
Maradu	T_{6a}	26	7	0	0
	T_{6b}	30	7	0	0
Thrikkakara	T_{7a}	27	7	0	0.1
	T_{7b}	43	6	0	0
Tripunithura	T_8	45	7	0	0

3.1.5Analysis of Bore well Water collected from different Municipalities

a. Determination of Alkalinity and Hardness

Municipality	Sample	Division	Alkalinity		Hardness	
			Drops	Value	Drops	Value
Maradu	B_{6a}	26	10	50	70	140
Thrikkakara	B_{7a}	27	7	35	55	110
	B_{7b}	43	6	30	15	30

b. Determination of pH, Ammonia and Chlorine

Municipality	Sample	Division	pH	Ammonia	Chlorine
Maradu	B_{6a}	26	6	0	0
Thrikkakara	B_{7a}	27	5	0	0
	B_{7b}	43	6	0	0

3.1.6 Analysis of water samples collected from Cochin corporation

a. Determination of Alkalinity and hardness

Sample	Division	Alkalinity		Hardness	
		Drops	Value	Drops	Value
T_9	13	5	25	3	15
T_{10}	8	5	25	10	20
T_{11}	26	4	20	5	25
T_{12}	53	8	40	15	75

b. Determination of pH, Ammonia and chlorine

Sample	Division	pH	Ammonia	Chlorine
T_9	13	5	0	0
T_{10}	8	5	0	0
T_{11}	26	7	0	0.1
T_{12}	53	7	0	0

3.1.7 Analysis of Well water collected from Cochin corporation

a. Determination of Alkalinity and hardness

Sample	Division	Alkalinity		Hardness	
		Drops	Value	Drops	Value
W_9	13	23	115	2	50

b. Determination of pH, Ammonia and chlorine

Sample	Division	pH	Ammonia	Chlorine
W_9	13	7	0	0

3.1.8 Analysis of Borewell water collected from Cochin corporation

a. Determination of Alkalinity and hardness

Sample	Division	Alkalinity		Hardness	
		Drops	Value	Drops	Value
B_{11}	26	64	320	65	325
B_{10}	8	62	310	24	120

b. Determination of pH, Ammonia and chlorine

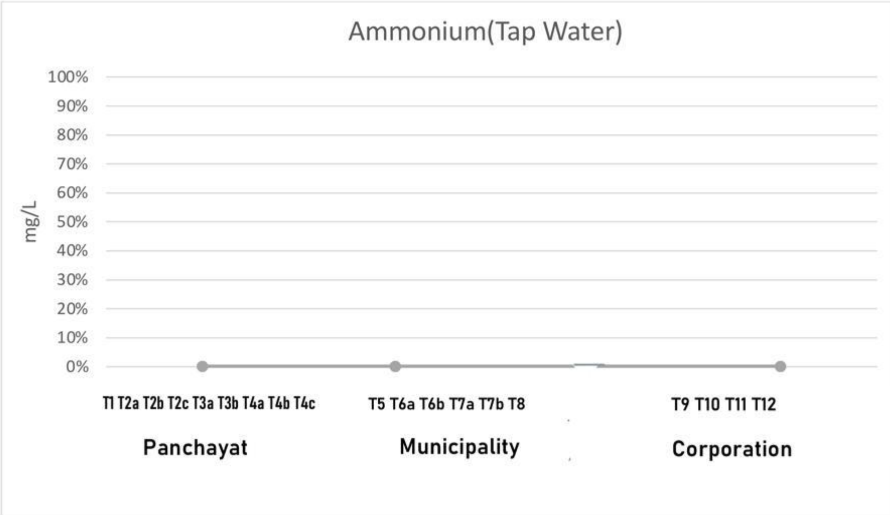
Sample	Division	pH	Ammonia	Chlorine
B_{11}	26	7	0	0
B_{10}	8	7	0	0

3.1.9 Determination of E. coli

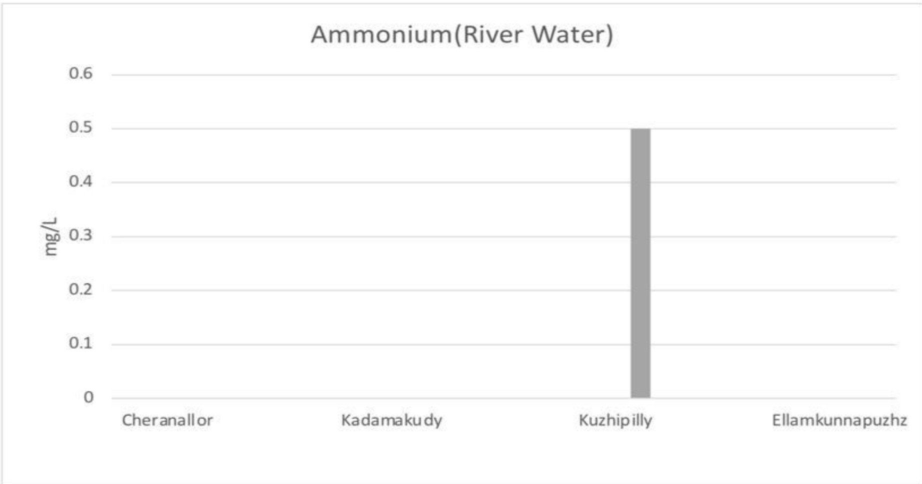
Sample	Panchayat/ Municipality/ Corporation		Source	Presence of E. coli
T_{3a}	Panchayat	Ellamkunnapuzha	Tap	Absence of E. coli
T_8	Municipality	Tripunithura	Tap	Presence of E. coli
T_{11}	Cooperation	Division-26	Tap	Absence of E. coli
R_{2b}	Panchayat	Cheranalloor	River	Presence of E. coli

3.2 Comparison of parameters between Panchayats, Municipalities and Corporation

3.2.1 Ammonium

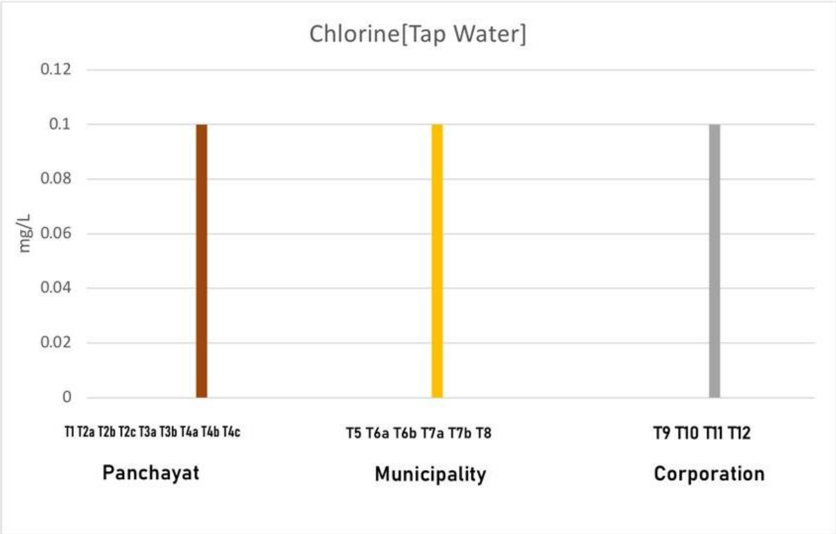


No presence of Ammonium

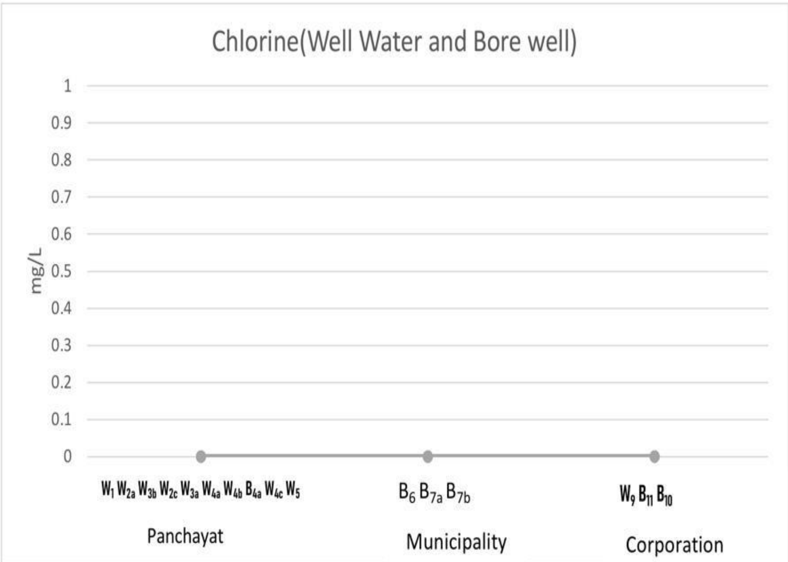


Presence of Ammonium in Kuzhipilly River

3.2.2 Residual Chlorine

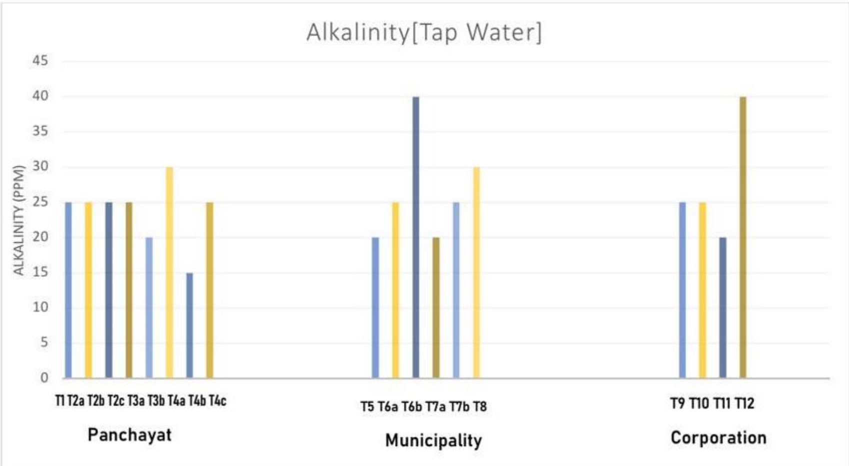


Presence of chlorine in T4b- Kadamakudy, T7a-Trikkakara, T11-Division 26

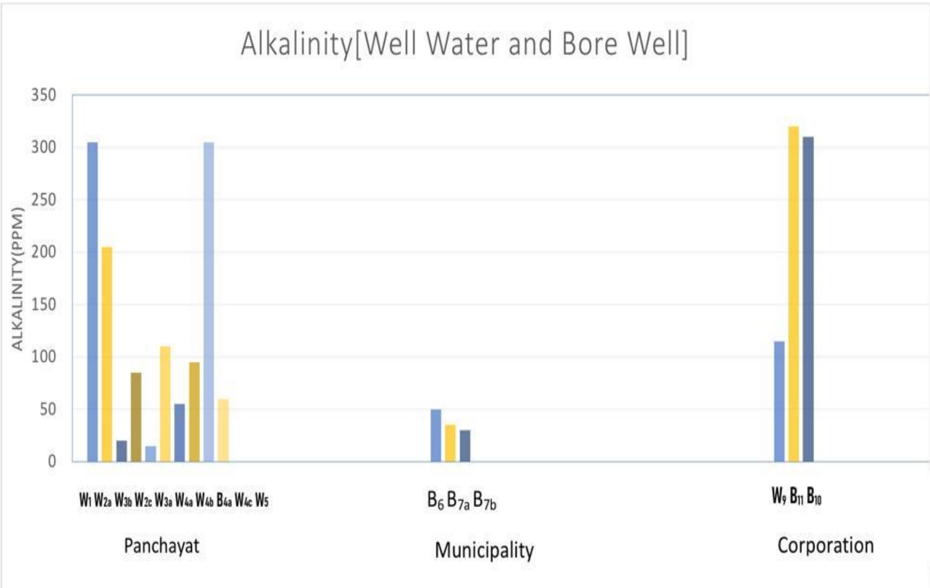


No presence of Chlorine in well water and Bore well.

3.2.3 Total Alkalinity

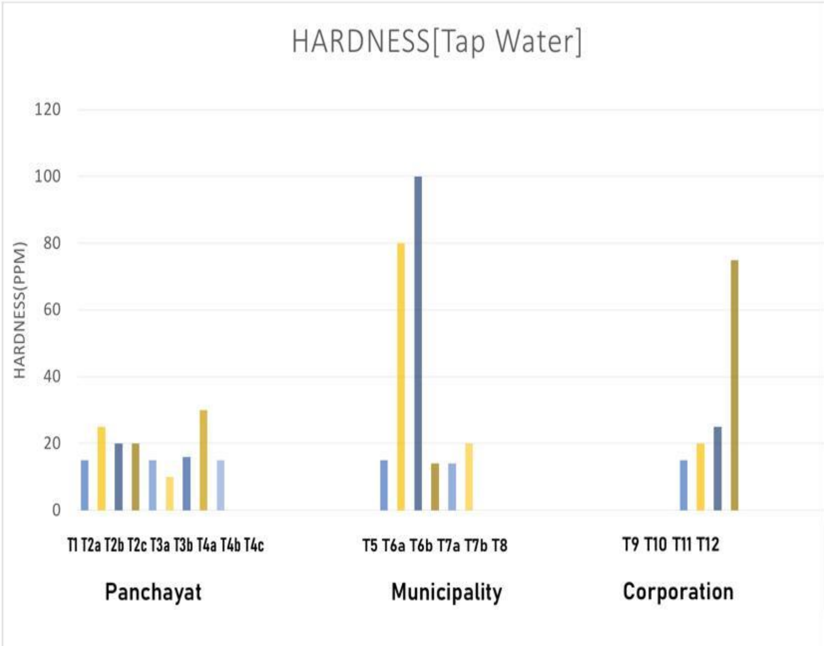


Alkalinity is low in T_{4b}(Kadamakudy)

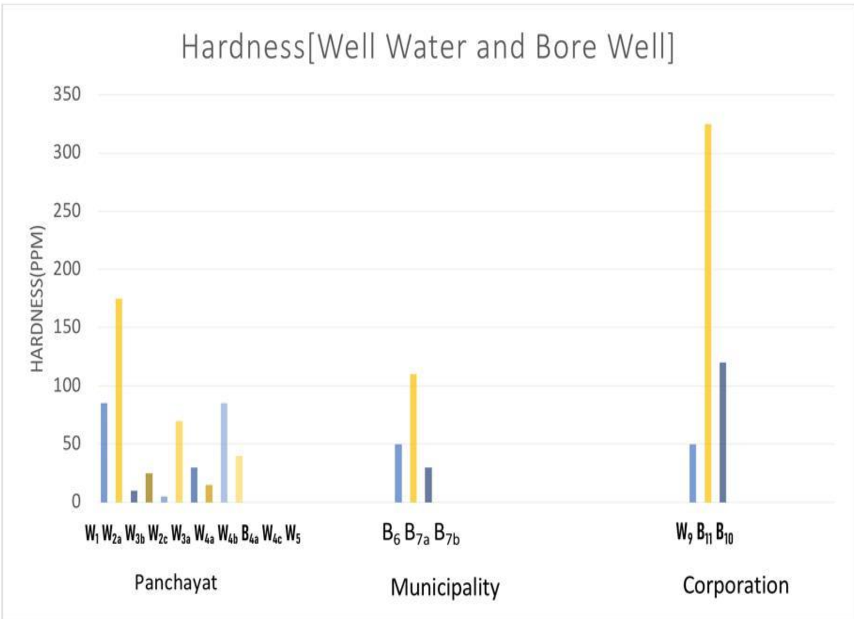


Alkalinity is low in W_{3a} (Ellamkunnapuzha)

3.2.4 Total Hardness

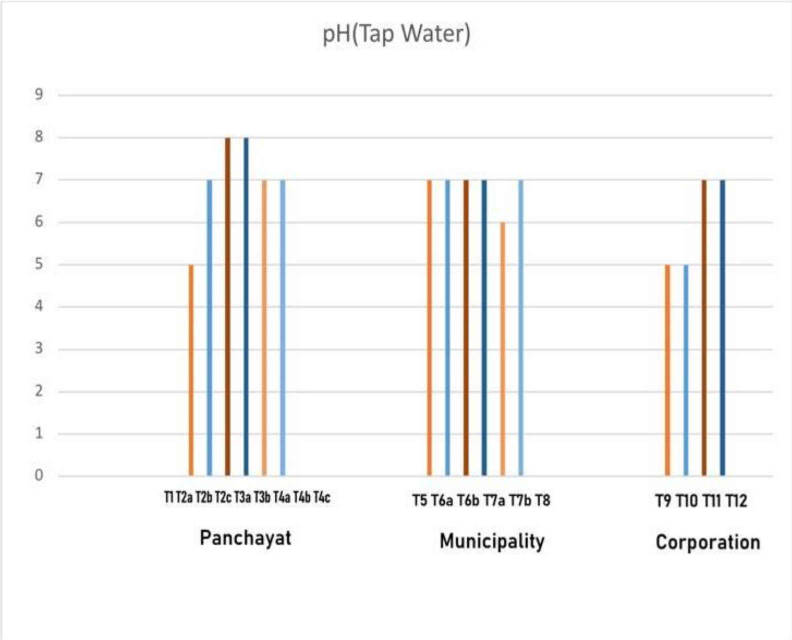


Hardness highest in T_{6b} (Maradu)

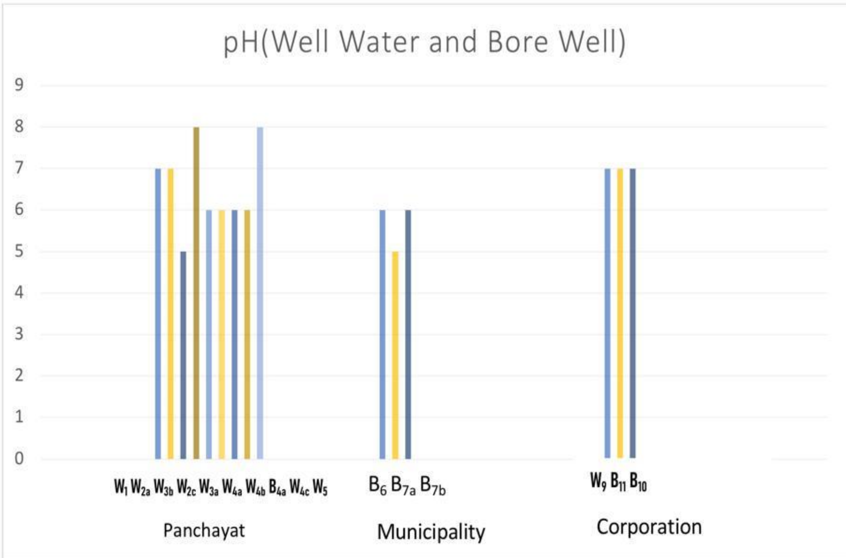


Hardness highest in B_{11} (Division-26)

3.2.5 pH

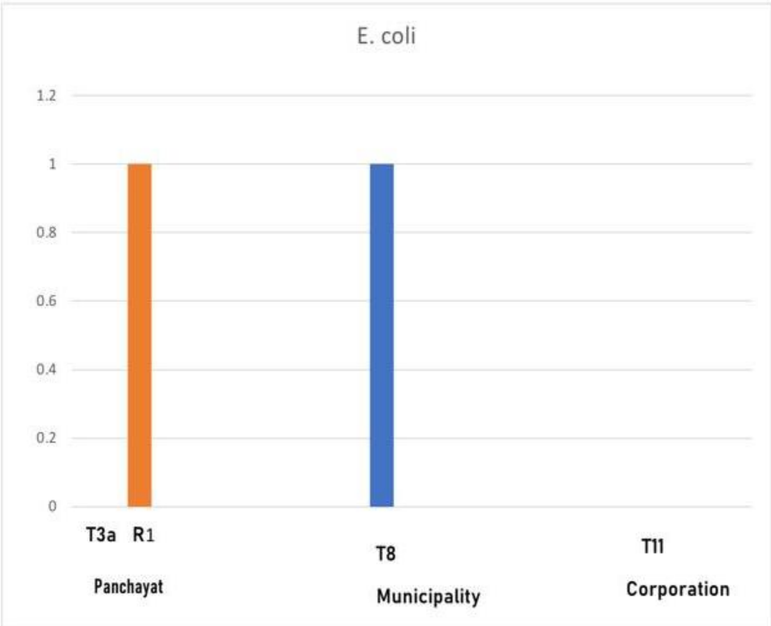


Acidic in T_{2b} and T_{2C} (Cheranallor)



Acidic in W_{2C} and W_5 (Cheranallor)

3.2.6 E. coli



Presence of E. coli in R_1 (Cheranalloor) and T_8 (Tripunithura)

Chapter 4

Conclusions

In conclusion, by becoming a part of the project we got a clear idea on water analysis and information about its different parameters like PH, Hardness of water, Alkalinity, Ammonia, E. coli, and Chlorine. It helps us to find out what is in our drinking water, tap water, pond and well water. knowing what is in our water supply is really important, it is Something that everyone should know but no one is bothered about water quality or what is in our drinking water that we use and consume daily because of less information about it. People should know about its importance.

After the experiment had been done, data were statistically analyzed and on comparing these parameters we found out that for the parameters like ammonium and residual chlorine all the samples showed values in between the normal permissible range. In the case of total hardness, tap water samples from some municipalities and corporation showed moderate hardness. While for some well water and bore well water samples hardness wasn't high as expected (it is normally expected to be very hard water). In the case of other parameters like total alkalinity tap water some samples from panchayats showed values below the normal range while well water samples from municipalities showed an exceptionally low value. The well water samples from municipalities also showed an acidic pH between the range 5-6, all samples from corporation showed neutral pH. For tap water except one or two samples from each region, others were normal. For the last parameter E. coli, a tap water sample from the municipality and a river water sample from the panchayat showed the presence of bacteria. It is shocking that in the municipality, e coli bacteria were present in the water which is used for domestic purposes. After the comparison we realized that the well water samples from municipalities are more contaminated when compared with other samples and the tap water sample from the municipality showed the presence of e coli. Water contamination is harmful for health and society. There must be awareness in the society about water quality and water quality tests before consuming and daily using it. By doing this we can prevent diseases and contamination in water and can lead a healthy life.

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