ASSESSMENT OF FLUORIDE CONTENT, pH AND TDS IN POTABLE WATER OF ALWAR CITY: AN ENVIRONMENTAL CONCERN

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ABSTRACT

Fluorosis is a disease, caused by excess intake of fluoride (>1.5ppm). Today, it is not only a clinical problem but a social problem too. Elemental fluorine exists as a diatomic molecule (consisting of two atoms in a molecule) with remarkably low dissociation energy (38kcal/mole); as a result, it is reactive and has a strong affinity for combining with other elements forming compounds called as fluorides. Fluorosis occurs not only in India but also in about 20 other countries, all of them facing the problem of excess fluoride in drinking water. Fluoride entering the body through water is almost completely absorbed where as fluoride ingested through food is absorbed to a much lesser extent. In present paper, the authors were randomly collected forty samples of potable water from different sources of four zones of Alwar city and analyzed for fluoride content, pH and Total Dissolved Solid (TDS). It was found that 95% water samples have less fluoride content than permissible limits (1.5ppm) but 80% samples have more TDS than permissible limits.

Keywords: *Potable water, Fluoride, Total Dissolved Solid.*

INTRODUCTION

Fluorides of common alkali metals, ammonium, Ag, Sn and Hg are readily soluble in water.[1-3]*While fluorides of alkaline earth metals, Pb, Cu, and Zn are partially insoluble in water. Fluorosis*[4-7]*, a disease caused by excessive intake of fluoride, occurs not only in India but also in about 20 other countries, all of them facing the problem of excess fluoride in drinking water.*[1-3,8,9] *Fluoride entering the body through water is almost completely absorbed whereas fluoride ingested through food is absorbed to a much lesser extent. Absorbed fluoride is distributed in smaller proportion.*

Fluoride content present in drinking water causes various health problems when the concentration of fluoride is greater than 1.5 ppm (According to WHO).[10] The prolonged intake of water containing excess of fluoride causes the crippling disease called fluorosis.[11] The first case of endemic fluorosis in India was reported from Andhra Pradesh in 1937. At least 17 Indian states including Rajasthan have been identified as having excess fluoride in drinking water. All the 33 districts in Rajasthan are endemic for fluorosis. According to WHO 20% villages out of total fluoride affected village in the world are found in India and out of total affected villages in India, 52% are in Rajasthan.[12,22-25,27] It is to be noted that India is not the only country but several other nations in the world are severely affected by the problem of fluorosis. Apart from India, high concentration of fluoride has been detected in the ground water in several countries including Argentina, Algeria, Australia, several African Nations, Bangladesh, and China etc.[9,12-18]

There are various defluoridation methods but in India, two treatment processes, namely Nalgonda technique (Flocculation and sedimentation) and AA - based filter (Adsorption) are used for removal of fluoride from drinking water but these existing methods for defluoridation drinking involve expensive and high technology or are slow, inefficient and unhygienic. G.F. liprote (1994) reported that aluminum fluoride can be made from direct combination of aluminum and fluoride. If aluminum compounds are added, the fluoride absorption is reduced by 50%. In such cases fluoride is less soluble form and faecal

excretion is increased.When everybody is trying to save our global environment by refusing Gray Chemistry and adopting Green Chemistry[26], the present work underline our concern for the same.

EXPERIMENTAL

Following materials and methods were used in this study-

Stock fluoride solution: Orion 940907 fluoride stock solution was used.

Standard fluoride solution: Dilute 100 ml stock solution to 1000 ml with distilled water 1000 ml: 10 ppm, F^-.

TISAB - III (Total Ionic Strength Adjustment Buffer): Orion 940911 TISAB III (concentrate with CDTA) was used.[19-21]

Ion Meter: - Orion 720A^+ ion meter was used to determine the concentration of fluoride.

Fluoride ion selective electrode: Orion 9609 BNWP ion plus sure flow fluoride electrode was used.

Determination of pH: pH was determined by systronics digital pH meter 335.[17]

Determination of total dissolved solid (TDS): This determination was carried out by the electronic method. Conductivity bridge 305 (systronics) was used to determine TDS of water. [17]

Location and Physiography of study area:

Rao Pratap Singh founded the study area Alwar in 1775. According to Cunningham Alwar derived its name from the Salwar tribe and was originally Salwapur, later on known as Salwar. Halwar and eventually Alwar. It is situated in North-East of Rajasthan between 27004' and 28004' North latitude and 76007' and 77013' East longitudes covering a geographical area of about 8380 sq. km. It is bounded on North and North-East by Gurgaon district of Haryana state and Bharatpur district, on the South-West by Jaipur district and South by Dausa district.

However, the Alwar city is located between North latitude 27030'20" and 27036'30'' and East latitude 76035' and 76040' and is covered in the survey of India G.T. Sheet no. 54A 10 5, 6. The population of Alwar city is 4, 32,952 persons.

Surface water sources have not been utilized so far for water supply. The total drinking water requirement of the city is meeting out from ground water resources i.e. tube wells and dug wells constructed in and around Alwar city.

It is one of the 33 districts of the Rajasthan state, it lies in the north-east part of the state. Alwar city was divided into four zones viz. north-east, south-east, north-west, and south-west by assuming the Hope-circus as centre point of the city during the study.

Water sampling: Potable water samples from four zones viz. north-east, south-east, north-west, and south-west were randomly and periodically collected in summer season in pre cleaned polythene bottles. Samples were taken from various sources viz. hand-pumps, tube-wells, and shallow-tube wells. Bottles closed tightly and brought to laboratory.

RESULTS AND DISCUSSION

Alwar city has been divided into four Zones (north-east, south-east, north-west, and south-west) for analyzing the fluoride content, pH and T.D.S as follows:

(i) Fluoride content, pH and T.D.S in Potable water in North-East zone: Ten water samples of different sources were collected and analyzed them as per standard procedure for Fluoride content, pH and T.D.S of potable water. Experimental results are recorded in Table-1.

1. ***pH:*** All analyzed water samples of this zone have pH within range.
2. ***Fluoride:*** In analysis of potable water sample of different sources of this zone for Fluoride content it was found that 80% water samples have less fluoride content and 20% have more fluoride content than permissible limits.
3. ***Total Dissolved Solid****:* 98% samples in this zone have more T.D.S than desirable limits.

Conclusion: 10 samples of this zone and their subsequent comparison with the water quality parameters shows that out of 10 samples, 8 samples have more T.D.S than desirable limits and can be regarded as unsuitable; 80% samples have lower value of fluoride content than permissible limit of W.H.O (1.5 ppm).

(ii) Fluoride content, pH and T.D.S in Potable water in South-East zone: Ten water samples of different sources were collected and analyzed them as per standard procedure for Fluoride content, pH and T.D.S of potable water. Experimental results are recorded in Table-2.

1. ***pH:*** All analyzed water samples of this zone have pH within range.
2. ***Fluoride:*** Analysis of potable water sample of different sources of this zone for Fluoride content has lower then permissible limits.
3. ***Total Dissolved Solid:*** 98% samples in this zone have more T.D.S than desirable limits.

Conclusion: 10 samples of this zone and there subsequent comparison with the water quality parameters that out of 10 samples, 8 samples have more T.D.S than desirable limits and can be regarded as unsuitable; All samples have lower value of fluoride content than permissible limit of W.H.O (1.5 ppm).

(iii) Fluoride content, pH and T.D.S in Potable water in North-West zone: Ten water samples of different sources were collected and analyzed them as per standard procedure for Fluoride content, pH and T.D.S of potable water. Experimental results are recorded in Table-3.

1. ***pH:*** All analyzed water samples of this zone have pH within range.
2. ***Fluoride:*** Analysis of potable water sample of different sources of this zone for Fluoride content has less value than permissible limits.
3. ***Total Dissolved Solid:*** 80% samples in this zone have more T.D.S than desirable limits.

Conclusion: 10 samples of this zone and their subsequent comparison with the water quality parameters shows that out of 10 samples, 8 samples have more T.D.S than desirable limits and can be regarded as unsuitable; All samples have lower value of fluoride content than permissible limit of W.H.O (1.5 ppm).

(iv) Fluoride content, pH and T.D.S in Potable water in South-West zone: Ten water samples of different sources were collected and analyzed them as per standard procedure for Fluoride content, pH and T.D.S of potable water. Experimental results are recorded in Table-4.

1. ***pH:*** All analyzed water samples of this zone have pH within range.
2. ***Fluoride:*** Analysis of potable water sample of different sources of this zone for Fluoride content have less value then permissible limits.
3. ***Total Dissolved Solid:*** 80% samples in this zone have more T.D.S than desirable limits.

Conclusion: 10 samples of this zone and their subsequent comparison with the water quality parameters shows that out of 10 samples, 8 samples have more T.D.S than desirable limits and can be regarded as unsuitable; All samples have lower value of fluoride content than permissible limit of W.H.O (1.5 ppm).

CONCLUSION

Fluoride at lower concentration (0.6-1.5ppm) according to WHO and Bureau of Indian Standard (10500-1991) is essential element for the development of teeth and bones and in growth, fertility, prevention of anemia in pregnancy and infancy (rodents).It has been found that the temperate areas where the natural fluoride level is low, the fluoridation of drinking water to 1ppm reduces the incidence of dental caries in the children by 40-60%. The present study shows (Tables and Charts) that approximately 95% of the potable water samples in Alwar city have lower value of fluoride content than permissible limit of WHO and about 80% samples have more T.D.S than the desirable limits. Thus, this study reveals that potable water of the most of sources, which are used for drinking & household purpose in Alwar city is not potable with respect to fluoride content and T.D.S.

Therefore on basis of the study of potable water in Alwar city, following recommendations are carried out-

1. Community Water fluoridation is safe and cost-effective and should be introduced and maintained whenever it is socially acceptable and feasible. The optimum water fluoride concentration will normally be within the range 0.5-1.5 ppm.
2. Fluoride tablets and drops have limited application as a public health measure.

3. In Low-fluoride communities school based fluoride rising programmers are recommended, but their adoption should be based on the cost of implementation and the caries status of the community.
4. Everyone should be encouraged to brush daily with fluoride toothpaste.
5. Salt fluoridation should be considered where water fluoridation is not feasible for technical, financial or socio-cultural reasons.
6. Surveys of dental caries should be conducted periodically.

It is concludes that 95 % water samples of all zones of Alwar city have lower value of fluoride content than permissible limit of WHO and about 80% samples have more TDS than the desirable limits. Thus, this study reveals that potable water of the most of sources, which are used for drinking & household purpose in Alwar city, is not potable with respect to TDS.

Table-1: Fluoride Content , pH and TDS in Potable water in North-East Zone of Alwar City

S. No.	Location	Source of Water sample	Fluoride (mg/l)	PH	TDS (mg/l)
1	Scheme-4	TW	0.2	6.31	2240
2	Scheme-1	TW	0.19	6.68	2240
3	Scheme-2	HP	0.5	6.54	2450
4	Scheme-3	HP	0.3	6.88	1470
5	Scheme-10	STW	2.25	7.45	469
6	Scheme-10	TW	0.7	6.44	1610
7	Sahabjoda	HP	0.7	6.69	910
8	Shivaji Park	HP	1.45	7.29	1400
9	Shivaji Park	STW	1.48	6.93	840
10	Shivaji Park	TW	2.35	7.26	420

Table-2: Fluoride Content , pH and TDS in Potable water in South-East Zone of Alwar City

S. No.	Location	Source of Water sample	Fluoride (mg/l)	PH	TDS (mg/l)
1	General Hospital	TW	0.2	6.45	2450
2	Indra Colony	HP	0.3	6.52	1190
3	Old Station Road	TW	0.6	6.61	2240
4	Kesav Nagar	STW	0.2	6.48	2240
5	Subhash Nagar	HP	0.02	6.78	1190
6	Mungaska	HP	1.0	7.06	1330
7	Polytechnical College	STW	0.4	7.28	700
8	Company Garden	TW	0.02	6.35	1820
9	R.R.College	TW	0.808	6.5	861
10	State Warehouse	TW	0.02	6.56	2240

Table-3: Fluoride Content , pH and TDS in Potable water in North-West Zone of Alwar City

S. No.	Location	Source of Water sample	Fluoride (mg/l)	PH	TDS (mg/l)
1	Bapu Bazar	STW	0.4	6.24	770
2	Jaggannath Temple	HP	0.2	6.84	1190
3	Mansa Devi Temple Road	HP	0.4	6.94	455
4	Hazuri Gate	STW	0.2	7.2	686
5	Pahad Gunj	HP	0.398	6.51	770
6	Deewan Ji Ka Bagh	HP	0.781	6.75	840
7	Meena Pahdi	STW	0.181	7.21	665
8	Samshan Ghat	TW	0.4	7.33	329
9	Behru Ka Chabutara	STW	0.5	6.5	546
10	Beerbal Mohalla	STW	0.4	6.55	770

Table-4: Fluoride Content , pH and TDS in Potable water in South-West Zone of Alwar City

S. No.	Location	Source of Water sample	Fluoride (mg/l)	PH	TDS (mg/l)
1	Scheme-8	HP	0.3	6.72	1120
2	Jagannath Mandir (Jaipur Road)	TW	0.537	6.77	371
3	Malviya Nagar	STW	0.3	7.22	714
4	Naya Bas	HP	0.25	6.58	1610
5	Bus Stand	STW	0.25	6.77	1050
6	Scheme-5	TW	0.6	6.5	1190
7	Lal Diggi	STW	0.4	6.55	602
8	Stadium	TW	0.45	7.09	980
9	Sonava	STW	0.4	7.33	616
10	Police Line	TW	0.45	6.85	490

Chart 1 :- Average Fluoride Content In Potable Water of different zones in alwar city.

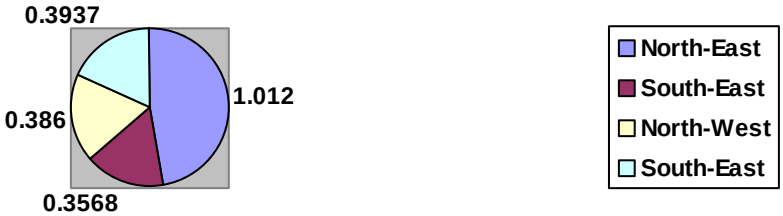

Chart 2 :- AverageFluoride Content In Potable Water of different zones in alwar city.

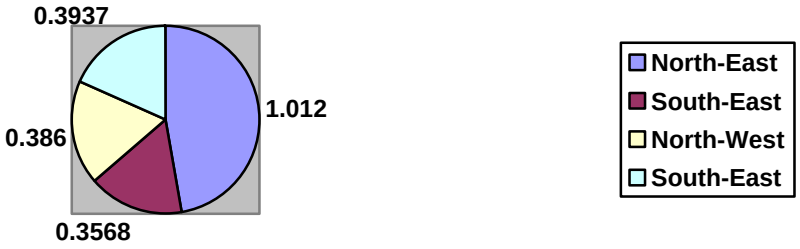

Chart 3. :- Average T.D.S In Potable Water of different zones in alwar city.

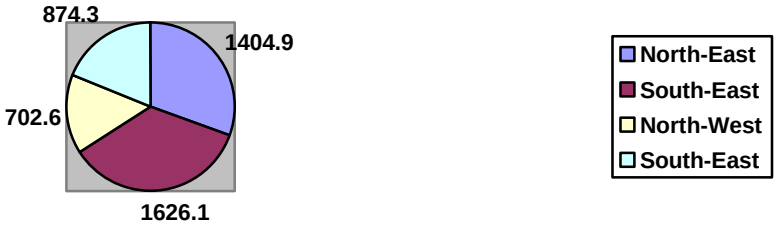

Table-5: Average Fluoride content, pH and T.D.S. Ions in potable water of different zones of Alwar city

Zones	North-East	South-East	North-West	South-West
Fluoride content (mg/l)	1.012	0.3568	0.386	0.3937
PH	6.84	6.65	6.80	6.87
T.D.S. (mg/l)	1404.9	1626.1	702.6	874.3

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