ANALYSIS OF FLUORIDE CONCENTRATION IN GROUND WATER IN KALIGIRI MANDAL, SPSR NELLORE DISTRICT

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Abstract

The survey was conducted in Kaligiri mandal, Nellore district are highlighted in Fluoride contamination. The Groundwater is the primary source of drinking water in this area and very few people are fed with water supply scheme. They have fluoride bearing minerals which are leached out to the groundwater and contribute high fluoride concentration in the groundwater. Total fifteen water samples are collected from different locations. This study used in SPADNS method. Fluoride levels in 93% of samples exceed the maximum permissible limits (1.5 mg/L). The observed Fluoride levels in this area range from 1.84–3.1 mg/L with an average of 2.2 mg/L. The high fluoride levels may lead to morbidity of dental fluorosis .It is finally concluded that the Kaligiri mandal need a sound Fluoride management plan and the removal of fluoride from drinking water is advisable.

Keywords: Contamination; Fluoride; Groundwater; SPADNS method.

Introduction:

Fluorine, one of the most reactive, light, and electronegative elements of the periodic table, is ranked 13th in terms of abundance on planet earth**.[1]** Fluorine does not, therefore, usually occur in elemental form in the environment but rather can form a variety of complexes and exists as the fluoride ion (F) in groundwater.[**2-4**] In nature, F exists in the form of different mineral complexes including calcium fluoride [CaF2], sellaite [MgF2], fluorapatite [Ca5(PO4)3F], cryolite [Na3AlF6], villiaumite [NaF)] topaz [Al2(SiO4)F2], tourmaline, muscovite, biotite, hornblende, and villianmite.1,3 Other minerals which contain F include mica and amphibole, where a hydroxyl ion (OH–) is replaced in the structural formula.[**5,6].** F is one of the most significant groundwater contaminants.[**7]** Globally, more than 50% of the population uses groundwater for drinking purposes[**.8]** Therefore, groundwater F pollution is a widespread and serious concern in both developed and developing countries. Elevated F concentrations in drinking water of >1.5 mg/L are frequently reported in many parts of the world. When ingested in small quantities (<0.5 mg/L or 0.7 ppm) fluoride is beneficial for teeth by reducing dental caries, whereas ingestion of higher concentrations (>1.5 mg/L) may cause fluorosis. Dental fluorosis manifests as opaque white spots or lines, and in severe cases, enamel becomes discolored and brittle, leading to chipping**.[9,10].** The high level of fluoride in drinking water beyond the permissible limit[2] has toxic effects, while its optimum level shows beneficial effects in reducing dental carries. The severity depends upon the amount ingested and the duration of intake**.** Fluoride contamination of groundwater is a growing problem in many parts of the world. High concentration of fluoride is reported both from hard rock (granites & gneisses) as well as alluvial aquifers**[11].**In India more than 66million people are at risk of developing fluorosis and high fluoride concentration in groundwater (greater than 1 mg/l) is widespread in the arid to semi-arid western states of Rajasthan and Gujarat and in the southern states of Andhra Pradesh, Karnataka and Tamil Nadu**[12,13,14,15].** People living in such areas were drinking high fluoride water without realizing its presence, which caused various bone diseases. The cause of high fluoride in ground water is geogenic being a result of the dissolution of fluoride bearing minerals. Fluoride in ground water is mainly influenced by the local and regional geological setting and hydro geological condition. However, soil consisting of clay minerals**[16,17],** theinfluence of local lithology, aided by other factors like semi-arid climate of the region

may be responsible for higher concentration of fluoride in the groundwater of the region. In sea area, fluoride containing chemical components of Ca, Mg, Na, Cl, SO4, bicarbonate, Bromide, Phosphate, Iron, Aluminium etc., Locally used agricultural pesticides and anthropogenic contamination of surface water due to many rivers carry on particulate matter on rainy seasons. Fluoride problems are wide spread in nine states of India covering almost the entire country. Nearly 66million of people face the risk of which an estimated 6million are childrenThe main source of fluoride in groundwater is rich in fluoride. Most of the people affected by high fluoride concentration in groundwater live in the tropical countries where the per capita consumption of water is more because of the prevailing climate**[18]**. Some Villages are heavily affected with fluorosis **[19,20].**Similarly, the Kondapuram mandal is rich with fluoride which forms the major reason for fluoride contamination in groundwater **[21]**, and the fluoride in the district of Nellore, Andhra Pradesh contain much higher fluoride than the world average fluoride concentration of 810 mg/kg **[22**]. It is well documented that fluoride can have both beneficial and detrimental effects on the dentition ever since Mc Kay and G.V. Black in 1916 published the effect of fluoride on dentition. **[23**] .The beneficial effects of fluoride on dental caries are due primarily to the topical effect of fluoride after the teeth have erupted in the oral cavity. In contrast, detrimental effects are due to systemic absorption during tooth development resulting in dental fluorosis..**[24]** developed a classification for fluorosis, which is still widely used, based on his interpretation of clinical appearance. **[25**]. Dean and Mckay suggested that optimum level of water fluoride should be below 0.9 - 1.0 PPM.**[26]** .The severity of dental fluorosis depends on the amount of fluoride exposure, the age of the child, individual response, as well as other factors including nutrition **[27**]

Methodology:

Study area;

The Kaligiri mandal of Nellore District of Andhra Pradesh, India. occupies an area of 397sq km and has a population of 40,589 are rural. It is the largest in area among the agriculture of Nellore district.The coordinates of the Kaligiri 14.8333°N 79.7000°E.It is in the 22M elevation(altitude)Kaligiri Mandal is bounded by by Anumasamudrampeta Mandal towards South , Jaladanki Mandal towards East , Kondapuram Mandal towards North , Vinjamur Mandal towards west.Kavali City, Kandukur City, Nellore , Gudur are the nearby Cities to Kaligiri.groundwater contamination in the study areas. covering entire Kaligiri during the year of 2018-19.

A total 25 ground water samples were collected from bore wells and open wells used for drinking water. The samples are collected simple random sampling in Kaligiri mandal total 25 samples were selected(Jirravaripalem,Kondareddypalem,Nadimimadigapalem,Thimmareddypalem,Kavalimustapuram) samples were collected in precleaned polyethylene bottle of 1 liter

The water samples are analyzed by SPANDS method . it involves the reaction of fluoride with a red zirconium dye solution .in the acidic medium zirconium reacts with alizarin Red-S to form violet complex, which is bleached on the addition of fluoride ion and colour changes from red violet to yellow green . 100 ml of filtered samples, then 5 ml of zirconyl acide solution was added to it for the removel of SO4 interference, followed by the addition of Alizarin Red –S now, wait for at least one hour .Measure the intensity of light at 570 nm and calculate the concentration with the help of standard curve . The above mentioned analytical procedure is followed as prescribed by APHA

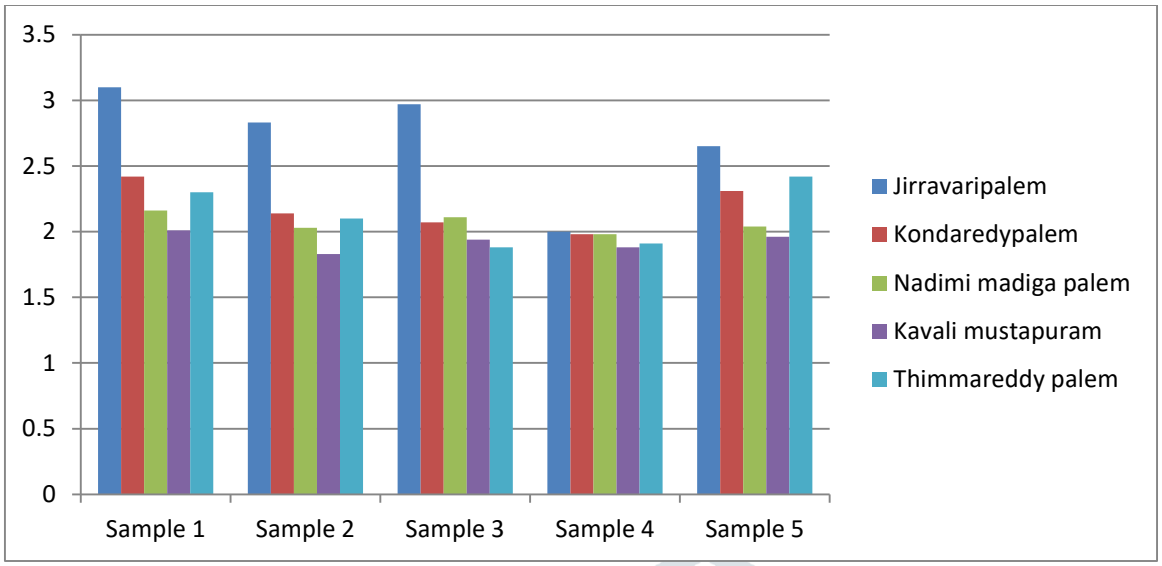
Result;A total 25 samples of the fluoride concentration were analyzed and summarized in Table 1. The fluoride concentration ranged from 0.8 to 1.0 mg/l. out of the 25 samples 25 samples are the above the permissible limit. The highest fluoride levels 3.1 observed at Jirravaripalem and lowest at kavalimustapuram. The mean values of kaligiri mandal are 2.18

In the study 25 samples out of 25 samples are above than the permissible limit. Especially in Kaligiri mandal jirravaripalem and Kondareddypalem villages is compeletely above than the permissible limit(2.23 and 3.1ppm).

Kaligiri mandal

Name of the Village and sources	Fluoride Concentration(mg/l)	Fluoride Standard level
Jirravaripalem(Borewell)	**3.1**	**0.8-1.0 mg/l**
Sri Colony, Borewell	**2.83**	**0.8-1.0 mg/l**
S.C Colony Handpump	**2.97**	**0.8-1.0 mg/l**
S.T colony, Handpump	**2.0**	**0.8-1.0 mg/l**
Hanuman nagar, Borewell	**2.65**	**0.8-1.0 mg/l**
Kondareddypalem (Borewell)	**2.42**	**0.8-1.0 mg/l**
Z.P.H.S Handpump	**2.14**	**0.8-1.0 mg/l**
Busstop (Borewell)	**2.07**	**0.8-1.0 mg/l**
M.P.P School,Borewell	**1.99**	**0.8-1.0 mg/l**
SC colony Borewell	**2.31**	**0.8-1.0 mg/l**
Nadimimadiga palem (Borewell)	**2.16**	**0.8-1.0 mg/l**
Busstop, Handpump	**2.03**	**0.8-1.0 mg/l**
S.T Cly, Handpump	**2.11**	**0.8-1.0 mg/l**
O.C Colony, Handpump	**1.98**	**0.8-1.0 mg/l**
B.C Cly, Borewell	**2.04**	**0.8-1.0 mg/l**
Kavalimustapuram (Borewell)	**2.01**	**0.8-1.0 mg/l**
Busstop(Borewell)	**1.83**	**0.8-1.0 mg/l**
M.P.U.P school(b.w)	**1.94**	**0.8-1.0 mg/l**
Temple, Handpump	**1.88**	**0.8-1.0 mg/l**
High School, Handpump	**1.96**	**0.8-1.0 mg/l**
Thimmareddypalem (handpump)	**2.3**	**0.8-1.0 mg/l**
Temple, Borewell	**2.1**	**0.8-1.0 mg/l**
MPES, Borewell	**1.88**	**0.8-1.0 mg/l**
Bus stop, Handpump	**1.91**	**0.8-1.0 mg/l**
ELE School Handpump	**1.97**	**0.8-1.0 mg/l**

Table:1 Fluoride Concentration of Kaligiri mandal in ppm



Graphical representation of fluoride concentration Kaligiri mandal.

Conclusion:

The fluoride content is beyond the limit prescribed by standards. Since drinking water is a basic need, the people should consume protected water containing fluoride within the prescribed limits. Hence the future generations in these areas have to take necessary steps to protect themselves from attacking dental and skeletal flurosis.

Refernces:

1 Singh CK, Rina K, Singh RP, Shashtri S, Kamal V, Mukherjee S. Geochemical modeling of high fluoride concentration in groundwater of Pokhran area of Rajasthan, India. B Environ Contam Tox 2011; 86(2):152-8.

2 Frencken JE, editor. Endemic fluorosis in developing countries: causes, effects and possible solutions [report of a symposium held in Delft, The Netherlands; 1990 Apr 27]. Leiden, The Netherlands: TNO Institute for Preventive Health Care; 1992.

3 Fawell J, Bailey K, Chilton J, Dahi E, Fewtrell L, Magara Y. Fluoride in drinking-water. London: IWA Publishing on behalf of the World Health Organization (WHO); 2006.

.

4 Deng Y, Nordstrom DK, McCleskey RB. Fluoride geochemistry of thermal waters in Yellowstone National Park: I. Aqueous fluoride speciation. Geochim Cosmochim Ac 2011;75(16):4476-89.

5 Edmunds WM, Smedley PL. Fluoride in natural waters. In: Selinus O, Alloway B, Centeno JA, Finkelman RB, Fuge R, Lindh U, Smedley PL, editors. Essentials of medical geology. 2nd ed. Dordrecht, The Netherlands: Springer; 2013. pp. 311-36.

6 Westrich HR. F-OH exchange equilibria between mica-amphibole mineral pairs. Cont Mineral Petr 1982; 78(3):318-23.

7 World Health Organization. Guidelines for drinking-water quality. 3rd ed. Volume 1: recommendations. Geneva: World Health Organization (WHO); 2004.

8 Ayoob S, Gupta AK, Bhat VT. A conceptual overview on sustainable technologies for the defluoridation of drinking water. Crit Rev Env Sci Techno 2008;38(6):401-70.
9. Beltrán-Aguilar ED, Barker L, Dye BA. Prevalence and severity of dental fluorosis in the United States, 1999-2004. NCHS Data Brief 2010; 53:1-8.

10. Jha SK, Singh RK, Damodaran T, Mishra VK, Sharma DK, Rai D. Fluoride in groundwater: Toxicological exposure and remedies J Toxicol

11. V. Agrawal, A. K. Vaish and P. Vaish, Curr Sci., 1997, 73, 743–746.

12. K. Brindha, R. Rajesh, R. Murugan and L. Elango, Environ Monit Assess., 2011, 172, 481–492,

13. J. Hussain, I. Hussain and K. C. Sharma, Environ Monit Assess., 2010, 162, 1-14.

14. P. Mamatha and S. M. Rao, Environ Earth Sci., 2010, 61, 131–142.

15. A. Sethuraman, E. Imam, Tesfamichael and G. Yohannes, J. Mater. Environ. Sci, 2013, 4(4), 520-525,

16. A. N. Deshmukh, P. M. Wadaskar and D. B. Malpe, Gondwana Geol. Mag. 1995, 9, 1–20.

17. D. Muralidharan, A. P. Nair and U. Satyanarayana, Curr Sci., 2002, 83, 699–702

18. Brindha K, Elango L. Fluoride in Groundwater: Causes, Implications and Mitigation Measures. In: Monroy, S.D. (Ed.), Fluoride Properties, Applications and Environmental Management, 111-136.

19.. Prevention and control of fluorosis in India. New Delhi: Rajiv Gandhi National Drinking Water Mission; 1993. Government of India; p. 25.

20. Agarwal V, Vaish AK, Vaish P. Ground water quality: Focus on fluoride and fluorosis in Rajasthan. Current Science. 1997; 73(9): 743–746.

21. Brindha K, Elango L. Fluoride in Groundwater: Causes, Implications and Mitigation Measures. In: Monroy, S.D. (Ed.), Fluoride Properties, Applications and Environmental Management, 111-136.

22. Yadav S, Khan TI, Gupta S, Gupta AB, Yadava RN. Fluorosis in India with special reference to Rajasthan. In: Proceedings of the International Conference on Water, Environment, Ecology, Socioeconomics and Health Engineering (WEESHE), Seoul National University. 1999: p 3–10.

23. Dean HT. Classification of mottled enamel diagnosis. J Am Dent Assoc. 1934;21:1421–6.

24. Dean HT, McKay FS. Production of mottled enamel halted by a change in common water supply.Am J Public Health. 1939;29:590–6.

25. Fejerskov O, Johnson NW, Silverstone LM. The ultrastructure of fluorosed human dental enamel. Scand J Dent Res. 1974;82:357–72. [PubMed]

26. Richards A, Kragstrup J, Josephsen K, Fejerskov O. Dental fluorosis developed in post-secretory enamel. J Dent Res. 1986;65:1406–9. [PubMed]

27.Thylstrup A, Fejerskov O. Clinical appearance of dental fluorosis in permanent teeth in relation to histologic changes. Community Dent Oral Epidemiol. 1978;6:315–28. [PubMed]