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Study to assess the nutrient dynamics of the well water of Sakthikulangara locality of Kollam District, Kerala, India

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Abstract
Water is the wonderful entity that is instrumental in origin and sustenance of all forms of life on earth, it is quite natural that this unique gift of nature is of paramount importance in the health of individuals and community. Hence an attempt has been made to assess the well water quality of the water samples collected from ten wells of Sakthikulangara coastal region of Kollam District. The present study is about the comparative analysis of drinking water from ten different regions of Sakthikulangara namely Temple Nagar, Edamanakkavu, Mallezhuthumukku, Minicapithan, Kavanad, Vattakayal, Kayikkara, Venkulangara, Maniyathumukku, Chepallil were analysed for the estimation of pH, nutrients such as nitrite, nitrate, phosphate, silicate by standard methods. The study revealed that the drinking water in the areas of Temple Nagar, Mallezhuthumukku and Maniyathumukku were showing an acidic pH and an increase in nitrite, nitrate and silicate content than other stations. It was polluted and it was harmful for use, so that the water became non-potable. The main reason for the water pollution is disposal of sewage, hospital waste and mainly industrial influences. Pollution in coastal area is mainly due to the influence of fertilizer industries and use of different chemical pesticides in crop field, sewage disposal etc. The results obtained in the present analysis revealed that the discharge of sewage, industrial and municipal waste etc. have contributed considerable pollution in well water samples in coastal region. There is an urgent need to protect well water samples from further water quality degradations in future. So it is necessary to protect our valuable water resources. The pollution of water causes different water borne diseases in day to day life, so it is our duty to protect water resources from all polluting factors and save our motherland.

Keywords: nitrate, nitrite, phosphate, silicate, coastal

1. Introduction
Human life is dependent on the presence of fresh water. Kerala is a state where majority of the populations use well water as the drinking water source. There are 65.95 lakhs households and 50 lakhs wells enumerated in Kerala with density ranging from 120-150 wells per square km [10]. Due to increased household density, scarcity of land and proximity of toilets, most of the wells are contaminated. Due to structural problems and poor maintenance, many of the wells become polluted and unfit for drinking. We often consume sub-standard water as it is difficult to distinguish safe/unsafe drinking water. The grave area of concern is the susceptibility to water borne diseases. Hence serious steps should be taken to safeguard abundance of this natural gift in God's own country.

In this context the present work was taken up to ascertain the presence of nutrients such as nitrite, nitrate, phosphate, silicate with respect to its varying pH in the water collected from wells of ten stations in the coastal regions of Sakthikulangara locality of Kollam district, Kerala State, India. The study thus indicates the variations in the nutrient status of the water samples from the Sakthikulangara region due to the various anthropogenic activities. The importance of fresh water in the maintenance of health and well-being of the community has been recognized by human civilizations from time immemorial [11]. Almost all water sources are unsafe for drinking, most containers are contaminated, latrines are inadequate, and there would be a real scarcity of safe drinking water [1]. Nitrate can be a natural constituent but high concentrations often suggest a source of pollution. Water quality standards are needed to determine whether ground water of a certain quality is suitable for its intended use. The study envisages the need for eliminating the disease of infectious etiology and to adopt preventive strategies that should be targeted to improve the quality of water for drinking purposes.

2. Materials and Methods
Well water samples were collected for the monsoon season from Sakthikulangara locality. Sakthikulangara is situated where Ashtamudi Lake confluences with the Arabian Sea. It is 7 km north from the core Kollam city and 31 km away from Paravur town. Heading from North Neendakara opens the entrance to the Sakthikulangara village. One of the major fishing harbours in Kerala is in Sakthikulangara. Sakthikulangara village or old Sakthikulangara panchayat also includes the major residential areas of Maruthady, Valavilthope, Ozhukkuthode, Ramankulangara, Vattakkayal, Vallikkeezhu, Poovanpuzha, Aravila, Kavanadu, Kaniyankavu, Mukkadu, Venkulangara, Edamanakkavu, Kallumpuram and a few small islands in Ashtamudi Lake. Sakthikulangara is a prominent place because of its proximity to the following places such as Seafood exporting, fish landing centre, boat building yards, Vattakkayal, Neendakara Fishing Harbour, Kavanad & Kollam bypass. Water samples collected from this locality from ten stations namely Temple Nagar,Edamanakkavu,Mallezhuthumukku,Minicapithan,Kavanad,Vattakayal,Kayikkara,Venkulangara,Maniyathumukku,Chepallil were analysed for the estimation of pH, nutrients such as nitrite, nitrate, phosphate, silicate following the methods [2].

3. Results and Discussion

Table 1: showing the variations in pH, nutrients of ten wells from Sakthikulangara

S. No	Parameters	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7	Station 8	Station 9	Station 10	BIS
1	pH	5.3	6.9	6.9	7	6	6.6	7.2	6.6	6.7	6.6	6.5 - 8.5
2	Nitrite(µg/l)	333	333	4620	333	N.D	N.D	1980	1880	660	333	0.1(mg/L)
3	Nitrate(µg/l)	1320	2786	4546	3520	1320	2200	2200	1760	2053	586	45(mg/L)
4	Phosphate(µg/l)	85.7	42.85	128	42.85	171	85.7	42.85	214	85.7	128	Not Listed
5	Silicate(µg/l)	6300	700	4200	5600	7700	5600	4200	8400	9800	12600	Not Listed

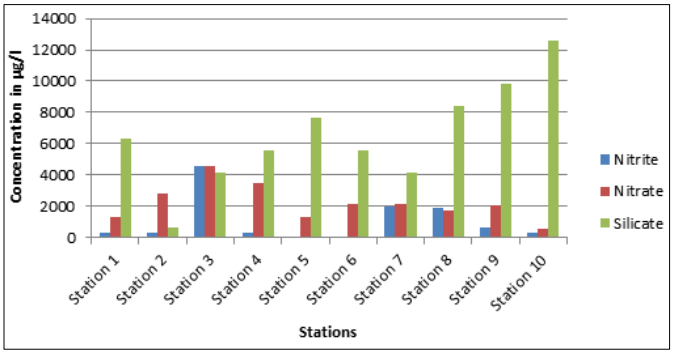

Fig 1: Graph showing the variations in Nitrite, Nitrate and Silicate content of the water samples.

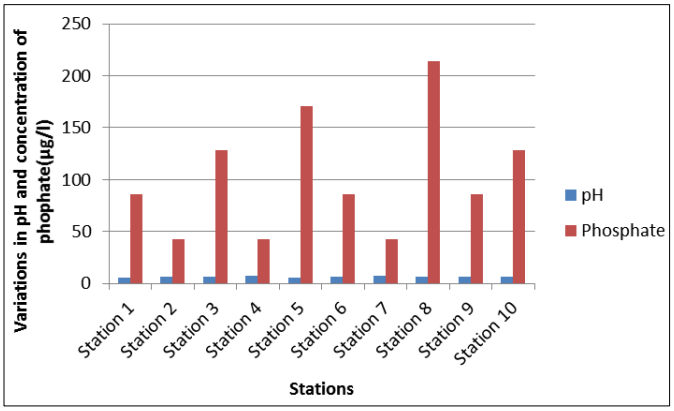

Fig 2: Graph showing the variations in pH and Phosphate content of the stations

A highly acidic pH (5.3) was observed in the well of Temple Nagar and a pH of 7.2 was noticed in Kayikkara station. Some was found to be slightly basic because of the presence of the carbonate and bicarbonate. The values were generally within 6.5 to 8.5 of the World Health Organization [12] pH standard in drinking water [12] for potable water. However, there were few exceptions with the value lower than 6.5. (Table 1).The pH increases (acidic) during day time due to photosynthetic activity because of consumption of carbon dioxide whereas it declines (alkaline) at night due to respiratory activity. The pH obtained was beyond this range (5.3-8.5). (Fig 2).The present study showed that most of the stations of water sample were acidic and the pH was obtained in the range of (5.3 to 6.2). This may be due to the influence of chemical and heavy metal concentration from industries. Nitrite concentration ranged from 333-4620µg/l while nitrates ranged from 586-4546µg/l. (Table 1).Station 3(Mallezhuthumukku) exhibited a highest concentration of nitrite and nitrate than other wells. Nitrates are naturally occurring contaminants of water causing health problems. Nitrates come from agricultural fertilizers, manure, domestic sewage, animal dung etc. can cause defects in blood cells (methemoglobinemia) in infants and are often converted into nitrosamines in the intestine which are carcinogenic [6]. Nitrate and Nitrite are naturally occurring ions that are part of nitrogen cycle. In general vegetables are the main source of nitrate intake when level in drinking water is below 10mg/1. High level of nitrate in drinking water due to excessive use of agricultural fertilizers, decayed vegetable water, domestic effluent, sewage disposal industrial discharges, leachable from refuse dumps, atmospheric precipitation has become a serious problem. Excess concentration of nitrate causes disease Methemoglobinemia. Oxygen transport depends on the maintenance of intra cellular hemoglobin in the reduced (Fe^{2+}) state. When hemoglobin is oxidized to methemoglobin the heme iron becomes (Fe^{3+}) and is incapable of binding oxygen. Methemoglobinemia is suspected in any cyanotic patient with no evidence of heart and lung disease of cyanosis is due to decreased oxygen saturation. Nitrites can produce a serious condition in fish called "brown blood disease" [5]. Nitrites also react directly with hemoglobin in human blood and other warm blooded animals to produce methemoglobin. Methemoglobin destroys the ability of red blood cell to transport oxygen. This condition is especially serious in babies under three months of age. It causes a condition known as methemoglobinemia or "blue baby disease". Phosphate concentration ranged from 42.85-214µg/l. Station 8 (Venkulangara) showed a higher phosphate content. Phosphorus is one of the key elements necessary for growth of plants and animals. Phosphorus in elemental form is very toxic and is subject to bioaccumulation. Organic phosphates are important in nature. Their occurrence may result from the breakdown of organic pesticides which contain phosphates. They may exist in solution, as particles, loose fragrant or in the bodies of aquatic organisms [8]. Silicate varied from 700-9800µg/l. (Graph1). Station 9 (Maniyathumukku) exhibited a higher concentration of silicates. The primary source of dissolved silica in natural waters is the chemical breakdown of silicate minerals in rock and sediments by chemical weathering process [7]. Silica plays an important role in the ecology of aquatic systems as it is an essential element for diatoms as it comprises 26-69% of cellular dry weight [9]. Previous studies have shown that exposure to airborne crystalline silica normally results in silicosis [3, 4].

4. Conclusion

The present work showed the comparative analysis of drinking water from ten different wells of Sakthikulangara. This study showed that the drinking water in the coastal area is polluted and it is harmful to use, especially in the (station1, 3 and 9). In this stations the water sample contain nitrate, nitrite, acidity, silicate beyond the permissible limits so that the water became non potable. The main reason for the water pollution was disposal of sewage, hospitality waste and mainly industrial influences.

Pollution in coastal area is mainly due to the influence of fertilizer from industries and use of different chemical pesticides in crop field, sewage disposal etc. Today water is facing different pollution problems. So it is necessary to protect our valuable water resources. The pollution of water causes different contaminated diseases in day to day life, so it is our duty to protect water resources from all polluting factors. A proper awareness has to be given to the common people for the sustainable use of these ground water sources. This study therefore was initiated to open up a line of thought on the potential health impact of nutrient dynamics in well water.

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