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ANALYSIS AND IMPACT OF FLUORIDE AND IODIDE FROM MAJOR DRINKING WATER RESERVOIRS IN NANDED DISTRICT

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ABSTRACT

Owing to the universal presence of fluoride in earth's crust, all waters contain fluoride in varying concentrations. Fluorine is an element of high biological activity and has a tendency to accumulate in organisms, making adverse effects possible even in very low levels of exposure. Iodine is an essential element for normal growth and development in animals and man. The effects of iodine deficiency on growth and development are seen at all stages of development and particularly in the fetus, the neonate and the infant. Water quality of two major drinking water reservoirs in Nanded district has been studied with special reference to the presence of fluoride and iodide along with other chemical parameters for the year January 2004 to December 2004. Study revealed that the fluoride and iodide content in the water was lower than minimum essential limit prescribed by various health organizations. The supply of iodine from food is recommended. The values of other parameters, i.e., pH and temperature were also found within the prescribed permissible limits for drinking water.

INTRODUCTION

There is no doubt that water and sustainable development are inextricably linked. Once viewed as an infinite and bountiful resource, water, today defines human, social and economic development. Without adequate supplies and management of fresh and salt-water resources, socioeconomic development simply cannot take place. Both, nationally and internationally, a reliable and safe water supply is an essential base for development and stability. If we look at the present scenario, we are leading towards crisis. The shortage of water in the country is slowly affecting the lives of people as well as the environment around them. At the same time, not much attention is given in utilizing this important resource. As a consequence, there is deterioration in the quality of water available for human consumption.

When selecting a source of water for domestic and drinking purposes, water must be tested for fluoride and iodide. A deficiency of these compounds in drinking water is detrimental to human beings and can cause serious diseases. A human body is very sensitive to fluoride in the diet, its importance is confirmed by the presence of fluoride in bone tissues and tooth enamel. Fluoride deficiency in drinking water (if below 0.6 mg/L) causes tooth caries. At the same time, excess fluoride (over 1.0 mg/L) causes fluorosis.

Many researchers have now proved that fluorosis occurs in localities where artesian waters are used for drinking. It has been realized that the fluoride problem in most parts is of recent origin. It is essentially related to the declining of ground water (water table) levels due to overexploitation (mainly for irrigation) of deeper aquifers containing high levels of fluoride minerals (i.e., fluorite, appetite, theropatite, triplite etc.). Surface water do not directly come in contact with fluoride bearing minerals, so the level of fluoride could be much less, sometimes, even cannot enough to support or prevent dental caries. The water containing 0.6 to 1.0 mg/L of fluoride is considered healthy water. If the

surface water comes in contact of point and non-point sources of fluoride, the level may be increased.

The daily requirement of iodine is 150 µg to 200 µg/day. A recent study revealed that, the iodine deficiency is wide spread in the country. A survey shows that even a single State or Union territory was not free from the problem of iodine deficiency disorders. Iodine deficiency affects development of fetus and the growth of human beings at all ages. It results in abortion, mental retardation, squint, goitre and many other diseases.

In nature, the main sources of iodine are vegetables, fruits, cereals, fish and table salts. It occurs as iodide in natural waters. But the concentration is so low, that water is seldom considered as a source of iodine. Iodine content of water is an indicator of iodide consumption of other edible items of the region. Though water, as a source of iodine could not be ruled out, it has been observed that the level of iodide in ground water is more than the surface water. It has also been observed that several people of the cities and villages use surface waters as a source of water (level of ground water declining rapidly), which may be devoid of iodine contents.

By considering these facts and background, the preliminary study was undertaken to investigate the status of fluoride and iodide in the major drinking water reservoir (Vishnupuri Project and Manar Project), which supply water to Nanded city and nearby villages. The present paper emphasizes on the characteristics of fluoride and iodide in these two major drinking water reservoirs of Nanded district.

STUDY AREA

Nanded is the easternmost district of Marathwada region of Maharashtra State. It is bounded by latitude 18°16' and 19°55' and longitudes 76°55' and 78°20'. The soil of the district is black and fertile. The gross irrigated area is 47,455 hectare and the net irrigated area is 38,317 hectare. Out of this surface water and groundwater irrigation is 8,883 and 29,434 hectare (1994-95) respectively (Central Ground Water Board, 2002). The climate of the region is generally dry except during the southwest monsoon. The rainfall recorded for the year June 2004 to May 2005 was 1074 mm. The land region of this area comprises of a well-exposed assemblage of Deccan trap and granite intrusive formations.

There are over 66 major, minor and medium reservoirs in Nanded district, but only two of them are major reservoirs, Lower Godavari Project (Vishnupuri Dam) and Lower Manar Project (Barul Dam). All the dams are constructed for irrigation purposes but these are also major source for drinking for nearby urban and rural areas.

Vishnupuri Project was the first longest lift irrigation project in the Asian continent, having total storage capacity of water 83.55 Mm^3. The dam was constructed in the year 1985 on Godavari river. Nanded Municipal Corporation supplies water to Nanded city and newly developed region CIDCO from Vishnupuri dam only. 16 Mm^3 of water is reserved for Nanded city and CIDCO. The total population of Nanded city is approximately 4.5 lakhs. More than 60 % residents of Nanded are drinking municipal water and rest use ground water. About 1 Mm^3 of water is reserved for Maharashtra Industrial Development Corporation (MIDC) area for different industries. Whereas, 4 Mm^3 of water is reserved for nearby villages.

Barul dam was constructed in 1964 on river Manar, which is the largest water storing capacity dam in the Nanded district. 128 Mm^3 of water is the total storing water capacity. About 4 Mm^3 of

water is especially reserved for drinking purpose. Out of that 0.709 Mm^3 of water is reserved for Kandhar Town and 3.291 Mm^3 of water is reserved for Barul and nearby villages. 0.82 Mm^3 of water is also reserved for sugar factory (Kalambar Cooperative Sugar Factory).

MATERIALS AND METHODS

Collection and analysis of water samples was done fortnightly for 1 year from January 2004 to December 2004. Water samples from the sampling sites were collected and stored in plastic bottles. The bottles were thoroughly cleaned and rinsed with distilled water before collection. Standard analytical methods prescribed by APHA (1995) and Trivedy & Goel (1986) were used for the sampling and analysis.

The samples were analysed for four physico-chemical parameters. Temperature was recorded on the sampling spots using mercury thermometer. The samples were brought to the laboratory for further analysis. pH was measured by digital pH meter (Systronics make). Fluoride concentration was estimated by SPANDS spectrophotometric method. The catalytic reduction, photometric method is applicable for measurement of iodide concentration. In natural and treated waters, this method gives acceptable results.

Table 1: Physico-chemical characteristics of the two lakes for the year 2004.

Months	Parameters							
	Vishnupuri Dam				Barul Dam			
	pH	Temp. (°C)	Fluoride (mg/L)	Iodide (µg/L)	pH	Temp. (°C)	Fluoride (mg/L)	Iodide (µg/L)
January-01	7.9	19.7	0.20	4.1	7.9	20.2	0.37	5.0
January-15	8.2	19.8	0.21	4.0	7.9	20.3	0.42	4.0
February-01	8.0	23.0	0.30	3.0	8.4	22.0	0.41	3.0
February-15	7.7	24.5	0.29	2.5	8.3	23.1	0.41	3.8
March-01	7.9	26.7	0.31	2.5	8.1	25.0	0.39	2.8
March-15	7.9	26.0	0.32	2.2	8.1	28.0	0.36	2.5
April-01	7.6	29.0	0.28	2.1	8.0	32.0	0.47	2.5
April-15	7.7	32.0	0.27	2.2	7.9	32.1	0.42	2.0
May-01	7.7	34.0	0.37	2.0	7.9	32.0	0.47	2.0
May- 15	7.7	33.0	0.36	2.0	7.8	31.8	0.48	2.0
June-01	7.5	32.5	0.35	3.5	8.0	33.0	0.53	2.5
June-15	7.5	30.7	0.28	4.0	7.8	32.0	0.58	2.5
July-01	7.3	28.0	0.30	5.5	7.4	30.6	0.59	7.8
July-15	7.3	27.0	0.30	7.9	7.4	28.1	0.41	7.8
August-01	7.5	26.6	0.28	8.1	7.3	25.0	0.32	8.0
August-15	7.4	27.0	0.27	7.5	7.2	27.0	0.32	8.0
September-01	7.3	27.4	0.27	7.5	7.3	25.1	0.37	7.1
September-15	7.2	27.2	0.22	7.0	7.4	25.8	0.40	7.8
October-01	7.5	26.0	0.22	5.0	7.7	25.9	0.41	6.0
October- 15	7.6	24.0	0.22	4.0	7.6	24.5	0.37	6.6
November-01	7.9	26.0	0.21	4.0	7.9	24.0	0.36	3.5
November-15	7.9	25.0	0.22	4.1	8.0	23.0	0.37	4.9
December-01	8.4	23.0	0.21	3.5	8.0	22.0	0.32	4.0
December- 15	8.3	21.0	0.21	4.0	8.0	20.4	0.32	4.0
S. D.	-	-	0.0522	1.94	-	-	0.0935	2.13
C. V. (%)	-	-	20.07	45.64	-	-	24.60	44.65

RESULTS AND DISCUSSION

It is evident from the results that water samples have wide variations in physico-chemical characteristics during all seasons. pH is an important parameter in assessing water quality and is used for calculating carbonate, bicarbonate, carbon dioxide concentrations and stability index. It governs the solvent properties of water and determines the extent and type of physical, biological and chemical reactions. In the present study pH of the water samples was found to be within a range of 7.3 (July) to 8.4 (December) for the Vishnupuri dam water, and 7.2 (August) to 8.4 (February) for Barul dam water. The minimum pH was obtained in the monsoon season, and the maximum in winter season. According to Rang et al. (1991), in Lake Udaisagar at Udaipur, pH ranged from 7.0 to 8.6. Sakhare & Joshi (2000) reported the pH values in the Palas Nilegaon reservoir of Osmanabad district Maharashtra, in the range of 7.2 to 8.6, which is sharply similar to observed values.

Maximum temperature was recorded in summer months, and minimum in winter. There are certain environmental factors such as sunlight intensity, atmosphere temperature and wind velocity, which influence the water temperature in reservoirs. The reservoir water gains the highest temperature during May-June due to increasing insolation in summer, when the rocky substratum in the littoral zone quickly gets heated up. The maximum temperature (34.0°C) was observed in the month of May, and minimum (19.7°C) in the month of January for Vishnupuri reservoir. The Barul dam showed maximum temperature (33.0°C) in the month of June, and minimum (20.2°C) in January. Temperature is one of the most important factors in an aquatic environment. In fact, it is possible that no other single factor has so many profound influences and so many direct and indirect effects (Welch 1952). In Quarry pool from Guntur District, Andhra Pradesh the range of the temperature recorded was 23.5°C to 36°C which supports the observations of Rupvati & Radha Krishna (1983). According to Bhatnagar (1984), surface water temperature in most of the reservoirs ranged between 18°C to 32°C in Lower lake of Bhopal.

Fluoride, when consumed in inadequate quantities (less than 0.6 mg/L) causes health problems like dental caries, lack of formation of bones, specially among children. On the contrary, if fluoride is consumed or used up in excess (more than 1.0 mg/L) it can cause different kinds of health problems like skeletal fluorosis and non-skeletal manifestation, which equally affect both young and old. The mean concentration, standard deviation and coefficient of variations of selected reservoirs for the year 2004 are found similar as observed by Sreenivasa Rao et al. (2001). Vishnupuri reservoir showed the maximum fluoride concentration (0.37 mg/L) in the month of May, and minimum (0.20 mg/L) in January.

Barul dam showed the maximum fluoride concentration (0.59 mg/L) in the month of July, and minimum (0.32 mg/L) in the month of August and December. Singh (2002) reported the concentration of fluoride in surface and subsurface waters of Damodar river basin in the range of 0.1 to 0.89 mg/L. This is probably due to the absence of fluoride bearing minerals.

Iodine is relatively scarce element in the earth crust. The daily requirement of iodine in the diet is much smaller, since the body uses much of iodine over and over again. But considerably more may be needed during stress of any kind and in person residing in cold climates. However, it is very difficult to determine the exact normal limits of daily dietary intake of iodine because it varies widely throughout the world depending on the iodine content of soil and water, and upon culturally established dietary preference even in any single area (WHO 2001). Considerable variation in iodine can be expected among different individuals and in the same individuals from day to day. The results

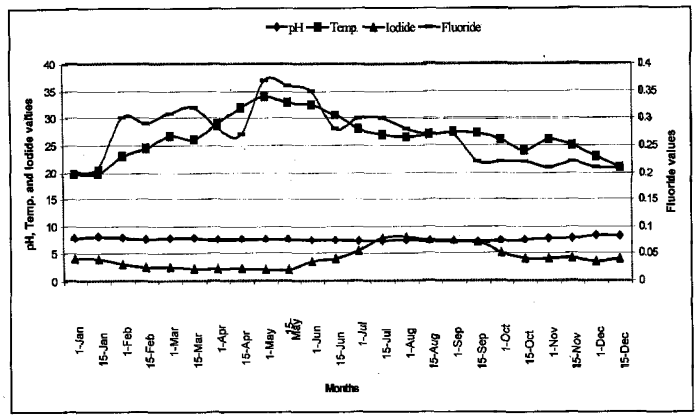

Fig. 1: Values of physico-chemical parameters in Vishnupuri dam.

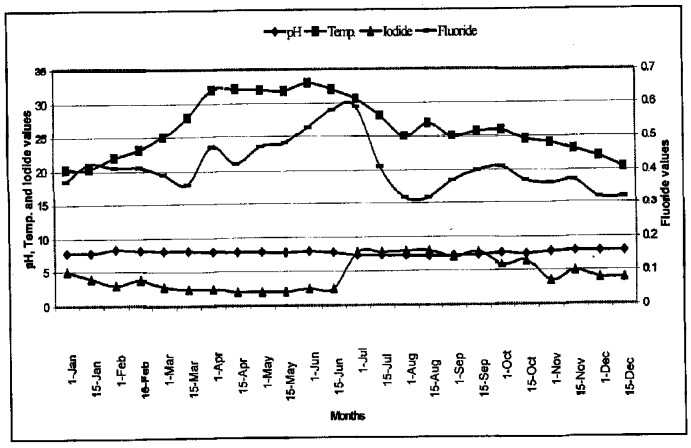

Fig. 2: Values of physico-chemical parameters in Barul dam.

obtained in the present study revealed that the iodide content of Vishnupuri reservoir was maximum (8.1 µg/L) in August, and minimum (2.2 µg/L) in May. Barul dam showed maximum iodide content (8.0 µg/L) in the month of August, and minimum (2.0 µg/L) in April and May. Shukla (1982) reported that about 90% of iodine is obtained through food and not water. Since, it enters the food through waters of the area, the water level can be taken as a good index.

Present international drinking water standard set by WHO (2004) for fluoride is 1.5 ppm. The level of fluoride in the selected reservoirs is quite low than this limit. The iodine content of the soil determines its presence in both the waters and locally grown foods. Iodide content in the selected reservoirs was not enough to support IDD but iodized salt may help to maintain required level.

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