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Determination of Fluoride Content in Drinking Water in Vicinity Areas of Shirpur Taluka

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Abstract: Fluoride is present in all waters and it is necessary for human health but high intake of it cannot be useful. The aim of this study is determination of fluoride content in water in vicinity areas of Shirpur taluka. 21 water samples collected from different villages in Shirpur taluka. Determination of fluoride concentration was done by using potentiometer. The concentration was given in mg/L and was compared with that of the specified limits. Results were indicated that in some samples fluoride concentration was exceeding the permissible limit and in some samples concentration was lower than permissible limit.

Key words: Fluoride · Potentiometer · TISAB · Water safety · Standards

INTRODUCTION

The major source of water for Shirpur taluka is the Tapi River and the ground water. Tapi River covers the most area for irrigation and for drinking. In the Shirpur Municipal Corporation the water is filtered and then sent for drinking but in the villages near by Shirpur the same filtered water is not available so the ground water is the major source for drinking as well as for irrigation.

Fluorine, the 13th most abundant element of the earth's crust, represents about 0.3g / kg of earth's crust. It occurs mainly in the form of chemical compounds such as sodium fluoride or hydrogen fluoride, which are present in minerals fluorospar, fluorapatite, topaz and cryolite. Fluorine is an important element for human beings, as it helps in growth and prevents the enamel of the teeth from dissolving under acidic conditions. Fluoride is frequently encountered in minerals and in geochemical deposits and is generally released into subsoil water sources by slow natural degradation of fluorine contained in rocks [1]. Various dietary components influence the absorption of fluorides from gastrointestinal tract and the absorbed fluorides are distributed throughout the body. Drinking water and sea food are good sources of fluoride. A higher concentration causes serious health hazards. The disease caused manifests itself in three forms, namely, dental, skeletal and non-skeletal fluorosis. Dental fluorosis produces widespread brown stains on teeth and may cause pitting. Skeletal fluorosis causes crippling and severe pain and stiffness of the backbone and joints. Even though extensive studies have been conducted, there seems to be no effective cure for these diseases. Therefore, it is desirable to drink water having a fluoride concentration less than certain value [2]. In India, the states of Andhra Pradesh, Bihar, Chattisgarh, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal are affected by fluoride contamination in water. This involves about 9000 Villages affecting 30 million people [3]. It must be noted that the problem of excess fluoride in drinking water is of recent origin in most parts. Digging up of borewell for irrigation has resulted in declining levels of ground water. As a result, deeper aquifers are used and the water in these aquifers contains a higher level of fluoride. The optimum concentration of fluoride depends on climate conditions and water consumption. The WHO guideline for fluoride is 1.5 mg/L [4], which is the same as EEC guideline [5], U.S. EPA, also it had determined maximum concentration 4 mg/L to prevent bone fluorosis [6]. The aim of this study is to determine the concentration of fluoride in the vicinity areas of Shirpur and compare it with the permissible limit.

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MATERIALS AND METHODS

Twenty one water samples were collected from the vicinity areas of Shirpur taluka like villages, college, hostel randomly and Bislery water was also taken. Collected samples were stored in a dark place in room temperature in plastic containers until the fluoride analysis was done. For determination the potentiometric method was used. Fluoride in drinking water can be easily estimated by direct potentiometric analysis using fluoride ion selective electrodes [1]. The electrode does not respond to bound or complexed fluoride. To overcome this, a buffer solution of high ionic strength must be added to it, so that the fluoride ions bound to complex molecules are liberated. When the concentration of fluoride present in the solution is low (less than 15 mg/L), direct potentiometric methods can be used. Potentiometer was used for taking potential of water samples. Make was of LABINDIA and model TITRA. The electrode was combination electrode.

Preparation of Solutions

Total Ionic Strength Adjustment Buffer (TISAB): 57 mL of glacial acetic acid, 58 g of NaCl, 4 g of cyclohexylaminedinitrilotetraacetic acid and 500 mL of distilled water were taken in a 1-L beaker. It was cooled in a water or ice bath and pH was adjusted to 5.0 to 5.5 by adding 6 M NaOH. Then Diluted to 1 L with water and stored in a plastic bottle.

Standard Fluoride Solution, 100 ppm: NaF was dried at 110°C for 2 hr. Cooled in a desiccator, 0.22 g was accurately weighed into a 1-L volumetric flask. (Caution! NaF is highly toxic. Immediately wash any skin touched by this compound with copious quantities of water.). Dissolved and diluted to the mark with water and stored in a plastic bottle.

Procedure: 50.00-mL portions of the water were transferred to 100-mL volumetric flasks and diluted to the mark with TISAB solution. A 5-ppm Fluoride solution was prepared by diluting 25.0 mL of the 100-ppm standard to 500 mL in a volumetric flask. 5.00, 10.0, 25.0 and 50.0 mL aliquots of the 5 ppm solution were transferred to 100 mL volumetric flasks, 50 mL of TISAB solution was added and diluted to the mark. (These solutions correspond to 0.5, 1.0, 2.5 and 5.0 ppm Fluoride, respectively, in the sample.) After thorough rinsing and drying with paper tissue, the electrode was immersed in the 0.5 ppm standard. Stirred mechanically for 3 min. then recorded the potential. The procedure was repeated for remaining standards and samples. Measured potential was plotted against the log of the concentration of the standards. This plot was used to determine the concentration in parts per million of fluoride in the Unknown [7].

RESULTS AND DISCUSSION

Twenty one water samples from different places in Shirpur were examined for fluoride content. The ion fluoride concentration in drinking water is shown in Table 1. Out of twenty one samples seven samples found fluoride content more than the permissible limit i.e. 4 mg/L. The highest concentration found was 6.35 mg/L in the water from Gidhade. The lowest level of fluoride was found in two places Dattane and Nimziri Naka it was 1.59 mg/L. remaining water samples contain ion fluoride level in between 1.59 mg/L to 4 mg/L.

One of the most important sources of water consumption in babies and children is the ground water and water from Municipal Corporation and the level of fluoride to both preventing of dental caries and fluorosis is an important factor. Lack of fluoride in children nutrition can lead to failing of healthy teeth and bones production, whereas fluorosis is an chronic disease that due to excess fluoride uptake and exhibit with mottling and yellowish or brownish teeth.

Table1: Fluoride concentration in different areas of Shirpur.

Sr. No.	Village	Potential	concentration
1	Gidhade*	73.8	6.35
2	Waghadi	75.6	3.49
3	Old Sukawad	76.1	2.70
4	Shirpur Nagar Palika	75.5	3.65
5	Aarthe*	74.2	5.71
6	Kurkhadi	75.6	3.49
7	Wadi Khurd*	74.9	4.60
8	Nimziri naka Shirpur	76.8	1.59
9	Sawalde	76.3	2.38
10	Sukawad	76.1	2.70
11	Gawhane*	73.9	6.19
12	RC Patel Gymkhana	75.4	3.81
13	Wadi Budruk	75.3	3.97
14	Upparpind*	74.5	5.24
15	Varshi*	74.8	4.76
16	Untawad*	75.2	4.13
17	Dattane	76.8	1.59
18	NMIMS Hostel	76.2	2.54
19	NMIMS College	76.1	2.70
20	Tap Water	75.5	3.65
21	Bislery Water	75.7	3.33

* The concentration of fluoride is more than limit 4 mg/L.

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