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Flouride and Nitrate Status of Some Ground Waters in Chittor District of Rajasthan State (India)

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Abstract:

In Rajasthan state the ground waters of some areas like Ramganj-mandi, Morak, Barmer, Jaisalmer, Chittor and Udaipur etc. are susceptible from drinking point of view.To test the quality of groundwater in Chittor district 14, ground water samples were collected from various places and analyzed for pH, E.C., Fluoride and Nitrate parameters by standard methods (A.P.H. A., Washington, USA, 1995). The study revealed that none of the ground waters was found suitable completely from drinking point of view. Some are having electrical conductivity > 1.4 dS/m, some are having pH >8.5, some area having fluoride >1.5 ppm and some are having nitrate>45 ppm. These are the limits of various parameters permitted by various International authorities like Bureau of Indian Standard, Indian Council of Medical Research,world health Organization etc. for drinking waters. So, it is recommended to the residents of above areas to use water for drinking purpose only after reverse osmosis or adopting suitable method of removing excess of Fluoride and Nitrate for drinking water to avoid unwanted pathogenic diseases harmful for human health.

Keyword- Fluoride, Nitrate, spectrophotometer, SPADNS dye, EC.

I. INTRODUCTION

Water or hydrol is one of the prime requirements of human beings,animals and plants lives for their survival. Still more than one billion people all over the world do not have an adequate and safe water supply and more than 800 millions of those live unsaved in rural areas. In India ground water is being used as raw water for 85% public water supply. In developing countries, 75% of the population had access to water supply. So they are always prone to loss of their lives or cast a big expenditure to save them from the occurrence of different water borne diseases. Water contamination due to pathogenic micro-organisms, chemicals, heavy metals, pesticides water disinfectants and thereby product as a consequence of Industrial and agricultural activity leaching from soil rocks and atmospheric deposition and other human activity has become a hazard to human health in several reasons of world.

The major sources of fluoride in groundwater are due to fluoride bearing minerals such as a fluorspar, cryolite, and fluor-apitite andhydroxyl lapatite. The fluoride content is a function of so many factors such as availability and solubility of fluoride minerals, velocity of flowing water, temperature, pH, concentration of calcium and bicarbonate ions in water etc.(Meenakshi et. al., 2004) In Indian conditions, the higher concentration of fluoride in groundwater is associated with igneous and metamorphic rocks.

Fluoride is most electronegative of all the chemical elements and is therefore never found in nature in elemental form and combined in the form of fluorides.It ranks 17 in advance of elements in earth crust representing about 0.06 to 0.09% of the earth`s crust (WHO, 1994). Fluoride is one of the important life elements to human health. It is essential for normal mineralization of bones and formation of dental enamelswith presence in small quantity(Chouhan and flora, 2010). When fluoride is taken up more than permissible limit (1.5 ppm), it become toxic and causes clinical and metabolic disturbances in animals and human being such as dental and skeletal fluorosis (Hussain, et. al.,2012).

Most abundant element found in the atmosphere is nitrogen nearly 80%(Berner, 1987) can be found in many forms, the major onesbeing N_2, N_2O,NO, NO_2, NH_3. Nitrate is the part of nitrogen-cycle in nature and it represents the most oxidized chemical form of N_2 found in the natural system. All living beings need nitrogen for their existence since; it is used to build many essential components such as a protein,RNA,DNA, vitamins as well as hormones and enzymes. Nitrate, though very essential for the very existence of life, is also one of the most widespread pollutants of groundwater in many parts of the world and in several instances this is due to intensification of Agriculture(Goldberg 1989). In India as high as 530 mg/l of nitrate has been reported in Churu district of Rajasthan. Potable water of nitrate at concentration > 45 mg/l can be detrimental to human health (canter, L.W., 1987).The permissible limit of NO_3^-in drinking water is 45 mg/l by the World Health organization (W.H.O.).Infants under 1, year old are particularly affected from excessive amount as it causes

‘’Methamoglobinaemia” commonly called as:“Blue baby syndrome” (W.H.O. IPCS,2002). The adverse effects of fluoride and nitrate contents in groundwater are very serious on human being and animal health. Therefore, this study was undertaken to analyze the ground water samples to know the status of groundwater in respect of fluoride and nitrate in Chittor district area located in Udaipur Division of Rajasthan state.

Review on literature showed that very less study have been taken in this study area with regard to chemical characteristics of groundwater yet. So, present study was to investigate the quality of underground waters with respect to fluoride and nitrate contents in Chittor district (Rajasthan).

II. LOCATION OF STUDY AREA

The study area of this paper that’s Chittor district is a part of Udaipur division in South of Rajasthan state. It is historical place where Chittor fort is one of the most important forts in India. It is related with the battle of Akbar-Maharana Pratap in history. It is specific area where available water is not adequate and suitable. Udaipur division has a latitude24^0 58` and longitude of $73^0$ 68`.Based on Population, the area is ranked # 100 in India. The area is clear as regard the weather with humidity to 22%. The average temperature is about 39^0C.The area elevation is about 585 meters height from the sea level.

Geography of study area

The Chittor district so called “MEWAR” is the study area of this paper. The northern part of Mewar is a gently sloping plain drained by the Bedach and Banas River and its tributaries, which empty northwest into the Chambal River, a tributary of the Yamuna River. The southern part of the reason is hilly and marks the divide between the Banas and its tributary and the head waters of the Sabarmati and Mahi River and their tributaries, which drain south into the Gulf of khambhat through Gujarat state. The Aravalli Range, which forms the north western boundary of the region, is composed mostly sedimentary rocks, like marble and Kota stone. Protected area includes jaisamand wildlife sanctuary, Kumbhalgarh wildlife sanctuary, the Baasi wildlife sanctuary and Sita mata wildlife sanctuary.Mewar area has tropical climate, rainfall average 660 mm/year and is the highest in South-west and lowest in the north-east of the reason.

Material and methods

In order to assess the groundwater quality in respect of fluoride and nitrate, fourteenwater samples have been collected from hand pumps, bore holes and open wells in Chittor area located in Udaipur division of Rajasthan state. The samples were collected in clean 1 litre capacity polythene bottles and analyzed for pH, electrical conductivity (E.C.),fluoride (F^-) and nitrate(NO_3^-) as per standard methods. The results were evaluated in accordance with the drinking water quality standards given by the World Health Organization (W.H.O., 2004 and Bureau of Indian Standards (B.I.S.), 2009).

The pH was measured with digital pH meter (model; instrument India Limited), E.C. was measured with conductivity meter(model; instrument India Limited)and fluoride content in the ground waters was measured by spectrophotometer using “SPADNS” as a colour developing agent. Similarly, nitrate content of groundwater was also measured by spectrophotometer using diphenyl amine as a colour developing agent and Ammonia as a neutralizer of watersamples.

III. RESULT AND DISCUSSION

The analytical values of water quality parameters in the ground waters collected from Chittor district are depicted in the Table-II. All the results are compared with that of standard permissible limits recommended by Bureau of Indian Standard (B.I.S.), Indian Council of Medical Research (I.C.M.R.) and World Health Organization(W.H.O.) as presented in Table-I. The analytical results parameter wise are discussed in preceding pages.

Table-I Prescribed standard for potable water

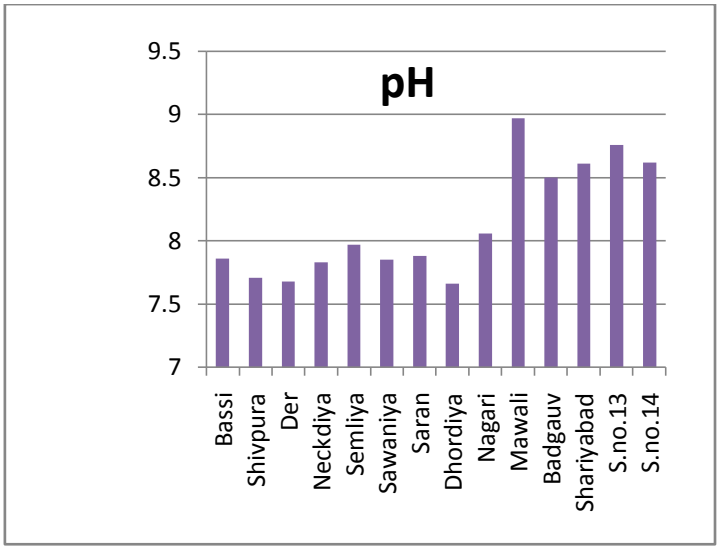
S.NO.	Parameters	B.I.S. (1999)	I.C.M.R. (1975)	W.H.O (2000)
1.	pH	6.5-8.5	7.0-8.5	6.5-8.5
2.	E.C.(dS/m)	-	-	1.40
3.	NO_3^-(ppm)	100	50	45
4.	F^-(ppm)	1.5	1.5	1.5

pH

The pH of water is very important indication of its quality and provides important information in many types of geo-chemical equilibrium or solubility calculation (Hem, 1985). All chemical and biological reactions are directly dependent upon the pH of water system. In the study area pH of groundwaters ranged from 7.66 to

8.97 with an average value of 8.14. Maximum pH was recorded in groundwater samplecollected from Mawali-village and that is 8.97 or says 9.0 which are alkaline in nature and not suitable for drinking purpose. 3 samples collected from Dhariabad, Udaipur and Kankroli are having bit higher value to that of 8.5 as recommended by the B.I.S., 1999,I.C.M.R., 1975 and W.H.O.,2000towards maximum permissible limit. So, these waters are also not suitable as Potable water.

Rests of all ground water samples are having pH under permissible limit and suitable for drinking and other purposes also.



Electrical conductivity (E.C.)

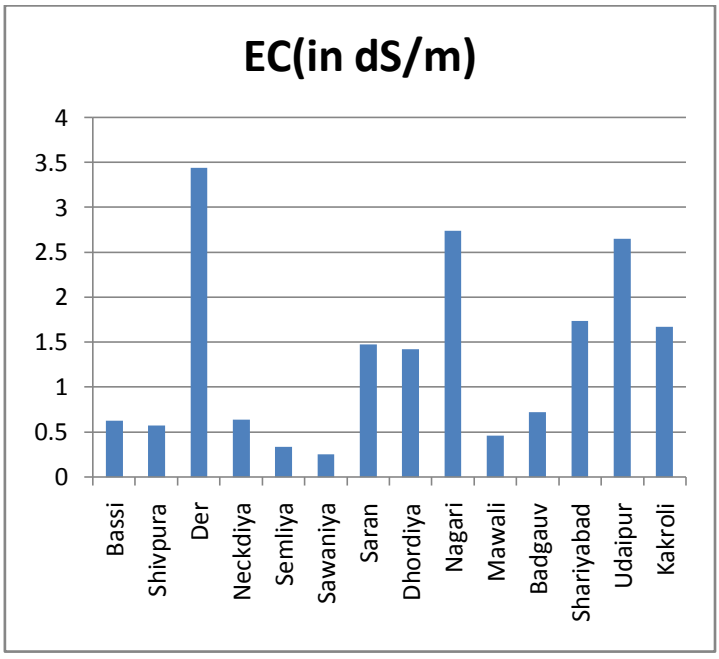
The electrical conductivity measurement provides anionic concentration and it's depending upon the temperature, concentration and type of Ions present (Hem, 1885). Based on EC values, the ground water quality can be classified as poor, medium or good.

Table- II: Analysis of ground water samples collected from various places in Chittor district of Rajasthan state

S. NO.	Samp-le no.	Location of water sample	pH	E.C. (dS/m)	F^- (ppm)	NO_3^- (ppm)
1.	1	**Bassi**	7.86	0.631	Tr.	46.4
2.	2	**Shiv pura**	7.71	0.576	Tr.	42.4
3.	3	**Der**	7.68	3.440	Tr.	78.4
4.	4	**Neckdiya**	7.83	0.640	Tr.	49.6
5.	5	**Semliya**	7.97	0.337	Tr.	41.6
6.	6	**Suwaniya**	7.85	0.257	0.80	40.8
7.	7	**Saran**	7.88	1.475	1.30	41.6
8.	8	**Dhordiya**	7.66	1.420	1.37	44.8
9.	9	**Nagari**	8.06	2.740	1.12	53.6
10.	10	**Mawali**	8.97	0.465	1.10	54.4
11.	11	**Badgauv**	8.50	0.724	2.74	47.2
12.	12	**Shariya Bad**	8.61	1.736	2.10	54.0
13.	13	**Udaipur**	8.76	2.650	0.90	43.2
14.	14	**Kankroli**	8.62	1.671	0.75	54.0

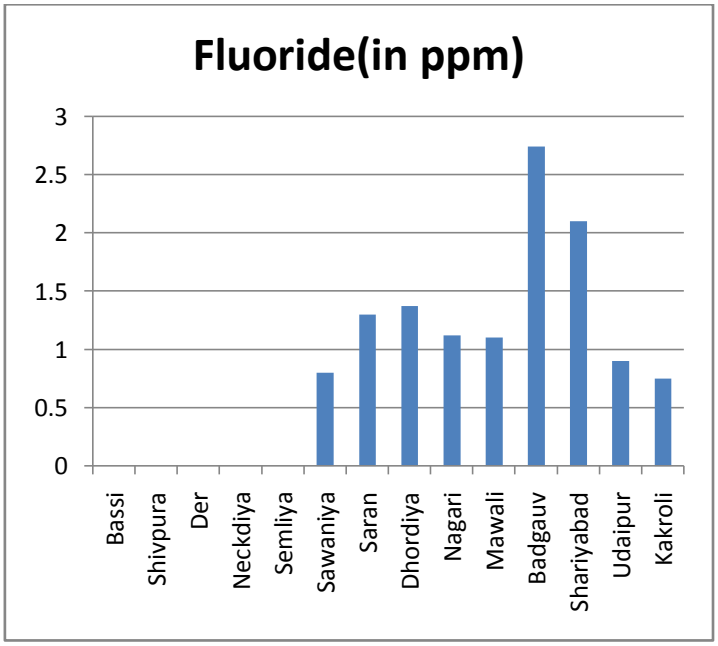
In the present study maximum E.C.(dS/m)values was observed in the sample collected from **Der- village and that is about 3.44 dS/m. This sample is not fit for drinking as well as irrigationpurposes**.**Beside, this sample groundwater water samples collected from Saran, Dhordiya, Nagari, Dhariyabad, Udaipur and Kankroli villages are having EC values above 1.4 (dS/m) and cannot be accepted for drinking purpose.**

Rest of all samples are having E.C. values below 1.4 dS/m which is the highest permissible limit as recommended by World Health Organization(W. H. O. 2000) are very much suitable for drinking, irrigation and other purposes.



Fluoride(F^-)

Fluorosis is a disease caused by excessive fluoride concentration in the drinking water. Concentration about 1.0 mg/l give rise to mottling of enamel of teeth a condition known as "dental fluorosis" still higher amount in excess of 3.0 mg/l causes abnormality in bone structure. These symptoms are known as skeletal fluorosis.Anothersymptomof fluorosis is "knock knees" often observed in high fluoride area. Fluoride concentration in groundwater of study area varies from trace to 2.74 mg/l with an average of 0.80 mg/l. **Highest fluoride concentration amonggroundwater's was recorded in Badgauv-village where its concentration found was 2.74 mg/l followed by Dhariyabad-village where fluoride content was found to be 2.10 mg/l .**Groundwater of both the villages need to treat fluoride concentration below up to1.5 mg/l before using it for drinking purposes. Rest all the groundwaters in the study are fit for drinking purpose from fluoride content point of view.

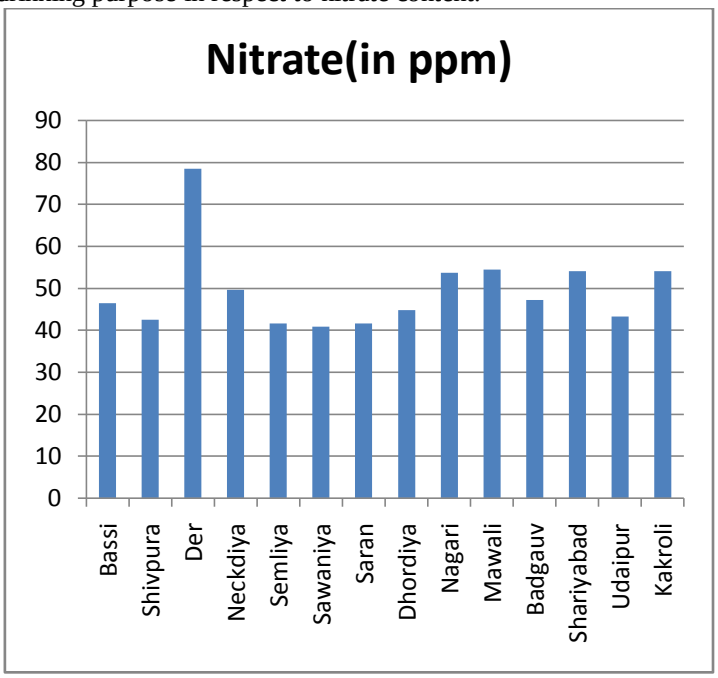


Fluoride in drinking water has both +veor -veeffect on human health. Low level of fluoride in drinking water makes the teeth resistance to decay and development of dentalcaries but high intake fluoride causes immediateabdominal pains. Excessive fluoride causes pain and damage to bones and joints and imparts ill effect on soft tissues organs and system also. Repeated abortions and male infertility are some of the complicationsoccurred due to the excessive use of fluoride in drinking water.

Nitrate(NO_3^-)

Excess availability of nitrate(NO_3^-)in groundwater is mainly due to the excess use of nitrogenous fertilizers in agriculture. Launching of nitrate to groundwater may be due to improper disposal of domestic water, septic tanks and improper soil and water management practices. Higher concentration of(NO_3^-) content in potable water have been prevent to be the cause of Numerous health diseases such as gastro-intestinal cancer, Blue baby syndrome, alzheimer disease, vascular dementia, multiple sclerosis in human being. Nitrate contamination leads to Eutrophication of water bodies.

Under present study the analytical data as given in Table- II reveal that the nitrate (NO_3^-)content in the groundwater of area under study range from 40.8 mg/l to 78.4 mg/l with an average of 49.43 mg/l. Out of 14 sites of groundwater 8 sites are having nitrate (NO_3^-)content more than permissible limit 45 ppm of drinking water as recommended by (W.H.O.) in 2000.Average nitrate content of a study area is 49.43 mg/l which is also higher than critical limit of drinking water that is 45 mg/l. Therefore, it may be concluded that groundwater of the area are not fit for drinking purpose in respect to nitrate content.



IV. CONCLUSION

On the study of analytical data of groundwater's of Chittor district that is pH, E.C.,F^- and NO_3^-it may be concluded that drinking waters that are used using by the People in study area are not suitable. Some waters are having pHabove critical limits; some are having higher E.C. fluoride content or nitrate content in the range which is not permitted for drinking use. Therefore, it may be recommended to use waters only after reverse osmosis or any suitable treatment for removing nitrate and fluoride content to prevent adverse health effects. (Canter,1987 and Maliyekkal, et al., 2008).

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