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Distribution of Fluoride Ions in Water and the Main Food. Assessing the Risk of fluorosis in Two Communities in South-Eastern Algeria: Ouargla and El Oued

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ABSTRACT:

In the eastern part of northern Sahara, several epidemiological studies have demonstrated the existence of a problem of endemic fluorosis resulting in dental and bone deformities. The main cause of this condition is attributed to ingestion, for a relatively long time at high fluoride drinking water. In two regions; Ouargla and El-Oued, various analyzes were performed, giving an idea about the presence of fluoride in water boreholes and giving our diet. Our results also showed that these waters were characterized by significant mineralization and excessive hardness (> 112 ° F).

Introduction:

If the major elements (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Cl^{-}, SO_4^{2-} ...) are present in relatively large amounts in water and food, and their presence is necessary for human health. Trace elements, in particular fluorine is essential in small quantities. It is beneficial in small doses, essential for the growth and maintenance of bone, teeth and preventing tooth decay, it has in fact a risk of dental and skeletal.

If its content exceeds the permissible levels, it accepted standard that varies from 0.7 to 1.5 mg/l for temperatures of 12-25 ° C (Pontié and al. 1996).

Fluorosis (dental and skeletal) is the most common disease in the world; it also continues to be a public health problem in North Africa. In southern Algeria, we are witnessing a "silent" fluorosis among citizens. Groundwater and consumed food seem to be the origin of this fluorosis (Messaïtfa, 2007).

With the exception of the work of Safer (2006) and Messaïtfa (2007) have identified a partial review of the fluoride content consumed by the population of southern Algeria, no comprehensive assessment is prepared to quantify fluoride intakes in these arid regions. In addition, arid climatic conditions (>40°C in summer), indicates a strong sweating human body and therefore, it seems that the standards of potability of water vis-à-vis fluoride recommended by the WHO (1,5 mg/l) is far from being implemented in such a condition.

This study aims firstly to determine the distribution of fluoride ions in drinking water and staple consumed foods in the areas of study and secondly, to establish a balance, to estimate the level of exposure and locate areas at risk of fluorosis in two regions of South-East Algeria (Ouargla and El-Oued).

1. Method of analysis:

This study focused on the analysis of fluoride in tea, the main food consumed in the region (dates, lentils,

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carrots, pumpkin, semolina) and the drinking water of 26 wells exploiting the Intercalary Continental, more than 1200 meters deep, and ground Terminal Complex shallow (60-200 m). Two districts are selected as sensitive fluorosis sites.

The total fluoride ion in water, food and tea was determined by potentiometry (ease of use and allows direct measurement). (Greenberg et al 1992. Rodier and al, 2005), in the laboratory of development and promotion of the Saharan resources (VPRS) of the University of Kasdi Merbah Ouargla, using a specific electrode fluorine (IM/BNC/IC9243 / 05)

The samples were mixed with a total buffer ionic strength (TISAB, pH = 5 to 5.5). Interference (Mameri and al. 2001) ions (Al^{3+}, Fe^{3+}, Ca^{2+}, Si^{2+}) are prevented by adding the ion troublesome.

The direct potentiometric readings are compared with a calibration standard curve (0.1 to 10 mg / l).

In addition, other parameters are analyzed in the laboratory of the National Agency of Hydric Resources (ANRH). Calcium and magnesium were determined by the method titrimetric EDTA. Bicarbonates by the volumetric method

The chloride contents were determined by the Mohr method. The alkalinity was determined by titration with sulfuric acid (N/50). The pH and conductivity of water were respectively measured by a pH meter (Hanna 211) and a conductivity meter (WTW LF 315 Bioblock).

2. Results and discussion:

Table 1. Fluoride ion content in water of Ouargla's region

Location of Water's Wells	Cond. (mS/cm)	pH	Concentration (mg/l)							
			Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	HCO_3^-	Cl^-	SO_4^{2-}	F^-
Université	3,17	7,53	330,0	129,26	590,0	29,0	099,13	956,25	1050,0	1,16
Nakhil	2,08	7,58	226,7	120,38	310,0	16,0	102,18	525,00	1000,0	1,15
El khafdji 4	2,97	7,45	283,3	138,26	480,0	27,0	080,83	860,00	962,50	1,25
Sellice	2,42	7,42	256,7	122,94	386,3	20,0	091,50	655,00	862,50	1,20
Ifri	2,12	7,42	160,0	126,71	403,6	16,5	079,30	520,00	931,25	1,14
Mekhadma 2	3,36	7,43	345,0	161,24	680,0	31,8	134,20	1210,0	1100,0	1,15
Ain Rahma	2,81	7,51	276,7	133,15	465,0	24,0	097,60	790,00	937,50	1,20
Hassi Miloud	2,10	7,97	230,0	104,45	302,5	14,5	083,88	502,50	812,50	1,23
Ain Louiz	3,53	7,35	361,7	152,36	680,0	31,8	115,90	840,00	1781,3	1,11
Bour Elhaicha	1,97	6,78	215,0	110,05	270,0	13,5	082,35	500,00	687,50	0,73
Said Otba	2,20	7,22	224,4	97,79	//	//	558,98	313,44	800	2,51
Bamendil 1	1,85	7,13	210,0	099,83	261,3	13,0	082,35	405,00	737,50	1,12
Ain Sahra	2,44	7,35	190,0	125,00	221,0	29,0	221,00	425,00	782,00	0,64

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El-Hadjira	3,98	7,15	340,0	159,00	291,0	19,0	159,00	504,00	1127,0	0,68
Hassi B. Abdalah 1	3,38	7,03	396,8	128,81	//	//	135,07	516,24	1050	1,83
Hassi B. Abdalah 2	2,61	7,09	306,7	133,15	425,0	20,8	115,90	635,00	1112,5	1,91
Sidi Khouiled	3,08	7,11	333,3	037,00	600,0	27,5	097,60	880,00	975,00	1,61
Hassi Messaoud	5,56	7,59	210,0	270,00	770,0	28,0	149,00	1325,0	1063,0	2,58
Blidet Amor	4,63	7,43	173,0	387,00	741,0	31,0	671,00	1613,0	1330,0	0,53
N'goussa	2,52	7,03	265,0	131,81	405,0	16,5	111,33	655,00	1000,0	1,54

Table 2. Fluoride ion content in water of El-oued's region

Location of Water's Wells	Cond. (mS/cm)	pH	Concentration (mg/l)							
			Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	HCO_3^-	Cl^-	SO_4^{2-}	F^-
El-Oued centre	//	7,17	304,4	141,3	//	//	//	//	1049,6	0,46
Robah	3,18	7,20	150	180	300	21	125	700	718	1,04
Bayada	3,93	7,70	140	197	447	25	146	700	1000	1,62
Hassi a/karim	5,2	7,16	55	427	455	30	183	1050	1500	2,02
Chohada	2,74	7,05	109	182	200	35	153	450	690	0,49

2.1. *Fluoride in water consumption***:**

The obtained results are presented in tables 1 and 2 for t Ouargla and El Oued regions, these results indicate the variation of the main physico-chemical parameters (pH, conductivity and mineralization) water of exploited aquifers

The analysis results are evaluated and compared to the quality requirements set by the regulations of WHO. Fossil waters of Southern Algeria, groundwater Intercalary Continental are fair quality, highly mineralized (> 2.5 g / l), slightly alkaline (pH around 7.5) of high chloride content, free of toxic substances , unwanted and microbiological parameters are missing, hard (112°f) and warm (50-60°C).

The fluoride ions are present in all waters sampled at variable concentrations ranging from 0.5 to 2.6 mg . Boreholes supplying the city of Ouargla, have the highest concentration compared to those supplying the city of El-Oued levels, and therefore the risk of human health in the region of Ouargla.

Table 3. Results of analyzes on mineralized solutions of dates's varieties

Varieties	Content in ions fluoride (mg/kg)
Daglet nor	70,80

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Ghars	28,65
Takermoust	10,61
Tafezouine	21,90
Tamjouheret	13,91

2.2. *Fluoride in dates***:**

The fluorine content contained in the different varieties of dates (Table 3), between 11 and 71 mg/kg, natural witnesses taken from soil and water

The highest concentration is observed for the variety "Daglet Noor" (71 mg/kg), the consumption of each of these varieties increases the fluoride content in the human body.

We show that the concentration of fluoride ions in agricultural soils increases with soil depth (Table 4). It is 1.3 mg / l on the surface, of 1.6 mg / l to 50 cm and 1.8 mg / l to 1 m.

Table 4. Rinsing samples of agricultural sand gave the following results:

depth (m)	Content in ions fluoride (mg/l)	
	Irrigated soil	Non Irrigated soil
En surface	1,31	1,01
0,5	1,60	1,76
1	1,83	2,18

Table 5. Results of analyzes on mineral solutions of some foods:

Foods	Content in ions fluoride (mg/kg)
Potatoes	22,30
Carrots	25,17
Lenses	05,35
Semolina	06,63
Pumpkin	17,87

Fluoride in other foods

The other most widely consumed foods in the region, have variable levels (Table 5), ranging from 5 to 25 mg/kg. The cores have the highest concentration (> 20 mg/Kg)

Table 6. Fluoride ion concentrations in tea (mg/l)

Quality of tea	Ouargla's Tap water		
	Dose 1	Dose 2	Dose 3
chunmée 41022	2,21	1,15	0,93
Chunmée A9380	2,38	1,52	0,95
chunmée 9371	2,80	1,82	1,39

2.3. Fluoride in green tea:

For tea (Table 6), the content depends on the duration of infusion of the leaf and tea quality. It gives a total daily intake of 4, from 29 to 6.01 mg/l, depending on the model of the tea leaves.

One way clear that tea consumption has a high concentration of fluoride ions and increases the amount administered to the human body with that prepared above water faucet body

Results consumption of fluoride ion:

It is practically difficult to establish the total amount of fluoride ingested daily, because the sources are variable, fluorine is present in all foods with varying amounts. Cereals (Haikel and al. 1986), fish (Malde and al.

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1997), salt (Martinez-Mier and al., 2005), tea (Cao and al. 2006 Messaïtfa, 2007), and beverages (Jimenez and al. 2004), are the most fluorine-rich foods.

A lack of data calculating the power consumption of the fluoride ion is based on the average daily water consumption (1.9 l/day), tea (0.4 l/day), dates (0.2 kg/day), potato (2.23 mg/day), carrot (1.26 mg/day), the lens (0.08 mg/day), semolina (0.26 mg/day) and end pumpkin (0.27 mg/day) (Messaïtfa, 2007), the daily amount of fluoride ingested by an adult capita is calculated by the following equation (Heikens et al 2005.)

The total daily consumption equal to: $\sum_i C_i I_i$

Such that:

(i) Represent the source (water, tea, date, or other food), (*C*) the concentration of the source (g/d or l/day). The results show that the amount of fluoride ions administered because of the consumption of water is 2.75 mg / 1.9 liter of water consumed per day. For a man who consumes 0.4 l /day of tea, tea concentration is 2 mg/400 ml, the amount of dates consumed is 8.6 mg/200 g of date, if it is considered that the inhabitants of these regions consume the sum of other fluoride ion concentrations in other foods.

so:

$$\sum_i C_i I_i \quad \textbf{= 17, 45 mg/jour}$$

Conclusion:

In order to establish a balance sheet of awareness about the diet and its impact on fluoride intake on the one hand and the risk assessment of fluorosis in two main communities in the South-eastern Algeria (Ouargla and El-Oued) on the other hand, it is based on determining the concentration of fluoride ions in the water consumption and the main food consumed (tea, potato, cornmeal, lentils, carrot, pumpkin). The results showed that the major sources of fluoride are: water, from 0 5 to 2.6 mg/l, the tea, from 4.3 to 6 mg/l, the dates of from 10 to 71 mg/kg and the contribution of the other most consumed in the region may be more food sources.

The waters studied in both regions have high fluoride contents that exceed the standard for drinking water (> 1.5 mg/l) and consequently the risk of dental fluorosis is very probable. Fluoride content contained in the different varieties of dates varies between 11 and 71 mg/kg, natural witnesses taken from soil and water. The highest concentration is observed for the variety Daglet Noor (71 mg/kg). We show that the concentration of fluoride ions in agricultural soils increases with soil depth.

The other most consumed foods in the region have varying contents ranging from 5 to 25 mg/kg. Potato (22.3 mg/kg), carrot (25.2 mg/kg), lentils (5.4 mg/kg), semolina (6.6 mg/kg), pumpkin (17,9 mg/kg). The cores have the highest concentration (> 20 mg/Kg). For tea, the content depends on the duration of infusion of the leaf and tea quality.

The amount of fluoride actually ingested by an adult than the optimum of 0.05 to 0.07 mg/kg/day (Levy, 1994), we see clearly that the sum of the calculated balance is greater than the recommended standard (<1.5 mg/l) of fluoride administered daily by the inhabitants of South-eastern Algeria.

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