Survey of drinking water flouride concentration with Constanta county localities

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Summary

Drinking water is still the main fluoride source needed by the human body for cariopreventive mineralization of dental enamel. Our survey has inspected 375 samples of drinking water in 200 localities of the Constanta county, Romania. With 4 of the 81 localities provided with water supply network, fluoride concentration surpasses 1 ppm, while in 21 localities, there are fountains the water of which likewise surpasses the same concentration. Thus, the county map of fluoride is made evident, which constitutes the starting point for devising prevention programs through fluoridation. Measurements were carried out by two methods: titrimetric or with fluoride-selective electrode.

Key words: fluoride, drinking water, fluorosis, orodental prevention.

Introduction

Current trends in dental caries prophylaxis rely on fluoride concentration in foodstuffs, drinking water and even the air. Fluoride beneficent effect in terms of dental caries prophylaxis and its use in dentistry are well established, due to lowering the demineralizing effect of acids, synthesized by cariogenic bacteria and to quickening remineralization in consequence of acid attacks [1]. The use of fluoride products must not exceed the cariopreventive dose. Therefore, these are to be correlated with iron intake from various external sources [2].

Concentration must be determined in the community water supply network as well as in wells, since drinking water is the major provider. Our survey was laid out prior to devising the Constanta county program for dental caries prevention, financed by the Ministry of Health and applied to the 20,000 children of 6-12 years old.

AIMS

The survey sought to analyze fluoride concentration in various water sources of the 200 Constanta county localities with a view to drawing up the most detailed possible concentrations map. Identification of fluoride concentrations was in view in locations likely exposed to fluorosis (where further fluoride intake is inadvisable), along with low concentration places, where therapeutic methods of fluoridation are to be enforced. It is likewise highly significant that now only dental surgeons and pediatricians be cognizant of fluoride concentration in their area drinking water but also the children's parents who, through cooperation with physicians can contribute themselves to ensuring optimal cario-prophylaxis.

Materials and method

The 375 water samples, originating with 81 water supply networks and 294 individual wells, were collected in single-use plastic cans from 13 towns and 187 rural localities.

Of the 81 places endowed with water networks, 38 are provided with wells as well, while the remaining 119 localities only possess individual sources (wells) (*Figure 1*).

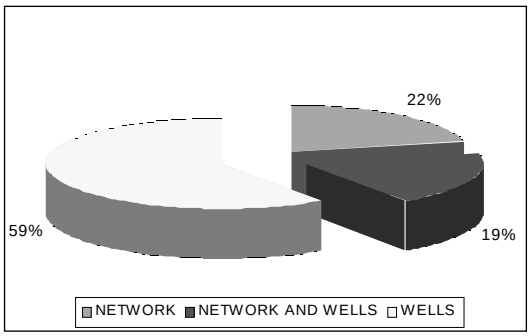

Figure 1. Drinking water sources by locality

Two methods were made use of, in order to assess fluoride concentrations:

- Titrimetric;
- dosing through fluoride-selective electrode.

The titrimetric method

Fluoride anions react with thorium nitrate to form a stable non-ionizable compound. When all fluoride anions have been submitted to complexing thorium, the nitrate reacts with sodium alizarine sulphonate to form a rosy hued lac, which signals the ending of fluoride-thorium nitrate reaction.

Method accuracy is up to 0.1 mg F/l. The chemical reaction is:

$$(NO_3)_4\,Th + 6NaF \rightarrow (ThF_6)Na_2 + 4NaNO_3$$

Dosing through ***fluoride-selective electrode*** is a ISO method currently used world wide. It is applied to fluoride concentrations of up to 0.1-10 ppm. When fluoride ions concentration in the solution under investigation is higher than that in the electrode, ions translate toward the latter thus developing a voltaic potential proportionate to the difference between fluoride concentrations.

A cyber scan pH 2500 set was used allowing simultaneous measuring of several parameters needed in laboratory and chemical tests of high accuracy.

Results

Our survey of fluoride concentration in drinking water highlights values of oaver 1 ppm in network water with 4 rural locations (e.g. 5%) as shown in *Table 1.*

Table 1. Localities provided with supply networks where fluoride concentration is over 1ppm

No.	Locality	Fluoride concentration (ppm)
1	Amzacea	2.75
2	Mihail Kogalniceanu	1.32
3	Dulcesti	1
4	Topraisar	1

The above measurements are acknowledged by the presence of dental fluorosis of various degrees in all children born at Amzacea where F concentration is 2.75 ppm [3, 4] *(Figure 2)*

Figure 2. Dental fluorosis at Amzacea

A total of 23 (28%) of the other localities endowed with water supply networks record values of F concentration ranging from 0.5 to 1 ppm. The remaining 54 localities (67%) record concentration values under 0.5 ppm *(Figure 3).*

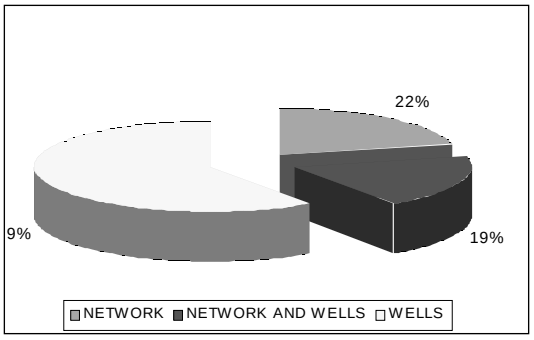

Figure 3. Fluoride concentration in water supply network of localities of Constanta county

The F concentration in the city of Constanta drinking water supply network is 0.37 ppm. There are 5 localities in the networks of which F

concentrations near 1 ppm F (over 0.8, even 0.98 ppm F).

Measurements made in the wells water of the 187 rural localities revealed values of over 1 ppm with a number of 21 locations (11%, *Table 2*) while other 42 (22%) displayed concentrations between 0.5 and 1 ppm; the remaining 124 (67%) measuring concentrations under 0.5 ppm *(Figure 4).*

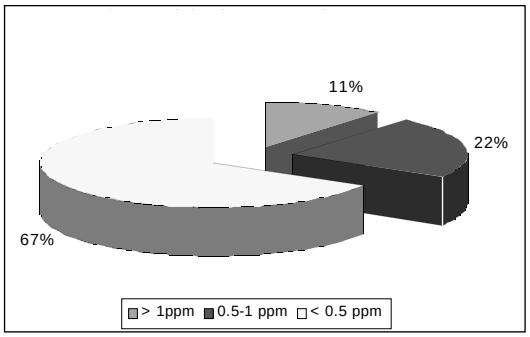

Figure 4. Fluoride concentration in rural localities wells

Table 2. Localities of which wells water concentration exceeds 1 ppm

No.	Locality	Fluoride concentration (ppm)
1.	Calugareni	1.08
2.	Nistoresti	1.05
3.	Fântânele	1.13
4.	Mireasa	1.00
5.	Sibioara	1.26
6.	Luminita	1.25
7.	Lumina	1.26
8.	Medgidia	1.90
9.	Valea Dacilor	1.90
10.	Ciocârlia de Sus	1.19
11.	Deleni	1.04
12.	Faurei	1.07
13.	Padureni	1.04
14.	Sipotele	1.05
15.	Petrosani	1.18
16.	Tufani	1.09
17.	Furnica	1.04
18.	General Scarisoreanu	1.1
19.	Pelinu	1.6
20.	Dulcesti	1.40
21.	Vânatori	1.64

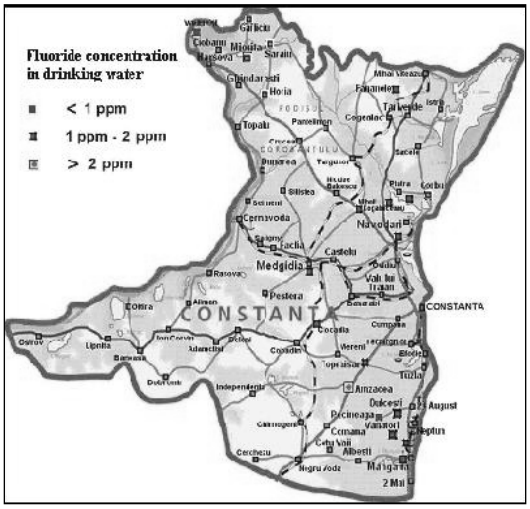

Figure 5. Fluoride map in the Constanta county

Discussion

Our research is the first determination in Romania of fluoride concentration in drinking water across a whole county. The clinic of Oral Health of the Faculty of Dental Medicine and Pharmacy of Constanta has also submitted to investigation the F concentration values in marketed mineral waters in Romania, advising that producers labeled them. It has been assessed that only one of the 19 mineral waters investigated revealed a concentration nearing 1 ppm F [5], as against certain mineral waters in Portugal, were concentration reaches 14 ppm F, in Bulgaria 5 ppm and in France 8.5 ppm [6]. A daily consumer of such waters is likely to develop fluorosis.

Areas of endemic fluorosis are met in East Africa (Ethiopia) and India [7], as well as in the Republic of Moldova, along with over 1,000 hotbeds in USA, Canada, Chile, Mexico, Australia, Sri Lanka, South Africa, Italy, Russia, Ukraine, Azerbaijan, Turkmenistan, etc [8]. Other areas of endemic fluorosis with us are in Banat, at Globul Craiovei, where F concentration in drinking water is over 1.5 ppm [6].

Specific steps must be taken in such exposed zones as fluoride intake through foodstuffs overlaps drinking water values. M. Triller et al. (1992), quoted by P. Godoroja [8], reckon that fluorosis surfaces precociously whether daily intake of assimilated F exceeds 105 mg during dental crowns mineralization length of time.

Conclusions

The subsequent points emerged in consequence of drinking water determinations operated in the county of Constanta:

1. 2/3 of urban and rural localities exhibit drinking water F concentration under 0.5 ppm;

2. Localities with F concentrations over 1 ppm are mainly grouped in the south-eastern area of the county;

3. Our determinations warrant the initiation and the carrying on of oral rinsing with fluoride solutions, which are currently in progress with 20,000 6-12 – year-old pupils;

4. At Amzacea where F concentration is 2.75 ppm, all children born in the area exhibit signs of fluorosis;

5. Families using well waters the concentration of which exceeds 1 ppm will be advised as to risks incurred through over dosage along with methods of averting damage.

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