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RESEARCH ARTICLE

ESTIMATION OF FLUORIDE CONTENT IN GROUND WATER OF YERRAGUNTLA MUNCIPAL TOWN OF YSR KADAPA DT., A.P, INDIA

Suresh P[1*], Baba Fakruddin K [2], Ramesh Babu A [3], Rajeswari B[4], Kiran Kumar Y[5] and Sunitha V[6]

[1,2,3,4,5]Department of Chemistry, SCNR Govt Degree College, Proddatur, YSR Kadapa dt. A.P, India
[6]Department of Geology and Geo informatics, Yogi Vemana University, Kadapa. A.P, India

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ABSTRACT

The southwestern parts of kadapa 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. Geologically the limestone is the most predominant rocks of the study area, these rocks 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 of Yerraguntla area and tested in the laboratory using Ion-Selective Electrode method. Fluoride levels in all samples exceed the maximum permissible limits of fluoride (1.5 mg/L) set by the ISO and WHO. The observed Fluoride levels in this area range from 2.65–3.80 mg/L with an average of 3.325 mg/L. The high fluoride levels may lead to morbidity of dental fluorosis. It is finally concluded that the yerraguntla area need a sound fluoride management plan and the removal of fluoride from drinking water is advisable.

INTRODUCTION

Fluorine is a fairly common element that does not occur in the elemental state in nature because of its high reactivity. This is the 13th element in order of abundance in earth's crust found as a complex fluoride (Table-1). Fluoride in minute quantity is an essential component for normal mineralization of bone, teeth and formation of dental enamel (Bell and Ludwig, 1970). Very low doses of fluoride (below 0.6 mg/L) in water promote tooth decay However, when consumed in higher doses (above 1.5 mg/L), it leads to dental fluorosis or mottled enamel and excessively high concentration (above 3.0 mg/L) of fluoride may lead to skeletal fluorosis.

In general, fluoride content in water between 1.5 and 2.0 mg/L may lead to dental mottling, which is characterized initially by opaque white patches on the teeth and in advanced stages leads to dental fluorosis (teeth display brown to black staining) followed by pitting of teeth surfaces. High manifestations of dental fluorosisare mostly found in children up to the age of 14 years, and skeletal fluorosis (Apambire *et al*, 1997) may occur when fluoride concentrations in drinking water exceed 4–8 mg/L. The high fluoride concentration manifests as an increase in bone density leading to thickness of long bones and calcification of ligaments. The symptoms include mild rheumatic/arthritic pain in the joints and muscles to severe pain in the cervical spine region along with stiffness and rigidity of the joints. The disease may be present in an individual at sub-clinical, chronic or acute levels of manifestation. Crippling skeletal fluorosis can occur when the water supply contains more than 10 mg/L of fluoride (Boyle and Chagnon 1995). The severity of fluorosis depends on the concentration of fluoride in the drinking water (Table-2). It is a worldwide problem not only India but in 20 developing countries like Argentina, U.S.A., Algeria, Libya, Turkey, Iran, China, Australia, south Africa, Kenya, Iraq, Srilanka, Canada, Thailand, New zealand, and Japan (Mameri *et al* 1998).

It is well established that India has two acute public health problem induced by utilization of groundwater as a source of drinking water having excess fluoride and arsenic though the origin of these two hazardous elements is attributed to geological reasons. In India fluoride is major inorganic pollutant which natural origin in groundwater. The health problems arising as a result of fluoride contamination are

*Corresponding author: **Suresh P**
Department of Chemistry, SCNR Govt Degree College, Proddatur, YSR Kadapa dt. A.P, India

more wide spread in India. The problem of excessive fluoride in ground water in India was first reported in 1937 in the state of Andhra Pradesh (Short, 1937). Today fluorosis is a major public health problem in most of the states in India (JAOAC, 1975). Nearly 177 districts have been confirmed as fluoride affected area. Recent studies show approximately 62 million People including 6 million children suffer from fluorosis because of consumption of water containing high concentration of fluoride (Susheela 1999). In Rajasthan the exisfifteence of fluoride was first detected from jobner near Jaipur city (Kalsiwal and Soloman 1959) later during 1964 in the villages of nagour and in 1976 high fluoride confifteent in drinking water were observed in bhilwara district and Mathur *et al* reported the prevalence of fluorosis in Ajmer district (Mathur *et al*,1976).

In Andhra Pradesh, reports states that fluoride contamination is high in some areas of Prakasham, Anantapur and Kadapa districts The Northern parts of kadapa 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. Geologically the limestone is the most predominant rocks of the study area these rocks have fluoride bearing minerals which are leached out to the groundwater and contribute high fluoride concentration in the groundwater. So it very necessary to understand the present contamination level, distribution and developing a methodology for safe drinking water source. On thorough literature survey it was observed that no reports are available on fluoride levels in groundwater in Yerraguntla area which is prompted us to take up this study.

Table 1 Minerals of fluoride

S.No	Minaral	Chemical Composition	Rocks
1	Fluorapatite	$CaF_2.3Ca_3(PO4)_2$	Pegmatite Pneumatolitic deposits
2	Fluorite	CaF_2	Pegmatite Metamorphosed limestone
3	Lepidolite	$K(Li,Al)_3(Al,Si,Rb)_4O_{10}(F,OH)_2$	Gabbros, Dolerites
4	Tremolite Actinolite	$Ca_2(MgFe^{+2})_5(Si_8O_{22})(OHF)_2$	Clay
5	Rock Phosphate	$NaCa_2(MgFe^{+2})_4(AlFe^{+3})(Si,Al)_8 O_{22}(OHF)_2$	Limestone, Fossils

Table 2 Concentration of fluoride in drinking water and its effects on human health

S.No	Fluoride concentration (mg/L)	Effect
1	Nil	Limited growth and fertility
2	Below 0.5	Dental caries
3	0.5-1.5	Promotes dental health, prevents tooth decay
4	1.5-4.0	Dental fluorosis(mottling and pitting of teeth)
5	4.0-10	Dental fluorosis and Skeletal fluorosis (pain in neck bones back)
6	Above 10.00	Crippling fluorosis

Study Area

Yerraguntla Municipal Town in YSR Kadapa district (Figure-1(b)) is located in Andhra Pradesh (Figure-1(a)). The area is located at 14.6333N and 78.5333E coordinates with an elevation of 152meters. This is dominantly an arenaceous consisting of conglomerate quartzite, Quartzite with shale formation of dolomitic lime stones. The main factors that control the quality of water are associated with lithology and soil. Water quality may vary depending upon variations in geological formations.

Table 3 Fluoride level in Yerraguntla Muncipal Town

S. No	Sample location	Fluoride level at 30^0 C in mg/L	S. No	Sample location	Fluoride level at 30^0 C in mg/L
1	Main Church	3.39	10	VNpalli Road	2.90
2	Vinayaka Nagar	3.80	11	Near Zuari factory	2.75
3	ZPHS Boys	3.76	12	Near ICL factory	3.34
4	Prakash Nagar	3.53	13	Railway station	3.12
5	Smashanam Kdp oad	3.70	14	Mpup school	3.32
6	Estate	3.69	15	Laksmi stone factory	2.88
7	MG Nagar	2.85	14	Mpup school	3.32
8	Current office	3.20	15	Laksmi stone factory	2.88
9	Saibaba Temple	2.65			

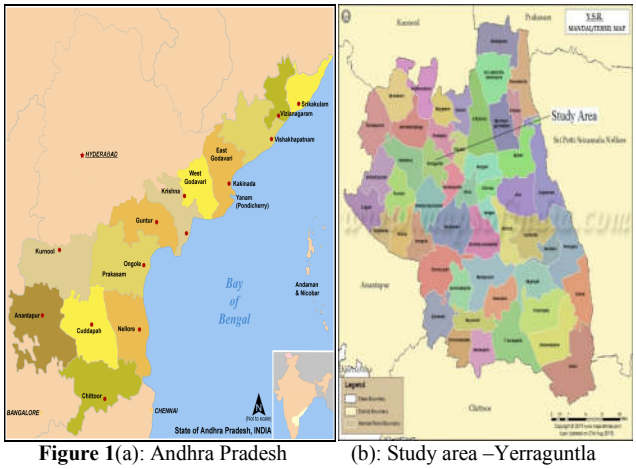

Figure 1(a): Andhra Pradesh (b): Study area –Yerraguntla

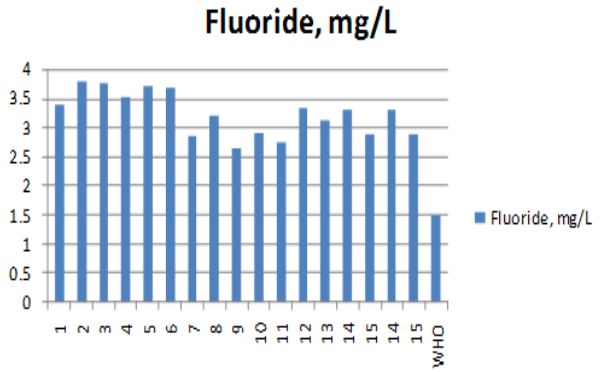

Figure 2 Fluoride levels in Yerraguntla Municipality

MATERIALS AND METHODS

Many methods have been suggested for the determination of fluoride ion in water given by official British and American compilation of Methods. The UV Visible Spectrometer & electrode method are the most satisfactory at the present time (APHA, 1981; Garcia, 1995; Erick, 2001).Ion selective electrode method very sensitive and accurate for fluoride determination (Amra and Amra,2011; Sunitha *et al*, 2012; Sunitha and Brahmanandaressy, 2014). A Total of Fifteen Samples are collected in good quality polythene bottles of one liter capacity. Sampling has been carried out

without adding any preservative in rinsed bottles directly for avoiding any contamination and brought to the laboratory. Fluoride concentration of sample was determined by ion Selective electrode method.

Fluoride Ion-Selective Electrode Method

Apparatus

Ion-Selective Meter (Thermo Scientific), Fluoride Electrode, Magnetic Stirrer

Reagent

Fluoride Standards of various ranges (0.2-20ppm) Fluoride Buffer (TISAB-Total ionic strength adjustment buffer)

Procedure

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

RESULTS AND DISCUSSION

It is well established that India has two acute public health problem induced by utilization of groundwater as a source of drinking water having excess fluoride and arsenic though the origin of these two hazardous elements is attributed to geological reasons. In India fluoride is major inorganic pollutant which natural origin in groundwater. The health problems arising as a result of fluoride contamination are more wide spread in India. Due to So proper deflourination techniques should be followed and fluoride free drinking water is supplied for healthy world.

In this study fifteen sample are selected for fluoride analysis of the groundwater and analyzed in thelaboratory by ion selective method. The result of the samples analyzed in the study area exceeds the maximum permissible limits of fluoride (1.5 mg/L) set by the ISI (1983) and WHO (1970). Average high fluoride (above 1.5 mg/L) distribution was found in all samples (Table 3). The lowest fluoride concentration (2.65mg/L) in the study area is observed in sample number 9. The highest fluoride concentration (3.80mg/L) was recorded from sample no. 2(Figure-2). In the Yerraguntla area fluoride contamination is mainly a natural process, i.e. leaching of fluorine-bearing minerals, since no man-made pollution has been noticed. Since fluorite, apatite, mica and various other minerals take part during rock–water interaction and liberate fluoride into the groundwater.

CONCLUSION

For the determination of fluoride concentration in the Yerraguntla area fifteen samples are collected from different location s and analyzed by ion selective meter. From the data it was observed that in all samples fluoride concentration was above WHO permissible limits. The highest and lowest fluoride concentration in the study area is 3.80mg/L and 2.65mg/L respectively. The lowest observed concentration which exceeds the maximum permissible limit shows the severity of the problem. In the fluoride-affected areas, both children and adults suffer from health disorders like mottling of teeth, deformation ligaments, bending of spinal column and ageing problem. It is finally concluded that the yerraguntla area need a sound Fluoride management plan and the removal of fluoride from drinking water is advisable.

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