

Risk Assessment for fluoride ion in Groundwater in Kurnool District of Andhra Pradesh

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Abstract

Generally, the fluoride ion in drinking water helps to human by preventing tooth decay. But excess fluoride in Drinking water will lead to Dental, and Skeletal fluorosis. Recent studies proved that excess fluoride in drinking water will produce different organ failures. So risk assessment study was carried in the study area. Total 10 samples collected from the hand pumps in rural village in Kurnool district, Andhra Pradesh state. The collected samples are analyzed for physical parameters and fluoride. The obtained results are compared with BIS standards. The average fluoride concentration observed 0.68 ppm and it is within the prescribed limits specified by BIS. Risk assessment carried out by using hazard quotient. After the investigation, confirmed that no risk observed for the collected samples.

Keywords: Fluoride, Dental fluorosis, Skeletal Fluorosis, Physical parameters, Hazard quotient.

1. Introduction

Fluoride is very reactive element in nature. It can easily bind to other elements. At low concentration it is very beneficial to humans. After ingestion into body of the humans by drinking or other process, it develops a bond with calcium and forms thick enamel on the teeth and other calcium elements in the body. But high content it weakens the bones and other calcium based elements in the body. So it produces Dental and skeletal fluorosis [1-3]. To avoid this chemical risk from the fluoride ion, BIS prescribed the standard limits. As per BIS norms the fluoride ion in drinking water should be in the range of 1.0 to 1.5 ppm [4]. Below 1.0 ppm will lead to tooth decay, and above 1.5 ppm will lead to skeletal and dental fluorosis. Sometimes the elevated fluoride in drinking water will produce chemical toxic in the human body [5]. Generally surface water does not contain excess fluoride due to fluoride dilution. But ground water contains excess fluoride due to the geological conditions and other parameters. The physical parameters such as pH, TDS, and temperature increase the fluoride in ground water. Fluoride bearing rocks also increase the fluoride in ground water.

Risk assessment was carried for evaluation of chemical toxicity to humans. USEPA presented a Hazard quotient (mathematical model) for risk assessment. The Hazard

quotient observed values is below 1 it may be no risk prone to humans. If it is above 1, it is unfit for drinking or ingestion [6-8].

2. Study area:

For these investigations, Selected some rural villages in Kurnool district Andhra Pradesh, where the major source for drinking water is ground water.

3. Materials and Methods:

From the study area total 10 samples are collected and labeled with sample number in the ascending order. The Physical parameters such as Potential of Hydrogen, Total dissolved solids, and temperature were measured at the sample site immediately after the collection of the samples using Water analyzer instrument. The fluoride ion in the samples is evaluated by using Ion selective electrode method with instrument Hanna pH meter (HI 5222). Hazard quotient is calculated using standard procedure prescribed by the USEPA and it is defined as the ratio of chronic daily intake and reference dose. Reference dose value for the fluoride is 0.06 mg/kg/day [9]. The chronic daily intake is calculated by using the standard data from USEPA.

$$\text{Chronic Daily Intake} = \frac{C \times IR \times ED \times EF}{BW \times AT} \quad (1)$$

Whereas C = Concentration of Fluoride in water sample (mg/l)

IR = Ingestion rate of water (l/day)

ED = Exposure Duration (years)

EF = Exposure Frequency (days/years)

BW = Average Body weight (kg)

AT = Average time for non-carcinogenic risk (day)

The IR for adults are 2.5 liter/day , Exposure duration is 30 years , Exposure frequency 365 days/years , Average body weight 65 kgs , Average time 2190 days.

4. Results and discussions:

The collected samples are analyzed. The obtained data is showed in the following table 1. The samples data are presented in the graphs format and it is displayed in following figures.

Table 1. The physical parameters observed data

Samples Numbers	pH	Total Dissolved Solids (ppm)	Temperature(°C)
1	6.87	790	35
2	7.02	1920	35
3	7.83	352	30
4	6.97	600	31
5	7.05	560	31.8

6	6.9	1700	31.9
7	6.64	2020	32
8	7.07	1230	32
9	7.01	1190	30
10	6.99	1050	32

4.2 pH:

The collected samples are analyzed for pH using Systronics water analyzer. The average value from the samples is 7.035. As per BIS standards the pH values for the drinking water is 6.5 to 8.5 so the water from the collected area is fit to drinking with pH parameter consideration. The pH samples are presented in graph format.

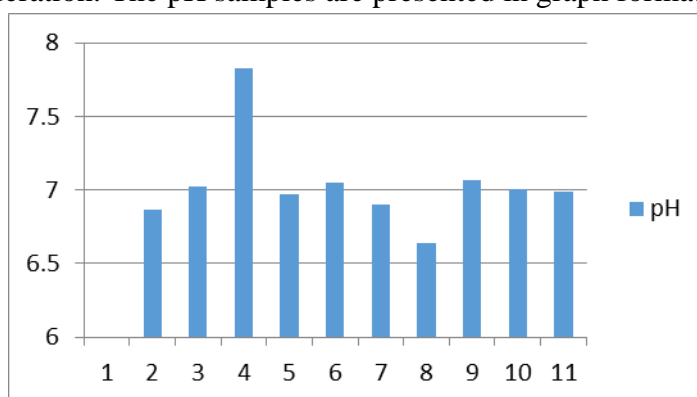


Figure 1. pH

4.2 Total Dissolved Solids:

The collected samples are analyzed for TDS using Systronics water analyzer. The average value from the samples is 1141.2 ppm. As per BIS standards the pH values for the drinking water is 500 ppm to 2000 ppm so the water from the collected area is fit to drinking with TDS parameter consideration.

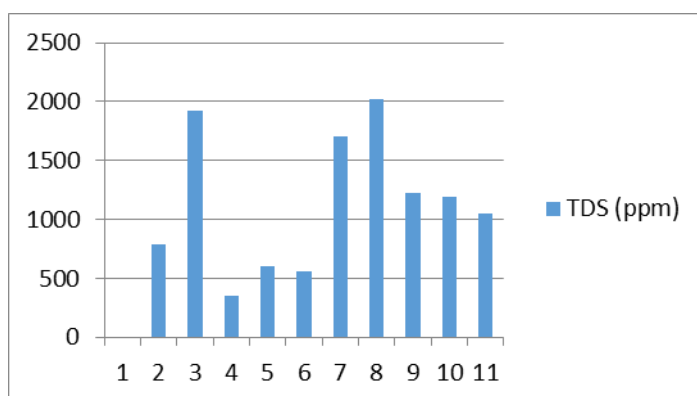


Figure 2. Total Dissolved Solids

4.3. Temperature

The collected samples are analyzed for Temperature using Systronics water analyzer. The average value from the samples is 32.07 ° C.

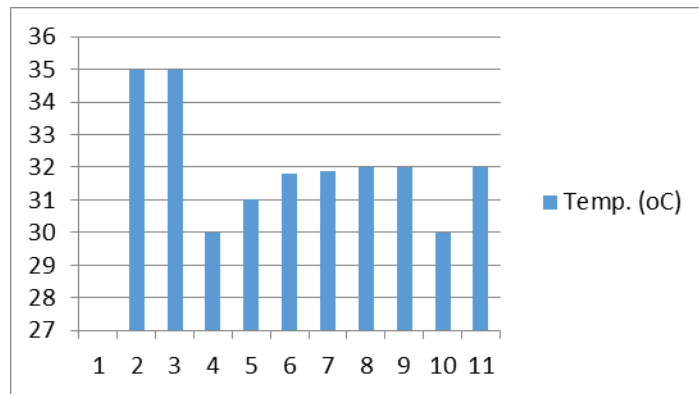


Figure 3. Temperature

4.4 Fluoride ion:

The collected samples are analyzed for Fluoride ion using Systronics water analyzer. The average value from the samples is 0.67 ppm. As per BIS standards the pH values for the drinking water is 1 ppm to 1.5 ppm so the water from the collected area is fit to drinking with Fluoride parameter consideration.

Table 2. The Fluoride ion observed data

Samples Numbers	Fluoride
1	0.489
2	1.49
3	0.357
4	0.628
5	0.425
6	0.668
7	0.503
8	1.02
9	0.769
10	0.44

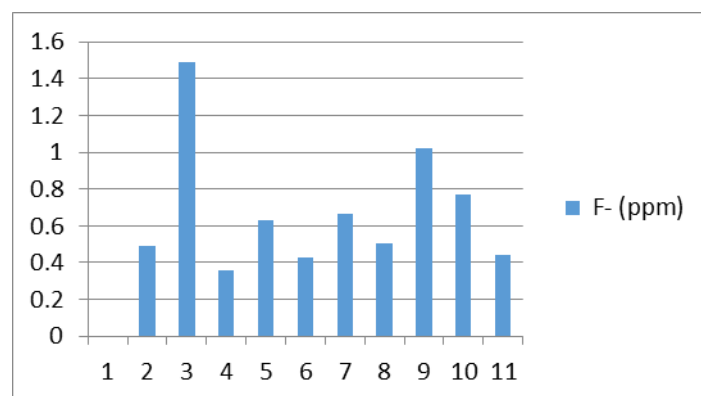


Figure 4. Fluoride

4.5 Risk Assessment for Fluoride ion:

The collected samples are analyzed for Fluoride ion risk assessment using standard procedure prescribed by the USEPA. So hazard quotient is calculated for the collected samples using the procedure which is already discussed in the previous section.

The observed Hazard quotient value is below 1 so it may be no non carcinogenic risk to humans.

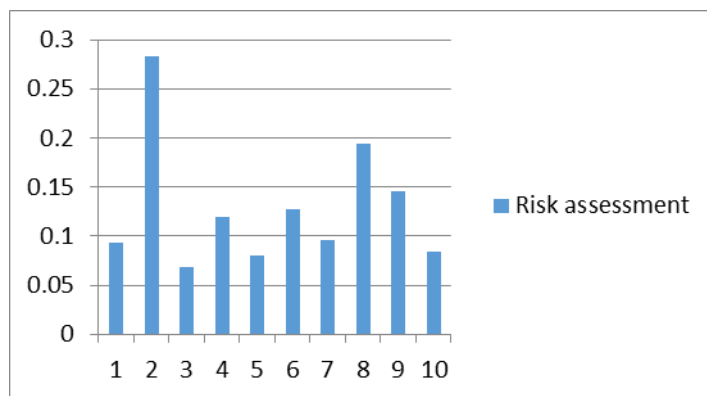


Figure 5. Risk assessment

5. Conclusion:

The fluoride content in the study area was in the BIS prescribed limit. So the sample source is fit for drinking purpose. From the risk assessment, it is proved that no risk cause due to fluoride ion in the drinking water. These investigation data could be useful for Government and other people for maintenance and monitoring water supply. The possible source of fluoride contamination may be geological and anthropogenic activities.

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