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# Evaluation of Physico-Chemical and Bacteriological Properties of Potable Water in Two Taluks of Kanniyakumari District, Tamil Nadu, India

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## ABSTRACT

Drinking water quality is determined by the water's biological, chemical, and physical features. As per the chemical and biological properties of drinking water, it should not contain any chemical or biological impurities and it should be colourless, odourless and tasteless. The study assessed the drinking water quality available in the selected spots of Kanniyakumari district. The physical, chemical and bacteriological parameters of the analytical results of open well drinking water were compared with the standard guideline values recommended by Indians standards and world health organisation (WHO 2004) for drinking and public health standards

In the present investigation the physico- chemical parameters like odour, Turbidity, Total dissolved solids, Electrical conductivity, pH, Total alkalinity as $CaCO_3$, Total hardness as CaCo3, Calcium, Magnesium, Sodium, potassium, Iron, Manganese, free Ammonia, Nitrite, Nitrate, Chloride, Fluoride, Sulphate, Phosphate, Dissolved $O_2$, fecal coliform per 100 ml were found within the permissible limits, Moreover, the coliform species were not detected from the water sample indicating that the water is safe for human consumption.

**Keywords:**

Drinking water, open well, physico-chemical properties, coliform.

## INTRODUCTION

Water is an essential requirement on the earth for sustenance of life. Determination of Physical, Chemical and bacteriological quality of water is essential for assessing its suitability for various purposes like drinking, domestic, agricultural and industrial use.

Water is an one of the most important compound to the ecosystem. Better quality of water is described by its Physical, Chemical and Biological characteristics. But some correlation was possible among these parameters and the significant one would be useful to indicate the quality of water.

The quality of drinking water should be checked at regular time interval, because, due to the use of contaminated drinking water, human population suffers from a variety of water borne diseases. It is difficult to understand the biological phenomena fully, because the chemistry of water reveals much about the metabolism of the Ecosystem and explain the general hydro biological relationship. The Physico-chemical parameters of water and the dependence of all life process of these factors make it desirable to take as an environment. Natural water bodies will vary in response to environmental conditions.

Drinking water, including bottled water, may reasonably be expected to contain at least small amount of some contaminants. The presence of these contaminants does not necessarily indicate that the water poses a health risk. Therefore clean drinking water is essential to humans and other lifeforms. A recent report (November 2012) suggests that by 2030, in some developing regions of the world, water demand will exceed supply by 50%. Water plays an important role in the world economy, as it functions as a solvent for a wide variety of chemical substances and facilitates industrial cooling and transportation.

The quality of water is of vital concern for mankind. Since it directly linked with human welfare. Poor quality of water adversely affects the plant growth and human health. (WHO 2004; Karanth 1997).

Water quality gets modified along the course of movement of water through the hydrological cycle and through the operation of the process like evaporation, transpiration, selective uptake by vegetation, oxidation – reduction, cation exchange, dissolution of minerals , precipitation of secondary minerals, mixing of water, leaching of fertilizers and manure, pollution and lake , sea biological process ( Appelo and Postuma, 1999).

Anthropogenic activities, namely, discharges of domestic waste, untreated waste from sewage treatment plants, plastic materials, disposal of personal care products and household chemicals, improper disposal of car batteries, construction activities, mining activities, and pilgrim activities are deteriorating the water quality of rivers(www. environmentalpollutioncenters.org,2018).Various agricultural, industrial, and mining activities contaminate ground water (Shaji,*et al*.2009) These activities alter pH of water, increases turbidity of water, and raise the content of total dissolved solids and metals(Ananthakrishnan, *et al*.2012).

As stated by Rai and Sharman (1995), lack of sanitation, improper waste disposal, faulty well construction and lack of water source protection measures and increased ground water contamination attributed to pollute ground water consumption.

The addition of various kinds of pollutants and nutrients through the agency, sewage, industrial effluents, agricultural run of etc. in to the water bodies brings about a series of changes in the

physicochemical and characteristics of water, which have been the subject of several investigations(Kannan, 1991).

Pollution of ground water due to industrial effluents and municipal waste in water bodies is another major concern in many cities and industrial clusters in India (Sreenivasan, 1970) . Ground water is very difficult to remediate, except in small defined areas and therefore the emphasis has to be on prevention.

## MATERIAL AND METHODS

### Study area

The study area is situated in the Vilavancode and Kalkulam taluk of Kanyakumari district.

Kanyakumari district lies between 77° 05' and 77° 36' of the eastern longitude and 8° 03' and 8° 35' of the northern latitude. It is bounded by Tirunelveli district on the north and the east. The southeastern boundary is the Gulf of Mannar. On the south and southwest, the boundaries are the Indian Ocean and the Arabian Sea. On the west and north – west, it shares boundaries with Kerala.

### Methodology

Drinking open well water samples were collected from seven locations of Kanyakumari district during the month of January 2017. The depth of the well from which the water samples were collected ranges between 20 feet to 75 feet. The container used for sampling were pre- cleaned, non reactive plastic bottles of one litre capacity and sterilized specially designed glass bottles of 100 ml capacity. Water samples were collected during the morning hours between 7.00 to 8.00 A.M. The bottles were sealed by screw cap. The name of the spot from which the samples were collected was Marayapuram, Mancode, Kulasekharam, Anducode, Chathencode, Kodumkulam and Kattathurai.

Each of the well water samples were analysed for its physical, chemical characteristics, such as Appearance, Odour, Turbidity, Total dissolved solids. Electrical conductivity, pH, Total Alkalinity, Total Hardness, Calcium, Magnesium, Sodium, Potassium, Iron, Manganese, free Ammonia, Nitrite, Chloride, Fluoride, Sulphate, Phosphate, Oxygen content and bacteriological faecal coliforom using standard procedures recommended by APHA.

## RESULTS AND DISCUSSION

Table I summarises the results on the Physico - Chemical and biological properties of drinking well water samples collected from seven different spots of Kanyakumari districts. The general appearance of drinking water collected from various sampling sites are clear and colourless. No specific odour recorded from analysed samples. The appearance of colour in water is caused by absorption of certain wavelengths of normal light by coloured substances (Patil et al., 2003).

**Table – 1 Physico – Chemical and Bacteriological properties of drinking Well water**

| | Limit | | | | Sampling Site | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Indian Standard | | WHO standard | | S1 | S2 | S3 | S4 | S5 | S6 | S7 |
| | Desirable | Undesirable | Desirable | Undesirable | | | | | | | |
| **PHYSICAL EXAMINATION** | | | | | | | | | | | |
| Appearance | | | | | C&C | C&C | C&C | C&C | C&C | C&C | C&C |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Odour | | | | | None | None | None | None | None | None | None |
| Turbidity NT Units | 5 | 10 | 5 | 10 | 2 | 1 | - | 1 | 1 | 2 | 1 |
| Total dissolved solid mg/1 | 500 | 2000 | 1000 | - | 187 | 126 | 400 | 313 | 130 | 233 | 376 |
| Electrical conductivity (mics/cm) | - | 300 | - | - | 283 | 191 | 606 | 475 | 197 | 353 | 570 |
| **CHEMICAL EXAMINATION** | | | | | | | | | | | |
| pH | 6.5-8.5 | 9.2 | 7.0-8.0 | No relaxation | 6.8 | 6.5 | 6.1 | 6.05 | 6.7 | 6.5 | 6.56 |
| Alkalinity – Phas $CaCO_3$ | - | - | - | - | - | - | - | - | - | - | - |
| Alkalinity – Total as $CaCO_3$ | 200 | 600 | - | - | 40 | 36 | 60 | 40 | 32 | 56 | 152 |
| Total Hardness as $CaCO_3$ | 300 | 600 | 300 | 600 | 52 | 56 | 180 | 136 | 60 | 80 | 168 |
| Calcium as Ca | 75 | 200 | 75 | 200 | 14 | 16 | 30 | 29 | 16 | 19 | 50 |
| Magnesium as Mg | 30 | 100 | 30 | - | 4 | 4 | 25 | 15 | 5 | 8 | 11 |
| Sodium as Na | 10.0 | - | 200 | - | 33 | 16 | 46 | 46 | 17 | 34 | 44 |
| Potassium as K | - | - | - | - | 7 | 6 | 10 | 8 | 4 | 6 | 6 |
| Iron Total as Fe | 0.3 | 1.0 | 0.5 | 5.0 | 0.24 | - | - | - | - | 0.12 | - |
| Magnesium as Mn | 0.10 | 0.30 | 0.1 | 0.3 | - | - | - | - | - | - | - |
| Free ammonia as $NH_3$ | - | - | - | - | 0.04 | 0.08 | 0.12 | 0.08 | 0.08 | 0.15 | 0.08 |
| Nitrite as $NO_2$ | - | - | - | - | - | - | - | 0.01 | 0.01 | 0.05 | 0.07 |
| Nitrate as $NO_3$ | 45 | No relaxation | 50 | No relaxation | 6 | 4 | 8 | 7 | 3 | 5 | 7 |
| Chloride as Cl | 250 | 1000 | 250 | 1000 | 68 | 40 | 136 | 128 | 40 | 76 | 88 |
| Fluoride as F | 1.9 | 1.5 | 1 | - | 0.2 | 0.0 | 0.2 | 0.0 | 0.2 | 0.2 | 0.2 |
| Sulphate as $SO_4$ | 200 | 400 | 250 | - | 6 | 3 | 23 | 7 | 6 | 10 | 14 |
| Phosphate as $PO_4$ | 5.0 | - | - | - | 0.10 | 0.00 | 0.05 | 0.15 | 0.00 | 0.00 | 0.00 |
| Tidy's Test 4 hrs as $O_2$ | - | - | - | - | 0.32 | 0.16 | 0.32 | 0.12 | 0.20 | 0.08 | 0.04 |
| **BACTERIOLOGICAL EXAMINATION** | | | | | | | | | | | |
| Fecal Coliform per 100 ml | - | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

All the parameters expressed in mg/L except pH and EC. (mics/ cm)

S1 - Marayapuram, S2 - Mancode , S3 - Kulasekharam, S4 - Anducode, S5 - Chathencode, S6- Kodumkulam, S7 - Kattathurai.

Turbidity of the experimental water samples varied from non detectable levels to two NTU. High turbidity has the capacity to significantly increase water temperature. The total dissolved solids of the water sample ranged from a minimum of 126mg/L to a maximum of 400 mg/L in S2 and S3 respectively. The values obtained are within the desirable limit of Indian standard (Table -1). The agrochemical from cultivated are and other pollutants such as untreated sewage and waste deposits affect soil and surface water and these finally leach down to the ground water system at a rate depending on the soil type. These processes also contribute to TDS (Bhardwaj, 2005). The value of Electrical conductivity (EC) ranged from 191 mics/cm to 606 mics/cm. The maximum value for EC was recorded at S3. The present study indicate that the pH range of water samples were between 6.05 to 6.8 and is found to be with in the desirable limit.

Total hardness value of the experimental samples varies from 52 mg/L to 180 Mg/L and are with in the limits set by Indian standard.(Kannan (1991) has classified water on the basis of hardness values in the

following manner; 0-60 mg/L, soft, 61-120 mg/L, Moderately hard, 121-160 mg/L, hard and greater than as 180Mg/L very hard. Hardness below 300 mg/L is considered potable but beyond this limit produces gastrointestinal irritation (ICMR, 1975).

The advisable limit for calcium recommended by Indian standard is 75 mg/L. In the present study, the calcium value ranged from 14 mg/L to 50 mg/L and the magnesium ranged from 4 mg/L to 25 mg/L which is below the proposed limit (30 mg/L). The taste threshold for the calcium ion is the range of 100-300 mg/L.

The desirable limit set for sodium is 100 mg/L. In the present study the sodium concentration ranged from 16 mg/L to 46 mg/L and are within the limit given by Indian standards. In the present study, the value of potassium ranged from 4 mg/L to 10 mg/L. The value recorded for iron in the water same was 0.12 mg/L (S6) 0.24 mg/L (S1) and not detected in (S2, S3, S4, S5, S7). At concentration most commonly found in drinking water, the presence of iron is not considered a health problem. Iron in drinking water can even provide health benefit. (U. S. Environment protection agency).

The amount of nitrite in the water sample ranges from 0.01 mg/L (S4 and S5) to 0.07 mg/L (S7). The concentration of nitrate in the water sample varies from 3 mg/L to 8 mg/L (S3) and are within the desirable limit. Nitrates represents the final product of the biological oxidation of ammonia.

Nitrogen fertilizer applied to crops upon leaching down get added with ground water is the sources of nitrate and nitrite. When ingested both nitrate and nitrite can oxidise blood haemoglobin to methaemoglobin.

The chloride values in the water sample ranged from 40 mg/L to 136 mg/L. The maximum value (136mg/L) was found at Kulasekharam (S3) and the minimum range (40mg/L) recorded in Mancode and Chathencode (S2 and S5). Chloride usually occurs as NaCl, $CaCl_2$ and $MgCl_2$ in widely varying concentrations in all natural waters. The fluoride concentration in most of the water sample was 0.2 mg/L and not recorded in S2 and S4. Fluroide is beneficial at low does (typically from 0.7 – 1.2 mg/L) to improve dental health. The WHO GV for fluoride is set at 1.5 mg/L because of the increased risk of dental fluorosis.

The amount of oxygen in the well water sample as per the tidy's test range from 0.0 mg/L to 0.32 mg/L. Oxygen (DO)is essential to all forms of aquatic life including the organisms that break down man – made pollutants. Concentrations of unpolluted fresh water will have the concentration close to 10 mg/L.

Microbiological examinations of drinking water is important, since the principal risk associated with water supplies is that of infectious disease which is related to faecal contamination. Coliform organisms have long been recognised as a suitable microbial indicators of drinking water quality because they are easy to detect.

The bacteriological analysis of the present study revealed that the water samples were found to be free form faecal coliforms.

## CONCLUSION

Due to increased human population, Industrialisation, use of fertilisers in agriculture and man-made activity, the natural aquatic resources are causing heavy and varied pollution in aquatic environment leading to water quality depletion. It is therefore necessary that the quality of drinking water should be checked at regular time interval because due to the use of contaminated drinking water, human population suffers from a variety of water borne diseases. Potability of water is estimated by the load of coliforms present in it. According to WHO standards, 10 coli forms per 100 $ml^{-1}$of water is permissible for community water sources.

Around two third of the population of Kanyakumari district depend on open well for meeting their domestic water requirements. Therefore, groundwater quality monitoring is of paramount importance and an attempt has been made to interpret a network of wells and the results, were presented in this report.

In the present investigation, the physico-chemical parameters enlisted were found within the permissible limit, Moreover coliform species were not detected from the water samples indicating that the water is safe for human consumption.

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