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Levels of Aluminum ions in Urine and Drinking Water Treated by residents with Aluminum Potassium Sulphate in Kosti Town, White Nile Provence Sudan

[1] **Salah E I,** [2] **Dawelbiet A.Y.,** [3] **Sabahelkhier M.K.,** [4] **Shama I. Y. Adam**

[1] Department of Biochemistry, Faculty of Education. University of Khartoum, Sudan

[2] Department of Biochemistry, University of Imam El-Mahdi., Kosti, Sudan

[3,4] Department of Biochemistry and Molecular Biology. Faculty of Science and Technology, El-Neelain University, Sudan

[1] salah111969@gmail.com

ABSTRACT

The aim of this study is to measure Aluminum ion in drinking water in Kosti city (level of Al^{3+} in drinking water) compared with standard level of aluminum ions in drinking water reported by World Health Organization (WHO). Aluminum ion which is used for purification of drinking water was measured by using Atomic Absorption Spectral Photometer. The results revealed that there was high level of Aluminum ions in water treated by Alum in houses compared with River water, in addition to that Aluminum ion used by the residents to clarify water from turbidity was reached 2.09 mg/l.

1. INTRODUCTION

Alum is one of a series of isomorphism double salts that are hydrated sulfates of univalent action such as potassium, sodium, ammonium, cesium, or thallium and trivalent action as aluminum, chromium, iron, manganese, cobalt, or titanium (Greenwood and Earnshaw, 1997). The occurrence of aluminum in treated water was considered for many years to be an undesirable aspect of treatment practice (Driscoll and Letterman, 1988; Van Benschoten and Edzwald, 1990). The treatment of surface water with aluminum sulphate has been in operation for over a hundred years all over the world. The use of alum as a coagulant for water treatment often leads to higher concentrations of aluminum in the treated water than in the raw water itself (Van Benschoten and Edzwald, 1990). The high level of Al^{3+} in drinking water which related to both level of Al^{3+} in raw water and high treated-water turbidity. The major findings of the studies were indicated that using of $Al_2 (SO4)_3$ as coagulant (0.1mg\l) lead to increase level of Al^{3+}in treated-water and Al^{3+} level in treated waters were highly variable from 0.05 to 0.25 mg/l. There was 40 - 50% chance of increase in Al^{3+} level in water over the concentrations in the raw water in plants by using Al-based coagulants (Miller *et al.,* 1984; Letterman and Driscoll, 1988). In Sudan bioavailability and chronic exposure of human to alum is not yet clearly known, in addition the rare studies have been made to estimate the levels of Al^{3+} in drinking water and the effects of alum on human health due to elevation of alum in drinking water particularly in the White Nile Provence, Kosti town. Aluminum level in the drinking water was no doubt one of the factors that may affect human health as its relation with Alzheimer's diseases or dialysis encephalopathy (Martyn *et al.,* 1989). Therefore, most people in Kosti town frequently received alum from different sources, in addition they are lacking the proper technical knowledge for treated the drinking water with Al^{3+} and also negative impacts on their health caused by using high level of Al^{3+} in drinking water.

The aim of this study is to Aluminum ion in drinking water in Kosti city (level of Al^{3+} in drinking water) compared with standard level of aluminum ions in drinking water that recommended by World Health Organization (WHO).

2. MATERIAL AND METHODS

2.1 Collection and Preservation of Sample (Water and Urine)

Drinking water samples were collected from kitchen tap, pots or barrels in houses of Kosti Town. The tap was turned on and allows water to run for 1-2 minutes. Two replicates of 6 water samples were taken from each different Blocks 29, 31, 33, 42, 46 and 47, in Kosti town. 100 ml of non acidified bottles was used for collection water sample .Then the samples were preserved by adding 0.4ml concentrated nitric acid (69 %) to make all contents of samples were soluble before being analyzed, in addition to ensure that bacterial removal from samples and to lengthen the storage time of the samples (MOH, 2004)

2.2 Methods
2.2.1 Determination of AL^{3+} in Urine and Hours as Water Sample

Determination of occurrence and level of Aluminum ion in drinking water that available in Kosti town was done by using Atomic Absorption Spectral Photometer nov AA 300 (A.AS). This instrument is a flame photometer with hydride technique as accessory, when combined with an auto sampler, it could be employed as a multi element automatic device. The nov AA 300 was fitted either with the motor driver 6-position lamp turret or with manual 2 position lamp turret. Atomic absorption measurement is the amount of light at the resonant wave length which is absorbed as the light passes through a cloud of atoms, as the number of atoms in the light path increases the amount of the high absorbed Al cathode increase in the predictable way. The analyze concentration is determined from the amount of absorption. Level Aluminum ion is usually determined

from a working curve after calibrating the instrument with standards of known level of Aluminum ion.

2.2.2 Determination of pH Houses Water Sample

PH meter was used to determine the acidity or alkalinity of houses water samples.

2.3 Statistical Analysis

Data from questionnaire, aluminum concentration in drinking water of blocks in Kosti town were analyzed using Statistical Package for Social Science (SPSS).

3. RESULTS AND DISCUSSIONS

3.1 Aluminum ion in Houses Water Sample

Figure (I) indicated that level of Aluminum ion in houses water samples that collected from blocks 29, 31, 33, 42, 46, and 47 was 3, 1.01, 2.4, 2.8, 1.01, 2.3mg/l, respectively. These results are explain that level of aluminum ion in drinking water treated by the residents ranged from 1.01 –3 mg/l which is higher than those range recommended by the WHO's standards (0.02 – 0.2 mg/L). These high values of Aluminum ions are directly come from uncontrolled use of Alum. Although, much effort has been devoted to identifying the genetic determinants of Alzheimer's disease (Corder et **al, 1993**) . Dialysis encephalopathy is one of the main observations in favor of the neurotoxicity of aluminum because it proves that aluminum is able to reach the brain and include neurofibrillary degeneration and death (Flaten, 1990). Several studies were indicated that there is association between aluminum exposure and dementia as aluminum found in water (Maclachlan *et al*, 1996). The results obtained are agreed with those findings by Driscoll and Letterman (1988).

3.2 Aluminum ion in Urine Sample

Figure (2) indicated that level of Aluminum ion in urine samples that collected from individual number 1,2,3, 4, 5, 6, 7, 8, 9, and 10 in Kosti town were 0.02, 0.04, Nil,0,02, 0.02, 0.02, Nil, 0.04, 0.02 and 0.05 mg/l, respectively. These results are filling within the range recommended by WHO.

4. CONCLUSION

It is clearly concluded that most of the residents in Kosti town are used aluminum potassium sulphate (ALKSO$_4$), mainly to clarify water turbidity but without reference to optimum level of Aluminum ion for treated the drinking water. This might be letter on caused effect of resident health particularly genetic determinants of Alzheimer's disease
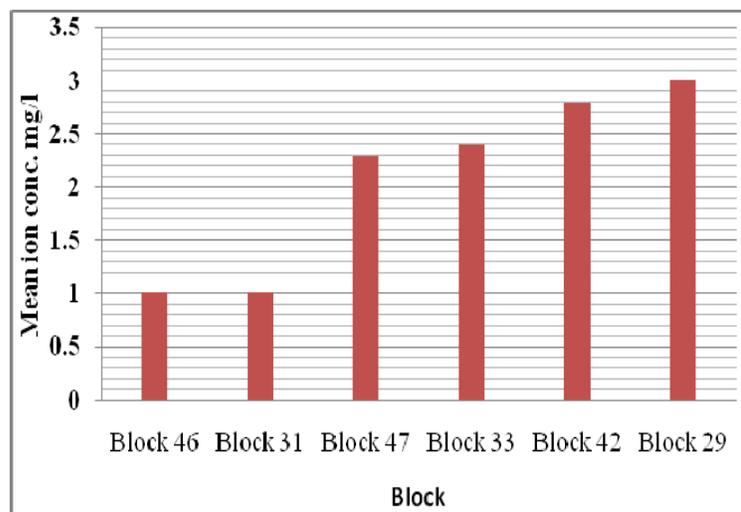

Fig 1: Level of Aluminum ions in drinking water that treated by Alum in houses in Kosti town

The German Environmental Agency is expecting to reduce urine levels to <15µg/L. The Mayo Clinic states that a daily excretion >20 µg/L indicates exposure to aluminum.
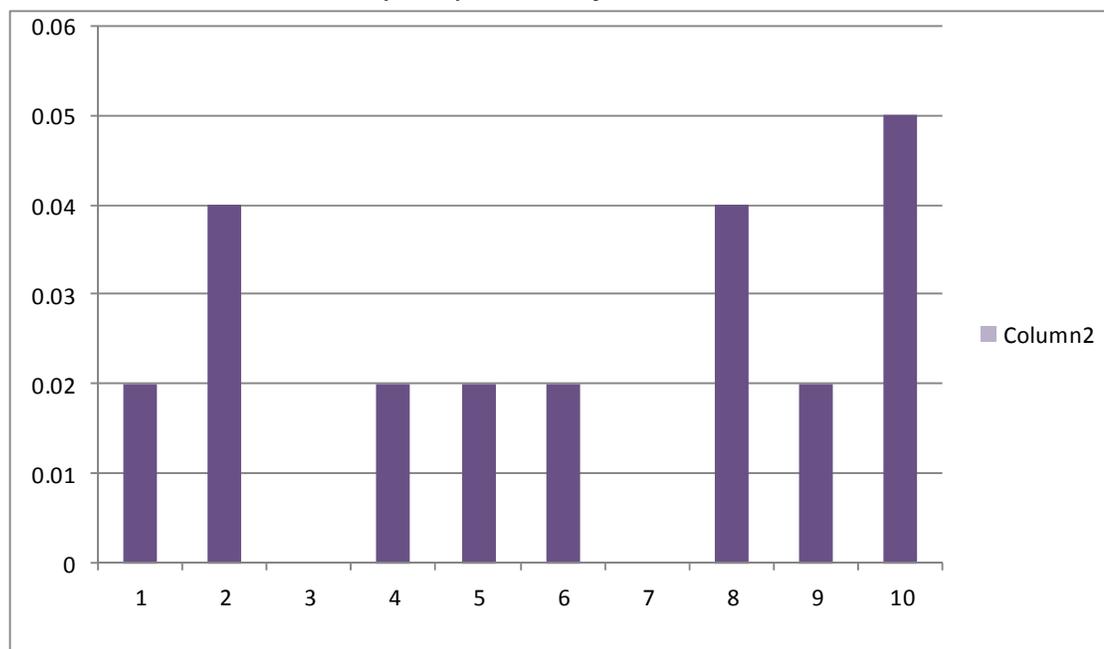
Fig 2: Level of Aluminum ions in urine that collected from resident of Kosti town

Analyte	Reported	Expected (Mass) Value Range (µg/L) (µg/L)
Aluminum (27)	35	32-44

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