

Fluoride in our lives – Analysis of ground water quality of Kaithal district, Haryana, India

Gurcharan Dass

Director-Principal Bharat Group of Colleges Khera Khurd, Delhi Road Sardulgarh, Mansa, Punjab, India.

Abstract

In this study, an attempt has been made to assess the quality of groundwater and municipal water for drinking purposes in the villages of District (Haryana). Ground water and municipal water samples collected from different villages of Kaithal District, Haryana were analyzed for their physico-chemical characteristics. The analysis results were compared with the WHO, ICMR and BIS standards of drinking water quality parameters with the following physico-chemical water quality parameters, namely pH, total dissolved solids, total alkalinity, total hardness, chloride, fluoride, calcium, magnesium, etc. From the analysed data it was found that parameters like fluoride, total dissolved solids, total hardness and magnesium exceed the maximum desirable and maximum permissible values for drinking purpose. Fluoride concentration, in particular, was exceeding the maximum permissible values for drinking purpose by all the standards, which is a serious concern for public health. Fluoride is responsible for dental and skeletal fluorosis. It is emerging as a social problem in many villages of northern India.

Keywords: Physico-chemical characteristics, drinking water quality parameters, ground water, municipal water

1. Introduction

Fluoride is an ion originating from the element fluorine. It is a constituent of earth's crust and consequently found in nature, to some degree, in all drinking water sources, particularly ground water sources. About 96% of the total fluoride in the human body is found in the bones and teeth. It is due to the fact that fluorine is most electronegative element and has an extraordinary tendency to attract the positively charged ions, such as calcium. Since bones and teeth have maximum amount of calcium in the body, therefore they attract the maximum amount of fluoride which deposits as crystals.

Fluoride is one of the important element which is essential for man as well as for animals. Most adults ingest between 1.0 to 3.0 mg of fluoride daily. The main source is usually drinking water, which, if it contains 1.0 ppm of fluoride, will supply 1.0 – 2.0 mg / day. Soft waters usually contain no fluoride, whilst very hard waters may contain over 10.0 ppm. Compared with that in water, the fluoride in foodstuffs is of little importance. Very few foods contain more than 1.0 ppm; the exceptions are sea-fish (which may contain 5.0 – 10.0 ppm) and tea. In Britain, Australia and China, where people drink tea frequently, the adult intake from this source may be as much as 3.0 mg daily. The regular presence of fluoride in minute amounts in human bones and teeth and its influence on the prevention of dental caries justifies its inclusion as an element of importance in human nutrition.

Although the occurrence of fluoride in calcified tissues was already known at the beginning of the 19th century. One of the earliest references relating it to dental caries is that of Magitot (1878). Early investigations that deserves particular consideration demonstrated that fluoride had a marked affinity for calcified tissue. In those studies, bone was exposed to dilute fluoride solutions for a five-month period and showed an increase in the fluoride content from 0.31 parts per 100 to 4.7 parts per 100. Two more late 19th century papers are also worthy of special comment. In one of these, the incorporation of fluoride in the diet was suggested as a

means of limiting dental caries, while other study reported that non-carious teeth contained greater fluoride concentrations than carious teeth.

Despite small number of acceptable investigations substantiating a fluoride-tooth decay relationship, the idea was widespread at the advent of the 20th century. A variety of fluoride-containing therapeutic agents were available for public consumption, including tooth-powders, tooth-pastes, mouth washes and pastilles. It took about half-century before adequate research would help clarify the role of fluoride in the prevention of dental caries and furnish a more sound basis for its therapeutic use.

Fluoride is one of the major elements for sustenance of all form of lives. The quality of ground water depends on several chemical constituents and their concentrations, which are basically derived from the geological formation of the particular region. Ground water occurs in confined and unconfined aquifers. Apart from natural constituents, additional constituents might be added to ground water by leachate from solid waste dumping sites^[1-4]

2. Materials and Methods

Kaithal (29°46.1' N Latitude and 76°23.3' E Longitude), which is located in northeastern part of Haryana state, is undergoing rapid urbanization and industrialization. Ground water samples from different hand pumps and tube wells of 12 sampling points were analyzed. Samples were collected in good quality polythene bottles of one litre capacity. Sampling was carried out without adding any preservatives in rinsed bottles directly for avoiding any contamination and brought to laboratory Monitoring was done during Jan 2014 to July 2015. Only high pure (AnalR grade) chemicals and double distilled water were used for preparing solutions for analysis Physical parameters like Ph and EC were determined with the help of digital portable water analyzer. The total hardness in ppm was determined by the following equation^[6].

$$TH = 2.497Ca^{+2} + 4.115Mg^{+2}$$

Table 1: Analytical methods (APHA-AWWA-WCPF, 1995) [8].

Ions	Analytical method
Ca ⁺⁺ , Mg ⁺² , CO ₃ ⁻² , HCO ₃ ⁻ , Cl ⁻	Volumetric method
F ⁻	Spectrophotometric method

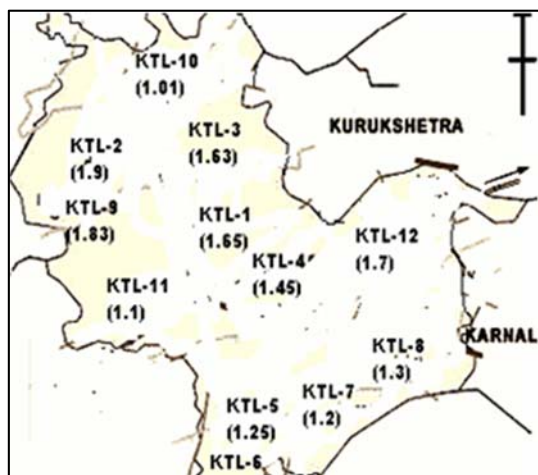
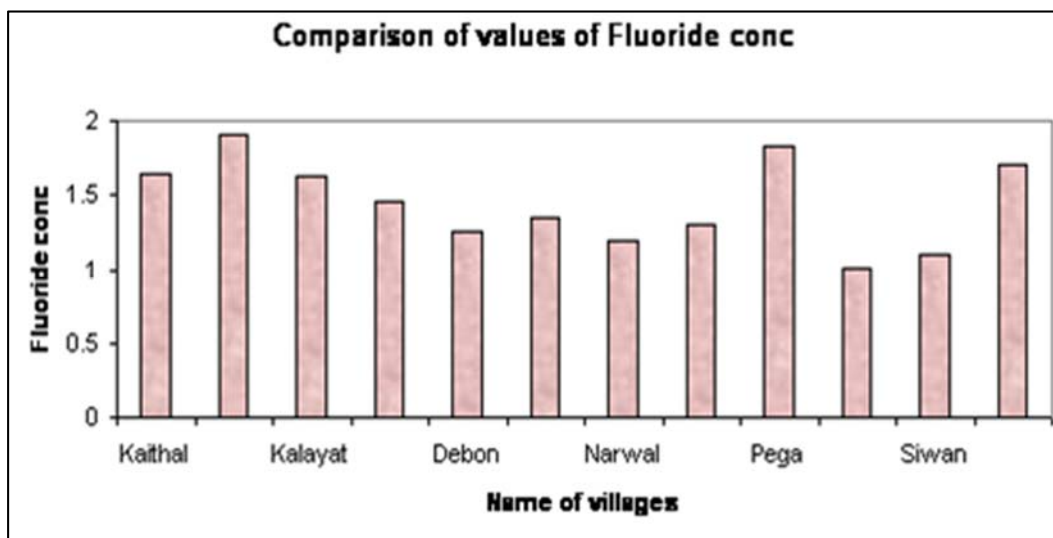
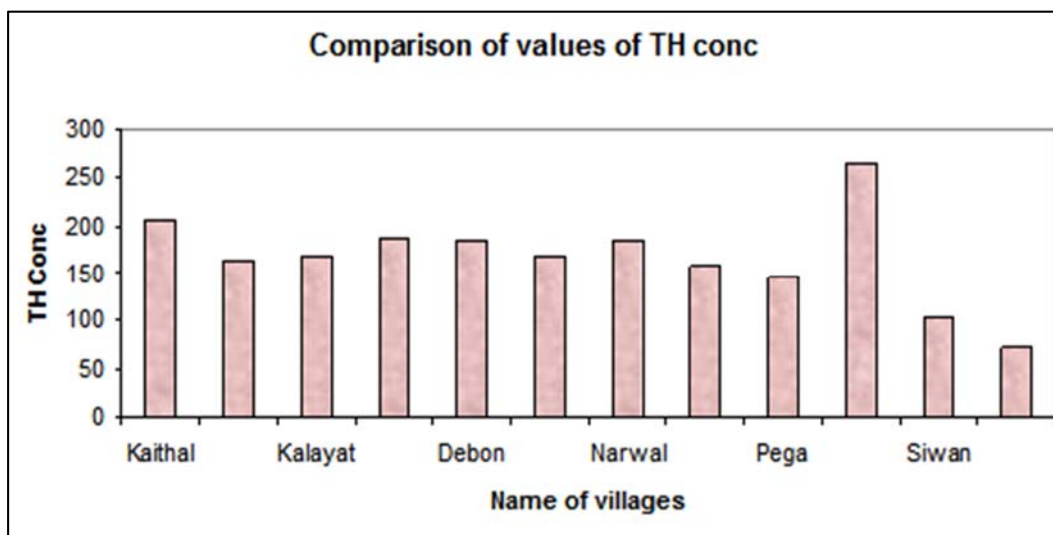
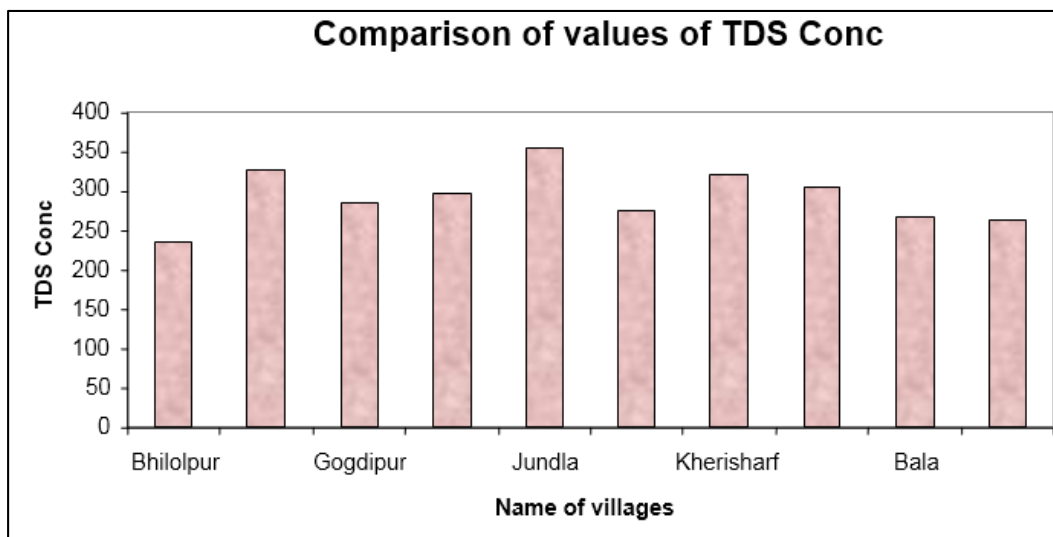


Table 2: The mean values of various physicochemical parameters of ground water of Kaithal District

Block	Depth (ft.)	Dr. Water Stnds. Supply	Tolerable Acceptable	pH	EC	Ppm	ppm	ppm	Ppm	ppm	Ppm	ppm	ppm
						1500	600	1000	1.5	200	30		
						TDS	TA	TH	Chloride	Fluoride	Calcium	Magnesium	Bicarb.
Kaithal	550	H.P	KTL-1	8.42	0.79	410	1075	206.5	86.2	1.65	21.3	185.2	1075
Gogh	280	H.P	KTL-2	7.44	0.42	266	980	165.2	45.05	1.9	36.2	129	980
Kalayath	150	H.P	KTL-3	8.48	0.85	550	650	169.3	19.2	1.63	34.2	135.1	650
Pundri	350	H.P	KTL-4	7.33	0.36	227	680	187.5	58.3	1.45	29.4	158.1	680
Debon	60	H.P	KTL-5	7.17	2.63	1828	770	186.05	79.6	1.25	46.8	139.25	770
Jakauhali	60	H.P	KTL-6	7.58	1.92	1314	890	169.5	96.8	1.35	43.58	125.92	890
Narwal	50	H.P	KTL-7	7.76	0.59	397	920	186.2	58.3	1.2	39.5	146.7	920
Rajjaund	50	H.P	KTL-8	7.14	2.91	1957	850	156.3	76.5	1.3	28.7	127.6	850
Pega	40	WELL	KTL-9	7.44	1.31	922	780	145.36	82.3	1.83	36.8	108.56	780
Narad			KTL-10	8.73	1.6	1140	450	263.69	46.3	1.01	49.2	214.49	450
Siwan			KTL-11	8.47	0.22	147	60	102.7	63.2	1.1	47.6	55.1	60
Chandana			KTL-12	8.35	0.18	135	670	71.91	76.5	1.7	39.32	32.59	670





3. Results and Discussions

The mean values of various physicochemical parameters are provided in Table 2. The results indicate that the quality of water varies from location to location. The Ph values were found within maximum permissible limit as per World Health Organisation (WHO), Bureau of Indian Standards (BIS) and Indian Council of Medical Research (ICMR) India Standards [9, 10] at all the sampling sites rural as well as urban. The underground water is characterized by the Total alkalinity in the range of 700 – 900 ppm. There seems to be on major cause for this alkalinity by any means of human activities. In fact 98% of ground water are dominated by calcium and bicarbonate ions in the limestone weathering in the catchments and limestone weathering. and underground beds. The results indicate that the quality of water varies considerably from location to location. The pH values were found higher than the maximum permissible as per World Health Organisation (WHO) and Bureau of Indian Standards (BIS) Standards [8] at nine sampling locations, namely Gogh, Kalayat, Pundri, Debon, Jakhauli, Narwal, Peda, Rajjaund, Narad and Siwan. One location of Kaithal City Narad had higher pH values even as per Indian Council of Medical Research (ICMR) All the sampling locations had high level of fluoride content as The mean values of various physicochemical parameters for the selected sites

The values of chloride were within the maximum permissible limits at all the sampling locations. The calcium concentrations were also within the maximum permissible limits at all the sampling locations. The magnesium concentrations were above the maximum permissible limits as per ICMR and BIS Standards at all the locations, Magnesium is considered as non toxic metal however at such at high concentration (200-350) is not acceptable for drinking purposes as it cause colour, taste and odour to water. There are no known cases of magnesium poisoning. However large oral doses may cause vomiting and diarrhoea The underground water is characterized by a relatively constant total alkalinity in the range of 800 to 1,000 ppm. However, the sample site Siwan had low alkalinity 60 ppm; whereas, Kaithal has higher alkalinity value 1075 ppm. There seems to be no major cause for this alkalinity by any means of human activities. In fact 98% of all groundwater are dominated by calcium and bicarbonate ions due to lime stone weathering in the catchments and underground beds

The underground water at all the sampling locations, except in Debon village, is characterized by maximum permissible TDS concentration level. The water sample from Debon village were found to possess high TDS values when compared with the maximum permissible limit of 1500 ppm as per WHO Standards but within the maximum permissible

limits as per ICMR and BIS Standards. Total hardness TH values were found to be within the maximum permissible limits at all the locations as per WHO, ICMR and BIS Standards. Further, the TH values were within the desirable limits at all the locations as per ICMR and BIS Standards except Narad, which is a good sign for the usage of the groundwater for potable purpose.

Hardness is due to multivalent metallic cations present in water, the most abundant calcium and magnesium others include iron, manganese, strontium and aluminium. Hard water is problem in water supply. it has an objectionable taste and requires more soap when used for washing as lathering does not occur until all of the hardness are precipitated at which point has been softened by soap. However all the sampling sites have TH conc less than the maximum permissible concentrations as per all the drinking water standards, which is a good sign usage of the ground water for drinking after boiling.

All the sampling locations had high level of fluoride content as per the WHO Standards, Further the majority of villages had fluoride concentration higher than the maximum permissible limit of 1.5 ppm as per ICMR and BIS Standards, which is a cause of concern. Even the municipal water supply in two villages, namely Gogdipur and Pega, had fluoride content more than 1.5 ppm. This suggests that there is an urgent need for chemical treatment for fluoride to make the water potable in the study area.

4. Conclusions

The underground water samples were analysed for Kaithal District in (Haryana) India and the analysis reports that the water quality calcium magnesium, chloride and fluoride concentration is a cause of concern. The fluoride concentration in entire study area is higher than the maximum permissible limit of 1.0ppm as per WHO Standards, and higher than the maximum permissible limit of 1.5ppm as per ICMR and BIS Standards at majority of locations is not suitable for drinking purposes. According to this report, the higher fluoride concentration in study area is a cause of concern with respect to health and social aspects and therefore chemical treatment is fluoride for necessary before making water for drinking purpose.

5. References

1. Kumar S. Studies on ground water pollution from dumping of municipal and solid wastes at Muzzafarpur. J of IHHE (India). 2008-2009; (4):14-18.
2. Robinson HD, Maris PJ. The treatment of leachate from domestic waste in landfill sites. J of Water Pollution Control Federation. 1985; 57(1):30-38.
3. Olamy MS, Saxena KL. Ground Water Pollution by open refuse dumpsat Jaipur. Indian J Environmental Health. 1977; 19:176-188.
4. Nicholse RV, Cherry JA, Reardon EJ. Migration of cotaminants in groundwater at landfill – A Case Study, J of Hydrology Netherlands. 1983; 63:131-176.
5. Gupta S, Deswal S, Kumar D, Dass G. Assessment of water quality in the villages f District (Haryana) India; Proc. of Enviroenergy 2009: Internatonal conference on Energy and Environment, Chandigarh India, 2009, 358-362.
6. Horowitz HS, Heifitz SB. Effects of prenatal exposure to fluoridation on dental caries Public Health Report. 1967; 82:297-304
7. http://kaithal.nic.in/kaithal_map.asp
8. APHA. Standard Mehodsfor Analysis of water and wastewater. Inc Washington DC. 2005,
9. BIS. Specification for drinking water, 1991. IS:10500
10. ICMR. Manual of Standards of Quality for Drinking Water Supplies. Special report 1975, 4.
11. Deswal A, Deswal S. Fluoride: A Two-Edged Sword. J of ARPAN. 2003; 2(1-2):34-42.
12. Deswal S, Gupta S. Water Quality of Panchkula District, Haryana: A Case Study. J Environmental Pollution Control. 2010; 14(1):24-28.