



Ground Water Quality Assessment of Rural Area of Deoli Tehsil, Tonk District (Rajasthan) with Special Reference to Fluoride Analysis†

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High rates of mortality and morbidity due to water-borne diseases are well known in India. Serious degradation of water quality in urban India has often been attributed to indiscriminate disposal of sewage and industrial effluents into surface water bodies. The population in rural India is mainly dependent on the groundwater as a source of drinking water. As a quality concern the groundwater is often found to be contaminated with fluoride, arsenic, iron and salts. In recent years, fluorosis has emerged as major public health issue in rural India. This paper briefly presents the water quality special focus on fluoride. One hundred thirty samples were collected from different villages of Deoli Tehsil, (Tonk), Rajasthan during the month of May-June 2009 in clean polyethylene bottles. Samples were analyzed for different parameters such as- pH, total alkalinity (TA), fluoride (F⁻), nitrate (NO₃⁻), total dissolved solids, chloride (Cl⁻), total hardness, electrical conductivity, Ca-H, Mg-H, CO₃²⁻, HCO₃⁻, Na⁺ and K⁺ by using standard techniques. The results revealed that the most of the water samples were below or beyond limits, according to the WHO standards (1996). The F⁻ concentration ranged 0.30 to 9.60 ppm. Minimum (0.30 ppm) and maximum (9.60 ppm) concentration of F⁻ was observed from Jalseena and Akodiya villages respectively. The drinking water of Deoli Tehsil is not potable, proper treatment of groundwater is suggested prior to its use for drinking purpose. Removal of fluoride from drinking water is suggested through various defluoridation techniques are available including quick reverse osmosis, electro dialysis and hit and trial method.

Key Words: Ground water quality, Deoli teshil, Fluorosis.

INTRODUCTION

Fluoride is recognized as an element of human health concern. It is present universally in water, earth crust, many minerals, rocks, *etc.*, it is also present in daily used things *viz.* tooth paste, drugs, cosmetic, chewing gums mouthwash, *etc.*¹. In small amount of fluoride is beneficial in prevention of cavities formation in the teeth and provide strength to skeleton system, but long term consumption of water containing excessive amount of fluoride causes fluorosis that affects teeth, bones, joints and ultimately leads to crippling.

The high concentrations of fluoride in drinking water is a problem faced by many countries like- India, Sri Lanka, China, the Rift Valley Countries in East Africa, Turkey and parts of South Africa²⁻⁶. According to survey made by Rajiv Gandhi National Drinking Water Mission, New Delhi many districts of more than 15 state are affected due to endemic fluorosis till

1992⁷. It can be seen that 30 % districts are affected in Panjab, Haryana, Madhy Pradesh, Maharastra and Bihar where as 50 % districts in Uttar Pradesh, Rajasthan, Gujrat, Andhara Pradesh and Tamilnadu are effected by fluorosis⁸⁻¹¹. Rajasthan state is thought to be the most seriously affected by high fluoride. All 33 district are endemic for fluorides¹²⁻¹⁷.

EXPERIMENTAL

Deoli is a city and a municipality in Tonk district in the state of Rajasthan. Deoli is situated 971 ft above sea level Deoli lies on the national highway no. 12 and 111 kms south to Jaipur. It is located between co-ordinates 25° 58' N 73° 62'. It has an average elevation of 296 m.

Deoli is bounded on the north by Jaipur, south by Bhilwara and Bundi, east by Sawaimadhopur and west by Ajmer.

Water-Sampling: One hundred thirty samples were collected from fluoride affected villages of Deoli Tehsil in

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clean polyethylene bottles from different sources *viz.* hand pumps, open wells, tube wells and PHED water supply. Samples were analyzed by using standard techniques¹⁸.

Fluoride ion-selective electrode method: Ion-selective meter, Fluoride electrode, magnetic stirrer.

Fluoride standards of various ranges (0.2-20 ppm) Fluoride Buffer (TISAB-total ionic strength adjustment buffer).

Calibrate the instrument take 10 mL sample in a beaker at 10 mL buffer solution. Put stirring bar into the beaker immerse electrode and start the magnetic stirrer and wait until reading is constant withdrawal electrode rinse with distilled water.

RESULTS AND DISCUSSION

The fluoride content of ground water ranged from 0.26 to 9.60 ppm. Permissible limit for F⁻ concentration is 1-1.5 ppm according to WHO¹⁹. The data revealed that 80 % villages are affected with high concentration of F⁻ lower in 14 % villages. However 6 % villages contained optimum limit of F⁻ concentration (Table-1). The data showed that concentration of F⁻ was found even up to the alarming limit of 9.60 ppm. The highest fluoride (9.60) concentration was reported from Akodiya village and minimum was observed from Jalseena village. Majority of the population of study area are suffering from skeletal fluorosis and dental fluorosis. In study area villages are dangerously affected with fluoride concentration having fluoride more than 1.5 mg/L. These villages are follows; Akodia, Gadigram, Poliyada, Poliyadi, Mundia Khurd, Sawatghard, Sarakawas, Digariya, Kawarpura, Alegendarpura, Benediya, Khurd, Thawala, Dalawasa, Dahaber Khurd, Ramthala, Dabarkala, Bijawad, Baida, Panwer, Gopipura, Bas Laxamana, Ambapura, Rugarail, Rathanpura, Dhakadiyawas, Niwariya, Kawarpura, Balapura, Shrinagar Bhimpura, Sagarapura, Syawata, *etc.*, People living in these villages are dangerously affected with fluorosis. They become old in short age. Their joints are almost finished after 30-40 age. They are using belts and bandages for their joints. Most of the persons above 50 year are knelt down on their kness. There teethes are in sympathetic conditions.

TABLE- 1
WHO PERMISSIBLE LIMIT AND PERCENTAGE OF
WATER QUALITY OF VILLAGES DEOLI TEHSIL

Parameters	Permissible limit	Villages (%)		
		Below (%)	Optimum (%)	Higher (%)
pH	6.9-9.2	-	100	-
F ⁻	1-1.5 ppm	14	6	80
EC	300 µmhos/cm	-	-	100
TDS	500-1500 mg/L	5.38	70	24.62
TH	100-500 mg/L	0.76	95.38	3.84
Cl ⁻	200-600 mg/L	48.47	46.15	5.38
Alkalinity	200 mg/L	3.85	-	96.15
Na ⁺	50-60 mg/L	26.15	13.07	60.76
K ⁺	20 mg/L	100	-	-
NO ₃ ⁻	40-50 mg/L	57.70	10	32.30

Skeletal fluorosis: Skeletal fluorosis is a bone disease caused by excessive consumption of fluoride. Skeletal fluorosis is not easily recognizable until the disease has developed to

an advanced stage. Maximum ill effects of fluoride are detected in the neck, spine, knee, pelvic and shoulder joints. Fluoride also affects small joints of the hands and feet. In this disease fluoride replaces hydroxides in bones causing chronic effects. Skeletal fluorosis have a number of stages (Table-2). The first stages is pre clinical that is the patient feels no symptom but changes have taken place in the body. In the first pre clinical stage biochemical abnormalities occur in the blood and in bone composition. In the second pre clinical stage, histological changes can be observed in bone in biopsies. In the early clinical stages of skeletal fluorosis, symptoms include, pain in the bone and joint; sensation of burning, pricking and tingling in the limb; muscle weakness, chronic fatigue, gastrointestinal disorder and reduce appetite²⁰.

TABLE - 2
GRADING OF SKELETAL FLUOROSIS
(RADIOLOGICAL FLUOROSIS)

Type	Grading	Description
Mild	I	Osteosclerosis only
Moderate	II	Osteosclerosis, periosteal bone formation, calcification of interosseous membrane, ligaments, capsules, muscular attachments, tendons.
Severe	III	Findings as in moderate with exostoses, osteophytosis and associated metabolic bone disease.

Dental fluorosis: Dental fluorosis is an irreversible condition caused by excessive ingestion of fluoride during tooth forming years common dental diseases are: 1) Dental caries or decay; 2) Pyorrhoea; 3) Dental fluorosis.

Dental caries and pyorrhoea disease account for a high percentage of mortality and morbidity of tooth. Fluoride in tooth paste, mouth rinses and varnish and sodium fluoride tablets administered as prescription can contribute to the fluoride burden of the body leading to dental fluorosis occur in children during the developmental stages when the teeth are exposed to fluoride. In dental fluorosis the decoloration (white-yellow-brown-black) will be away from the gums and on the enamel surface and it can never be removed. In dental fluorosis the enamel will lose its luster and shine. Calcium rich constituents of teeth *viz.* enamel and dentin have strong affinity for fluoride during the formation of teeth. Fluoride combines with calcium forming calcium fluorapatite crystal during the mineralization of teeth²¹.

Non-skeletal fluorosis: The conventional belief that fluoride affects only bone and tooth has been negated in recent years as the evidences on the involvement of the soft tissues/organ of the body are convincing. Investigations on soft involvement in fluorosis have attracted attention in the recent past and convincing evidence from fluorosis patients is now available to demonstrate the damage of: 1) Skeletal muscle; 2) Erythrocytes; 3) Gastrointestinal mucosa; 4) Ligaments; 5) Spermatozoa in human fluorized patients.

Conclusion

The population of study area was also found affected with skeletal fluorosis, bone fluorosis and dental fluorosis. The presence of excessive quantity of fluoride in drinking water is accompanied by a characteristic sequence of changes in teeth,

TABLE-3
CLASSIFICATION OF DENTAL FLUOROSIS

Type	Grading	Description
Normal Enamel	0	The enamel presents the usual translucent semi-vitriform type of structure. The Surface is smooth, glossy and usually of a pale, creamy white color,
Questionable fluorosis	0.5	Slight aberrations from the translucency of normal enamel seen, ranging from a few white flecks to occasional white spot. This classification is used in instances where a definite diagnosis of the mildest form of fluorosis is not warranted and a classification of "Normal" Not justified.
Very Mild fluorosis	1	Small opaque, paper white areas scattered irregularly over the tooth but not involving as much as approximately 25% of the tooth surface.
Mild fluorosis	2	The white opaque areas in the enamel of the teeth are more extensive, but do not involve as much as 50% of the tooth.
Moderate fluorosis	3	All enamel surface of the teeth are affected and surfaces subject to attrition show marked wear.
Severe Fluorosis	4	All enamel surface are affected and hypoplasia is so marked that the general form of tooth may be affected. The major diagnosis of this classification is the discrete or confluent pitting.

bone and particular tissues. Therefore drinking water of Deoli tehsil is not potable, proper treatment of groundwater is suggested prior to its use for drinking purpose. Removal of fluoride from drinking water is suggested through various defluoridation techniques are available including quick reverse osmosis, electrodialysis and hit and trial method. The Nalgonda technique is an economical way for defluoridation. Activated alumina technology may be used, which is based on ion exchange resin. Public awareness and health education are most important measure to be widely adopted. This can be done by using audio-visual aids, seminars, conferences, symposium and training N.G.O.s. must be encouraged in such programmed for public welfare. Public awareness programmes must be organized for promotion of calcium rich diet and use of vitamin C in food. Minimum use of phosphatic fertilizers in endemic areas should be encouraged. Use of fluoride rich tooth paste, mouth wash and other cosmetic item should be discourage.

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