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Study of Physiochemical Characteristics of Ground Water in the Special Reference to Fluoride of Some of the Villages of Sardarshahar Tehsil in Churu District of Western Rajasthan

Gayatri Khatri and C.K.Bahura

Department of Zoology, Govt. Dungar College, Bikaner (Raj.) INDIA.

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ABSTRACT

Ground water is increasingly being sought as a source of drinking water due to the scarcity, non-availability and bacteriological pollution of surface water. This paper deals in the physico-chemical characteristics of the ground water samples of tube wells of ten villages in Sardarsahar Tahsil (Churu) of Rajasthan State. The different parameters determined are pH, TDS, fluoride, chloride, total alkalinity and total hardness. It has been observed that all values are higher compared to APHA (American public Health Association), AWWA (American water work Association) and WPCF (1975). Other parameters were found within desirable limits. The high value of these parameters may have health implications, so, this ground water is not good for health and therefore, needs attention.

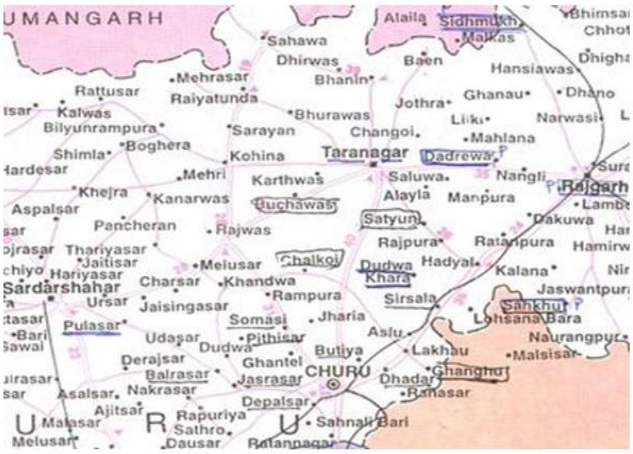
Introduction

Good quality water is inadequate even for normal living and is getting contaminated due to domestic wastes, industrial wastes, agricultural wastes, runoff from urban areas and soluble effluents (Karunakaran et al., 2005). Study and interpretation of the chemical characteristics of natural water was done by Hem (1991). Water quality parameters of ground water, river water and industrial effluents have been reported by several workers (Ansari et al., 1999). The human body is very sensitive to fluoride in the diet. According to APHA (American public Health Association), AWWA (American water work Association) and WPCF (1975) it is essential for growth of bones and teeth, when it is upto 1 ppm. In relation to drinking water it is generally believed that too little (< 0.5 mg l-1) or too much (> 1.5 mg l-1) can affect bone and teeth structure (Edmunds and Smedley, 1996, 2003). Due to the scarcity of surface water, Rajasthan has to depend on ground water resources to a great extent. Ground water fluoride contents in high levels are present in all the 33 districts and have become a serious health related issue in 23 districts of Rajasthan (Datta et al., 1999). Estimation finds that 65% of India's villages are exposed to fluoride risk (UNICEF, 1999).

Higher fluoride concentration exerts a negative effect on the course of metabolic processes and an individual may suffer from skeletal fluorosis, dental fluorosis, non-skeletal manifestation or a combination of the above (Susheela and Kumar, 1991). Fluorosis has become pandemic and it has assumed global status in the public health point of view (Pillai and Stanley, 2002). Rajasthan state is thought to be the most seriously affected by high fluoride concentrations. People in several districts of Rajasthan are forced to consume water with fluoride concentration up to 44 mg l-1 (Agrawal et al., 1999). The present study has therefore undertaken to analyze the fluoride content and physico-chemical characters of Sardarsahar Tahsil (Churu).

Study Area

The selected project area has been done in 52 villages lie in Sardar sahar in Churu district, which is touch the boundary of Nagaur and Bikaner district



Materials and Methods

Sampling methods

The samples were collected from tube well near the residential and agricultural areas of different villages of Sardarsahar (Churu district). The water samples were extensively used for drinking and other domestic purposes. The samples were collected in high grade plastic bottles of one litre capacity after rinsing with Distilled water.

Analytical Methods: The physicochemical characteristics of the ground water samples were determined by Standard methods (APHA, 2002) .The pH, TDS was measured by using portable meters and manual method on the spot. The concentrations of Magnesium, Calcium hardness were estimated by volumetric methods and Total hardness of water was estimated by complex metric titration with EDTA. Chlorides content here determined volumetrically by AgNO3 titrimetric method.

Tele:

E-mail address: aseri.gayatri23@gmail.com

Table 1. Physico- Chemical analysis of groundwater collected from different villages of Sardhar Sahar (Churu)

S.no	NAME OF VILLAGE	SCORE & LOCTOIN	WATER QUALITY (mg/l)											Mg++	Electrocal and connective Ity (µmho cm^{-1})
			TDS	CL	NO3-	F-	SO4 -2	Total Alkalinity	pH	Total Hardness	Ca Hard as $caco_3$	Ca++	Mg Hard as $caco_3$		
	-	-	-	-	-	-									
1	Jaitasar	Tube well NO.1	2835	420	120	4.2	180	310	7.2	640	310	124	330	79.2	3997
2	Ghadsisar	Tube well NO.1	1829	670	150	4.1	70	170	8.1	310	170	68	140	33.6	2337
3	Khundiya	Tubewell	3959	460	177	2.9	175	340	8.1	860	430	172	430	103.2	1814
4	Rajasar Beekan	Tubewell	2331	840	170	4.2	160	170	8.1	410	210	84	200	48	4001
5	Asasar	Tubewell	945	200	90	3.6	30	110	7.9	170	90	36	80	19.2	3131
6	Bhojoosar Upathiyan	Tubewell	1268	350	110	5.6	30	110	8.1	310	110	44	200	48	3117
7	Sawai Bari	Tubewell	2709	630	160	5.2	60	130	7.8	340	130	52	210	50.4	3046
8	Kaloosar	Tubewell	2205	380	110	4.0	110	280	8.1	37.	140	56	230	52.2	3894
9	Ranaser Beeken	Tubewell NO.1	3339	600	110	5.1	135	290	8.1	360	160	64	200	48	5778
10	Asalsar	Tubewell	2016	420	90	3.8	140	185	7.7	210	90	36	120	28.8	3024

Other parameter like F- was estimated by spectrophometric method. The results are comparable with WHO and BIS water standards (BIS, 2003; WHO, 2004).

Location of sampling stations: The samples were collected from villages of Sardar sahar of Churu district namely Bhatwala, Jaitasar , Rajas etc. (Table 1)

Results and Discussion

The results of physico-chemical parameters of water samples including fluoride concentration are depicted in the Table 1.Very high positive correlation was found between Ca and Mg and EC and TDS. Besides this, various ions have a good correlation with TDS. Fluoride concentration in the different regions (Khundiya, Bhojoosar Upadhiyan and Jaitasar) varied between 2.9 to 5.6 mg l^{-1}. It was revealed that only 15.62% villages out of total villages studied had drinking water within permissible limit for fluoride whereas 84.37% villages had aquifers beyond the permissible limit of fluoride. Similarly 13.04% samples were found within permissible limit for fluoride whereas 86.96% had fluoride beyond permissible limit (>1.5 mg l-1, WHO, 2006).

pH: All chemical and biological reactions are directly dependent upon the pH of water system. The lower values of pH may cause tuberculation and corrosion while the higher values may produce incrustation, sediment deposit and difficulties in chlorination for disinfection of water. In the present study the pH values in all the samples range from 7.0 to 8.3, which are all within the permissible limit. The pH of water is very important indication of its quality and provides information in many types of geochemical equilibrium or solubility calculations.

Fluoride: Fluoride is important in human nutrition for the normal development of bones. The required level of fluoride is 1.0 to 1.5 mg/L. Due to higher concentration of fluoride in ground water may develop molting of teeth, skeletal fluorosis, deformation in knee joints etc. In the present study, it is observed that the fluoride content varied from 2.9 to 5.6 mg./L. Thus, it is not in the permissible range and there is threat to human health due to fluoride in drinking water.

Similar study was conducted in some districts of Rajasthan among which in more than 40% area in Nagaur district fluoride concentration varied between 1.5 to 13.5 mg l^{-1} (Seth, 2005). Similarly acute toxicity of fluoride was observed in Didwana block of the nagaur district where among 152 surveyed villages it was found that 56% ground water had fluoride concentration in the range of 1.7 mg l^{-1} and above (Vyas et al., 2006).The results of the present study approved the earlier findings. A positive correlation (r= 0.893) has also been observed between fluoride and pH as earlier reported by Teotia et al. (1981) and Trivedi (1988).

Electrical conductivity ranged between 3064 to 3976 µmho cm^{-1} in eastern zone, 1430 to 9760 µmho cm^{-1} in south eastern zone and 1596 to 3976 µmho cm^{-1} in southern zone. All natural water contains varying concentrations of Total dissolved Salts as a result of the dissolution of minerals in rocks, soils and decomposing plant material. In the eastern zone Total Dissolved Salts varied from 2284 to 3584 mg l^{-1} while in south eastern zone it was recorded between 1372 to 6420 mg l^{-1} and in southern zone it ranged from 1020 to 3700 mg l^{-1}.

Chloride: Chloride contents in fresh water are largely influenced by evaporation and precipitation. Chloride is the most troublesome anion in the irrigation water. They are generally more toxic than sulphate to most of the plants and are best indicator of pollution. Chloride contents varied from 220 to 3360 mg/L in all the samples analyzed

Total hardness: Hardness is an important criterion for determining the usability of water for domestic, drinking and many industrial supplies. The value of water samples varies from 150 to260 mg/L. The desirable limit for total hardness is 300 mg/L. (ICMR). Water hardness is primarily due to the results of interaction between and the geochemical formations. The Total hardness is an important criterion for determining the usability of water for domestic, drinking and many industrial supplies. The value of total hardness in water samples varies from 170 to860 mg/L. The desirable limit for total hardness is 300 mg/L. The hardness of water is due to the presence of alkaline earths such as calcium and magnesium. Higher values of hardness are responsible for incrustation and scaling in pipelines. The principal ion contributing TDS are carbonate, bicarbonate, chlorides, fluorides, sodium, potassium, calcium and magnesium (EPA, 1976).

Chloride varied between 82.36 to 2073.20 mg l^{-1} in eastern zone, 102.24 to 4245.8 mg l^{-1} in south eastern zone and 76.68 to 3626.68 mg l^{-1} in southern zone. If calcium is present in higher concentration it is most effective in reducing the fluoride concentration. A strong negative correlation between Ca and F in the ground waters that contain Ca in excess of that required for the solubility of fluoride minerals has been observed by many researchers (Boyle, 1992; Janardhana et al., 2009). Calcium content in the eastern zone ranged between 18.43 to 120.24 mg l^{-1}, in the south eastern zone 3.20 to 769.53 mg $l^{-1}$and in the southern zone 7.21 to 252.50 mg l^{-1} whereas magnesium content was recorded between 7.80 to 273.23 mg l^{-1} in eastern zone, 2.93 to 643.79 mg l^{-1} in south eastern zone and 6.83 to 178.00 mg l^{-1} in southern zone of nawa tehsil. Due to low fluoride solubility hardness showed negative correlation with fluoride content (Hem, 1991). In the present study it was observed that with the increasing concentration of fluoride in ground water hardness decreased while alkalinity increased. In the eastern zone total hardness was recorded between 84 to 1380 mg l^{-1}, in south eastern zone it ranged between 20 to 4560 mg l^{-1} and in southern zone it varied from 46 to 1360 mg l^{-1} whereas alkalinity in the eastern zone varied from 260 to 900 mg l^{-1}, in south eastern zone it ranged from 210 to 3100 mg l^{-1} and in southern zone it was recorded between 190 to 520 mg l^{-1}. Acceptable range of alkalinity as per guidelines suggested by BIS (1991) is 200 mg l^{-1} (maximum), beyond this limit taste becomes unpleasant. 600 mg l^{-1} (Permissible in the absence of alternate source). The results are in agreement with the findings of Saini and Bhardwaj (2006). Similar observations were reported earlier by many investigators (Sabal and Khan, 2008). After evaluating the data of the study it is concluded that the ground water of Nawa tehsil is degraded and deteriorated as it is polluted with high amount of fluoride and can result in dental and skeletal fluorosis.

Conclusions

On the basis of above discussion, it may be concluded that quality of ground water varies from place to place. Sixty percentage studied area shows higher values of fluoride in the drinking water samples. Some places have higher values of TDS, Alkalinity, Hardness and chloride while remaining parameters are within the permissible limits. In these areas, the treatment technology must be implemented to ensure good health of the living beings.

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