WATER FLUORIDE IN THE MOLO DIVISION OF NAKURU DISTRICT, KENYA

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SUMMARY: Water samples were collected from 40 households in four sublocations of the Molo division of the Rift Valley in Nakuru District of Kenya. The mean fluoride concentration was 0.28 ± 0.03 ppm. Of the samples collected, 62.5% were from streams/springs, 15.0% from tap water, 10.0% from borehole water, 10.0% from dam water, and 2.5% from rain water. Turi sublocation had 75% of the total number of boreholes in this study, and had the highest mean fluoride concentration (0.44 ± 0.06 ppm), whereas Kamara had the lowest mean fluoride concentration (0.19 ± 0.08 ppm). Kerisoi and Sachagwan sublocation had mean fluoride concentrations of 0.21 ± 0.07 ppm and 0.32 ± 0.04 ppm, respectively. Borehole water had more fluoride (0.66 ppm) than any other water source, while rain water had the least amount of fluoride (0.07 ppm). The highest fluoride encountered in this study was 2.0 ppm while the lowest was 0.06 ppm.

Key words: Fluoride; Molo, Kenya; Water source.

Introduction

Kenya lies on the Eastern Coast of Africa and is bordered by the Indian Ocean and the Somali Republic on the east, by Ethiopia and Sudan on the north, by Uganda on the west, and by Tanzania on the south. Dental fluorosis has been endemic to eastern Africa and particularly in Kenya for many years,[1] and thus is an important public health problem. The sources of high fluoride are thought to be primarily from drinking water, particularly in the volcanic rock regions of the country.

Kenya has both surface and ground water sources. These sources, however, are limited in quantity and quality, and in many cases they are located far from the highly populated areas. Hence water has to be piped for long distances to the urban centres. Most of the rural population still continues to fetch water from rivers, springs, streams, and shallow wells, and to use it without any form of treatment. In most of the self-help water supply schemes, piped water is available but is untreated. All the urban centres have improved water supply systems, but in many cases they are not adequate to supply all the people. For this reason, the peripheral populations in these areas are in situations similar to those in the rural areas and have to depend on an unimproved water supply.

Materials and Methods

Molo subdivision is made up of 11 sublocations, of which four were selected using the random selection technique of Cannon and Roe.[2] The four selected sub-

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locations, namely Sachangwan, Kerisoi, Kamara, and Turi, had a total of 197 households of which 40 were selected by the same random technique. Water samples (Table 1) were obtained from the 40 households. The samples were collected in clean 500-mL polyethylene bottles, transported to the laboratory in a cool box, and then stored at -20°C while awaiting analysis, as in our earlier report on fluoride in borehole water around Nairobi.[3] Prior to analysis each solution was adjusted to the same pH (5.0 to 5.5) with TISAB III (total ionic strength buffer, Orion ® 940911).

TABLE 1. Number of samples

Sublocation	Total No	Tap	Stream	Dam	Borehole	Rain
Sachangwan	7	4	3	0	0	0
Kerisoi	13	1	8	3	1	0
Kamara	10	0	9	1	0	0
Turi	10	1	5	0	3	1
Total	40	6	25	4	4	1

The pH and F levels were determined with a digital pH meter (Orion ® 3020) and a F specific ion electrode (Orion ® 96-09). Calibration of the F electrode was repeatedly checked with appropriate standards during the measurement.

Fluoride standard solutions (0.1, 1.0 and 10.0 ppm) were prepared by diluting a 100-ppm standard solution (Orion ® 94-09-07) with deionised water.

Two parallel tubes were filled will 3.0 mL standard fluoride solution and 0.3 mL of TISAB III buffer was added to each tube before analysis.

A calibration curve was prepared from these standards.

The average relative millivolt value for each standard was plotted against the fluoride concentration on a 4-cycle semi-logarithmic paper. The difference between a ten-fold increase in fluoride concentration was between 54 and 60 relative millivolts.

Results and Discussion

Investigations of the fluoride content of African drinking waters have been reported by Ockerse from South Africa,[4,5] by Williamson,[1] by Manji and Kapila,[6] by Gitonga and Nair,[7] and by Karuiki *et al*[8] from Kenya; and by Wilson[9] from Nigeria. These studies are of special interest because they provide background information on fluoride levels in African water. Since the catchment basins in East Africa are composed primarily of basic volcanic rocks, fluoride is likely to be present in water in these areas.

TABLE 2.

Fluoride concentrations in water available for consumption in 4 sublocations in Molo

Sublocation	Samples (n)	Mean F(ppm)	SD	Mean acreage
Sachangwan	7	0.324	±0.04	17.9
Kerisoi	13	0.206	±0.08	8.18
Kamara	10	0.188	±0.08	4.5
Turi	10	0.443	±0.06	82.5

The mean fluoride concentrations from the four sublocations (Table 2) were significantly different ($P<0.05$) after statistical analysis by the Statview program. It is interesting that the mean acreage varies proportionally with the mean fluoride concentration for each sublocation. A regression test revealed that acreage and fluoride are highly related ($p=0.0552$). This observation may be due to difference in soil type or climatic variation. Kerisoi and Kamara sublocations are fairly wet as compared to Turi and Sachagwan. However, the relationship between acreage and fluoride cannot be explained entirely in this way. Turi sublocation has higher mean fluoride than other sublocations probably because it also contains three of the four borehole samples.

TABLE 3.

Mean fluoride concentrations for the various sources of water in Molo

Water source	no of samples (%)	mean F(ppm)	S D
Tap	6 (15)	0.327	±0.151
Stream	25 (62.5)	0.232	±0.101
Dam	4 (10)	0.199	±0.092
Borehole	4 (10)	0.657	±0.0901
Rain	1 (2.5)	0.07	-

Borehole water contains higher fluoride concentration than other sources of water (Table 3). After analysis of 1286 samples, Gitonga and Nair[7] found that 61% of the samples had fluoride concentration above 1 ppm, while Gikunju *et al*[3] reported 80% of their samples had more than 1 ppm fluoride. These studies involved borehole samples only. In the present study all sources of water were considered, and only 10% were borehole water and only 2.5% contained fluoride above 1 ppm.

Borehole water in this study contains more fluoride (0.66 ppm) than any other water source. However, only 10% of the households are exposed to the borehole water. Most households consume water from streams and springs. Apparently rain water also contains low amounts of fluoride, but only 2.5% of households depend on rain water.

Other households also use rain water but to a lesser degree. Perhaps some people are shy to indicate that they use rain water for domestic consumption, yet rain water is relatively safe according to our study.

Most of the households in Molo (62.5%) use streams or springs as their source of water, mainly because rural water development projects have not been initiated, possibly because the majority of the people settled in Molo fairly recently.

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