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THE OCCURANCE OF ALUMINIUM IN MUNICIPAL TREATED WATER SUPPLY OF BUSHEHR & BORAZJAN AREA OF IRAN

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Abstract

In recent years, a potential connection between human intake of aluminium and Alzheimer's disease has drawn attention to the aluminium concentration in drinking water. It is therefore of interest to investigate the aluminium concentration in drinking water, produced under different circumstances. A random selection of 152 water samples were taken by the supply source including, ground, surface and a combination of both for determination of a aluminium concentration in the type of water (raw, finished, or untreated distribution) from Bushehr and Borazjan areas in which aluminium sulphate is used as a coagulation agent. Ground, raw and finished waters samples were collected from each facility, four times throughout a year and analyzed for aluminium by Eriochrome Cyanine R Method. The results indicate that aluminium is more likely to exist in finished waters than in raw and ground water of Bushehr & Borazjan municipal water, by which aluminium sulphate is the main causative agent of increasing the aluminium

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concentration of finished water below the guideline value regarding the W.H.O standard, but 33.8 times more than U.S. limitation. Therefore, application of iron coagulent compounds should be reconsidered.

Introduction

Aluminum is the third most abundant element of the earth's crust, occurring in minerals, rocks, and clays. This wide distribution, accounts for the presence of aluminum in nearly all natural waters as s soluble salt, a colloid, or an insoluble compound. Soluble, colloid, or an insoluble aluminum also may appear in treated water or wastewater as a residual from coagulation with aluminum containing material (1).

The results of studies in which animals was exposed to aluminum under controlled conditions, have demonstrated a relationship between certain neuropathological disorders and aluminum exposure(8,9). Recently, evidence has been presented to support the speculation that there is a relationship between aluminum and both Alzheimer's disease and dialysis encephalopathy in humans(5,6). Davidson et al. found that kidney dialysis patients suffered dementia when their dialysis fluid contained an aluminum concentration of 80 ug/l (5). Removal of the aluminum from the fluid prior to dialysis decreased a patient's chance of exhibiting the symptoms of dementia. Aluminum has been detected in both senile plaques and neurofibrillary tangle bearing neurons in brains of patients with Alzheimer's disease, (4,6). Findings from reviewing the literature, suggest that human intake of aluminum may be important in causation of Alzheimer's disease and the aluminum concentration in drinking water has been intensively discussed in recent years.(2,7,11,12,13,15) Overview the clinical genetics handbooks which have been written in recent years focus on the genetic aspects of Alzheimer's disease, by which its ethiology and pathogenesis is unknown yet, and it may have several genetic ethiologies. The gene for -amyloid precursor protein and other genes for early and late-onset Alzheimer's diseases are on Chromosomes 21,14,19 respectively (3,10,14).

Materials and Methods

The city districts of Bushehr and Borazjan were undertaken in order to assess the degree of people exposure to aluminum, arising from drinking water. Samples were collected in one litre polyethlene container, stored at 4°C and analyzed by Eriochrome Cyanine R method using spectrophotometer on a wavelength of 535nm. The interference of the color and turbidity was eliminated by adding EDTA to one portion of sample to provide a blank, and for iron and manganese elimination, fulfilled by adding ascorbic acid(1).

In order to control the precision and accuracy, three standard reference solutions with different aluminum concentrations (50, 100, 200 ug/l) were analyzed with each group of duplicate samples. The standard reference solution of 50 ug/l was used according to the standard methods, by which states: rapid sand filtration plants should have aluminum concentration no greater than this figure (1) 10 sample from each one of three water resources including ground, raw surface and mixed of both well and treated water, were taken for the pretest.

The standard curve was developed by Least Square Method as shown in Figure 1.

The statistical analysis of the results from the pretest revealed concentration of aluminum in combination of both well and treated water ranging from 150 to 182 with a mean 170.2 a median of 328.5 and standard deviation of 12.8 ug/l.

It was concluded from the pretest that for 95% confidence limit , standard error of 2 and the permissible error of 2.24 ug/l, it is required to study a total of 131 samples ($N=\frac{S^2 \quad Z^2}{d^2}$). As a result the work was continued from May 1993 to February 1994 on 142 additional samples properly distributed in the regions, and to detect any seasonal differences, samples were collected in May, August, October 1993 and February 1994 (total samples 152). The result shown in Table 1.

Results and Discussion

The results of each group of ten duplicate pretest samples of Bushehr wells and Bushigan raw surface water indicate no detectable concentrations of aluminum, but the third water resource named combination of both well and treated water ranging from 150 tho 182 with a mean 170.2, a median of 328.5 and standard deviation of 12.8 ug/l.

The conclusion asserted from each 38 duplicate seasonal samples taken from combination of both well and treated potable water in May, August, October 1993 and February 1994, is that the average concentration of aluminum in May is more than 3 times higher than those of the other seasonal samples. The data show that none of paired samples of ground and suface waters had detectable amounts of aluminum, but this element is more likely to exist in all paired samples from combination waters.

In combination finished waters, aluminum concentrations were no found to be beyond the permissible level.

The concolusion obtained is that with a confidence limit of 95% , standard error of 2, and permissible error of +2.24, the average concentration of aluminum in combination finished water of Bushehr and Borazjan drinking water is within 167.2 to 168.9 ug/l.

Considering the maximum allowable concentrations of 0.05 and 0.2 PPm as recommended for aluminum in drinking water in the United States and WHO Standard of 1993 respectively as showing in Table 2 (16), the concentration of aluminum in drinking water is therfore under the safe limit regarding the WHO standard, but 33.8 times more than U.S. limitation. Therefore applicatio of iron coagulent compounds recommended.

Table 1- Statistical analyses of the residual aluminum concentration in drinking water of Bushehr & Borazjan area of Iran(ug/l)

Time	N	Mode	Mean x	Median	S.D.P. n	S.D.S. n-1	C.V.P.	C.V.S.	C.L.
May 1993	38	174	174.079	174	1.4213	1.4404	0.8165	0.8274	173.618 174.540
August 1993	38	161	160.711	161	1.5879	1.6092	0.9880	1.0013	160.195 161.226
October 1993	38	170	169.184	170	2.9545	2.9941	1.7463	1.7697	168.225 170.143
Februrary 1994	38	169	168.316	168	1.7030	1.7258	1.0118	1.0253	167.763 168.869
Total	152	168	168.072	169	5.1899	5.2071	3.0879	3.0981	167.230 168.914

Min = 157

Max = 177 Range= 157--177

S.D.P.: Standard Deviation of Population

S.D.S.: Standard Deviation of Sample

C.V.P.: Coefficient of Variation of Population

C.V.S.: Coefficient of Variation of Sample

C.L. : Confidience Limit

Table 2- National and International Water Quality Standards for Aluminium in Drinking Water.(Sollers and colleagues, 1989. Simpson. Hatton and Brockbank, 1988).

Organisation / Government	Guideline level mg Al/l	Maximum acceptable Concentration mg Al/l
W.H.O.	0.2	--
E.E.C.	0.05	0.2
Belgium	0.05	0.1
F.R.G.	0.05	0.2
Sweden	--	0.1
Switzerland	0.05	0.5
U.S.A.	0.05	--
Finland	--	0.2
Denmark	0.05	0.2
Austria	--	0.2

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