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# DETERMINATION OF FLUORIDE CONCENTRATION IN GROUND WATER OF MUDDANUR AREA OF YSR KADAPA DISTRICT (AP) 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 Muddanur area and tested in the laboratory using Ion-Selective Electrode method. Fluoride levels in 93% of samples exceed the maximum permissible limits (1.5 mg/L) set by the ISO and WHO. The observed Fluoride levels in this area range from 1.43–2.54 mg/L with an average of 2.07 mg/L. The high fluoride levels may lead to morbidity of dental fluorosis .It is finally concluded that the Muddanur need a sound Fluoride management plan and the removal of fluoride from drinking water is advisable.
**Keywords:** Contamination; Dental fluorosis; Fluoride; Groundwater; Ion-Selective Electrode.
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## 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 of element 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.

**Table 1: Minerals of fluoride**

| # | Mineral | Chemical Composition | Rocks |
|---|---|---|---|
| 1. | Fluorapatite | $CaF_2.3Ca_3(PO4)_2$ | Pegmatite Pneumatolitic deposits |
| 2. | Fluorite | CaF2 | Pegmatite Metamorphosed limestone |
| 3. | Lepidolite | $K(Li, Al)_3(Al, Si, Rb)_4O_{10}(F,OH)_2$ | Gabbros, Dolerites |
| 4. | Tremolite Actinolite | $Ca_2(MgFe^{+2})_5(Si_8O_{22})(F,OH)_2$ | Clay |
| 5. | Rock Phosphate | $NaCa_2(MgFe^{+2})_4(AlF^{+3})(Si, Al)_8O_{22}(OHF)_2$ | Limestone, Fossils |

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 fluorosis are 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), daily intake, continuity and duration of exposure, and climatic conditions. So it very necessary to understand the present contamination level, distribution and developing a methodology for safe drinking water source. Water is an essential natural resource for sustaining life and environment that we have always thought to be available in abundance and free gift of nature. However, chemical composition of surface or subsurface water is one of the prime factors on which the suitability of water for domestic, industrial and agriculture purpose depends. Fresh water occurs as surface water and ground water in this groundwater contributes only 0.6% of the total water resources on earth. It is major and preferred source of drinking water in rural and urban areas particularly in India. 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, Newzealand, and Japan (Mameri *et al.*,1998).

**Table 2: Concentration of Fluoride in Drinking water and its Effects on Human Health (mg/L)**

| # | Fluoride concentration | 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 |

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. The problem of excessive fluoride in ground water in India was first reported in 1937 in the state of Andhra Pradesh (Short and Mcrobert, 1937). Today fluorosis is a major public health problem in most of the states in India. 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 existence 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 content in drinking water were observed in Bhilwara district and Mathur *et al* 1976, reported the prevalence of fluorosis in Ajmer district (Mathur and Tamboli, 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. On thorough literature survey it was observed that no reports are available on fluoride levels in groundwater in muddanur area which is prompted us to take up this study. Total fifteen ground water samples are collected from different locations of muddanur area and tested in the laboratory.

**Study Area:** Muddanur Town in YSR Kadapa district (Figure-1(b)) is located in Andhra Pradesh (Figure-1(a))**.** The area is located at latitude of 14.6872 and an altitude of 78.3931 coordinates with an elevation of 187meters. 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.


**Figure 1(a): Andhra Pradesh**


**Figure 1(b): Study Area–Muddanur**

## EXPERIMENTAL

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 and electrode method are the most satisfactory at the present time (APHA, 1981; Garacia, 1995). Ion selective electrode method very sensitive and accurate for fluoride determination (Amra and Amra, 2011; Sunitha *et al.*, 2012; Sunitha and Brahmanandareddy, 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 (0.2-20 ppm) Fluoride Buffer (TISAB-Total ionic strength adjustment buffer).
- **Procedure**: The Ion Selective meter is calibrated before the determination of

fluoride in the ground water samples. Calibration solutions were prepared from standard fluoride solutions by serial dilution. For each experiment the electrode is withdrawn from the test solution and washed 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.

**Table 3: Fluoride level in Muddanur Town**

| # | Sample location | Fluoride level at $30^0$ C in mg/L | # | Sample location | Fluoride level at $30^0$ C in mg/L |
|---|---|---|---|---|---|
| **1** | Main Church | 1.84 | **9** | Saibaba Temple | 1.43 |
| **2** | V. Nagar | 2.30 | **10** | Tadipatri Road | 1.76 |
| **3** | ZPHS School | 1.74 | **11** | Railway Station Road | 2.36 |
| **4** | KothaKottala | 2.20 | **12** | PLVD Road | 1.85 |
| **5** | KDP Road | 2.45 | **13** | BalaNagireddy Hospital | 2.54 |
| **6** | JMd Road | 1.94 | **14** | Mpup school | 1.78 |
| **7** | MG Nagar | 2.32 | **15** | Cinema Hall Road | 2.38 |
| **8** | Current office | 2.24 | - | | |

In this study fifteen sample are selected for fluoride analysis of the groundwater and analyzed in the laboratory by ion selective method. The result of the samples analyzed in the study area exceeds (Figure 2) the maximum permissible limits of fluoride (1.5 mg/L) set by the ISI (ISI, 1983) and WHO (WHO, 1970). Average high fluoride (above 1.5 mg/L) distribution was found in 93% of samples (Table 3). The lowest fluoride concentration (1.43 mg/L) in the study area is observed in sample number 9. The highest fluoride concentration (2.54 mg/L) was recorded from sample no. 13.

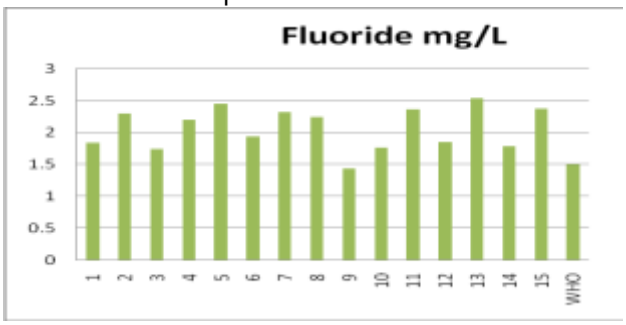


**Figure 2. Comparison of Fluoride levels in Muddanur with WHO Permissible limit**

In the Muddanur 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 Muddanur area fifteen samples are collected from different locations and analyzed by ion selective meter. From the data it was observed that in fourteen samples fluoride concentration was above WHO permissible limits. The highest and lowest fluoride concentration in the study area is 2.54 mg/L and 1.43mg/L respectively. It was observed that 93% of samples exceed the maximum permissible limit which 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 Muddanur area need a sound

Fluoride management plan and the removal of fluoride from drinking water is advisable.

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