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ALUMINIUM TOXICITY IN RATS : THE ROLE OF TANNIC ACID AS ANTIOXIDANT

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ABSTRACT :

Prospective studies suggest that tea may protect against oxidative stress that induced tissue damage. A potential mechanism for such effect by polyphenolic antioxidants tannic acid derived from tea was evaluated in this study. Treatment of rats with aluminium chloride for 80 days caused moderate toxicity on liver, kidney's and spleen as shown by elevation of free radicals (lipid peroxidation and nitric oxide) and reduction of antioxidants (superoxide dismutase, catalase, gluathione transferase, and glutathione and vitamin E) as well as histopathological changes. However, improvement was noticed in the rats treated with tannic acid in addition to aluminium chloride. This study proved that tannic acid has a role as an antioxidant in protection of rats from the aluminum toxicity.

INTRODUCTION :

Aluminium is the third most abundant element in the earth's crust. Aluminium has many uses, mainly in the form of alloys in packaging, building, construction, transportation and electrical applications. Over 95% of beer and carbonated drinks are packaged in two piece aluminium cans. Cooking in aluminium utensils results in the transfer of aluminium to foods. Human exposure to aluminium come from food and drinking water as well as from pharmaceuticals. The normal average daily intake is 1 to 10 mg for adults (Greger, 1992). Aluminium is poorly absorbed following either oral or inhalation exposure and is essentially not absorbed dermally. In plasma 80 to 90% of aluminium binds to transferrin, an iron-transport protein for which there are receptors in many body tissues. Aluminium is removed from blood by the kidneys and excreted in urine (De Voto and Yokel, 1994). There were indications that aluminium could induce toxic manifestation such as osteomalacia (Cournot-Witmer *et al*, 1986), gastrointestinal toxicity and alzheimer's disease (Perl and Brody, 1980), and changes in the hepatic functions (Demircan *et al.*, 1998).

Oxidative stress is a disturbance in the pro-oxidant-antioxidant balance leading to cellular damage. Antioxidants play an important role in the metabolism of reactive oxygen species and hence responsible for protecting cell against oxidative stress (Halliwell and Cutteridge, 1985). Liver is a major site of aluminium toxicity in experimental animals (Klein *et al.*,

1989 and Spencer *et al.*, 1995) The effect of aluminium on hepatic functions had been reported by many investigators (Galle and Giudicelli, 1982; Demircan *et al.*, 1998). Aluminium nephrotoxicity was reported by El-Sherbiny and El-Sayed (1998).

The black tea contained a complex mixture of polyphenols to which aluminium was partly bound (Baxter *et al.*,1989). Polyphenolic tannic acid is used as antioxidant in various food and beverages (Khan and Hadi, 1998). So, the aim of the present study is to evaluate the role of tannic acid as antioxidant against the oxidative damage that may induced by long-term aluminium exposure on liver, kidneys and spleen of male rats.

MATERIALS AND METHODS:

Chemicals:

Thiobarbaturic acid (TBA), sodium dodecyl sulfate, butanol, 1,1,3,3-tetra-methoxypropane (TMP), pyridine, phosphoric acid, triton x, 1-chloro-2, 4-dinitrobenzene (DTNB), 5,5-dithiobis, 2-nitrobenzoic acid, glutathione (GSH), superoxide dismutase enzyme (SOD), and epinephrine were purchased from Sigma Chemicals Co., Sant Louis USA. All other chemicals were the highest grade available.

Animals and the design of experiments:

Thirty-two male Sprague-Dawely rats, 100 g average body weight were purchased from Helwan Breading Farm, Ministry of Health, Egypt. Animals were maintained in the animal house, Faculty of Medicine, Assiut University at 25^0C on natural day and night cycle for 80 day. A standard bellet diet *ad labitum* were provided. Rats was then categorized randomly into four groups, 8 rats each. Rats of the first group drank bidistilled water. Rats of the second group received orally aluminium chloride (30 mg/Kg body weight/day) dissolved in bidistilled water. Rats of the third group received orally tannic acid (50 mg/Kg body weight/day) dissolved in distilled water. While rats of the fourth group received orally the previous doses of aluminium chloride and tannic acid in combination.

Collection of samples:

All groups of rats were maintained at the experimental condition for 80 day, then all rats were scarified and blood were drawn into a tube containing heparin. Liver, kidneys, and spleen were excised immediately and washed in phosphate buffer (pH 7.4). Blood samples were centrifuged at 4000 rpm for 10 min to separate plasma. 10% homogenate(w/v) of liver, kidneys, and spleen were made in 0.1 M phosphate buffer (pH 7.4) using glass homogenizer. The cytosols were made by centrifugation of homogenates at 250000 rpm for 30 min. All samples of plasma, homogenates and cytosoles of liver, kidneys, and spleen tissues were stored at -20^0C for the subsequent biochemical determinations.

Biochemical determinations:

Plasma glucose level was determined by kit (Bio. Med. Cat No MTGLU 500 France). Alanine and asparate aminotransminase were assayed by the method of Reitman and Frankel (1957). Alkaline phosphatase was estimated according to white *et al.* (1976). Plasma total lipids was determined using commercial kit (Bio.Med.Adwic codes No: 8311300). Plasma triglycerides was determined by colorimetric method using commercial kit (Bio. Med. Ref. MTTR 1200, France). Plasma cholesterol was measured by commercial kit (Bio Merieux, France). Total protein in plasma and tissues

homogenates and cytosoles was determined by the method of Lowry *et al.* (1951).

Lipid peroxidation products as TBARS (Thiobarbituric reactive substance) was measured according to the method of Ohkawa *et al.* (1979). Nitric oxide was measured as nitrite concentration colorimetrically by the method of Ding *et al.* (1988).

Superoxide dismutase (SOD) activity was determined according to its ability to inhibit the autooxidation of epinephrine at alkaline medium according to the method of Misra and Fridovich (1972). Catalase activity was measured basing on its ability to decompose hydrogen peroxide (H_2O_2) according to Lück (1963). Glutathione s-transferase activity toward 1-chloro-2,4-dinitrobenzene as substrate was determined by the method of Habig *et al.* (1974).

Glutathione was determined by using the method of Beutler *et al.* (1963). Vitamin E (α-tocopherol) was determined by using emmerie-Engel reaction based on the reduction of ferric to ferrous ions forming a red complex with α,α-dipyridyl (Roe, 1961).

Histopathological investigation:

Paraffin sections of liver, kidneys, and spleen tissues (5-7 μ) were prepared and stained with H&E for the histopathological examinations according to Bancroft and Stevens (1982).

Statistical analysis:

All data were statistically analyzed by analysis of variance (ANOVA-Tukey test).

RESULTS :

Data in table (1) indicated that the level of plasma glucose and AST in the aluminium treated rats was significantly increased compared to that of control ones while plasma ALT in aluminium/tannic treated group was significantly increased compared to tannic acid treated group but significantly decreased compared to that of aluminium treated group. Plasma AST of aluminium treated group was significantly increased compared to the tannic acid treated and control groups, while AST of aluminium/tannic treated group significantly decreased compared to that of aluminium treated group. Plasma ALP was significantly decreased in aluminium treated rats compared to the control group and tannic acid treated group, while significantly increased in aluminium/tannic acid treated group compared to the other groups. A significant increase in plasma total lipids of aluminium treated group compared to the tannic acid treated group and control group, but significantly decreased in tannic acid treated group compared to the control one. Plasma total lipids of aluminium/tannic acid treated group was significantly increased versus tannic acid treated group, but significantly decreased compared to the aluminium administered group. Triglycerides level in plasma was significantly increased in aluminium treated rats compared to control and tannic acid treated ones while a significantly increase was recorded in aluminium/tannic acid treated rats against the other treated rats. The plasma cholesterol was significantly decreased in all treated groups compared to control group.

Table (2) showed that lipid peroxides as thiobarbituric reactive substances was significantly increased in the liver of aluminium treated group compared to control and tannic acid treated group ones however, in aluminium/tannic acid treated group it was significantly decreased compared to aluminium treated group. Lipid peroxides in the kidney tissues of aluminium treated group was

significantly increased compared to the control group and tannic acid treated group and in aluminium/tannic treated group compared to tannic acid treated group and control group. In the spleen tissues there was no significant changes in the lipid peroxides of all experimental groups.

The data in table (3) showed the nitric oxide as nitrite concentration in the tissues of liver, kidney and spleen. The levels of nitrite concentration in the liver tissues of the four experimental groups did not shown any significant changes. Nitrite concentration in the kidneys tissues of aluminium/tannic acid treated group was significantly increased compared to control group and tannic acid treated group and in aluminium treated group compared to control group. In the spleen tissues of aluminium treated group nitrite concentration was significantly decreased compared to tannic acid treated group. The activity of superoxide dismutase (table 4) in the liver tissues was significantly inhibited in the three treated groups compared to control group. Meanwhile significantly increased in the spleen tissues and no changes in the kidney tissues.

Table (5) showed that catalase activity in the liver tissues was significantly inhibited in aluminium treated group compared to the control group and tannic acid treated group, while in aluminium/tannic acid treated group was significantly increased versus aluminium treated group. In the kidney tissues catalase activity was significantly decreased in aluminium treated rats compared to tannic acid treated and control rats, but significantly increased in aluminium/tannic acid treated rats compared to aluminium and tannic acid treated and control rats. The activity of catalase in the spleen tissues of aluminium, aluminium / tannic acid, and tannic acid treated groups was significantly increased compared to the control group, and in aluminium/tannic acid treated group versus tannic acid treated group.

Glutathione S-transferase activity was significantly increased in the liver tissues of aluminium treated group compared to the control group and tannic acid treated group. In the kidney and spleen tissues there was no changes in the glutathione s-transferase activity between the four experimental groups (table 6).

The amount of glutathione in the liver, kidney and spleen tissues of the four experimental group presented in table (7). Glutathione content in the liver tissues showed a significant decrease in aluminium treated group compared to control and tannic acid treated group, however, a significant increase in the liver of aluminium/tannic acid treated group versus aluminium treated group. The content of gluathione in the kidney's tissues showed a significant increase in aluminium/tannic acid treated group compared to the control and aluminium treated group. Also, glutathione content of kidney's tissues of tannic acid treated group showed a significant increase compared to that of control group, but, showed a significant decrease in aluminium treated rats versus tannic acid treated rats. In the spleen tissues glutathione content did not show any changes between the four experimental groups.

Table (8) showed the levels of vitamin E in the tissues of liver, kidney and spleen. Liver and kidney's content of vitamin E showed no significant changes between the four experimental groups. Vitamin E content in the spleen tissues showed a significant increase in the tannic acid treated group compared to aluminium treated and control groups and in aluminium/tannic acid treated group compared to aluminium treated group and control group. However, it significantly decreased in the spleen tissues of aluminium treated rats versus tannic acid treated rats.

Table(1): The effect of aluminum chloride ($ALCl_3$), tannic acid (TA), and the combination of $ALCl_3$ and TA on some biochemical parameters in the plasma of male rats.

Plasma parameters	Control group	Aluminium treated group	Tannic acid treated group	Aluminium plus tannic acid treated group
Glucose (mg/dl)	109.o1 ± 22.95	137.71± 8.23**a	123.76 ±13.80	122.45 ±11.67
ALT (U/dl)	43.13 ±15.98	85.00±3.25**a,c	37.75 ±8.48	52.00±5.42**b,c
AST (U/dl)	92.56±15.06	120.36±18.87**a,c	87.56±10.30	80.44±11.45
ALP (U/dl)	97.03±1.23	69.83±13.78**a,c	122.05±19.40	138.33±14.80**a,b,c
Total Lipids (mg/dl)	27.99±6.54	35.81±3.37**a,c	20.55±2.90**a	27.11±2.33**b,c
Triglycerides (mg/dl)	49.45±5.95	68.20±3.09**a,c	56.37±5.99	105.83±13.50**a,b,c
Cholesterol (mg/dl)	62.93±9.95	48.74±3.96**a	53.45±3.86**a	45.55±1.77**a,c

Table(2):The effect of aluminum chloride ($ALCl_3$), tannic acid (TA), and the combination of $ALCl_3$ and TA on the lipid peroxides as thiobarbituric reactive substances (nmoles/mg proteins) in the tissues of liver, kidney and spleen of male rats.

Organ	Control group	Aluminium treated group	Tannic acid treated group	Aluminium plus tannic acid treated group
Liver	1.73 ± 0.31	2.48 ± 0.39**a,c	1.62 ± 0.21	1.91 ± 0.13**b,*c
Kidney	0.87 ± 0.07	1.03 ± 0.12**a,*c	0.88 ± 0.09	1.00 ± 0.14*a,c
Spleen	1.25 ± 0.47	1.07 ± 0.36	0.98 ± 0.17	0.98 ± 0.24

Table (3): The effect of aluminum chloride ($ALCl_3$), tannic acid (TA), and the combination of $ALCl_3$ and TA on the nitric oxide as nitrite concentration (nmoles/mg proteins) in the tissues of liver, kidney, and spleen of male rats.

Organ	Control group	Aluminium treated group	Tannic acid treated group	Aluminium plus tannic acid treated group
Liver	1.04 ± 0.19	0.96 ± 0.14	1.08 ± 0.61	0.94 ± 0.17
Kidney	0.80 ± 0.08	0.93 ± 0.14*a	0.90 ± 0.06	1.04 ± 0.17**a,*c
Spleen	0.72 ± 0.14	0.60 ± 0.08*a	0.66 ± 0.03	0.67 ± 0.07

Table (4):The effect of aluminum chloride ($ALCl_3$), tannic acid (TA), and the combination of $ALCl_3$ and TA on the superoxide dismutase activity (U/mg proteins) in the tissues of liver, kidney and spleen of male rats.

Organ	Control group	Aluminium treated group	Tannic acid treated group	Aluminium plus tannic acid treated group
Liver	7.96 ± 1.43	5.63 ± 0.83**a	6.04 ± 0.39**a	5.93 ± 1.25**a
Kidney	8.54 ± 1.58	7.67 ± 1.52	7.67 ± 1.59	7.66 ± 1.50
Spleen	7.71 ± 1.56	11.28 ± 2.41**a	10.41 ± 0.94**a	9.87 ± 0.93

Table (5):The effect of aluminum chloride ($ALCl_3$), tannic acid (TA), and the combination of $ALCl_3$ and TA on the catalase activity (U/mg proteins) in the tissues of liver, kidney and spleen of male rats.

Organ	Control group	Aluminium treated group	Tannic acid treated group	Aluminium plus tannic acid treated group
Liver	1.67 ± 0.47	1.30 ± 0.19**a,c	1.71 ± 0.14	1.67 ± 0.20*b
Kidney	1.73 ± 0.31	1.29 ± 0.14**a,c	1.68 ± 0.10	2.01 ± 0.34*a,**b,*c
Spleen	0.35 ± 0.06	0.34 ± 0.06*c	0.42 ± 0.04*a	0.45 ± 0.13**a,b

Significant difference * P<0.05 **Highly significant difference ** <0.01**

a : Compared to control.

b : Compared to aluminium treated group.

c : Compared to tannic acid treated group.

Table (6): The effect of aluminum chloride ($ALCl_3$), tannic acid (TA), and the combination of $ALCl_3$ and TA on the glutathione S-transferase activity toward 1-chloro 2,4-dinitrobenzene (nmoles/min/mg proteins) in the tissues of liver, kidney and spleen of male rats.

Organ	Control group	Aluminium treated group	Tannic acid treated group	Aluminium plus tannic acid treated group
Liver	732 ± 132	890 ± 57**a,c	728 ± 52	784 ± 125
Kidney	530 ± 68	564 ± 44	514 ± 52	560 ± 18
Spleen	315 ± 88	282 ± 43	288 ± 22	307 ± 59

Table (7): The effect of aluminum chloride ($ALCl_3$), tannic acid (TA), and the combination of $ALCl_3$ and TA on the glutathione level (µg/mg proteins) in the tissues of liver, kidney and spleen of male rats.

Organ	Control group	Aluminium treated group	Tannic acid treated group	Aluminium plus tannic acid treated group
Liver	6.34 ± 0.61	5.42 ± 0.61**a,*c	6.03 ± 0.31	6.42 ± 0.41**b
Kidney	5.18 ± 0.48	5.26 ± 0.46**c	5.87 ± 0.33**a	5.74 ± 0.49*b,c
Spleen	5.20 ± 0.86	5.21 ± 1.00	5.05 ± 0.76	5.30 ± 0.95

Table (8): The effect of aluminum chloride ($ALCl_3$), tannic acid (TA), and the combination of $ALCl_3$ and TA on the vitamin E (µg/mg proteins) in the tissues of liver, kidney and spleen of male rats.

Organ	Control group	Aluminium treated group	Tannic acid treated group	Aluminium plus tannic acid treated group
Liver	0.45 ± 0.07	0.51 ± 0.08	0.52 ± 0.02	0.48 ± 0.12
Kidney	0.27 ± 0.07	0.23 ± 0.03	0.22 ± 0.02	0.23 ± 0.05
Spleen	0.35 ± 0.06	0.34 ± 0.06*c	0.42 ± 0.04*a	0.45 ± 0.13**a,b

Significant difference * P<0.05 Highly significant difference ** <0.01
a : Compared to control.
b : Compared to aluminium treated group.
c : Compared to tannic acid treated group.

Histopathological examination:

Liver: In the aluminium treated rats, the liver showed diffuse vacuolar degeneration in the hepatocytes of most cases. Some hepatocytes undergo necrosis with pyknosis of their nuclei (Fig.1a). Some cases showed focal areas of necrosis infiltrated with mononuclear cells (Fig.1b). Other few cases showed large areas of coagulative necrosis associated with massive hemorrhage (Fig.1c). Slight vacuolar degeneration of hepatocytes was the only finding in both aluminium/tannic acid and tannic acid treated groups (Fig.1d).

Kidney: The renal cortex of aluminium treated rats showed swollen of the glomerular tuft with increase of their cellularity (Fig.2a), while there were small focal areas of tubular nephrosis in renal medulla (Fig.2b). In the aluminium/tannic acid treated rats there was a slight cellular proliferation in the glomerular tuft (Fig.2c) as well as congestion of interstitial capillaries in the renal medulla (Fig.2d). In tannic acid treated group, the kidney structure was more or less normal.

Spleen: In the spleen of aluminium treated group there was exhaustion as well as necrosis of lymphocytes in the white pulp in association with congestion of the capillary sinuses in the red pulp (Fig.3a). The spleen of rats in the other two group were more or less normal (Fig. 3b).

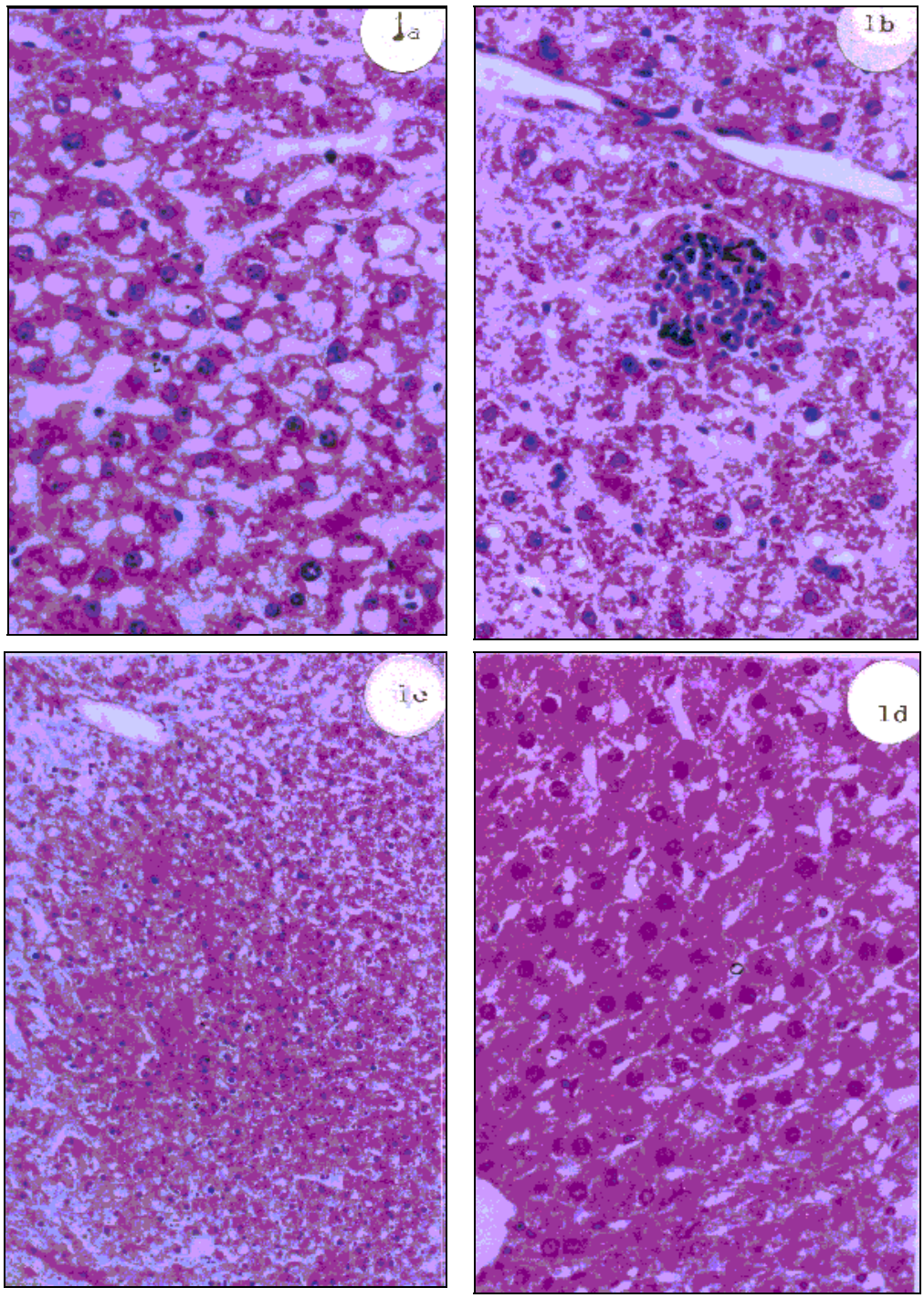

Fig. (1): Liver showing:

1a: Diffuse vacuolar degeneration of the hepatocytes H & E.10x25.

1b: Focal area of necrosis infilterated by mononuclear cells. H & E.10x25.

1c: Massive area of necrosis and hemorrhage H & E 10x10.

1d: Slight vacuolar degeneration of the hepatocytes H &E .10x25.

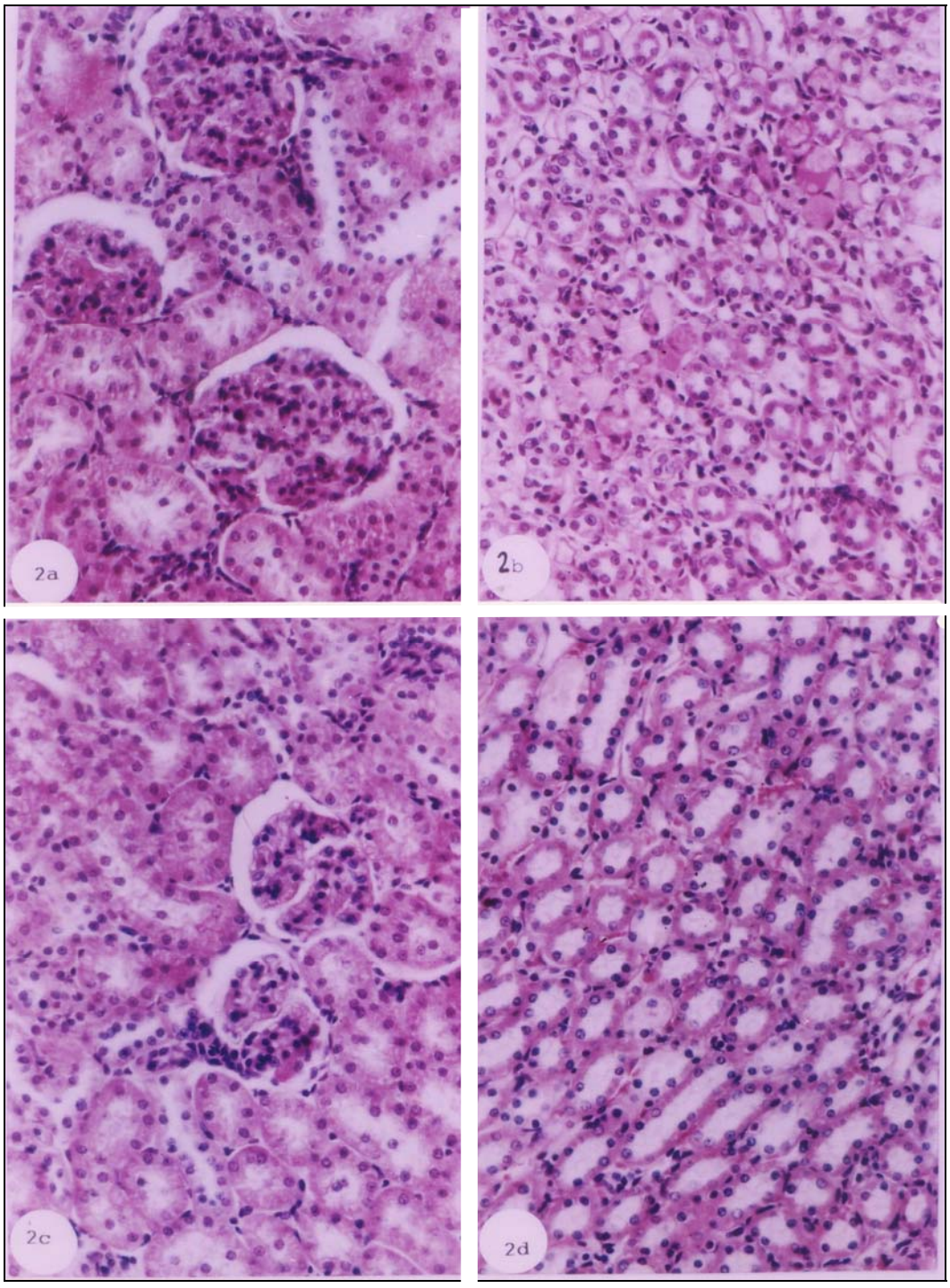

Fig.(2): Kidney showing:

2a: swollen and hypercellularity of the glomerular tuft H & E. 10x25.

2b: Necrobiosis of the collecting tubules in the renal medulla H & E. 10x25.

2c: More or less normal histology of the renal cortex H & E.10x25.

2d: Only slight congestion in the interstatium of the renal medulla.H &E. 10x25.

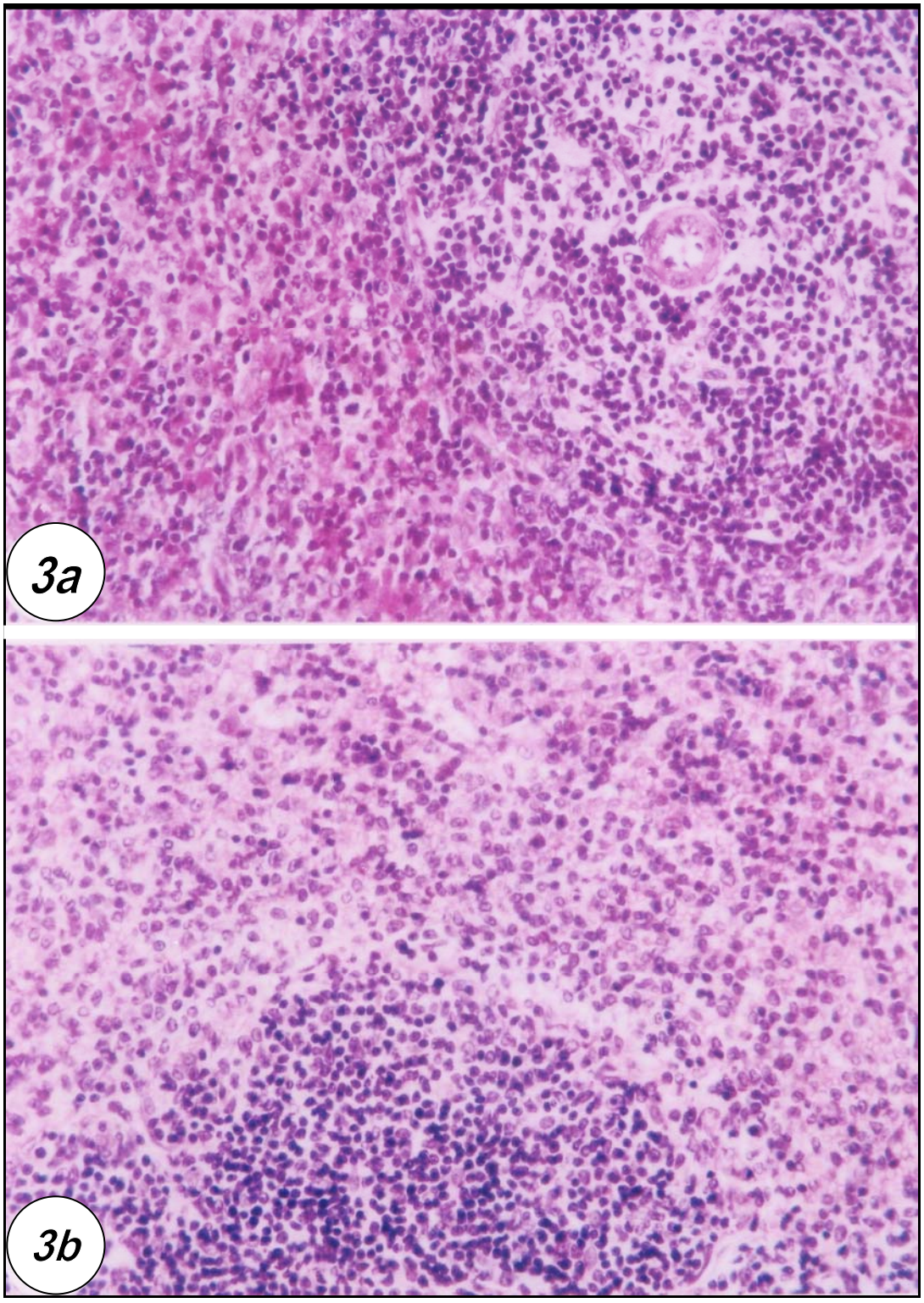

Fig. (3): Spleen showing:

3a: Exhustion and necrosis in the lymphocytes of the white pulp H & E. 10x25.

3b: More or less normal histology of white and red pulp H & E.10x25.

DISCUSSION :

Aluminium was reported to produce an inhibition in the hepatic glycolysis (Xu *et al.*, 1990). In the present study, it was clear from the obtained results that chronic aluminium administration induced an elevation in the plasma glucose level. These results indicated that glucose utilization was decreased and hepatic glycolysis was inhibited which was in good agreement with that of Lai and Blass (1984) and Joshi (1990) who found an inhibition in the liver glycolysis during aluminium intoxication. However, the plasma glucose level of aluminium/tannic acid treated group showed a non significant difference compared to that of the control group which might indicate that tannic acid prevent or cure the aluminium action on glycolysis.

Liver is the major site of aluminium accumulation in the experimental animals (Spencer *et al.*, 1995). The effect of aluminium on hepatic functions had been reported by Klein *et al.*, (1989) and Marie, (1994). Our obtained results indicated that the levels of ALT and AST in the plasma of aluminium treated group were significantly increased compared to the control and tannic acid treated group. Meanwhile, plasma ALP level was significantly decreased in aluminium treated group compared to control group. In this aspects, Marie (1994) found that ALT and AST were significantly decreased compared to control group of Nile catfish that treated with aluminium. El-Yamany *et al.* (1997) reported that serum and hepatic ALP was significantly decreased in rats treated for long time with aluminium. On the other hand, plasma ALT and AST of aluminium/tannic acid treated group were significantly decreased compared to that of aluminium treated group which might reflect the toxic effect of aluminium administration and the inhibitory action of tannic acid on aluminium toxicity. The necrobiotic changes in the hepatic parenchyma in the aluminium treated group and its abscense in the aluminium/tannic acid treated group will document this result.

Concerning the toxic effect of aluminium on lipid metabolism, our obtained data showed a significant increase in the plasma total lipids and triglycerides of aluminium treated rats compared to tannic acid treated group, while plasma level of cholesterol was significantly decreased in aluminium treated group compared to that of controls. These data are in agreement with El-Yamany (1997) who found that chronic administration of aluminium caused a significant increase in the serum levels of total lipids and triglycerides. In addition, Voget (1986) reported that excessive aluminium in food and/or water increased serum cholesterol levels. The increase of total lipids in the circulation might be due to hepatocellular degeneration (Roy *et al.*, 1991).

Peroxidation of unsaturated lipids of cell membrane occurred by reactive oxygen species was taken as an index of oxidative stress in tissues (Halliwell and Gutteridge, 1985). In the present study, the hepatic lipid peroxidation was significantly increased in aluminium treated rats compared to the control and the tannic treated group. Quinlan *et al.*, (1988) reported that aluminium-induced lipid peroxidation in rat liver microsomes. Aluminium might bind to the lipid components of the microsomal membranes which caused rearrangement of its lipid and thereby rendering these lipids accessible to be attacked by free radicals (Yoshino *et al.*, 1999). However, the level of lipid peroxides as thiobarbituric acid reactive substances in liver of rats that treated with aluminium/tannic acid was significantly decreased compared to that of aluminium

treated group, but it was not significant compared to the control group, which might indicate the inhibitory effect of tannic acid on aluminium toxicity. The level of lipid peroxides in the kidneys of aluminium treated rats showed a highly significant increase compared to the control rats. These results are in agreement with that of Bertholf *et al.* (1987) who reported that aluminium intoxication stimulated lipid peroxidation in the kidney. In addition, a significant increase in the level of lipid peroxides in the kidneys of aluminium/tannic acid treated group compared to the control group indicate the slight effect of tannic acid. In spite of that histopathological examination of the kidney revealed a benefit effect of tannic acid on the collecting tubules of the renal medulla as it overcomed the degenerative change produced in aluminium treated group.

Recently, there has been growing interest in nitrogen centered free radicals species nitric oxide. The activity of nitric oxide depends on its redox properties where it reacts with oxygen yielding nitrogen dioxide or peroxynitrite, both are strongly oxidative molecules and more cytotoxic than nitric oxide itself (Neri *et al.*, 1995). The results of the present study indicated that the treatment of rats with aluminium or aluminium and tannic acid in combination produced an elevation in nitric oxide level of kidney's tissue. However, it decreased in the spleen tissue of rats that treated with aluminium, and did not show any significant changes in the liver tissues.

Superoxide dismutase and catalase play an important role in metabolism of reactive oxygen species and hence, responsible for protecting cell against oxidative stress (Halliwell and Gutteridge, 1985). The obtained results of the present experiment indicated that superoxide dismutase activity in the liver tissue was significantly inhibited in rats treated with aluminium compared to control rats. However, it was significantly increased in the spleen tissue and did not show any changes in the kidney. Chainy *et al.* (1996) reported that aluminium failed to induce any inhibitory effect on the activity of superoxide dismutase in the liver tissue of rats that treated with aluminium. Catalase activity was significantly decreased in the liver and kidneys of rats treated with aluminium. However, *In vitro* studies of Chainy *et al.* (1996) and Serra *et al.* (1991) found that aluminium failed to inhibit the activity of catalase. However, Swain and Chainy (1997) attribute the inhibitory effect of aluminium on catalase activity to the direct effect of the metal on enzyme molecules or their synthesis. The results of the present study suggested that tannic acid might modulate the catalase activity in liver and kidney which was inhibited due to the effect of aluminium on the enzyme activity of liver and kidney of treated rats.

Glutathione is present in most cells and participates in the cellular defense system against oxidative stress by reducing disulphide linkage of protein and other cellular molecules or by scavenging free radicals which participate in cell damage (Fulton and Jeffery, 1994). Results of the present study showed that glutathione content in liver tissues was decreased in aluminium treated group compared to that of control and tannic acid treated group. In this respect Fulton and Jeffery (1994) concluded that aluminium produced a course of hepatic damage that began with glutathione depletion.

Vitamin E, being the major lipid-soluble chain breaking antioxidant in mammalian tissues and body fluids, is important for the *in vivo* protection of lipid membrane lipoprotein structure against free radical lipid peroxide (Cheeseman *et al.*, 1988). In the present study, vitamin E content was significantly increased in

the spleen tissue of aluminium/tannic acid treated group compared to that of control and aluminium treated groups. This may produced antioxidant effect reflected on the histopathology of the spleen in the aluminium/tannic acid treated group.

REFERENCES

1-Bancroft, J.D. and Stevens,A.(1982): Theory and Practice of Histological Technique .2 nd Ed. Charcil livingstone.Edinbergh, London.

2-Baxter M.J.; Burell J.A; Crews R.C.; and Massey R.C. (1989): Aluminium in infant formula and tea leaching during cooking inaluminium in food and the environment. Edited by Massy RC and Taylor .PP.77-87. Royal Society of Chemistry, Cambridge.

3-Bertholf R.L.; Nicholson J.R. Wills M.R. and Savory J. (1987): Measurement of lipid peroxidation products in rabbit brain organs (response to aluminium exposure). Ann. Clin. Lab.Sci., 17:418- 423.

4-Beutler E.; duron O.; and Kelly B.M .(1963): Improved method for the determination of blood glutathione. J. Lab. Clin. Meth, 61:882-888.

5-Chainy G.B.; Samanata L. and Rout M.(1996): Effect of aluminium on superoxide dismutase, catalase and lipid peroxidation of rat liver. Res. Commun. in Molec. Pathol. Pharmacol., 94:217-220.

6-Cheeseman K.H. Emery S.; Maddix S.P.; Slater T.F.; Burton G.W.; and Ingold K.(1988): Studies of lipid peroxidation in normal and tumor tissues. Biochem. J., 250:247

7-Cournot-Witmer G.; Zingraff G.; and Ptachot J.J. (1986): Effect of aluminium on bone and cell localization. Kid Int., 29: 537-540.

8-Demircan M.; Orkan E.; Canan C.; Funda Y.; Sebil A.; and Geylan O.(1998): Aluminium in total parenteral nutrition solution produce portal inflammation in rats. JPGN,26:274-278.

9-De Voto E., Yokel R.A. (1994): The biological speciation and toxicokinetics of aluminium. Environ Health Perspect, 102:940-951.

10-Ding A.H.; Nathan C.F.; and Stuchr D.J. (1988): Release of reactive nitrogen intermediate and reactive oxygen intermediate from mouse peritoneal macrophages. Comparison of activating cytokines and evidence for independent production. J. Immunol., 141: 2407-2412.

11-El-Sherbiny, S.A. and El-Sayyed. I.I. (1998): Protective effect of glutathione against aluminiumtoxicity affecting femur bone of pregnant diabetic and non diabetic albino rats. J.Egypt.Germ. Soc.Zool., 26:87-102.

12-El-Yamany N.A.; Al-Azhary D.B. and Abdel-Moumen L.A.(1997): Biochemical and histochemical changes in liver of Aluminium-intoxicated albino rats: Examination of succenic acid as chelating agent. J. Union. Arab. Biol., Cairo, 7:383-410.

13-Fulton B. and Jeffery E. (1994): The temporal relationship between hepatic GSH loss, hemeoxigenase induction and cytochrome P 450 loss following intraperitoneal aluminium administration to mice. Toxicol. Appl. Pharmacol., 127:291-297.

14-Galle, P. and Giudicelli, C.P.(1982): Toxicate de I'aluminium poure I'hepatocyte localization ultrastructural at microanalyses desdepots. Nouv. Presse. Med., 11: 1123-1125.

15-Greger J.L. (1992): Dietary and other sources of aluminium intake, In: Aluminium in biology and medicine. New York: Wiley, pp.26-49.

16-Habig,W.H.; Pabst,M.J..and Jokoby, W.B. (1974): Glutathione s-transferase. J. Biol. Chem., 249:7130-7139.

17-Halliwell B. and Gutteridge J.M. (1985): Free radicals in biology and medicine. Clarendon press Inc: Oxford.

18-Joshi J.G. (1990): Aluminium, a neurotoxin which affects diverse metabolic reactions. Biofactors, 2: 163-169.

19-Khan N.S.;and Hadi S.M. (1998): Structural features of tannic acid important for DNA degradation in the presence of Cu^{+2}. Mutagenesis, 13:271-274.

20-Klein G.L.; Heyman M.B.; LeeT.C.; and Rassin D.K.(1989): Aluminium altered glycine and turine conjugation of bile acid following aluminium administration. J. Peditor Gastrointes. Nutr., 9:361-364.

21-Lai B. and Blass J.P. (1984): Inhibition of brain glycolysis by aluminium. J. Neurochem., 42:438-446.

22-Lowry OH.; Rosenbrough NJ.; Far AL.; and Randall RJ. (1951):Protein measurement with folin phenol reagent. J. Biol. Chem., 193: 265-275.

23-Luck H. (1963): Catalase. In methods of enzymatic analysis edited by Bergmer HU. Academic Press, New York, PP.885-888.

24-Marie M.A.S. (1994): Toxic effect of aluminium on plasma parameters and liver functions of Nile Catfish Clarias lazera. J. Egypt. Ger. Soc. Zoll., 13:279-294.

25-Misra H.P. and Fridovich I. (1972): The role of superoxide anion in the autooxidation of epinephrine and a simple method for superoxide dismutase determination. J. Biol. Chem., 3170-3175.

26-Neri L.; Di-Renzo G.C.; Cacerta g.; Gallineli A.; and Facchinett F.(1995): Impact of the L-arginine/nitric oxide system in pregnancy. Obstet. Gynecol Survey, 50_851-858.

27-Ohkawa H.; Ohishi N.; and Yagi K. (1979): Assay for lipid peroxides in animal tissue by thiobarbaturic acid reaction. Anal. Biochem., 95:351-358.

28-Perl D.P. and Brody A. R. (1980): Alzheimer's : X-ray spectrometric evidence of aluminium in neurofibrally tangle bearing neurons. Science, 208:297-299.

29-Quinlan G.J.;Gutteridge J.M. and Halliwell B.(1988): Action of aluminium ions on iron stimulated lipid peroxidation in liposome, erythrocytes and rat liver microsomal functions. Biochimica. Biophysica. Acta, 962:196-200.

30-Reitman S. and Frankel S. (1957): A colorimetric determination of serum glutamic oxaloacetic and glutamic transaminase. Am. J. Pathol., 28:56-63.

31-Roe J.H. (1961): Standard methods of clinical chemistry, Vol.3 edited by David Selgson, Acad. Press.New York, p. 35.

32-Roy A.K.; Taloukder G., and Sharma A.(1991): Similar effects *in vivo* of two aluminium salts on the liver, kidney, bone and brain of *Ratus norvegicus*. Bull. Environ. Contam. Toxicol.,47: 288-295.

33-Serra M.A.; Barassi V.; Caravese C., and Sabbioni E. (1991): Aluminium effect on the activity of superoxide dismutase and other antioxigenic enzymes in vitro. Biol. Trac., 31:79-96.

34-Sjogren B.; elinder V.G; and Lidums V. (1988): Uptake and urinary excretion of aluminium among welders. Internation. Arch. of Occupational and Environ. Health, 60:77-79.

35-Spencer A.J.; Wood A.J.; Saunders M.S.; and Lote C.J.(1995): Aluminium deposition in liver and kidney following acute intavenous administration of aluminium cloride or citrate in conscious rats. Hum. Exper. Toxicol., 14:787-794.

36-Swain M.K.and chainy G.B. (1997): Aluminium effect on lipid peroxidation and on the activity of superoxide dismutase in cerebral hemisphere and liver of young chicks. J. Trac. Elem. Med. Biol., 11:77-82.

37-Voget T.(1986): Water quality and health study of possible relation between aluminium in drinking water and dementia. Social Ognomiske Studier 61, Central Bureaus of Statistics, Oslo, Norway.

38-White W.L.; Erickson M.M.; and Stevens S.G. (1976): Chemistry of theclinical laboratory, PP.101-107, Mosby Co. Louis.

39-Xu Z..X.; Fox S.; Melethel L.; Winderg I. and Badr M. (1990): Mechanism of aluminium-induced inhibition of hepatic glycolysis. J. Pharm. Exp.Ther., 254:301-305.

40-Yoshino M.;Ito M.; Haneda M.; Tsubouchi R. and Murakami K.(1999): Prooxidant action of aluminium ion-stimulation of iron mediated lipid peroxidation by aluminium. Bio Metals, 12:237-240.

سمية الألمونيوم على الفئران: دور حامض التانيك كمضاد للأكسدة

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أشارت دراسات عديدة سابقة إلى مقدرة الشاى على حماية الخلايا والأنسجة من الإجهاد التأكسدى، ولهذا تم فى هذه الدراسة استخدام حامض التانيك أحد مكونات الشاى كمضاد للأكسدة. وتم فى هذه الدراسة تعريض الفئران لكلوريد الألمونيوم (٣٠ مجم/كجم من وزن الجسم) لمدة ٨٠ يوماً مما تسبب فى سمية متوسطة على كبد، كلى وطحال هذه الفئران، وذلك من خلال زيادة نسبة الشوارد الحرة (الأكسدة الفوقية للدهون وأكسيد النيتريك)، ونقص فى مضادات الأكسدة (السوبر أكسيد ديسميوتيز، الكتاليز والجلوتثيون تراسنفيريز والجلوتاثيون وفيتامين هـ). علاوة على التغيرات الباثولوجية. قد لوحظ تحسن واضح فى هذه التغيرات فى الفئران التى تم معالجتها بحامض التانيك مع كلوريد الألمونيوم. وقد اتضح من هذه الدراسة دور حامض التانيك كمضاد للأكسدة فى التقليل من سمية كلوريد الألمونيوم فى الفئران.