RESEARCH ARTICLE

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PROTECTIVE ROLE AND AMELIORATING EFFECT OF VITAMIN E IN HEPATIC AND RENAL FUNCTIONS OF MICE TREATED WITH ALUMINUM CHLORIDE

ABSTRACT:

A total number of 250 adult male albino mice were randomly divided into 3 groups: control group and three treated groups exposed to three levels of AlCl3 (25, 50, and 100 mg/kg). Each one of the treated groups divided into three subgroups; the first subgroup treated with $AlCl_3$ only for 2, 4, and 8 weeks, the second subgroup treated with $AlCl_3$ plus vitamin. E (3 mg/kg) for the same periods of time. Biochemical findings in this study showed highly significant increase in activity of serum: aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphates (ALP), bilirubin concentration, urea and creatinine levels in $AlCl_3$ treated mice. Also was showed significant decrease in total protein and albumin concentration all over the experimental period compared to control group. While mice treated with $AlCl_3$ plus vitamin E showed significant reduction in activity of AST, ALT, ALP, bilirubin concentration, serum urea, and creatinine levels and showed significant increase in total protein and albumin concentration compared to control and mice treated with $AlCl_3$. Scanning electron microscopy and X-ray microanalysis showed that normal values of aluminum concentration in the liver tissue in the control mice were 0.6%. These values were increased to 4.0% after treatment with 100 mg/kg of $AlCl_3$ for 4 weeks, but in mice treated with $AlCl_3$ and with vitamin E together for the same period the values were decreased to 1.2%. The normal values of aluminum concentration in the kidney tissue in the control mice were found to be 0.2% in the cortex and 0.3% in the medulla. These values were increased to 2.8% in the cortex and to 3.7% in the medulla after treatment with 100 mg/kg of $AlCl_3$ for 4weeks, but in mice treated with $AlCl_3$ and vitamin E simultaneously the values were decreased to 0.7% in the cortex and to 1% in the medulla.

KEY WORDS:

Aluminum toxicity, liver function, kidney function, SEM microanalysis, vitamin E.

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INTRODUCTION:

The impacts of aluminum intoxication on human health have been increasingly alarming in recent years. Annual production of aluminum is about 22.000 metric tons worldwide (Jain *et al.*, 2009). Aluminum is widely used in environment and many kinds of products because a combination of properties gives it special advantages over other materials (Al-Kahtani, 2010). It is extensively used in daily life, building, canning, tanning, automobile, aviation, paint, paper, ceramic, glassware industries, many manufactured foods, medicines, cheese, tea, and cosmetics and is also added to drinking water during purification purpose that provides easy exposure to human beings (Kumar and Gill, 2009; Newairy *et al.*, 2009; Yousef and Salama, 2009). Due to its abundance, every organism contains small quantities of aluminum, and it can be found in practically all of tissue of mammals, including the brain, liver, kidney, heart, blood, and bones (Zandieh and Banazadeh, 2005; Kutlubay *et al.*., 2007; Al-Hashem, 2009, Tomljenovic and Shaw, 2011; Chaitanya *et al.*, 2012; Rani *et al.*, 2014). Most individuals

consume 1-10 mg aluminum per day from natural sources (Agarwal and Jain, 2011).

Until recently, aluminum was considered harmless for the human as it is readily excreted through urine (Tomljenovic and Shaw, 2011; Sivakumar *et al.*, 2012). However, studies of environmental toxicology conducted in recent years indicated that aluminum could be a cause of many diseases in humans, animals, and plants (Barabasz *et al*. 2002; Kutlubay *et al.*, 2007). Different forms of aluminum are environmental xenobiotics which accumulate in different organs and provoke free radical-mediated cardiotoxicity, hepatotoxicity, nephrotoxicity, neurotoxicity and caused alternations in antioxidant enzymes, both *in vivo and vitro* (Bihaqi *et al*., 2009; Türkez *et al*., 2010; Kan *et al*., 2010; Lemire *et al*., 2011; Belaïd-Nouira *et al.*, 2012; Shrivastava, 2013).

Because of the health problems induced by many environmental pollutants many efforts have been undertaken in evaluating the relative and naturally antioxidant potential of some agents including vitamins (Kawahara, 2005; Shcherbatykh and Carpenter, 2007). The present study tries to evaluate the efficacy of vitamin E in antagonizing the toxic effects of $AlCl_3$ on liver and kidney of mice during short and long term exposure.

MATERIAL AND METHODS:

Health adult male albino mice, approximately weighting between 22 ± 5 gm were used in this experiment. The mice were purchased from ophthalmology research center in Giza, Egypt. Animals were housed in plastic cages at an environmentally controlled room (25-27°C) and allowed free access to food and tap water. Animals were left one week before start of the experiment for acclimation.

A total number of 250 adult male albino mice were used through this study that randomly divided into 4 groups:

The first group (A): contained 25 mice and served as control group received intraperitoneal injection of distilled water.

The second group (B): contained 50 mice and received 25 mg/kg of $AlCl_3$ intraperitoneal as law dose for 2, 4 and 8weeks. This group was divided into two subgroups, each of 25 mice.

The third group(C): contained 50 mice and received 50 mg/kg of $AlCl_3$ intraperitoneal as a medium dose for 2, 4, and 8 weeks. This group was divided into two subgroups, each of 25 mice.

The fourth group (D): contained 50 mice and received 100 mg/kg of $AlCl_3$ intraperitoneal as a high dose for 2, 4, and 8 weeks. This group was divided into two subgroups, each of 25 mice.

In the three treated groups: B, C, and D the first subgroups injected with $AlCl_3$ only, the second subgroups injected with $AlCl_3$ plus vitamin E. The injections were performed for 3 times per week. Animals of each subgroup were anaesthetized with diethyl ethyl and killed by cervical dislocation after 2, 4, and 8 weeks for first and second subgroups. The dosages of $AlCl_3$ and vitamin E were based on the work of Chinoy and Memon (2001).

Biochemical analyses:

Fresh blood samples were immediately collected without anticoagulant, allowed to clot, and centrifuged at 3000 x g for 10 min to obtain serum for biochemical analysis. Kinetic determination of serum aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were performed according to the method of Reitman and Frankel (1957). Alkaline phosphatase (ALP) was determined according to the method of Principato *et al.* (1985). The methods adopted for the concentration of serum albumin was Doumas *et al*. (1971) and for the concentration serum total protein was Lowry *et al.* (1951). Serum total bilirubin concentration was measured according to the method of Malloy (1984). Creatinine concentration was determined according to the method of Bartels *et al*. (1972). Urea concentration was determined according to the method of Kaplan (1984).

Scanning Electron Microscopy and X-ray (SEM X- ray) Microanalysis:

Specimens of the organs were immediately fixed in 2.5% gluteraldehyde in 0.1 M phosphate buffer (PH 7.4). After rinsing in 0.1 M phosphate buffer samples were post fixed in phosphate buffer solution of 0.1 osmium tetraoxide at 37ºC for 1.5 hour. These samples were then rinsed in 0.1 M phosphate buffer. Samples were then dehydrated through a grade ethanol series and critical point dried with liquid CO_2 then examined by SEM and read the result by X-ray in Faculty of Science, Alex University laboratory.

Statistical analysis:

Statistical analysis of the present study was conducted, using the mean ± standard deviation and one-way Analysis of Variance (ANOVA) tests and Dunnett test according to the computer program InStat 3.

RESULTS:

Liver and kidney functions results:

The activities of ALT, AST, and ALP were significantly increased after mice injected by the different doses of $AlCl_3$ all over the experimental period compared to control group, while mice treated with $AlCl_3$ and vitamin. E simultaneously showed

significantly reduction of ALT value compared to $AlCl_3$ treated group (Table 1).

Bilirubin, urea and creatinine concentrations were significantly increased after mice injected by the different doses of $AlCl_3$ all over the experimental period compared to control group, while mice treated with $AlCl_3$ and vitamin. E simultaneously showed significantly reduction of ALT value compared to $AlCl_3$ treated group (Table 2).

The concentrations of albumin and total protein were significantly decreased after mice injected by the different doses of $AlCl_3$ all over the experimental period compared to control group, while mice treated with $AlCl_3$ and vitamin. E simultaneously showed significantly reduction of ALT value compared to $AlCl_3$ treated group (Table 3).

Table 1. Serum ALT, AST, and ALP activity of mice injected intraperitoneally with different three dose levels of Al_3 during three time intervals.

Al_3 Dose mg	Doses Duration in Weeks	Controls	$AlCl_3$	$AlCl_3$ + Vitamin E
Serum ALT activity U/L				
	2	40.3 ± 3.8	101.3 ± 11.5*a	68.0 ± 6.6*b
25	4	51.5 ± 5.4	212.5 ± 22.8*a	122.3 ± 12.1*b
	8	60.4 ± 7.3	470.7 ± 42.1*a	174.6 ± 12.5*b
	2	40.3 ± 3.8	124.3 ± 12.5*a	77.7 ± 8.6*b
50	4	51.5 ± 5.4	252.3 ± 27.7*a	166.0 ± 15.9*b
	8	60.4 ± 7.3	536.0 ± 55.3*a	378.3 ± 29.6*b
	2	40.3 ± 3.8	137.0 ± 13.6*a	104.7 ± 11.5*b
100	4	51.5 ± 5.4	380.7 ± 34.4*a	272.3 ± 28.3*b
	8	60.4 ± 7.3	618.4 ± 65.5*a	417.0 ± 38.9*b
Serum AST activity U/L				
	2	60.5 ± 8.7	281.3 ± 24.4*a	146.3 ± 16.5*b
25	4	80.4 ± 7.5	472.0 ± 37.5*a	265.6 ± 24.5*b
	8	92.7 ± 8.4	689.7 ± 63.6*a	383.3 ± 34.4*b
	2	60.3 ± 8.7	331.3 ± 34.6*a	201.0 ± 15.9*b
50	4	80.3 ± 9.5	583.4 ± 46.5*a	398.6 ± 42.5*b
	8	92.7 ± 8.4	811.7 ± 78.2*a	528.0 ± 55.7*b
	2	60.3 ± 8.7	451.3 ± 43.5*a	290.0 ± 28.7*b
100	4	80.3 ± 1.5	621.0 ± 64.8*a	421.6 ± 45.9*b
	8	92.7 ± 8.4	991.0 ± 82.5*a	687.0 ± 74.0*b
Serum ALP activity U/L				
	2	88.3 ± 1.5	126.0 ± 9.6*a	98.0 ± 5.0*b
25	4	92.6 ± 7.8	578.3 ± 58.2*a	207.0 ± 18.0*b
	8	99.6 ± 8.4	868.0 ± 70.5*a	683.3 ± 65.7*b
	2	88.5 ± 1.5	143.6 ± 16.5*a	108.0 ± 11.6*b
50	4	92.5 ± 8.8	607.7 ± 50.2*a	323.0 ± 29.8*b
	8	92.6 ± 6.4	984.6 ± 80.2*a	742.6 ± 77.2*b
	2	88.3 ± 7.3	266.0 ± 25.7*a	217.3 ± 24.4*b
100	4	92.6 ± 8.8	733.6 ± 63.7*a	402.6 ± 31.9*b
	8	109.3 ± 6.4	1128.0 ± 120*a	871.3 ± 78.2*b

Each reading represents Mean ± SD of n = 10. The data were subjected to one-way analysis of variance (ANOVA) and Dunnett test. The effect of time at all different concentrations of aluminum was significant at P ≤ 0.001. The symbol * in the same row mean that the difference is significant at P < 0.05 in comparison with controls and the same letter in the same column mean that the difference between the different three doses in each enzyme activity is significant at P < 0.05.

Table 2. Serum bilirubin, Urea and Creatinine in mice injected intraperitoneally with different three dose levels of Al3 during three time intervals

Al_3 Dose mg	Doses Duration in Weeks	Controls	$AlCl_3$	$AlCl_3$ + Vitamin E
Bilirubin (mg/dl)				
	2	0.13 ± 0.02	0.52 ± 0.05*a	0.14 ± 0.02*b
25	4	0.24 ± 0.03	0.65 ± 0.05*a	0.40 ± 0.02*b
	8	0.63 ± 0.05	1.05 ± 0.14*a	0.76 ± 0.04*b
	2	0.13 ± 0.02	0.75 ± 0.06*a	0.42 ± 0.07*b
50	4	0.24 ± 0.03	0.88 ± 0.06*a	0.66 ± 0.05*b
	8	0.63 ± 0.05	1.21 ± 0.11*a	0.93 ± 0.06*b
	2	0.13 ± 0.02	0.97 ± 0.07*a	0.83 ± 0.05*b
100	4	0.24 ± 0.03	1.13 ± 0.16*a	0.77 ± 0.06*b
	8	0.63 ± 0.05	1.36 ± 0.14*a	1.04 ± 0.12*b
Urea (mg/dl)				
	2	33.6 ± 4.4	67.7 ± 5.7*a	41.8 ± 3.7*b
25	4	37.0 ± 4.6	73.7 ± 6.2*a	56.0 ± 3.6*b
	8	41.0 ± 4.0	130.3 ± 12.5*a	97.2 ± 8.6*b
	2	33.6 ± 4.4	77.3 ± 6.5*a	54.0 ± 4.8*b
50	4	37.0 ± 4.6	90.0 ± 5.9*a	65.6 ± 5.5*b
	8	41.0 ± 4.0	167.0 ± 16.4*a	126.6 ± 11.6*b
	2	33.6 ± 4.4	108.3 ± 11.6*a	65.0 ± 4.0*b
100	4	37.0 ± 4.6	119.0 ± 10.6*a	83.6 ± 5.8*b
	8	41.0 ± 4.0	252.3 ± 24.04*a	192.7 ± 14.5b
Creatinine (mg/dl)				
	2	0.38 ± 0.04	1.23 ± 0.15*a	0.69 ± 0.05*b
25	4	0.53 ± 0.06	1.44 ± 0.15*a	0.77 ± 0.04*b
	8	0.64 ± 0.03	2.12 ± 0.17*a	1.50 ± 0.16*b
	2	0.380.03	1.54 ± 0.09*a	0.82 ± 0.03*b
50	4	0.530.06	1.83 ± 0.14*a	0.93 ± 0.05*b
	8	0.640.04	2.63 ± 0.18*a	1.83 ± 0.13*b
	2	0.38 ± 0.04	2.00 ± 0.18*a	0.87 ± 0.04*b
100	4	0.53 ± 0.06	2.23 ± 0.21*a	1.17 ± 0.15*b
	8	0.64 ± 0.03	3.00 ± 0.18*a	2.29 ± 0.21*b

Each reading represents Mean ± SD of n = 10. The data were subjected to one-way analysis of variance (ANOVA) and Dunnett test. The effect of time at all different concentrations of aluminum was significant at P ≤ 0.001. The symbol * in the same row mean that the difference is significant at P < 0.05 in comparison with controls and the same letter in the same column mean that the difference between the different three doses in each serum parameter is significant at P < 0.05.

Table 3. Serum albumin and total protein of mice injected intraperitoneally with different three dose levels of Al3 during three time intervals

Al_3 Dose mg	Doses Duration in Weeks	Controls	$AlCl_3$	$AlCl_3$ + Vitamin E
Albumin (g/dl)				
	2	3.23 ± 0.25	2.70 ± 0.20*a	3.02 ± 0.28*b
25	4	3.13 ± 0.35	2.12 ± 0.17*a	2.87 ± 0.24*b
	8	2.95 ± 0.31	1.89 ± 0.14*a	2.47 ± 0.25*b
	2	3.23 ± 0.25	2.12 ± 0.20*a	2.93 ± 0.23*b
50	4	3.13 ± 0.25	1.90 ± 0.16*a	2.50 ± 0.20*b
	8	2.95 ± 0.31	1.76 ± 0.14*a	2.02 ± 0.18*b
	2	3.23 ± 0.35	2.01 ± .23*a	2.62 ± 0.21*b
100	4	3.13 ± 0.25	1.59 ± 0.14*a	2.18 ± 0.23*b
	8	2.95 ± 0.35	1.02 ± 0.09*a	1.64 ± 0.12*b
Total protein (g/dl)				
	2	8.7 ± 0.8	5.51 ± 0.3*a	8.23 ± 0.7*b
25	4	8.3 ± 0.5	4.87 ± 0.5*a	6.70 ± 0.6*b
	8	7.7 ± 0.8	4.17 ± 0.4*a	5.67 ± 0.4*b
	2	8.7 ± 0.6	5.07 ± 0.3*a	7.73 ± 0.6*b
50	4	8.3 ± 0.7	4.63 ± 0.3*a	6.40 ± 0.4*b
	8	7.7 ± 0.8	3.78 ± 0.4*a	4.98 ± 0.5*b
	2	8.3 ± 0.7	4.40 ± 0.4*a	7.23 ± 0.8*b
100	4	8.2 ± 0.5	3.84 ± 0.3*a	5.58 ± 0.4*b
	8	7.5 ± 0.6	3.14 ± 0.3*a	4.52 ± 0.3*b

Each reading represents Mean ± SD of n = 10. The data were subjected to one-way analysis of variance (ANOVA) and Dunnett test. The effect of time at all different concentrations of aluminum was significant at $P \leq 0.001$. The symbol * in the same row mean that the difference is significant at $P < 0.05$ in comparison with controls and the same letter in the same column mean that the difference between the different three doses in each parameter is significant at $P < 0.05$.

SEM X-ray microanalysis results:

The liver tissue:

The normal values of aluminum concentration in the liver tissue in the control mice were found to be 0.6% (Fig. 1). These values were increased to 4.0% (Fig. 2) after treatment with 100 mg/kg of $AlCl_3$ for 4 weeks, but in mice treated with $AlCl_3$ and with vitamin E together for the same period the values were decreased to 1.2% (Fig. 3).

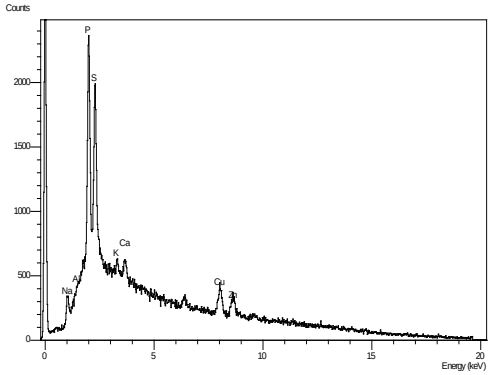

Fig. 1. The level of aluminum in the liver of control mice.

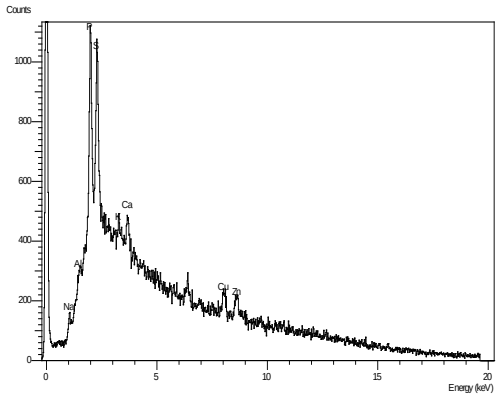

Fig. 2. The level of aluminum in the liver of mice treated with aluminum chloride.

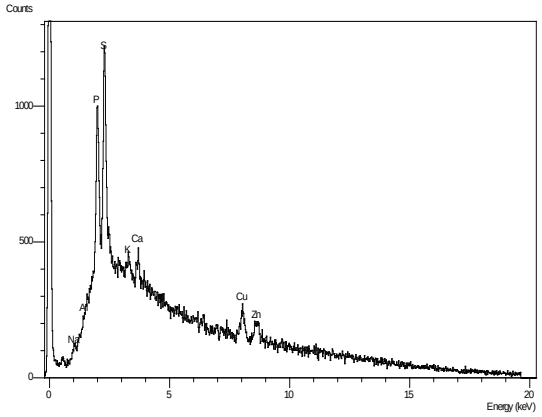

Fig. 3. The level of aluminum in the liver of mice treated with aluminum chloride and vitamin E simultaneously.

The kidney tissue:

The normal values of aluminum concentration in the kidney tissue in the control mice were found to be 0.2% in the cortex (Fig. 4a) and 0.3% in the medulla (Fig. 4b). These values were increased to 2.8% in the cortex (Fig. 5a) and to 3.7% in the medulla (Fig. 5b) after treatment with 100 mg/kg of $AlCl_3$ for 4 weeks, but in mice treated with $AlCl_3$ and vitamin E simultaneously the values were decreased to 0.7% in the cortex (Fig. 6a) and to 1% in the medulla (Fig. 6b).

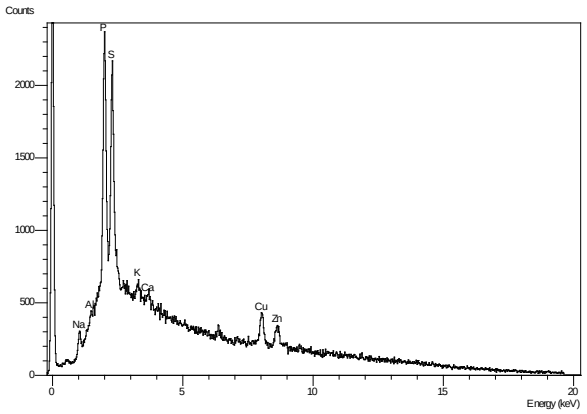

Fig. 4a. the level of aluminum in the kidney cortex of control mice.

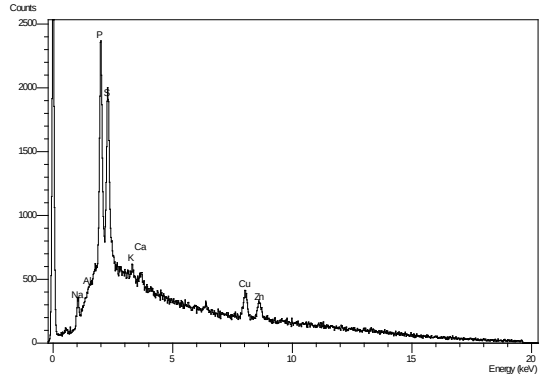

Fig. 4b. the level of aluminum in the kidney medulla of control mice.

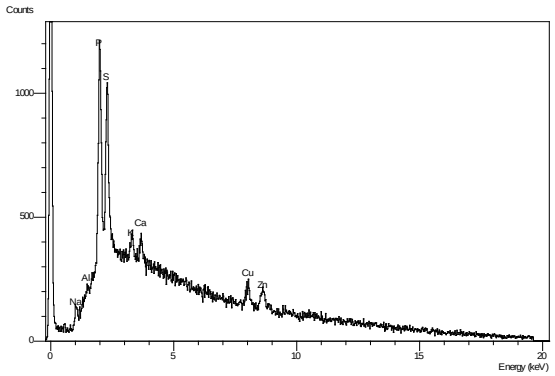

Fig. 5a. the level of aluminum in the kidney cortex of mice treated with AlCl3.

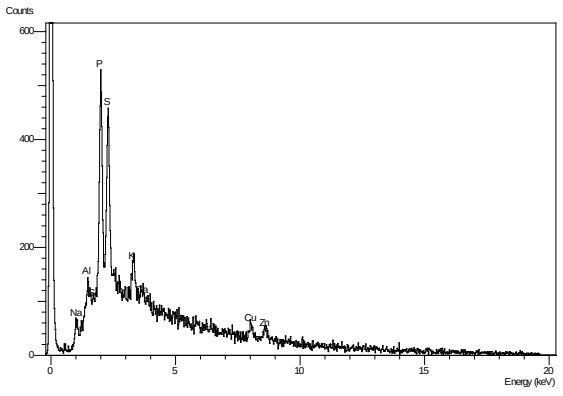

Fig. 5b. the level of aluminum in the kidney medulla of mice treated with AlCl3.

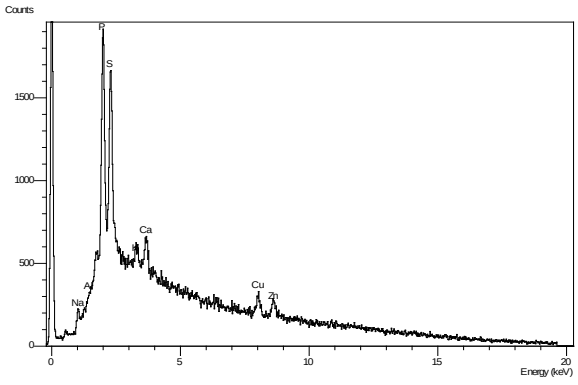

Fig. 6a. the level of aluminum in the kidney cortex of mice treated with AlCl3and vitamin E simultaneously

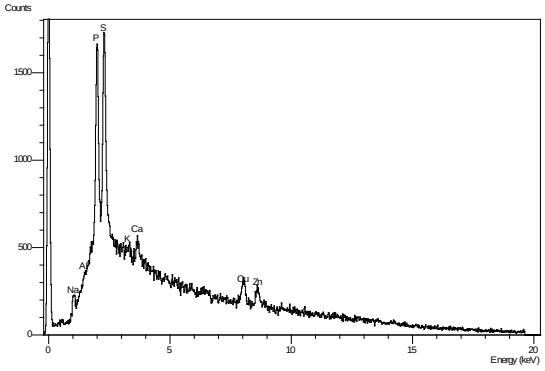

Fig. 6b. the level of aluminum in the kidney medulla of mice treated with AlCl3and vitamin E simultaneously.

DISCUSSION:

The activities of serum enzymes ALT and AST were progressively increased in $AlCl_3$-treated mice during time periods of experiment. In $AlCl_3$ plus vitamin E treated mice, vitamin E improves elevation in ALT and AST activity, although the activity still significantly higher than control. This may suggest that vitamin E has hepato-protective effect against hepatotoxicity of aluminum. This data is consistent with finding of Abdel Aziz and Zabut (2011) as they reported transaminase exhibited a significant increase in $AlCl_3$-treated albino rats, and restored by vitamin E. The increase in serum AST and ALT of mice treated with $AlCl_3$ are in agreement with the finding of Al-Hashem (2009) in albino rat and Sallam *et al.* (2005) in rabbit. They found that exposure to $AlCl_3$ cause necrosis to the liver. Therefore, the increase of these enzymes in serum is indicative of liver damage and thus alterations in liver function (Mohamed and awad, 2008; Türkez *et al.*, 2011; Mohammed, 2010; Medani *et al.*, 2011; Sharma *et al.*, 2011; Amit *et al.*, 2012; Ibegbu *et al.*, 2013).

The enzyme ALP is a sensitive biomarker to metallic salts since it is a membrane bound enzyme related to the transport of various metabolites. The activity of ALP is concerned with energy metabolic activity and process in the body and the decrease in its activity may indicate impaired energy processing of the cells. The enzyme is present in practically all tissues of the body, especially in the membranes (Abdel Aziz and Zabut, 2011). The present study indicated that treatment with $AlCl_3$ caused a significant increase in the activity of serum ALP during the period of experiment. While administration of vitamin E with $AlCl_3$ caused significant improvement of ALP activity due to treatment with $AlCl_3$. These findings are in agreement with Abdel Aziz and Zabut (2011) who reported that vitamin E reversed the toxic effects of aluminum ions on the activity of ALP. The present increase in the activity of serum ALP are in accordance with the findings of Sallam *et al*. (2005), Al-Hashem

(2009), Türkez *et al.* (2011), and Medani *et al*. (2011) in other animals experimentally treated with $AlCl_3$. Moshtaghie *et al.* (2006) showed that short and long terms of aluminum administration increased significantly in rat serum ALP activity, and these changes are a dose and time dependent processes.

The current results showed also increase in total bilirubin in the blood of mice treated with $AlCl_3$. While mice treated with $AlCl_3$ plus vitamin E showed significant reduction of serum total bilirubin, but still closer to control. Bilirubin is a breakdown of hemoglobin. It is transported from the spleen to the liver and excreted into bile (Sharma *et al.*, 2011). The increase in total bilirubin in the blood of mice treated with $AlCl_3$ may result from decrease liver uptake, conjugation, or increased bilirubin production from hemolysis. These results are in agreement with the findings of Fyiad (2007) and AL-Hashem (2009).

The elevation in serum urea and creatinine levels reported in $AlCl_3$ treated mice can be considered as a significant marker of renal dysfunction. With progressive renal insufficiency there is retention in blood of urea and creatinine (Mohammed, 2010; Sharma *et al*., 2011). The increase in urea concentration in plasma of animals treated with aluminum may be due to its effect on liver function as urea is the end-product of protein catabolism (Fyiad, 2007; Al-hashem, 2009; Al-kahtani, 2010; Shrivastava, 2013). Also, Mohammed (2010) and Kowalczyk *et al.* (2004) reported that the increase of serum urea and creatinine concentration are due to the precipitation of aluminum in the renal cells leading to insufficient in its filtration, and cause renal failure. It is obvious from our data that treatment with $AlCl_3$ plus vitamin E significantly protected the kidney function and these were confirmed by the reduction in the level of serum creatinine and urea.

Albumin synthesized in the liver at a rate that is dependent on protein intake subject to feedback regulation by the plasma albumin level (Zandieh and Banazadeh, 2005). In this study there was a significant decrease in serum albumin and total protein of mice treated with $AlCl_3$ indicating poor liver functions or impaired synthesis, either primary as in liver cells damage or secondary to diminished protein intake and reduced absorption of amino acids caused by a malabsorption syndromes or malnutrition. The present data are consistent with previous finding by Mohammed (2010), Medani *et al*. (2011), and Sharma *et al*. (2011).

However, the decrease in the levels of total protein in aluminum treated mice might be due to changes in protein synthesis and/or metabolism in the liver. While mice treated with $AlCl_3$ plus vitamin E ameliorate serum albumin and total protein level in comparison with $AlCl_3$-treated mice. The significant reduction in serum albumin level in Al-treated mice confirms the hepatic toxicity since albumin is synthesized in liver (Fyiad, 2007; Mohamed and Awad, 2008).

In the present study the qualitative analysis of aluminum in liver and kidney of group that treated with 100 mg/kg of $AlCl_3$ showed a variety of changes. Where an observable high concentration of aluminum in $AlCl_3$-treated group, but showed low concentration of aluminum in group treated with $AlCl_3$-treated vitamin E simultaneously. Also, this study noticed increasing of aluminum accumulation in the liver tissue rather than kidney. Abuo-Shafey *et al.* (2010) reported that the treatment of mice with aluminum chloride revealed a relationship between the concentration of aluminum in different organs and the amount of aluminum received and the period of treatment.

Recent trends in controlling and treating diseases tend to favor natural antioxidant compounds rather than synthetic ones (Shrivastava, 2013). Vitamin E (alpha-tocopherol) is a naturally occurring antioxidant nutrient that plays an important role in animal health by inactivating harmful free radicals that are produced through normal cellular activity and from various stressors (Amit *et al.*, 2012). Vitamin E is an important lipid-soluble antioxidant placed in a special region of membranes, is a well-characterized chain-breaking antioxidant with the particular function of preventing lipid peroxidation in membrane systems (Turgut *et al.*, 2006; Momeni *et al.*, 2012). Vitamin E is an important component in human diet and considered the most effective liposoluble antioxidant found in the biological system. Vitamin E could improve daily food intake, body weight gains and feed efficiency ratio. It is known to have been proven beneficial in some diseases processes.

In conclusion, the present data demonstrated that there is negative influence of $AlCl_3$ as indicated by alternations of biochemical parameters of liver and kidney in male mice. In addition, vitamin E was able to ameliorate the adverse effects of $AlCl_3$.

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الدور الوقائي والتأثير المحسن لفيتامين E على وظائف الكبد والكلية للفئران المعاملة بكلوريد الألمونيوم

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تم تقسيم عدد 250 فأر من ذكور الجرذان البالغة إلى أربع مجموعات: المجموعة الضابطة وثلاث مجموعات عوملت بجرعة (25-50-100 ملجم/كجم) من وزن الفأر. قسمت كل من هذه المجموعات إلى مجموعتين وتم معاملة المجموعة الأولي منهم بمحلول كلوريد الألمونيوم فقط، والمجموعة الثانية فتم معاملتها بمحلول كلوريد الألمونيوم لمدة أسبوعين، أربعة أسابيع، ثمانية أسابيع مع فيتامين E. استمرت التجربة لمدة ثمانية أسابيع. أظهرت نتائج هذه الدراسة زيادة مستمرة في نشاط كل من إنزيمات الأنين أمينوترانسفريز (ALT) واسبارتيت امينوترانسفرير (AST) وألكالين فوسفاتيز (ALP) وكذلك تركيز (Bilirubin) في مجموعات الفئران التي تم معاملتها بمحلول كلوريد الالمونيوم مع جميع الجرعات طوال فترة التجربة، كما لوحظ نقص في تركيز كل من البروتين (Total protein) والالبومين (Albumin). أظهرت النتائج أيضا انخفاض ملحوظ في نشاط الإنزيمات السابقة وتركيز Bilirubin وزيادة في تركيز كل من البروتين والألبومين في مجموعات الفئران التي تم معالجتها بفيتامين E مع كلوريد الالمونيوم على مدار ثمانية أسابيع. وجد أيضا زيادة واضحة في مستوي اليوريا وتركيز الكرياتينين طوال فترة التجربة لجميع الجرعات والتي تم معاملتها بمحلول كلوريد الألمونيوم، وانخفض تركيز كل من اليوريا والكرياتينين انخفاضا واضحا في المجموعات التي تم معالجتها بفيتامين E مع كلوريد الألمونيوم. اظهر الميكروسكوب الإلكتروني مع اشعة اكس زيادة في نسبة الالومنيوم في انسجة الكبد الى 4% وفى الكلية الى 2.8 – 3.7 % في الفئران التي حقنت بالتركيزات العالية. حدث انخفاضا واضحا مستوى الالومنيوم في الكبد والكلية في المجموعات التي تم معالجتها بفيتامين E مع كلوريد الألمونيوم.