

## **PROTECTIVE EFFECT OF SOME MEDICINAL PLANTS AGAINST ALUMINUM TOXICITY**

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### **ABSTRACT**

A total number of 35 Male albino rats were obtained from El Osman Farm, Cairo, Egypt. Animals were housed in stainless steel cages and provided with food and water ad libitum. All animals were healthy and clinically free of diseases.

Rats were randomly divided into 5 equal groups, each group contained 7 rats and fed on one of the following diets: Group 1: Control diet, Group 2: Control diet + 1000ppm Aluminum, Group 3: Control diet+ 1000ppm+Garlic 5%, Group 4: Control diet+ 1000ppm + Nigella sativa 5%, Group 5: Control diet+ 1000ppm + Garlic 2.5 %+ Nigella sativa 2.5%. Blood samples were collected of each group after 30 and 60days from the beginning of the experiment. Blood samples were centrifuged at 3000 rpm for 15 min. and serum was separated and kept in frozen until subsequent analyses. And at the end of the experiment blood samples were collected too in EDTA tubes for Determination the hematological parameters. Finally, at the end of the experiment, rats were sacrificed to obtain the livers, and kidneys for examination it. The results indicated that Aluminum has adverse effects on animal and human health. The present study demonstrated that medicinal plants (garlic and nigella) in combination with aluminum minimized its hazards. Consequently, the exposure to aluminum should be reduced and attention paid to sources of aluminum in foods, water and personal care products. Furthermore, using diets rich in medicinal plants (garlic and nigella) could be beneficial in alleviating aluminum toxicity.

**Key Words:** garlic, nigella, Aluminum

### **INTRODUCTION**

Aluminum is a trivalent action found in its ionic form in most kinds of animal and plant tissues and in natural waters everywhere (Jiang, et al., 2008). It is the third most prevalent element and the most abundant metal in the earth's crust, representing approximately 8% of total mineral components (Verstraeten, et al., 2008). The sources of Al are specially corn, yellow cheese, salt, herbs, spices, tea, cosmetics, aluminum ware and containers. Also, Al is widely used in antacid drugs, as well as in food additives and toothpaste (Abbasali et al., 2005). Aluminum has been proposed as an environmental factor that may contribute to some neurodegenerative diseases, and affects several enzymes and other

biomolecules relevant to Alzheimer diseases (Ferreira-moan and Barragan, 1994 and Nayak and Chatterjee, 2001). Aluminum is known to cause toxic effects to a variety of organ systems including brain, as well as bone, kidney and blood (Oteiza et al., 1993).

Plants are the green factors in our planet; they convert carbon dioxide and water to carbohydrates, and nitrogen to amino acids. Besides food, plants are considered the nature's green pharmacy, which provide drugs to maintain the good health and to restore the failed health of humans. The medical arts had its origin when mankind first began to use remedial measures to get rid of their pains, sufferings and other illnesses (Badr et al., 2012).

The seeds of *Nigella sativa* sometimes known as black seed, black cumin or habatul Barakah have long been used in the Middle East as a traditional medicine for a variety of complaints, headache, cough, flatulence, as a choleric, antispasmodic and uricosuric. Furthermore, the pharmacological and toxicological studies have demonstrated that crude extract or ethanolic extract of *Nigella sativa* and some of its active constituents might have protective effect against renal ischemia-reperfusion-induced oxidative injury and nephrotoxicity and hepatotoxicity that induced by either disease or chemicals (Ali and Blunden, 2003 and Hosseinzadeh and Montahaei, 2007).

*Allium sativum* which is commonly called garlic belongs to the family Liliaceae and genus *Allium* (Krishnaraju et al. 2006). Garlic is commonly used in food and its medical properties have been well recognized since time immemorial. The traditional medical practitioners have considered garlic as an excellent medicinal plant that has a lot of therapeutic potential. Borek (2001) reported that garlic compounds have tremendous anti-oxidant property which exerts actions by scavenging reactive oxygen species (ROS) enhancing cellular antioxidant enzymes and increasing glutathione in the cells.

The present study was designed to ascertain the beneficial effects of *Nigella sativa* and *Allium sativum* on the histopathological changes in liver and kidney and some serum parameters and complete blood count in normal rats.

## **MATERIALS AND METHODS**

This study was carried out in the Animal House laboratory of the Animal Production Department, Faculty of Agriculture, Al- Azhar University.

**Animals:** A total number of 35 Male albino rats were obtained from El Osman Farm, Cairo, Egypt. Animals were housed in stainless steel cages and provided with food and water ad libitum. All animals were healthy and clinically free of diseases.

**Experimental design:**

Rats were randomly divided into 5 equal groups. Each group contained 7 rats and fed on one of the following diets: Group 1: Control diet, Group 2: Control diet + 1000ppm Aluminum, Group 3: Control diet+ 1000ppm+Garlic 5%, Group 4: Control diet+ 1000ppm + Nigella sativa 5% ,Group 5: Control diet+ 1000ppm + Garlic 2.5 %+ Nigella sativa 2.5%

**Histopathological Studies:**

At the end of the experiment, rats were sacrificed to obtain the livers and kidneys. Immediately after extraction, the livers and kidneys were immersed in formalin concentration 10% for two days, then washed in water, dehydrated in ascending grade of ethyl alcohol and finally cleared by xylene and embedded in melted paraffin wax. The liver and kidney blocks were sectioned at six-micron cut and stained by eosin and hematoxylin according to Pearse (1968).

**Serum parameters:**

Serum total protein assay: Serum total protein was determined using colorimetric method according to Burtis (1999)

Serum albumin assay: Serum albumin was measured using kits depending on the method according to Gindler and Westgard (1973)

Serum alanine transaminase (ALT) assay: Serum ALT was determined by using a colorimetric method according to Mathieu et al. (1982a).

Serum aspartate transaminase (AST) assay: Serum AST was determined using colorimetric method according to Mathieu et al. (1982b).

Serum urea assay: Serum urea was measured by colorimetric method based on the method of Tabacco et al. (1979).

**Statistical analysis:**

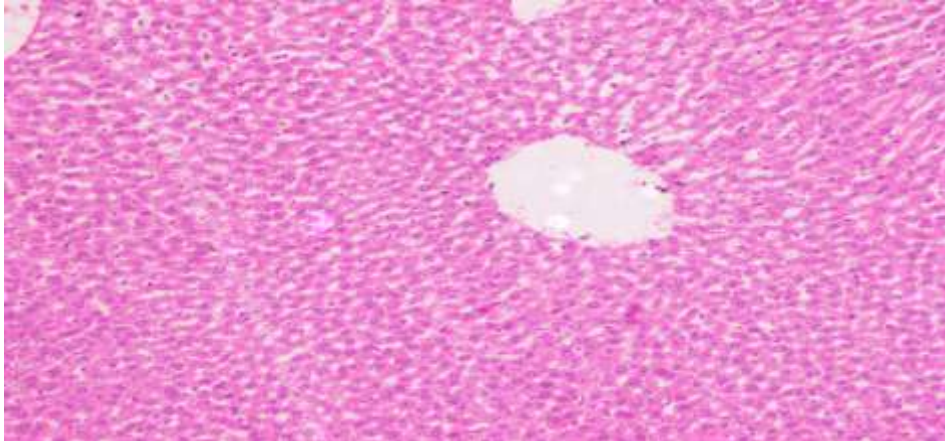
Statistical analyses were carried out using SPSS program. One-way analysis of variance (Procedure ANOVA of SPSS version 20) followed by Duncan's multiple range test (Duncan, 1955) to test the effect of Nigella sativa and Allium sativum after 4 and 8 weeks from the experiment within.

**RESULTS AND DISCUSSION:**

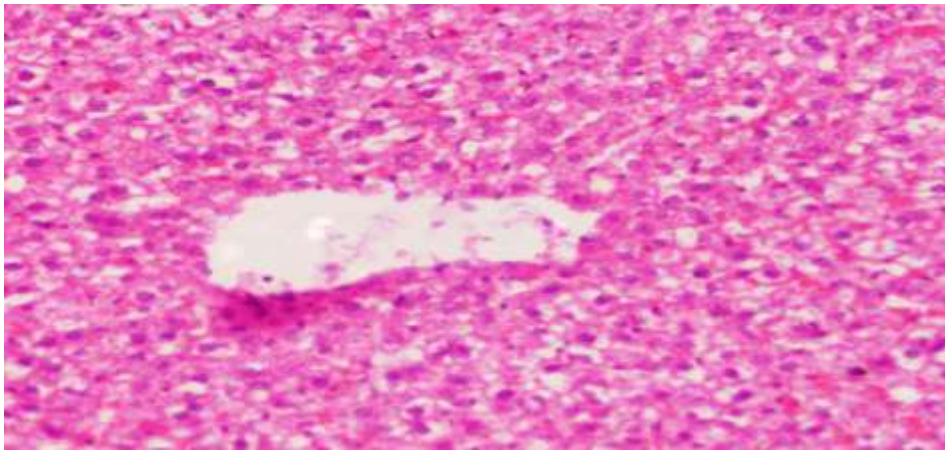
**Effect of aluminum and medicinal plants on histopathological changes in the liver:**

The effect of each aluminum, medicinal plants and mix with aluminum and medicinal plants on histopathology of rats, liver was examined in comparison with that of the control rats. The liver section of the control rats showed normal hepatic architecture and portal tracts and hepatic sinusoids (Fig 1). Meanwhile in 1000ppm aluminum treated group liver Sections in the liver tissue showed preserved lobular architecture. The portal tracts consisted of hepatic artery, portal vein and bile duct. The central veins, some were normal & some congested. The hepatocytes were normal in arrangement and cytoplasm & nuclei. Hepatic sinusoids revealed mild congestion (H & E., Stain, X 100) (Fig 2). While the groups that were

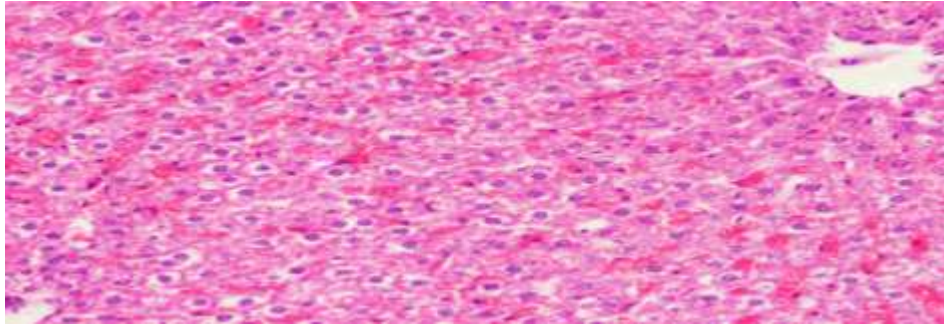
treated with medicinal plants, the liver sections were normal. Sections in the liver tissue showed preserved lobular architecture. The portal tracts consisted of normal hepatic artery, portal vein and bile duct. The central veins, some were normal & some congested. The hepatocytes were normal in arrangement of cytoplasm & nuclei. (H & E., Stain, X 100) (Fig 3,4&5)



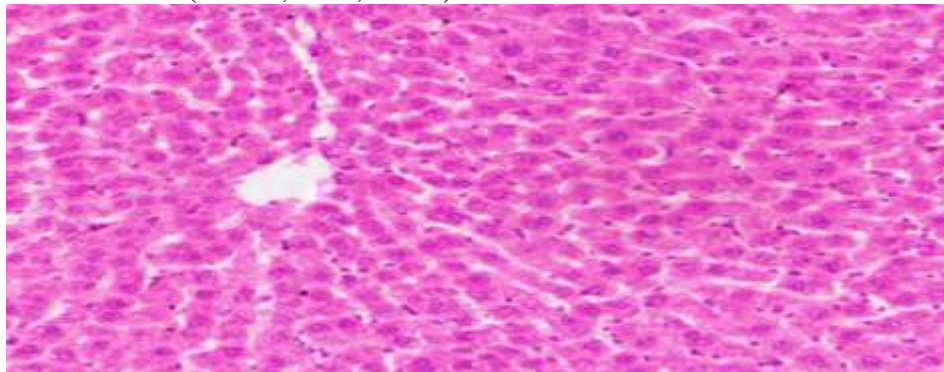
**Fig (1):**Sections in the liver tissue showed preserved lobular architecture. The portal tracts consisted of normal hepatic artery, portal vein and bile duct. The central veins, some were normal & some congested. The hepatocytes were normal in arrangement of cytoplasm & nuclei. (H & E., Stain, X 100).



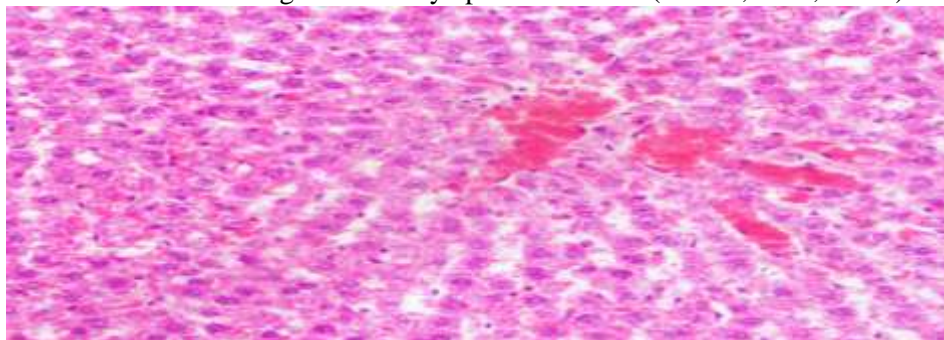
**Fig (2):**Sections in the liver tissue showed preserved lobular architecture. The portal tracts consisted of hepatic artery, portal vein and bile duct. The central veins, some were normal & some congested. The hepatocytes were normal in arrangement and cytoplasm & nuclei. Hepatic sinusoids revealed mild congestion (H & E., Stain, X 100).



**Fig (3):**Sections in the liver tissue showed preserved lobular architecture. The portal tracts consisted of normal hepatic artery, portal vein and bile duct. The hepatocytes were normal in arrangement of cytoplasm & nuclei. (H & E., Stain, X 100).



**Fig (4):**Sections in the liver tissue showed preserved lobular architecture. The portal tracts consisted of hepatic artery, portal vein and bile duct. The central veins, some were normal & some congested. The hepatocytes were normal in arrangement and cytoplasm & nuclei. (H & E., Stain, X 100).



**Fig (5):**Sections in the liver tissue showed preserved lobular architecture. The portal tracts consisted of normal hepatic artery, portal vein and bile duct. The central veins, some were normal & some congested. The hepatocytes were normal in arrangement of cytoplasm & nuclei. (H & E., Stain, X 100).

The above results in liver section revealed that treatment of rats with aluminum chloride 1000ppm caused moderate congestion of central veins, portal veins and hepatic sinusoids. . While the results showed that treatment with medicinal plants garlic, nigella and the mixture between them showed normal results in liver samples , Sections in the liver tissue showed preserved lobular architecture. The portal tracts consisted of normal hepatic artery, portal vein and bile duct. The hepatocytes were normal in arrangement of cytoplasm & nuclei.

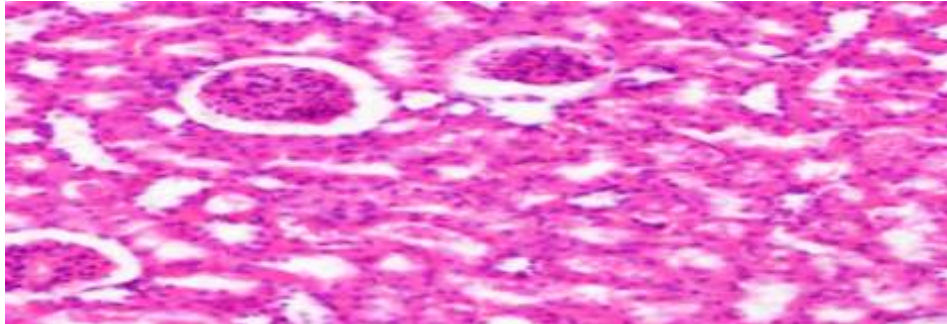
Which indicates that the treatment with garlic or nigella or the mixture between them had positive effects in evading the harmful effects of aluminum in liver tissues.

#### **Effect of aluminum and medicinal plants on histopathological changes in the kidney:**

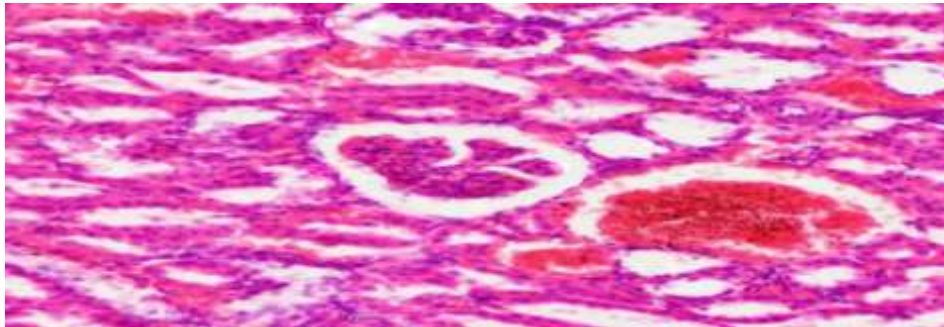
The effect of each aluminum, medicinal plants and mix with aluminum and medicinal plants on histopathology of rats, Kidney was examined in comparison with that of the control rats. Sections in the kidney tissue showed preserved architecture. The cortex revealed normal glomeruli and tubules. The medulla revealed normal tubules and mild congested blood vessels of interstitial tissue. (H & E., stain, x 100) (Fig 6). Meanwhile in 1000ppm aluminum treated group Sections in the kidney tissue showed preserved architecture. The cortex revealed normal glomeruli and tubules. The medulla revealed normal tubules and mild congested blood vessels of interstitial tissue. (H & E., stain, x 100) (Fig 7). While the groups that were treated with medicinal plants, the liver sections were normal Sections in the kidney tissue showed preserved architecture. The cortex revealed normal glomeruli and tubules with mild congestion of the cortical blood vessels. The medulla revealed normal tubules and mild congested blood vessels of interstitial tissue. (H & E., stain, x 100) (Fig 8,9&10)

The above results in Kidney section revealed that treatment of rats with aluminum chloride 1000ppm the Sections in kidney tissue showed preserved architecture. While the results showed that treatment with medicinal plants garlic, nigella and the mixture between them showed normal results in Kidney samples , Sections in the kidney tissue showed preserved architecture. The cortex revealed normal glomeruli and tubules. The medulla revealed normal tubules and mild congested blood vessels of interstitial tissue.

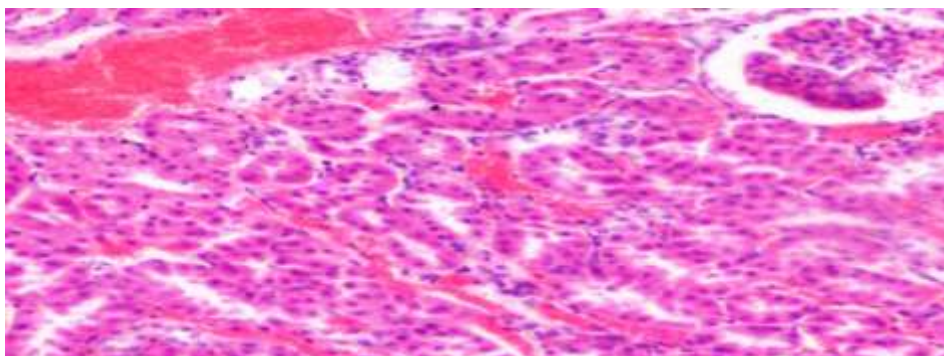
Which indicates that the treatment with garlic or nigella or the mixture between them had positive effects in evading the harmful effects of aluminum in Kidney tissues .



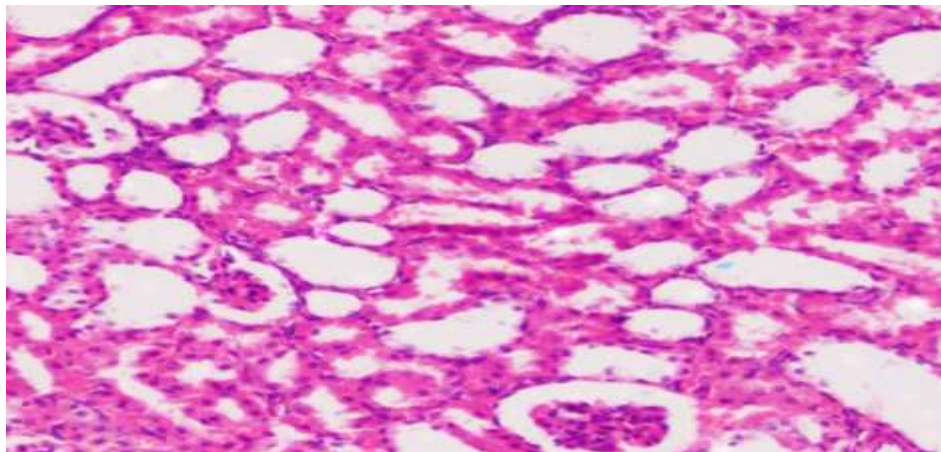
**Fig (6):**Sections in the kidney tissue showed preserved architecture. The cortex revealed normal glomeruli and tubules. The medulla revealed normal tubules and mild congested blood vessels of interstitial tissue. (H & E., stain, x 100).



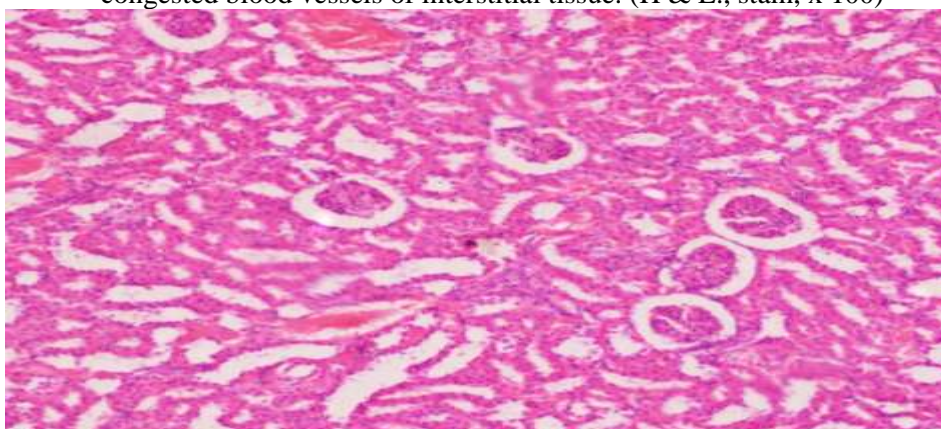
**Fig (7):**Sections in the kidney tissue showed preserved architecture. The cortex revealed normal glomeruli and tubules with mild congestion of the cortical blood vessels. The medulla revealed normal tubules and mild congested blood vessels of interstitial tissue. (H & E., stain, x 100)



**Fig (8):**Sections in the kidney tissue showed preserved architecture. The cortex revealed normal glomeruli and tubules with mild congestion of the cortical blood vessels. The medulla revealed normal tubules and interstitial tissue. (H & E., stain, x 100).



**Fig (9):**Sections in the kidney tissue showed preserved architecture. The cortex revealed normal glomeruli and tubules with mild congestion of the cortical blood vessels. The medulla revealed normal tubules and mild congested blood vessels of interstitial tissue. (H & E., stain, x 100)



**Fig (10):**Sections in the kidney tissue showed preserved architecture. The cortex revealed normal glomeruli and tubules with mild congestion of the cortical blood vessels. The medulla revealed normal tubules and mild congested blood vessels of interstitial tissue. (H & E., stain, x 100)

### **Protective effect of medicinal plants against aluminum on Serum total protein**

Table (1) showed that the aluminum treatment had a negative effect on the decrease in the total protein rate, while the treatment with medicinal plants had an effect in improving the increase in the total protein percentage, and the best effect was due to the mixture between garlic and nigella.



**Table (1): Mean  $\pm$  S.E for Protective effect of medicinal plant plants against aluminum on serum total protein concentrations (g/dl)**

Groub	30days		60days	
	Mean $\pm$ SE	D T .	Mean $\pm$ SE	D T .
G1- Control	7.100 $\pm$ 0.057	B	6.900 $\pm$ 0.032	B
G2 – AL 1000 ppm	5.650 $\pm$ 0.160	D	5.486 $\pm$ 0.239	C
G3 – 1000 ppm+G5%	7.400 $\pm$ 0.264	B	6.310 $\pm$ 0.164	B
G4 – 1000 ppm+N5%	6.533 $\pm$ 0.272	C	6.463 $\pm$ 0.236	B
G5– 1000 ppm+G&N 2.5%	8.366 $\pm$ 0.120	A	7.646 $\pm$ 0.186	A

**Protective effect of medicinal plants against aluminum on serum Albumin concentrations.**

Table (2) showed that the aluminum treatment had a negative effect on the decrease in the Albumin rate, while the treatment with medicinal plants had an effect in improving the increase in the Albumin percentage, and the best effect was due to the mixture between garlic and nigella.

**Table (2): Mean  $\pm$  S.E for Protective effect of medicinal plant plants against aluminum on serum Albumin concentrations (g/dl)**

Groub	30days		60days	
	Mean $\pm$ SE	D T .	Mean $\pm$ SE	D T .
G1- Control	4.900 $\pm$ 0.057	B	4.693 $\pm$ 0.054	A
G2 – AL 1000 ppm	4.133 $\pm$ 0.033	C	3.796 $\pm$ 0.071	B
G3 – 1000 ppm+G5%	4.430 $\pm$ 0.176	BC	4.503 $\pm$ 0.214	A
G4 – 1000 ppm+N5%	4.733 $\pm$ 0.145	B	4.400 $\pm$ 0.231	A
G5– 1000 ppm+G&N 2.5%	5.600 $\pm$ 2.251	A	4.860 $\pm$ 0.100	A

**Protective effect of medicinal plants against aluminum on serum creatinine concentrations.**

Table (3) showed that the aluminum treatment had a negative effect on the increase in the creatinine rate, while the treatment with medicinal plants had an effect in improving the decrease in the creatinine percentage, and the best effect was due to the mixture between garlic and nigella .

**Table (3): Mean  $\pm$  S.E for Protective effect of medicinal plant plants against aluminum on serum creatinine concentrations (U/L)**

Groub	30days		60days	
	Mean $\pm$ SE	D T .	Mean $\pm$ SE	D T .
G1- Control	0.730 $\pm$ 0.005	B	0.803 $\pm$ 0.043	BC
G2 – AL 1000 ppm	0.936 $\pm$ 0.020	A	0.976 $\pm$ 0.008	A
G3 – 1000 ppm+G5%	0.756 $\pm$ 0.016	B	0.733 $\pm$ 0.176	C
G4 – 1000 ppm+N5%	0.630 $\pm$ 0.011	C	0.860 $\pm$ 0.011	B
G5– 1000 ppm+G&N 2.5%	730 $\pm$ 0.005	B	0.743 $\pm$ 0.008	C

**Protective effect of medicinal plants against aluminum on serum urea concentrations.**

Table (4) showed that the aluminum treatment had no significant increase in the urea percentage, while the treatment with garlic and

nigella led to an increase in the urea percentage, while the mixture of garlic and nigella did not show any change in the urea percentage compared to the control group.

**Table (4): Mean  $\pm$  S.E for Protective effect of medicinal plant plants against aluminum on serum Urea concentrations (mg/dl)**

Groub	30days		60days	
	Mean $\pm$ SE	D T .	Mean $\pm$ SE	D T .
G1- Control	27.666 $\pm$ 2.603	B	73.333 $\pm$ 1.452	B
G2 – AL 1000 ppm	35.666 $\pm$ 2.027	B	83.833 $\pm$ 2.602	A
G3 – 1000 ppm+G5%	56.000 $\pm$ 6.350	A	72.400 $\pm$ 0.461	B
G4 – 1000 ppm+N5%	53.333 $\pm$ 0.881	A	73.666 $\pm$ 2.333	B
G5– 1000 ppm+G&N 2.5%	36.333 $\pm$ 1.763	B	73.333 $\pm$ 2.027	B

#### Protective effect of medicinal plants against aluminum on serum ALT concentrations.

Table (5) showed that the aluminum treatment had significant increase in  $\circ$  ALT percentage, while the treatment with garlic and nigella led to an decrease in ALT percentage, while the mixture of garlic and nigella did not show any change in the urea percentage compared to the control group.

**Table (5): Mean  $\pm$  S.E for Protective effect of medicinal plant plants against aluminum on serum ALT concentrations (U/L)**

Groub	30days		60days	
	Mean $\pm$ SE	D T .	Mean $\pm$ SE	D T .
G1- Control	45.333 $\pm$ 2.027	C	61.000 $\pm$ 0.577	C
G2 – AL 1000 ppm	55.333 $\pm$ 1.201	A	74.333 $\pm$ 1.763	A
G3 – 1000 ppm+G5%	40.666 $\pm$ 0.881	D	66.333 $\pm$ 0.333	B
G4 – 1000 ppm+N5%	51.333 $\pm$ 0.333	B	64.333 $\pm$ 1.732	BC
G5– 1000 ppm+G&N 2.5%	45.333 $\pm$ 0.577	C	65.666 $\pm$ 2.027	BC

#### Protective effect of medicinal plants against aluminum on serum AST concentrations.

Table (6) showed that the aluminum treatment had significant increase in  $\circ$  ALT percentage, while the treatment with garlic and nigella led to an decrease in ALT percentage, while the mixture of garlic and nigella did not show any change in the urea percentage compared to the control group.

**Table (6): Mean  $\pm$  S.E for Protective effect of medicinal plant plants against aluminum on serum AST concentrations (U/L)**

Groub	30days		60days	
	Mean $\pm$ SE	D T .	Mean $\pm$ SE	D T .
G1- Control	354.666 $\pm$ 1.855	B	215.333 $\pm$ 1.452	B
G2 – AL 1000 ppm	377.000 $\pm$ 3.464	A	234.666 $\pm$ 2.027	A
G3 – 1000 ppm+G5%	334.666 $\pm$ 2.603	C	200.000 $\pm$ 1.732	C
G4 – 1000 ppm+N5%	326.333 $\pm$ 7.796	C	168.666 $\pm$ 6.887	E
G5– 1000 ppm+G&N 2.5%	353.000 $\pm$ 1.732	B	187.000 $\pm$ 5.131	D

## CONCLUSION

Aluminum has adverse effects on animal and human health. The present study demonstrated that medicinal plants (garlic and nigella) in combination with aluminum minimized its hazards. Consequently, the exposure to aluminum should be reduced and attention paid to sources of aluminum in foods, water and personal care products. Furthermore, using diets rich in medicinal plants (garlic and nigella) could be beneficial in alleviating aluminum toxicity.

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### التأثيرات الوقائية لبعض النباتات الطبية ضد سمية الألومنيوم

محمد ابشر علي ، مدحت حسين خليل ، مصطفى اسماعيل بدر ، سيد سليمان عبدالغفار

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تم الحصول على 35 من ذكور الجرذان البيضاء من مزرعة عثمان ، القاهرة ، مصر. تم إيواء الحيوانات في أقفاص من الفولاذ المقاوم للصدأ وتم تزويدها بالطعام والماء بالشهرة. كانت جميع الحيوانات صحية وخالية من الأمراض إكلينيكيًا.

تم تقسيم الجرذان عشوائياً إلى 5 مجموعات متساوية ، احتوت كل مجموعة على 7 فئران وتغذت على إحدى الحميات التالية: المجموعة 1: التحكم في النظام الغذائي ، المجموعة 2: التحكم في النظام الغذائي + 1000 جزء في المليون من الألومنيوم ، المجموعة 3: التحكم الغذائي + 1000 جزء في المليون + الثوم 5% ، المجموعة 4: حمية التحكم + 1000 جزء في المليون + حبة البركة 5% ، المجموعة 5: حمية التحكم + 1000 جزء في المليون + ثوم 2.5% + حبة البركة 2.5%. تم جمع عينات الدم من كل مجموعة بعد 30 و 60 يوماً من بداية التجربة. تم طرد عينات الدم عند 3000 دورة في الدقيقة لمدة 15 دقيقة. وتم فصل المصل وحفظهما مجمدين حتى التحليلات اللاحقة. وفي نهاية التجربة تم جمع عينات الدم

أيضاً في أنابيب EDTA لتحديد المعلمات الدموية. أخيراً ، في نهاية التجربة ، تم التضحية بالفئران للحصول على الكبد والكلى لفحصها. أشارت النتائج إلى أن الألمنيوم له آثار سلبية على صحة الإنسان والحيوان. أظهرت الدراسة الحالية أن النباتات الطبية (الثوم والحبّة السوداء) مع الألومنيوم قللت من مخاطرها. وبالتالي ، يجب تقليل التعرض للألمنيوم وإيلاء الاهتمام لمصادر الألمنيوم في الأطعمة والماء ومنتجات العناية الشخصية. علاوة على ذلك ، فإن استخدام النظم الغذائية الغنية بالنباتات الطبية (الثوم وحبّة البركة) يمكن أن يكون مفيداً في التخفيف من سمية الألومنيوم.