e-ISSN: 2248-9126
Vol 4| Issue 2| 2014| 133-138 Print ISSN: 2248-9118

Indian Journal of Pharmaceutical Science & Research

www.ijpsrjournal.com

INFERRING THE CHEMICAL PARAMETERS FOR THE DISSOLUTION OF FLUORIDE IN GROUNDWATER

Manish Upadhyay

Department of Chemistry, Dr. CV Raman University, Kota, Bilaspur, (C.G), India.

ABSTRACT

At the commonly recommended dosage, the only clear adverse effect is dental fluorosis, which can alter the appearance of children's teeth during tooth development; this is mostly mild and is unlikely to represent any real effect on aesthetic appearance or on public health. The critical period of exposure is between ages one and four years, with the risk ending around age eight. Fluorosis can be prevented by monitoring all sources of fluoride, with fluoridated water directly or indirectly responsible for an estimated 40% of risk and other sources, notably toothpaste, responsible for the remaining 60%. Compared to water naturally fluoridated at 0.4 mg/L, fluoridation to 1 mg/L is estimated to cause additional fluorosis in one of every 6 people (95% CI 4–21 people), and to cause additional fluorosis of aesthetic concern in one of every 22 people (95% CI 13.6–∞ people). Here, *aesthetic concern* is a term used in a standardized scale based on what adolescents would find unacceptable, as measured by a 1996 study of British 14-year-olds. In many industrialized countries the prevalence of fluorosis is increasing even in unfluoridated communities, mostly because of fluoride from swallowed toothpaste. A 2009 systematic review indicated that fluorosis is associated with consumption of infant formula or of water added to reconstitute the formula, that the evidence was distorted by publication bias, and that the evidence that the formula's fluoride caused the fluorosis was weak.. In the U.S. the decline in tooth decay was accompanied by increased fluorosis in both fluoridated and unfluoridated communities; accordingly, fluoride has been reduced in various ways worldwide in infant formulas, children's toothpaste, water, and fluoride-supplement schedules.

Keywords: Fluoridation, dosage, fluorosis, aesthetic, consumption.

INTRODUCTION

Safe drinking water is essential to humans and other life forms. Access to safe drinking water has improved over the last decades in almost every part of the world, but approximately one billion people still lack access to safe water and over 2.5 billion lack accesses to adequate sanitation. There is a clear correlation between access to safe water and GDP per capita. However, some observers have estimated that by 2025 more than half of the world population will be facing water-based vulnerability. A recent report (November 2009) suggests that by 2030, in some developing regions of the world, water demand will exceed supply by 50%.Water plays an important role in the world economy, as it functions as a solvent for a wide variety of chemical substances and facilitates industrial cooling and transportation.

Approximately 70% of the fresh water used by humans goes to agriculture .Water is thechemicalsubstance with chemical formulaH_2O: one molecule of water has two hydrogenatomscovalentlybonded to a single oxygen atom.

Water appears in nature in all three common states of matter and may take many different forms on Earth: water vapor and clouds in the sky; seawater and icebergs in the polar oceans; glaciers and rivers in the mountains; and the liquid in aquifers in the ground.At high temperatures and pressures, such as in the interior of giant planets, it is argued that water exists as ionic water in which the molecules break down into a soup of hydrogen and oxygen ions, and at even higher pressures as superionic water in which the oxygen crystallises but the

Corresponding Author:- **Manish Upadhyay** Email: Man_bsp@rediffmail.com

hydrogen ions float around freely within the oxygen lattice.Fluoride's effects depend on the total daily intake of fluoride from all sources. About 70–90% of ingested fluoride is absorbed into the blood, where it distributes throughout the body. In infants 80–90% of absorbed fluoride is retained, with the rest excreted, mostly via urine; in adults about 60% is retained. About 99% of retained fluoride is stored in bone, teeth, and other calcium-rich areas, where excess quantities can cause fluorosis. Drinking water is typically the largest source of fluoride. In many industrialized countries swallowed toothpaste is the main source of fluoride exposure in unfluoridated communities. Other sources include dental products other than toothpaste; air pollution from fluoride-containing coal or from phosphate fertilizers; trona, used to tenderize meat in Tanzania; and tea leaves, particularly the tea bricks favored in parts of China. High fluoride levels have been found in other foods, including barley, cassava, corn, rice, taro, yams, and fish protein concentrate. The U.S. Institute of Medicine has established Dietary Reference Intakes for fluoride: Adequate Intake values range from 0.01 mg/day for infants aged 6 months or less, to 4 mg/day for men aged 19 years and up; and the Tolerable Upper Intake Level is 0.10 mg/kg/day for infants and children through age 8 years, and 10 mg/day thereafter.

OBJECTIVES OF THE PRESENT WORK

The quality of water is of vital concern for mankind since it is directly linked with human welfare. It is matter of history that faecal pollution of drinking water caused water borne diseases which wiped out entire population of cities.

The aim of this study was to determine the amount of fluoride in drinking water of five villages of Ramanujnagar Block of Surajpur dist. Polluted water is the culprit in all such cases. The major sources of water pollution are domestic waste from urban and rural areas, and industrial wastes which are discharged in to natural water bodies.For this Physico-chemical analysis of drinking water samples will be taken from different five villages of block Ramanujnagar and awares to avoid all problems which come from more fluoride.

Introduction of selected area

Surajpur (newly formed dist of Sarguja division), with an area of 16034.4 Sq.kms with 54 percent of tribal population is one of the under developed districts in Chhattisgarh. About 36% of area encompasses reserved and protected forest land. Ambikapur is the district headquarters. The total population of the district is 1970661 (2001) census, out of which 93.03 % is rural population. The net irrigated area is 31968 ha. out of which 6077ha. (19 percent only) is irrigated by ground water. The district has subtropical climate characterised by hot summer and monsoon rainfall followed by dry and cold winter season. The normal rainfall of the district is 1600.9 mm. The annual temperature varies from 39.6°C to 43°C in summer and 8.6° to 23.9°8C in winter.

Ground Water Resources

Ground water resource table 1 presented below are as per the estimations carried out jointly by CGWB,Govt. of India and Ground Water Survey Circle, Govt. of Chhattisgarh. The figures pertain to the year 2004. All the blocks in the district have been categorised as safe from ground water development point of view.

MATERIAL AND METHODS

Samples were collected and analysed as per procedure laid down in the standard methods for examination of water and waste water of American public Health Association (APHA) compsite sampling method was adopted for collection of samples of water from five location of village Sample for chemical analysis were collected in polyethylene container's. Samples collected for metal contents were acitified (1.0 ml HNO_3 per liter samples).

Some of the parameter like P^H Temperature, conductivity, dissolves oxygen T.D.S. were analysed on site using portable water analysis kit. The other parameter were analysed at laboratory.

Method:SPADNS SPECTROPHOTOMETRIC

Apparatus

a. Distillation apparatus: 1L round bottom long neck, borosilicate glass boiling flask, thermometer adapter, connecting tube and an efficient condenser, with thermometer adapter and a thermometer reading up to 200oC, the apparatus is shown in the Figure.

Alternative types of distillation apparatus may be used.

b. Spectrophotometer for use at 570nm. It must provide a light path of at least 1 cm or a spectrophotometer with a greenish yellow filter (550 to 580nm).

Reagents

a. Sulphuric acid, H2SO4, conc., reagent grade

b. Silver sulphate, Ag2SO4, crystals, reagent grade

c. Stock fluoride solution. Dissolve 221.0mg anhydrous sodium fluoride, NaF, in distilled water and dilute to 1000 mL; 1 mL = 100µg Fd.

Standard fluoride solution. Dilute 100 mL stock fluoride solution to 1000 mL with distilled water; 1 mL = 10µg Fe.

SPADNS solution: Dissolve 958mg SPADNS, sodium 2 - (parasulphophenylazo)-1,8 - dihydroxy-3,6-naphthalenedisulphonate, in distilled water and dilute to 500 mL; protect from light - stable for 1 year.

f. Zirconyl-acid reagent: Dissolve 133mg zirconyl chloride octahydrate, ZrOCl2.8H2O, in about 25 mL distilled water, add 350 mL conc HCl and dilute to 500 mL.

g. Mixed acid zirconyl-SPADNS reagent: Mix equal volumes of SPADNS solution and zirconyl-acid reagent - stable for 2 years.
h. Reference solution: Add 10 mL SPADNS solution to 100 mL distilled water. Dilute 7 mL Conc HCl to 10 mL with distilled water and add to SPADNS solution - stable for 1 year. Set the instrument to zero with this solution.
i. Sodium arsenite solution: Dissolve 5g NaAsO2 and dilute to 1L with distilled water.

RESULT AND DISSCUSSION

Village I –Parsapara

A Total number of six samples were collected and tested for their fluoride concentration. Three samples represent surface water collected from Parsapara and represented as s1-sw_1, s2-sw_2,s3-sw_3 while the remaining samples were collected from under-ground water / tube wells s4-sw_4, s5-sw_5,s6-sw_6 .All the six samples were colourless, odourless, and free from solid suspension. The results of absorbance have been compiled below for these samples.

Village II - Baraul

A Total number of six samples were collected and tested for their fluoride concentration. Three samples represent surface water collected from Baraul and represented as s1-sw_1, s2-sw_2,s3-sw_3 while the remaining samples were collected from under-ground water / tube wells s4-sw_4, s5-sw_5,s6-sw_6.All the six samples were colourless, odourless, and free from solid suspension. The results of absorbance have been compiled below for these samples:-

Village III- HANUMANGARH

A Total number of six samples were collected and tested for their fluoride concentration . Three samples represent surface water collected from Hanumangarh and represented as s3-sw_1, s3-sw_2,s3-sw_3 while the remaining samples were collected from under-ground water / tube wells s3-sw_4, s3-sw_5,s3-sw_6 .All the six samples were colourless . odourless, and free from solid suspension. The result of absorbance has been compiled below for these samples:-

Village IV- BHARUAMUDA

A Total number of six samples were collected and tested for their fluoride concentration. Three samples represent surface water collected from Bharuamuda and represented as s5-sw_1, s5-sw_2,s5-sw_3 while the remaining samples were collected from under-ground water / tube wells s5-sw_4, s5-sw_5,s5-sw_6 .All the six samples were colourless, odourless, and free from solid suspension. The results of absorbance have been compiled below for these samples:-

Village V- UMESHPUR

A Total number of six samples were collected and tested for their fluoride concentration. Three samples represent surface water collected from Umeshpur and represented as s6-sw_1, s6-sw_2,s6-sw_3 while the remaining samples were collected from under-ground water / tube wells s6-sw_4, s6-sw_5,s6-sw_6 .All the six samples were colourless, odourless and free from solid suspension. The results of absorbance have been compiled below for these samples:-

Results of analyses of Water from Five villages of Surajpurdist of Ramanujnagar Block are recorded in table 1,2,3,4 and 5. In all the five villages each have six sampling station (three were collected from the surface and three samples were collected from the tube well) of village- BARAUL fluoride was recorded in the range of 2.40, 2.80, 3.50, 2.50, 3.0 and 3.0 mg/l. Maximum permissible limit for fluoride as world Health organization (WHO) is 1.5 mg/l. all six samples fluoride found excess of their permissible limit.

Water samples analyses of five villages of Surajpurdist of Ramanujnagar Block are recorded in table 1,2,3,4 and 5. In all the five villages each have six sampling station (three were collected from the surface and three samples were collected from the tube well) of village- HANUMANGARH fluoride was recorded in the range of 2.44,2.44, 3.0, 2.50, 2.50, and 2.16 mg/l. Maximum permissible limit for fluoride as Indian standard (IS) is 0.6 to 1.2 mg/l. all six samples fluoride found excess of their permissible limit .

Maximum permissible limit for fluoride as NEERI manual (1991) is 1.0 mg/l. Water from five villages of Surajpurdist of Ramanujnagar Block are recorded in table 1,2,3,4 and 5. In all the five villages each have six sampling station (three were collected from the surface and three samples were collected from the tube well) of village-Bharuamuda fluoride was recorded in the range of 2.05, 3.00, 3.10, 3.55, 3.40 and 1.90 mg/l. all six samples fluoride found excess of their permissible limit . The concentrations of fluoride from five villages are recorded in table. In all the five villages each have six sampling station (three were collected from the surface and three samples were collected from the tube well) of village-Dhodhagaon fluoride was recorded in the range of 3.16, 3.18, 2.50, 3.0, 3.50 and 3.20 mg/l. all six samples fluoride found excess of their permissible limit .Maximum permissible limit for fluoride as NEERI manual (1991) is 1.0 mg/l and maximum permissible limit for fluoride as world Health organization (WHO) is 1.5 mg/l. The concentrations of fluoride from five villages are recorded in table. three were collected from the surface and three samples were collected from the tube well of village- UMESHPUR fluoride was recorded in the range of 2.0, 3.07, 2.30, 3.0, 3.50 and 3.18 mg/l. all six samples fluoride found excess of their permissible limit .Maximum permissible limit for fluoride as NEERI manual (1991) is 1.0 mg/l and maximum permissible limit for fluoride as world Health organization (WHO) is 1.5 mg/l.

Table 1. Estimation of ground water resource

Annual Available Ground Water Resources (ha m)	**154455**
Allocation for Domestic Use in the year 2025 (ha m)	**7302**
Gross Draft for Irrigation (ha m)	**26326**
Balance Ground Water Availability for Future Irrigation (ha m)	**120827**
Stage of Ground Water Development (%)	**20.05**
Additional Area that can be Brought Under Irrigation (ha) (assuming 90% stage of development and crop water requirement of 0.7 m)	**73550 (4.3 % of the geographical area)**

Table 2. Fluoride Concentration of water samples in village Parsapara

samples	Fluoride in mg/l
s1-sw_1	2.40
s1-sw_2	2.80
s1-sw_3	3.50
s1-sw_4	2.50
s1-sw_5	3.0
s1-sw_6	3.0

Table 3. Fluoride Concentration of water samples in village Baraul

samples	Fluoride in mg/l
S2-sw_1	2.44
S2-sw_2	2.60
S2-sw_3	3.0
S2-sw_4	2.50
S2-sw_5	2.50
S2-sw_6	2.16

Table 4. Fluoride Concentration of water samples in village Hanumangarh

samples	Fluoride in mg/l
S3-sw_1	2.05
S3-sw_2	3.00
S3-sw_3	3.10
S3-sw_4	3.55
S3-sw_5	3.40
S3-sw_6	1.90

Table 5. Fluoride Concentration of water samples in village Bharuamuda

samples	Fluoride in mg/l
S5-sw_1	3.16
S5-sw_2	3.18
S5-sw_3	2.50
S5-sw_4	3.0
S5-sw_5	3.50
S5-sw_6	3.20

Table 6. Fluoride Concentration of water samples in village Umeshpur

Samples	Fluoride in mg/l
S6-sw_1	2.0
S6-sw_2	3.05
S6-sw_3	2.30
S6-sw_4	3.0
S6-sw_5	3.50
S6-sw_6	3.18

Figure 1. Fluoride Concentration of water samples in village Parsapara

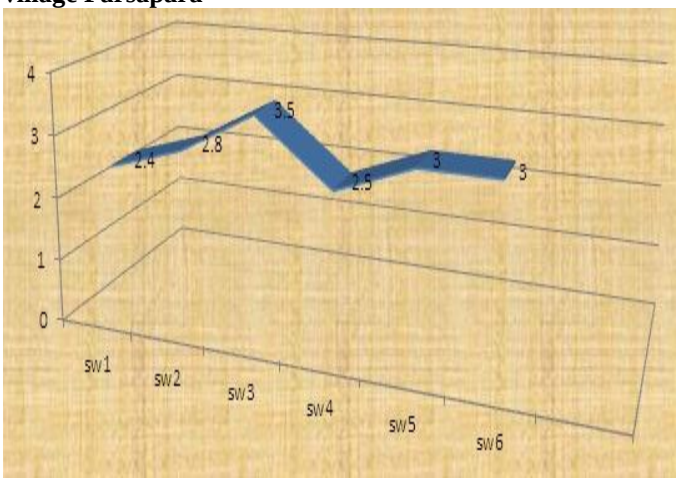


Figure 2. Fluoride Concentration of water samples in village Parsapara

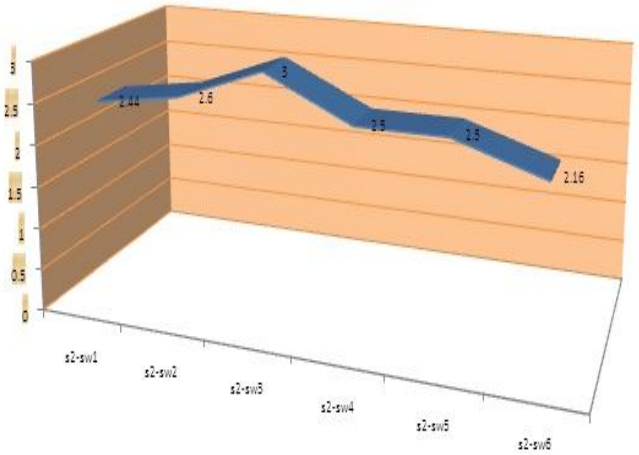


Figure 3. Fluoride Concentration of water samples in village Hanumangarh

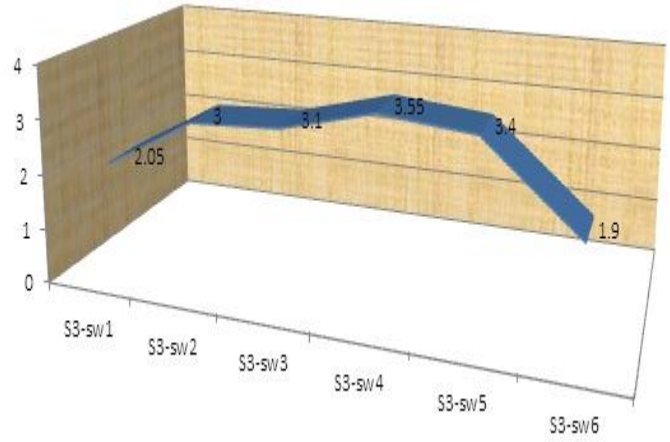


Figure 4.Fluoride Concentration of water samples in village Bharuamuda

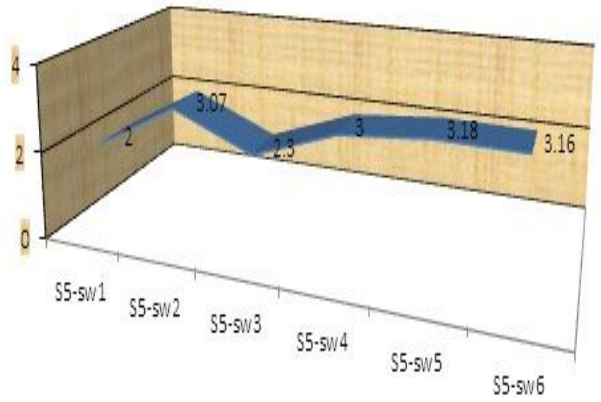
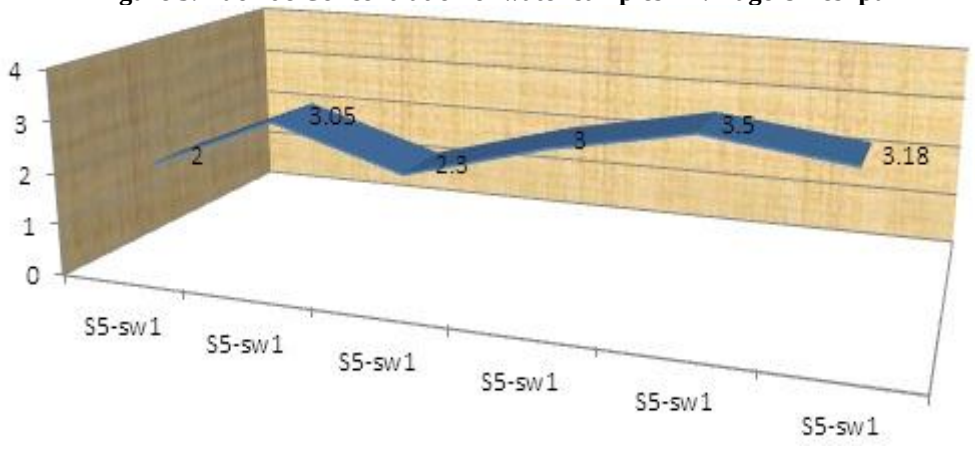


Figure 5.Fluoride Concentration of water samples in village Umeshpur



CONCLUSION

Fluoride in naturally occurring in water can be above or below from recommended levels. Both the excess and deficiency of fluoride in water produces adverse effects on the health. Maximum acceptable limit for fluoride as world Health organization (1985) is 1.5 mg/l. In present study the fluoride concentration of water samples of all five villages were found over the permissible limit. Therefore, there was harmful effect of fluoride were found in all villages.

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