

**ASSESSMENT OF FLUORIDE IN GROUNDWATER OF RAYA
BLOCK DISTRICT MATHURA (U.P.)**

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ABSTRACT

Eight water samples, (4 from hand pumps and 4 from tube wells) were collected from different villages of Raya block district Mathura for the study of physico-chemical condition of ground water. The duration of study was from January 2011 to June 2011. The physico-chemical parameters analysed were pH, temperature, turbidity, DO, BOD, COD, chloride ions, fluoride ions, sulphate ions, nitrate ions and total hardness. It was observed that all other parameters are within range when we compared with WHO standards, only fluoride ions and chloride ions were present in excess amount in tube well water of Karab village, that is sample no. 4. It has also been observed that tube well water samples have higher fluoride ions concentration as compared to hand pump water samples.

Keywords : *Raya Block, fluoride, ground water.*

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INTRODUCTION :

Water is prime necessity of life and is an important component of the living system. It is being used by man for various purposes like drinking, cooking, bathing, washing, house hold activities, irrigation, electricity generation, industrial production and disposal of sewage and industrial waste.

At present the menace of water born diseases and epidemics still looms layer on the horizon of the developing country. Ground water is the major source of water supply for domestic purposes in the urban as well as in rural parts of India. Various reasons for this include the non-availability of potable surface water and a general belief that ground water is pure and safer than surface water due to earth covering. The ground water contributes only 0.6% of the total water resources on earth. The ground water is the preferred and major source of drinking water in rural as well as in urban areas particularly in the developing countries like India as treatment of this water is often not required. The 90% of the total drinking water requirement and 50% of the agricultural requirement is fulfilled by the ground water in India but in the era of economical growth, groundwater is getting polluted due to urbanization and industrialization. The ground water is generally colourless but contains salts such as chlorides, sulphates, nitrates etc. of different metals. Water is one of the most important component for sustaining life but it is also the source of several sickness in human beings. The presence of hazardous contaminants like fluoride, nitrate, sulphate, toxic heavy metals etc. have been reported in many parts of India (Sahu *et.al.*, 2006 & Jagmohan Oberoi and K.C. Gupta, 2010).

Fluoride is the major inorganic pollutant of natural origin found in ground water. In minute quantity fluoride is an essential element needed for normal development and growth of animals and extremely useful for human beings. Fluoride is abundant in the environment and main source to humans is drinking water. Fluoride gets accumulated in hard tissues of the body and play an important role in mineralization of bones and formation of dental enamel (Bell & Ludwig, 2004). It is known that growth of many plant species (Daives *et.al.*, 1952) is also stimulated but excessive intake of fluoride is toxic to plants and causes clinical disturbances in animal and human beings. There are many countries like Argentina, USA, Algeria, Libya, Egypt, Jordan, Turkey, Iran, Iraq, Kenya, China, Japan, New Zealand, Australia, Thailand, Canada, Sri Lanka, Syria etc. (Mameri *et.al.*, 1998) which are endemic for fluorosis.

Fluoride is commonly found above the normal values in ground water of many states like U.P., M.P. Punjab, Haryana etc. Indian standards (Meenakshi *et.al.* 2004) for drinking water prescribes the desirable limit 1.0 mg/l. According to WHO (1997) permissible limit for fluoride in drinking water is 1.5 mg/l whereas United States Public Health Sciences (1962) has set a range of allowable concentration of fluoride in drinking water for a region depending on its climatic conditions. The amount of water consumed and consequently ingested being influenced primarily by the air temperature (Heyroth, 1952 & Galagan & Lamson, 1953). According to USPHS, the maximum allowable concentration of fluoride in drinking water in Indian conditions comes to 1.4 mg/l while as per Indian standards it is 1.5 mg/l (Meenakshi *et.al.*2004).

Fluoride ions have dual significance in water supplies. High concentration of fluoride causes dental fluorosis (disfigurement of teeth), at the same time a concentration less than 0.8 mg/l results in dental carries. The major source of fluoride in ground water are fluoride bearing rocks such as fluoropar, cryolites, fluorapatite and hydroxylapatite (Agrawal *et.al.* 1997).

In India, the fluorosis was first identified in Tamilnadu in 1937 (Shortt *et.al.*, 1937). later, this disease was also identified in different states. At present more than 30 million people in 13 states have been affected by this disease (Aggarawal *et.al.*, 1982 & Susheela, 1993). The disease is making its appearance in newer non-fluorotic areas due to geo-environmental conditions. According to WHO (1970), one hospital bed out of four in the world is occupied by a patient who is sick because of polluted water.

Fluoride ion concentration in drinking water is playing a vital role in human health systematic fluorosis (Basin, 2003 & Kumar *et.al.*, 2003) and is an endemic problem in several developing countries like India, Pakistan and Africa etc. Exposure to high level of fluoride can cause endemic fluorosis, arthritis, cancer stiff joints, weight loss, brittle bones, anaemia and weakness and characterize endemic fluorosis. Discoloured, blackend, white teeth characterize dental fluorosis (Damel, 2002). Fluoride can damage a foetus and adversely affect the I.Q. of children (Semmla & Vineetha, 2004). Right level of fluoride in drinking water can provide beneficial effects like developing tooth buds, makes the structure of the enamel and dentin harder and more resistant to acid attack produced by bacteria. Fluoride from saliva enters enamel of newly erupted teeth and enhances enamel classification (Hari *et.al.*, 2000).

MATERILAS AND METHODS :

Eight water samples from hand pumps (H1 – H4) and tube wells (T1 – T4) were collected in polythene bottles. The samples were analysed for pH, temperature, turbidity, DO, BOD, COD, chloride, fluoride, sulphate, nitrates and total hardness in the months of January to June 2010.

Temperature was measured by Celsius thermometer, pH and turbidity were measured by digital pH meter (type – 335), digital Nephlo turbidity meter (type – 132) respectively. DO, BOD and COD were determined in laboratory using the method suggested by APHA (1985) and NEERI manual (1986). Chloride and nitrates were estimated by volumetric titration with AgNO₃. Total hardness was determined by volumetric titration (EDTA method). Sulphate was estimated by UV-VS spectro-photometer (type -118). Fluoride concentration was determined spectrophotometrically using Alizarin red – S and SPAND reagents. The Alizarin red-S method was found useful in higher fluoride range while SPANDS reagents was employed in low fluoride range. (Gupta *et.al.*, 1993). The results for ground water are presented in table 1 and table 2.

Table-1 Physico-chemical analysis of water samples collected from hand pumps of different villages of Raya block district Mathura.

Parameters	Site	Jan	Feb	Mar	Apr	May	Jun
pH	H ₁	7.3	7.6	7.6	7.2	7.5	7.8
	H ₂	7.5	7.4	7.7	7.8	7.5	7.4
	H ₃	7.5	7.4	7.5	7.9	7.5	7.9
	H ₄	7.3	7.5	7.3	8.0	7.2	8.1
Temperature (°C)	H ₁	18.10	22.15	22.95	26.15	26.86	28.10
	H ₂	17.26	21.97	23.15	26.55	26.98	27.95
	H ₃	18.25	19.45	21.23	25.14	27.82	28.47
	H ₄	17.15	20.45	21.22	24.95	26.88	27.47
Turbidity (NTU)	H ₁	1.4	1.9	1.6	2.0	1.9	1.9
	H ₂	1.5	1.3	1.3	1.2	1.5	1.5
	H ₃	0.8	0.8	0.8	0.8	0.7	0.6
	H ₄	5.0	4.9	4.9	4.7	4.9	4.8
DO (mg/l)	H ₁	6.37	6.15	6.57	5.92	6.32	6.40
	H ₂	6.50	6.19	6.07	5.77	5.78	5.61
	H ₃	6.33	5.47	5.53	6.13	6.15	6.11
	H ₄	6.27	6.11	6.05	5.87	6.38	5.55
BOD (mg/l)	H ₁	11.2	11.0	10.8	11.5	11.3	10.8
	H ₂	8.6	10.6	10.8	9.5	9.3	10.5
	H ₃	9.1	9.8	10.8	11.5	9.3	10.7
	H ₄	11.2	9.5	10.8	11.5	11.3	10.8
COD (mg/l)	H ₁	84	76	74	78	74	80
	H ₂	76	76	84	78	85	79
	H ₃	63	66	71	68	70	69

	H ₄	69	66	72	68	72	69
Chloride (mg/l)	H ₁	1220	1200	1240	1250	1215	1195
	H ₂	465	465	500	490	485	480
	H ₃	990	970	975	975	970	980
	H ₄	1210	1170	1170	1175	1160	1200
Fluoride (mg/l)	H ₁	1.10	1.10	1.00	0.95	0.90	1.00
	H ₂	0.80	0.90	0.90	0.80	1.00	1.00
	H ₃	0.90	0.90	0.70	0.80	0.70	0.70
	H ₄	1.60	1.50	1.60	1.70	1.50	1.60
Sulphate (mg/l)	H ₁	232	238	255	250	251	245
	H ₂	190	170	170	165	175	185
	H ₃	185	195	195	175	170	170
	H ₄	220	210	170	170	180	195
Nitrate (mg/l)	H ₁	23	22	25	27	26	26
	H ₂	31	31	35	34	31	33
	H ₃	42	41	41	38	38	38
	H ₄	29	29	26	30	27	27
Total hardness (mg/l)	H ₁	741	750	740	740	730	750
	H ₂	320	300	310	310	345	305
	H ₃	300	285	295	300	285	300
	H ₄	290	310	280	300	309	320

H₁ – Gausana; H₂ – Raya; H₃ – Ganga Nagla; H₄ – Karab

Table-2 Physico-chemical analysis of water samples collected from tube wells of different villages of Raya block district Mathura.

Parameters	Site	Jan	Feb	Mar	Apr	May	Jun
pH	T ₁	7.3	7.5	7.4	7.4	7.6	7.3
	T ₂	7.7	7.45	7.6	7.6	7.6	7.9
	T ₃	7.5	7.5	7.5	7.3	7.6	8.0
	T ₄	7.6	7.5	7.6	7.4	7.7	7.8
Temperature (°C)	T ₁	17.19	21.96	22.18	25.14	26.74	27.79
	T ₂	18.13	22.10	24.23	25.78	27.00	28.14
	T ₃	17.80	20.21	22.23	24.15	26.12	27.97
	T ₄	17.83	21.22	22.13	25.18	27.11	28.21
Turbidity (NTU)	T ₁	1.8	1.6	1.7	1.6	1.5	1.9
	T ₂	1.1	1.1	1.2	1.4	1.4	1.1
	T ₃	0.8	0.7	0.7	0.7	0.8	0.8
	T ₄	4.8	4.7	4.8	4.6	4.9	5.0
DO (mg/l)	T ₁	5.90	5.57	5.67	6.12	6.13	6.41
	T ₂	6.31	6.42	5.91	5.87	5.60	5.98
	T ₃	5.98	6.17	6.11	6.27	6.23	5.87
	T ₄	6.48	6.17	6.15	5.97	5.44	6.15
BOD (mg/l)	T ₁	10.50	12.10	10.40	10.40	11.50	11.20
	T ₂	10.30	10.20	8.60	8.90	8.80	10.50
	T ₃	9.50	11.00	10.50	10.60	9.60	9.20
	T ₄	11.40	11.00	9.60	9.60	9.40	9.10
COD (mg/l)	T ₁	76	74	81	84	80	76
	T ₂	77	79	81	80	84	85
	T ₃	65	61	66	66	69	70

	T ₄	68	71	72	66	67	67
Chloride (mg/l)	T ₁	1150	1190	1200	1175	1175	1170
	T ₂	420	415	420	470	470	460
	T ₃	985	985	980	970	990	965
	T ₄	1170	1180	1190	1190	1175	1185
Fluoride (mg/l)	T ₁	1.00	0.80	0.70	0.70	0.80	0.60
	T ₂	0.90	0.70	0.70	0.80	1.00	1.00
	T ₃	0.80	0.80	0.60	0.60	0.90	0.90
	T ₄	1.60	1.60	1.70	1.80	1.70	1.60
Sulphate (mg/l)	T ₁	210	215	215	210	165	195
	T ₂	180	180	165	160	165	165
	T ₃	190	190	185	185	190	170
	T ₄	200	170	170	190	195	195
Nitrate (mg/l)	T ₁	21	19	19	23	22	22
	T ₂	29	30	31	31	33	34
	T ₃	37	42	42	41	38	38
	T ₄	26	26	29	29	30	28
Total hardness (mg/l)	T ₁	209	198	188	165	175	188
	T ₂	155	178	110	115	185	107
	T ₃	85	75	85	55	75	67
	T ₄	135	140	175	145	285	145

T₁ –Gausana; T₂ – Raya; T₃ – Ganga Nagla; T₄ – Karab

RESULTS AND DISCUSSION :

Results obtained during the analysis have been given in table 1 and 2. The pH of samples collected from various villages were in the range of 7.2 to 8.1 (hand pump) and 7.3 to 8.0 (tube well), Temperature ranged 17.15 to 28.47 °C (HP) 17.17 to 28.21 °C (TW), turbidity ranged 0.6 to 5.0 NTU (HP) and 0.7 to 5.0 NTU (TW), DO ranged 5.47 to 6.57 mg/l (HP) and 5.44 to 6.48 mg/l (TW), BOD ranged 8.6 to 11.5 mg/l (HP) and 8.60 to 12.10 mg/l (TW), COD ranged 63.0 to 85.0 mg/l (HP) and 61.0 to 85.0 mg/l (TW), chloride ranged 465 to 1250 mg/l (HP) and 415 to 1200 mg/l (TW), fluoride ranged 0.50 to 1.60 mg/l (HP) and 0.60 to 1.80 mg/l (TW), sulphate ranged 165 to 255 mg/l (HP) and 160 to 215 mg/l (TW), nitrate ranged 22 to 42 mg/l (HP) and 19 to 42 mg/l (TW), total hardness 280 to 750 mg/l (HP) and 55 to 285 mg/l (TW).

CONCLUSION :

From the above study it is clear that all other parameters are within range when we compare with WHO standards, only fluoride and chloride is present in excess amount in tube well water of Karab village, that is sample no. 4. it has been observed that tube well water samples have higher fluoride concentration as compared to hand pump water. Regular intake of fluoride rich water seems to be main course for high incidence of fluorosis. Chemical

weathering under arid to semiarid conditions with relatively high alkalinity seems to have favored high concentration of fluoride in ground water.

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