

The possible protective effect of vitamin C on monosodium glutamate induced renal toxicity in male albino rats

Original
Article

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ABSTRACT

Introduction: Monosodium glutamate (MSG) is widely used as a food additive to improve the taste of food. Despite its taste stimulation and appetite enhancement, some reports indicated that MSG is toxic and induce an oxidative stress. Vitamin C (ascorbic acid) is a natural antioxidant that prevents the excess production of free radicals.

Aim of the work: Our aim was to study the toxicological effect of MSG on the renal cortex of adult male albino rats and to evaluate the possible role of ascorbic acid as a protective agent.

Materials and methods: Forty adult albino rats were divided equally into four groups. Group I was the control group; group II received ascorbic acid intraperitoneal injection (500 mg/kg/day) for 4 weeks; group III rats were intraperitoneal injected with monosodium glutamate (4mg/kg/day) for 4 weeks; and in group IV, rats were injected intraperitoneally with ascorbic acid (500 mg/kg/day) for one week then followed by 4 weeks treated with monosodium glutamate and ascorbic acid as the same previous dose. At the end of the experiment, specimens from the kidney were taken and prepared for HandE, immunohistochemical stain and electron microscopic studies.

Results: MSG induced degenerative changes in renal tubules as destruction in epithelial cell, loss of the brush border, exfoliated cellular debris in lumen of some tubules. Interstitial cells infiltration and blood vessels congestion were also noticed. There were signs of apoptosis as well as significant increase in caspase 3 antibodies expression. These changes were ameliorated by protective using of the ascorbic acid.

Conclusion: MSG caused an apparent kidney injury on the histological, immunohistochemical and ultrastructure level. The ascorbic acid can ameliorate these effects.

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INTRODUCTION:

Glutamate has been proposed as a significant excitatory amino neurotransmitter^[1]. The Food and Drug Administration (FDA) considers monosodium glutamate (MSG) as a safe additive in 1959. On the other hand, the FDA proved that some population could respond to it in a complex manner^[2]. Experimental studies observed various toxic effects after prolonged consumption of MSG^[3]. It is also an experimental neurotoxin, has been commonly used as a food additive that empowering chemosensory discernment^[4]. Glutamate can present naturally in many kinds of foods as seafood, cheeses, poultry and vegetables^[5]. This flavor enhancer found in variable kinds of processed foods as flavored potato chips, many food snacks, canned sauces or soups, marinated meats, frozen foods and stuffed or prepared chicken. Furthermore, it will be extensively utilized within food industries, and for restaurants^[6]. Despite there will be no issue on the usage of small amounts of MSG in food manufacturing, this may be

of a great problem if there is frequent intake of these small amounts in distinctive regular dietary supplies. Moreover, MSG might be under many titles, causing difficulty in determination the foods containing this additive^[7]. Previous studies found that renal fibrosis is accompanied with the chronic use of MSG^[8]. The renal lipids contain many long-chain polyunsaturated fatty acids causing kidney damage by variable mechanisms^[9].

Vitamin C (ascorbic acid) is a water soluble vitamin so this allowing it to be a good scavenger for aqueous radicals that destroy the membrane lipids. It has a protective role in most of the cytotoxicity^[10]. It is considered the cheapest antioxidant to be used so we choose it in this study to evaluate its efficacy and mechanism to ameliorate renal MSG toxicity.

The present study aims to highlight on the histopathological alterations and genotoxicity of the kidney of adult albino rats treated with MSG and possible protective role of ascorbic acid.

MATERIALS AND METHODS:

Animals:

The present study was carried out on forty adult male albino rats (purchased from the animal house of the Faculty of medicine, Assuit University), weighing from 190 to 200 gm. They were housed in clean properly ventilated cages under the same environmental conditions with free access to food and water throughout the whole period of experiment. They were acclimatized to their environment at least two weeks before starting the experiment.

Chemicals:

Monosodium glutamate and ascorbic acid were purchased from sigma, cornil lap company, Cairo, Egypt.

Mouse monoclonal caspase3 were bought from Thermo scientific company and stored in refrigerator. The CASP3 protein is a member of the cysteine-aspartic acid protease (caspase) family. Sequential activation of Caspase-3 plays a central role in the execution-phase of cell apoptosis.

Animals and treatment:

The Institutional Animal Care and the Research Ethics Committee of the Faculty of Medicine, Sohag University, Egypt, approved the experimental protocol.

The animals were divided into four groups 10 animals for each:

Group I: were served as untreated control group.

Group II: were received ascorbic acid intraperitoneal injection (500 mg/kg/day) for 4 weeks^[11].

Group III: were received MSG given intraperitoneal in a dose of 4 mg / kg b.w/day for 4 weeks^[12].

Group IV: were received ascorbic acid given intraperitoneal in a dose of 500 mg /kg/ day for one week then followed by 4 weeks simultaneously treated with MSG and ascorbic acid as the same previous dose.

Kidney samples:

The animals were sacrificed after being anaesthetized by ether. Kidneys were fragmented from 0,5-1 cm in thickness, renised in saline and fixed in 10%formalin for 24 hours. The preserved organs were processed, dehydrated with alcohol, cleared with xylol, infiltrated and embedded with paraffin wax. Paraffin wax blocks were sectioned at 5µ thick with a rotary microtome using a disposable blade. Sectioned slides were stained for

1-Light microscopy:

A- haematoxylin and eosin for general structure

B-PAS for carbohydrate

c- Immunohistochemistry by using activated caspase 3 antibody

Sections were deparaffinized with xylene and rehydrated with ethanol then put in distilled water for 5 min. Hydrogen

peroxide 0.6% used for 10 minutes as peroxidase blocking reagent. The slides were washed in 20% diluted phosphate buffered saline (PBS) rapidly then for 5 min. The slides were boiled in a microwave oven at a high medium for 10 min. The sections used for caspase 3 antibodies with 1:200 dilutions were incubated for 60 min at room temperature in the absence of light and then were extensively washed in PBS and incubated with biotinylated secondary antibodies then with the avidin–biotin complex. Finally, it incubated with diaminobenzidine and chromogen 1: 4 for 1 min. The sections were counterstained with hematoxylin. Positivity for caspase3 appeared as brownish coloration of cytoplasm

d- Toluidine blue

Kidney samples of 0.1 ml thick were taken from all animals for electron microscopy and immediately fixed in 2.5% glutaraldehyde for 24h and embedded in Epon, Semithin sections (0.5-1µm) were prepared by using ultra microtome (LKB).

2- Electron microscopy:

Ultrathin sections (500-800A) from selected areas of trimmed blocks were made and collected on copper grids. Ultrathin sections were contrasted with uranyl acetate for 10min and lead citrate for 5min.

RESULTS:

Ascorbic acid group II showed similar results as control animal's group I as follow.

Light microscopic examination

Sections stained with HandE revealed that kidney formed from stroma of connective tissue capsule and parenchyma formed from cortex and medulla. The renal cortex occupied by renal corpuscles surrounded by proximal convoluted tubules, distal convoluted tubules, and collecting ducts. Each renal corpuscle was formed of a glomerulus surrounded by a double walled Bowman's capsule with a filtration space in-between. The parietal layer was lined by simple squamous cells, whereas the visceral layer was lined by podocytes. The glomerulus contained tufts of capillaries lined by flat endothelial cells. Proximal convoluted tubules (P.T) were lined by three to five large cuboidal cells with rounded vesicular nuclei, acidophilic cytoplasm, ill-defined boundaries and a prominent apical brush border. Distal convoluted tubules (D.T) were lined by small cuboidal cells with no brush border, wide lumen, so more nuclei than those in P.T with distinct boundaries and basal striation (Fig. 1).

Sections stained with periodic acid sheif stain (PAS) were positive reaction in brush border of P.T cells, dense cytoplasmic reaction and basement membrane of tubules. Positive reaction was also seen in glomerular capillaries basement membrane (Fig. 2).

Immunostained sections by caspase 3 revealed negative reaction in the glomeruli and renal tubules cells (Fig. 3).

In semithin sections stained with toluidine blue, P.T

cells showed high intensity of basophilic granules in cytoplasm and apical brush border with narrow lumen and contained rounded vesicular nucleus. DT cells showed wide lumen and low cuboidal cell with distant boundaries and basal infolding. Parietal layer of Bowman's capsule and glomerular capillaries contained flat endothelial cells (Fig. 4).

Electron microscopic examination

Glomerular capillaries of renal corpuscle lined by endothelial cells, podocytes and mesangial cells in between. Blood urinary barrier showed fenestrated endothelial cell contained rounded nuclei with peripheral heterochromatin and pinocytotic vesicles with thick basement membrane (BM) divided into lamina densa and lamina rara in between. Podocytes had primary and secondary process terminated by feet processes resting on BM of filtration barrier. Mesangial cells presented between glomerular capillaries with irregular heterochromatic nuclei and scanty cytoplasm (Fig. 5). P.T cells had apical numerous microvilli (brush border) and intercellular junction canaliculi between two cells. Their cytoplasm contained euochromatic rounded nucleus, lysosomes, RER and basal membrane invaginations associated with elongated mitochondria (Fig. 6). D.T cells showed numerous elongated mitochondria between basal infolding, RER cisterne and euochromatic nucleus with prominent nucleolus (Fig. 7).

Treated animals

MSG treated rats (group III)

Light microscopic examination

Sections stained with HandE revealed severe degenerative changes in renal tubules in the cortex as destruction in lining epithelial cell and loss brush border in P.T. There were exfoliated cellular debris in lumen of tubules. Cells of renal tubules showed dense nuclei and cytoplasmic vacuolation, some cells showed separation from basement membrane (Fig. 8). There were interstitial cells infiltration and severe congestion in blood capillaries between tubules. There was increased Bowman's space with destructed partial layer of Bowman's capsule, atrophic glomerulus and inflammatory cells in between with fat globules (Fig. 9).

Sections stained PAS were showed marked decrease in the intensity of positive reaction in tubular cells, no brush border and destructed basement membrane of some cells (Fig. 10).

Immunostained sections by caspase 3 showed strongly positive cytoplasmic reaction in renal tubules with appearance of dark brown stained areas and weak reaction in glomerular capillaries (Fig. 11).

In semithin section stained with toluidine blue, P.T showed destructed brush border, irregular pyknotic nucleus and cytoplasmic vacuolation. There was congestion of blood capillaries between tubules (Fig. 12). D.T showed

widening of lumen with exfoliation cells as macrophage and decreased thickness of cells with vacuolation cytoplasm and decreased intensity of basophilia. There were mononuclear inflammatory cells between tubule (Fig. 13). There was no parietal layer of Bowman's capsule and dilated congested glomerular capillaries close to tubules (Fig. 14).

Electron microscopic examination

There was electron lucent basement membrane of glomerular capillaries. Feet processes of podocyte disrupted the filtration barrier (Figs. 15&16). P.T showed destructed apical microvilli and loss basal infolding. Some nuclei showed chromatinolysis and other pyknotic. Cytoplasm contained hypertrophied destroyed cristae of mitochondria and dilated RER (Fig. 17&18). D.T showed chromatinolytic nuclei, vacuolated cytoplasm, destructed apical cell membrane and loss basal infolding (Fig. 19). There were interstitial mononuclear inflammatory cells in between renal tubules (Fig. 20).

MSG with ascorbic acid treated rats (group IV)

Light microscopic examination

Sections stained with HandE revealed that some P.T appeared intact brush border and vesicular nucleus and acidophilic cytoplasm. Others tubules showed vacuolated cytoplasm and dense nucleus. There was mild blood capillaries congestion (Fig. 21). Some D.T showed exfoliated cell remnant. There was still increased Bowman's space but complete parietal layer (Fig. 22).

Sections stained PAS revealed moderate positive reaction compared to control in brush border and basement membrane (Fig. 23).

Immunostained sections by caspase 3 showed some negative staining cells and others weakly positive cells compared to group III (Fig. 24).

In semithin section stained with toluidine blue, PT cells showed some cells with intact brush border with increased intensity of the stain with basophilic granules and other destructed brush border with vacuolated cytoplasm (Fig. 25). There was intact parietal layer of Bowman's capsule but still mild widening of space of Bowman's capsule (Fig. 26).

Electron microscopic examination

Blood urinary barrier contained podocyte with feet processes resting on thick basement membrane similar to control group. There had endothelial cell of glomerular capillaries and mesangial cells in between (Fig. 27, 28). Some P.T showed partially intact microvilli of brush border and some basal infolding with small dense basal mitochondria. There had small rounded euochromatic nucleus, lysosomes and intercellular junction canaliculi between two cells (Fig. 29). D.T showed loss basal infolding but mitochondria and nucleus were similar to control (Fig. 30).

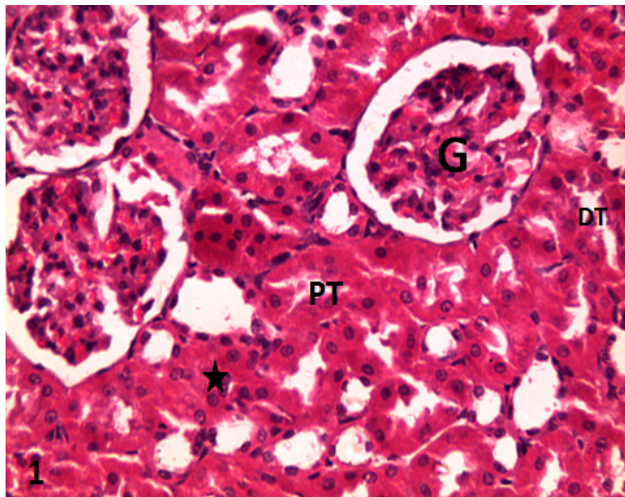


Fig. 1: A Photomicrograph of the kidney (control and group II) stained by Hxand E showing: proximal tubules (PT) with brush border and vesicular nucleus (star) and distal tubules (DT) with wide lumen and renal corpuscles contained glomerular capillaries (G). (×400)

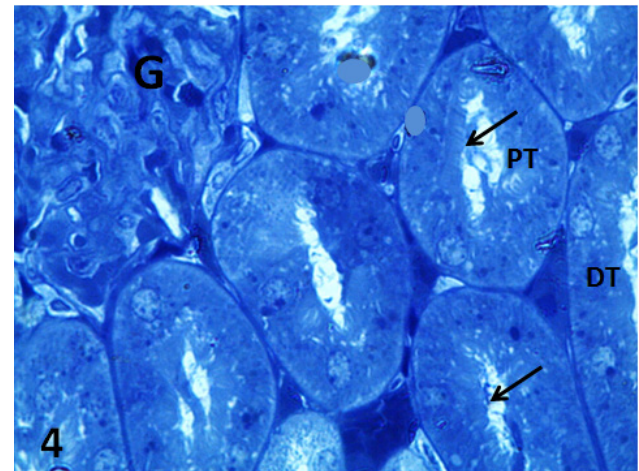


Fig. 4: Photomicrograph of the kidney (control and group II) stained by toluidine blue. Basophilic granules observed in cytoplasm of PT and apical brush border (arrows) with rounded vesicular nucleus, glomerular capillaries were close to tubules and contained flat endothelial cells (G). (×1000)

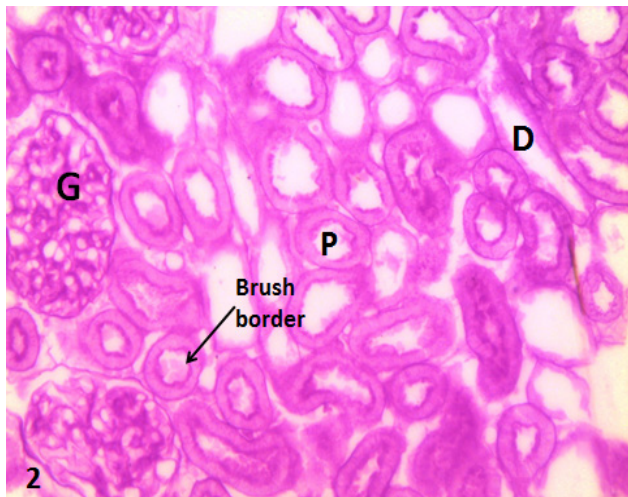


Fig. 2: A photomicrograph of the kidney (control) stained by PAS. Positive reaction observed in brush border of P.T cells (arrow), highly positive cytoplasmic reaction and basement membrane. (×400)

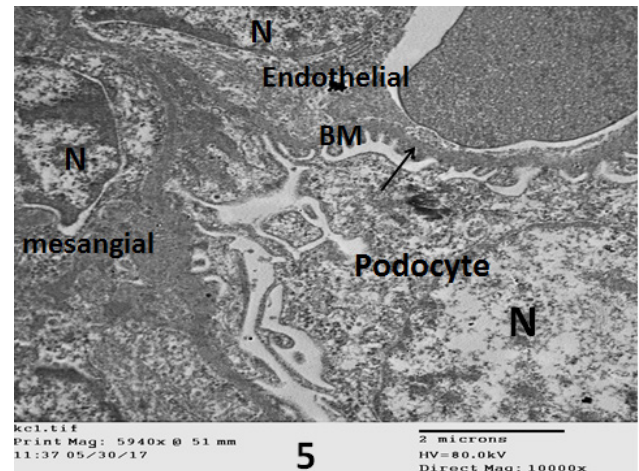


Fig. 5: An electromicrograph of the kidney (control and group II) showing: Glomerular capillaries lined by endothelial cells, podocytes and mesangial cells in between. Blood urinary barrier lined by thick basement membrane (BM) and Podocyte have feet processes resting on BM (arrow). (×1000)

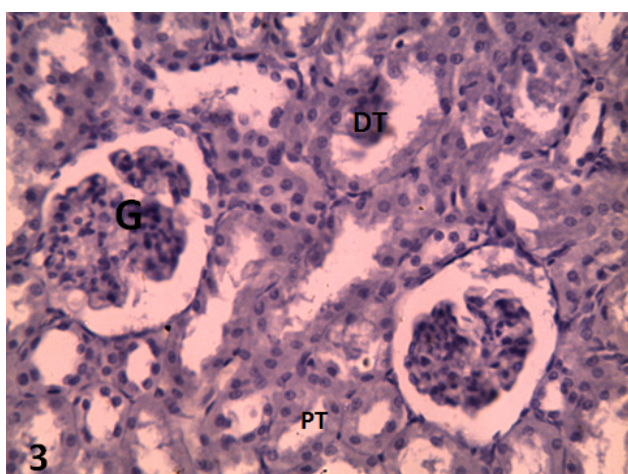


Fig. 3: Photomicrograph of the kidney (control and group II) stained by caspase 3. Immunostained reaction observed negative in the glomerulus and renal tubules. (×400)

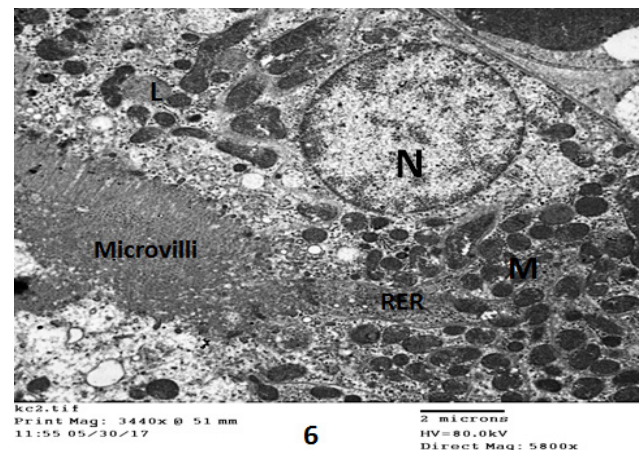


Fig. 6: An electromicrograph of the kidney (control and group II) showing: PT cells show apical numerous microvilli (brush border), euochromatic rounded nucleus (N), lysosomes (L), RER and basal membrane invaginations associated with elongated mitochondria (M). (×5800)

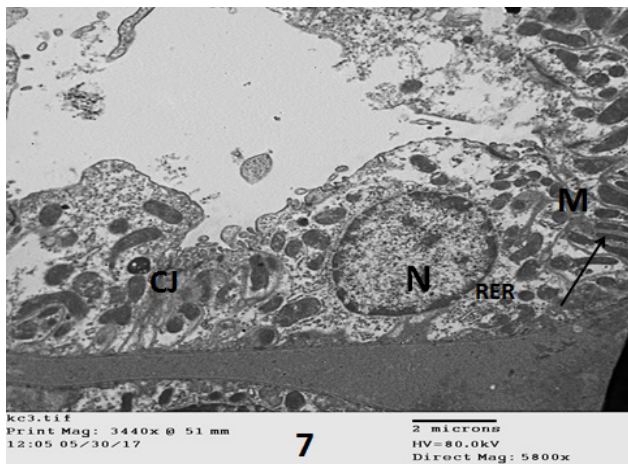


Fig. 7: An electromicrograph of the kidney (control and group II) showing: DT cells contain numerous elongated mitochondria between basal infolding (arrow), RER cisterne euchromatic nucleus with prominent nucleolus (N) and cell junction between cells (CJ). ($\times 5800$)

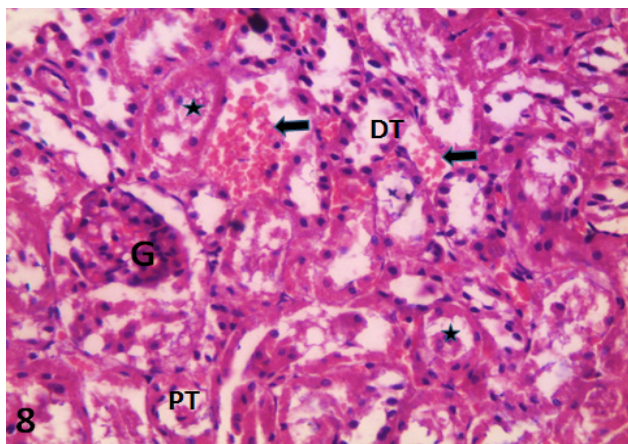


Fig. 8: A Photomicrograph of the kidney (group III) stained by Hxand E showing: proximal tubules loss their brush border and there is vacuolation of their cytoplasm, intratubular acidophilic deposition (star), increase in the Bowman's space with exfoliated cells and congestion of intraglomerular capillaries (G), capillaries congestion between renal tubules (arrows). ($\times 400$)

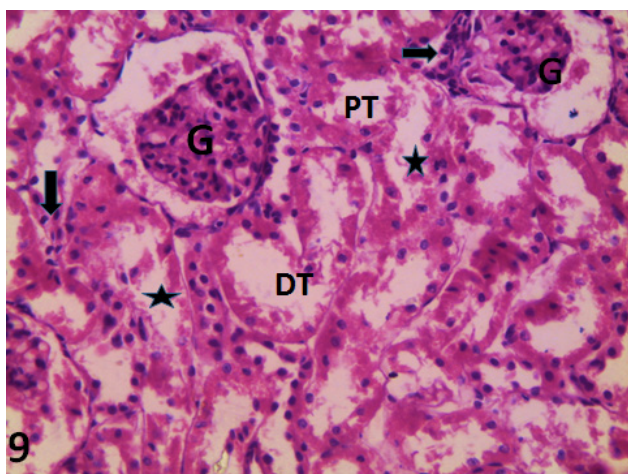


Fig. 9: A Photomicrograph of the kidney (group III) stained by Hxand E showing: There is interstitial cells infiltration between tubules (arrows). Cells of renal tubules contain dense nucleus and cytoplasmic vacuolation, some cells showed separation from basement membrane (star). ($\times 400$)

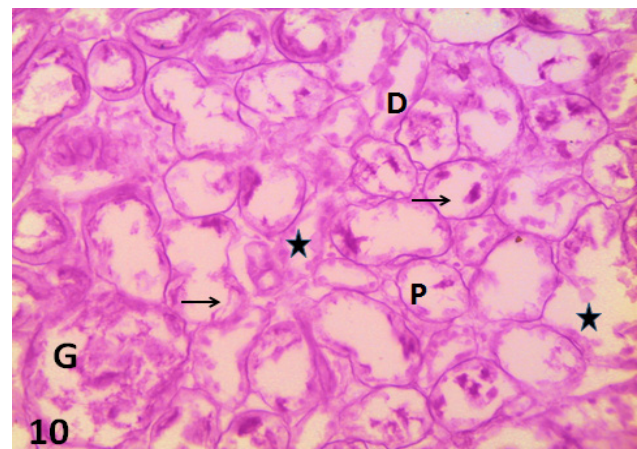


Fig. 10: A photomicrograph of the kidney (group III) stained by PAS. Marked decrease in the intensity of positive reaction in tubular cells, no brush border (arrows) and destroyed basement membrane of some cells (star). ($\times 400$)

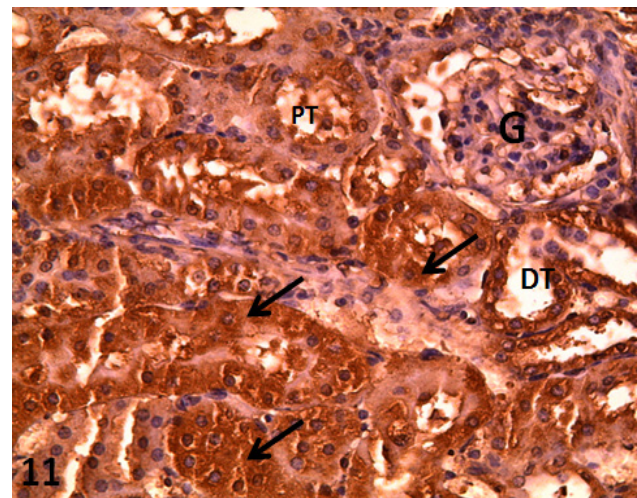


Fig. 11: A Photomicrograph of the kidney (group III) stained by caspase 3. Strongly positive cytoplasmic reactions observe in renal tubules (arrows) and weak reaction in glomerular capillaries. ($\times 400$)

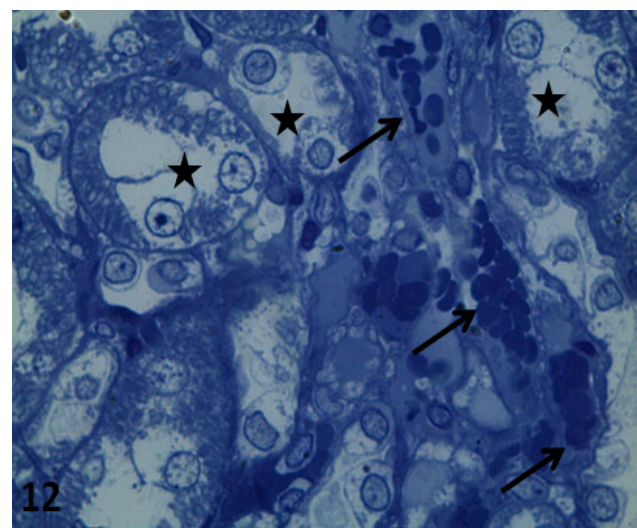


Fig. 12: A Photomicrograph of the kidney (group III) stained by toluidine blue. PT show destructed brush border, irregular pyknotic nucleus and cytoplasmic vacuolation (star), congestion of blood capillaries between tubules (arrows). ($\times 1000$)

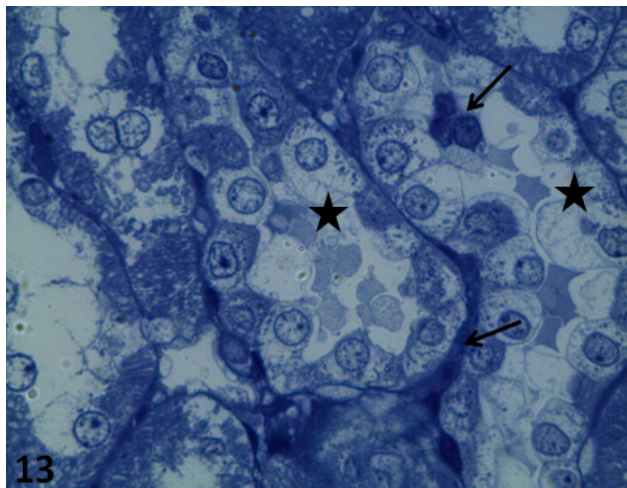


Fig. 13: A Photomicrograph of the kidney (group III) stained by toluidine blue. DT is wide with exfoliation cells and vacuolated cytoplasm and decreased intensity of basophilia (star). There are mononuclear inflammatory cells inside and between tubule (arrows). (×1000)

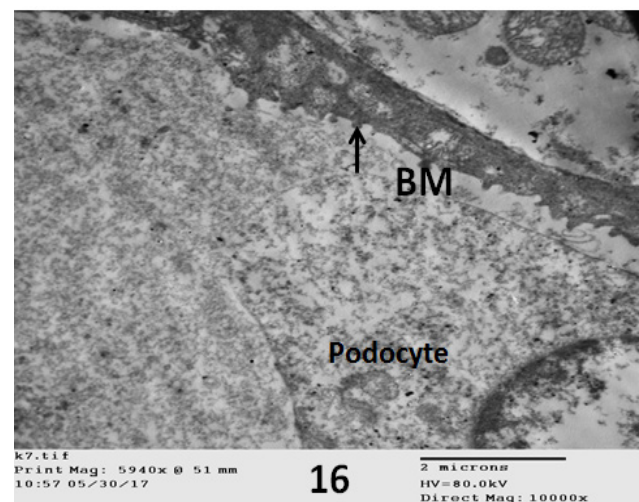


Fig. 16: A magnified part of previous section showing: electron lucent basement membrane of glomerular capillaries (BM), disruption of feet processes of Podocyte (arrow). (×1000)

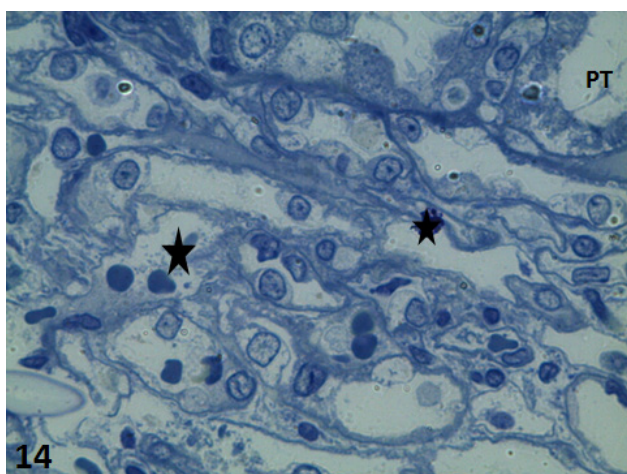


Fig. 14: A Photomicrograph of the kidney (group III) stained by toluidine blue. There is no parietal layer of Bowman's capsule and dilated congested glomerular capillaries close to tubules (star). (×1000)

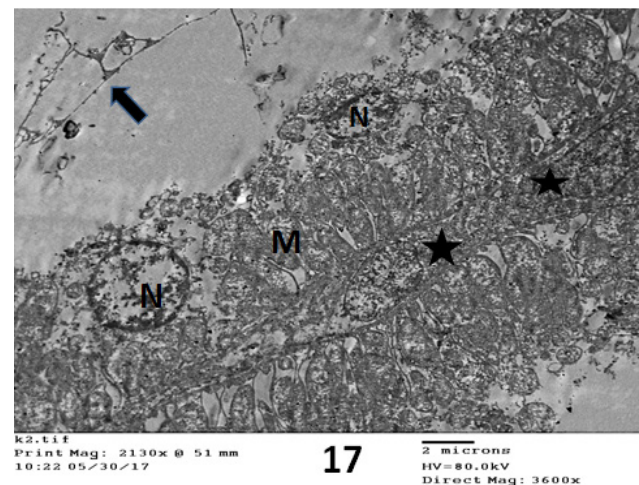


Fig. 17: An electromicrograph of the kidney (group III) showing: PT has destructed microvilli of brush border (arrow) and no basal infolding. Some nuclei showed chromatinolysis and other pyknotic nucleus (N). There are interstitial inflammatory cells in between cells (star). (×3600)

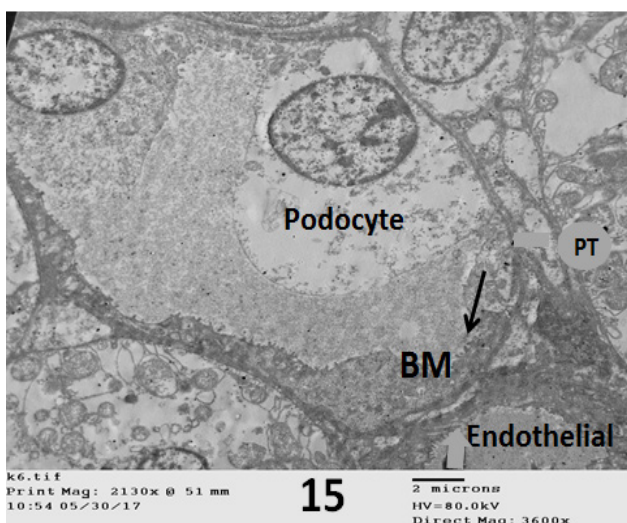


Fig. 15: An electromicrograph of the kidney (group III) showing: basement membrane of glomerular capillaries (BM), disruption of feet processes of Podocyte (arrow). (×3600)

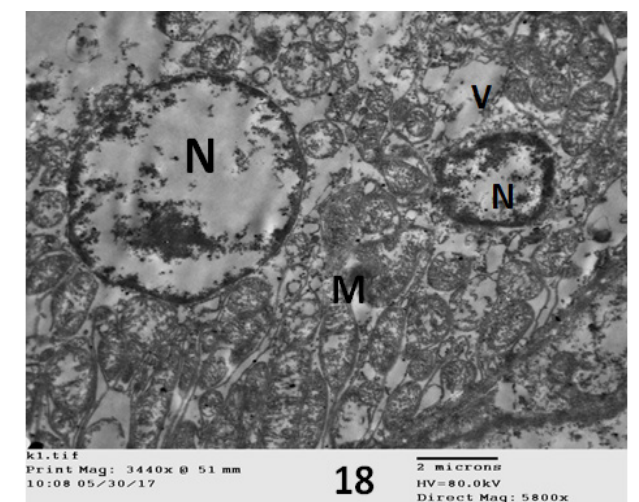


Fig. 18: An electromicrograph of the kidney (group III) showing: Cytoplasm of PT contains hypertrophy destructed cristae of mitochondria (M) and dilated RER (V). (×5800)

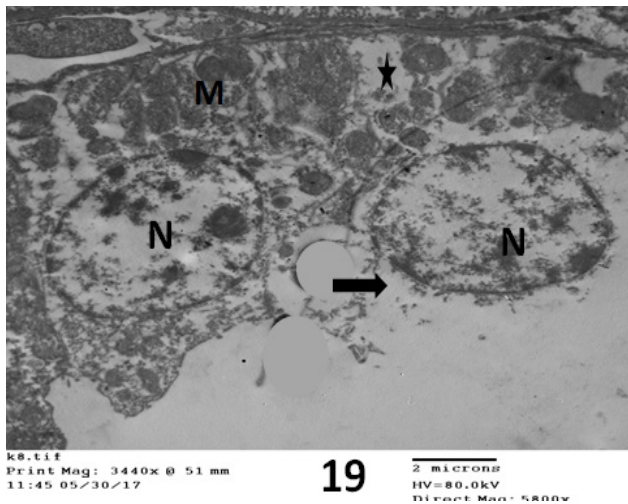


Fig. 19: An electromicrograph of the kidney (group III) showing: DT cells contain chromatinolytic nuclei (N), vacuolated cytoplasm (star), and destructed apical cell membrane (arrow). ($\times 5800$)

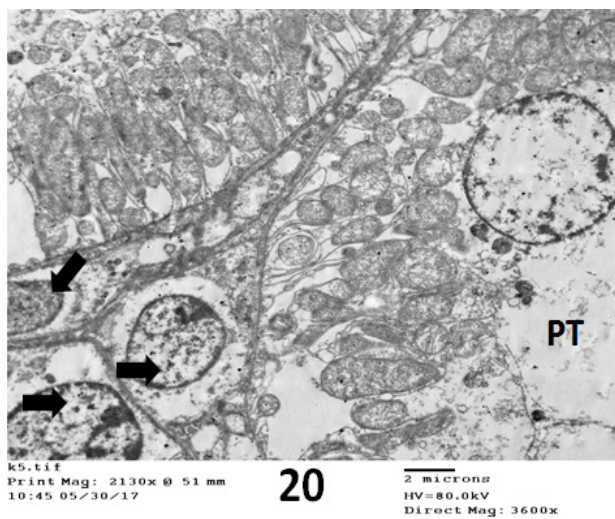


Fig. 20: An electromicrograph of the kidney (group III) showing: interstitial inflammatory cells in between cells of renal tubules (arrows). ($\times 3600$)

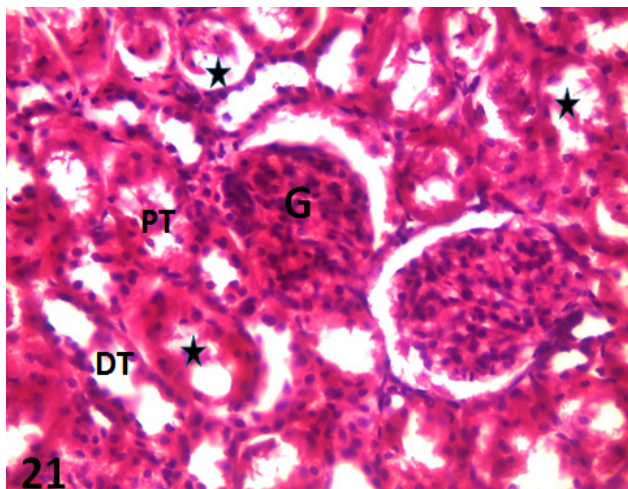


Fig. 21: A Photomicrograph of the kidney (group VI) stained by Hxand E showing: There still increase bowman's space but complete parietal layer (G), Some DT showed exfoliated cell remnant (star). ($\times 400$)

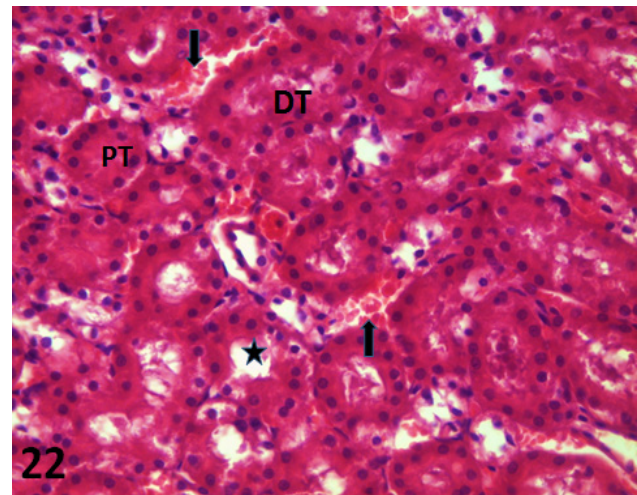


Fig. 22: A Photomicrograph of the kidney (group VI) stained by Hxand E showing: Some PT appears as normal with brush border and vesicular nucleus and acidophilic cytoplasm (PT). Others tubules show loss their brush border, vacuolated cytoplasm and dense nucleus (star). There was mild blood capillaries congestion (arrow). ($\times 400$)

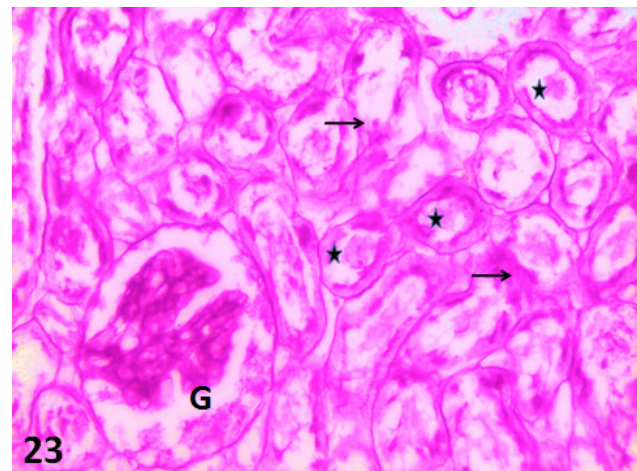


Fig. 23: A photomicrograph of the kidney (group VI) stained by PAS. There is moderate increase positive reaction compared to control in brush border and basement membrane (star) but other destructed (arrow). ($\times 400$)

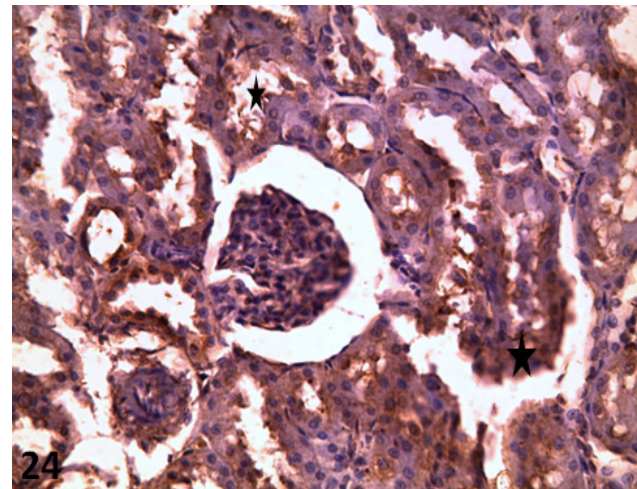


Fig. 24: A Photomicrograph of the kidney (group VI) stained by caspase 3. Some cells appear negative staining and others weakly positive cells compared to group II (star). ($\times 400$)

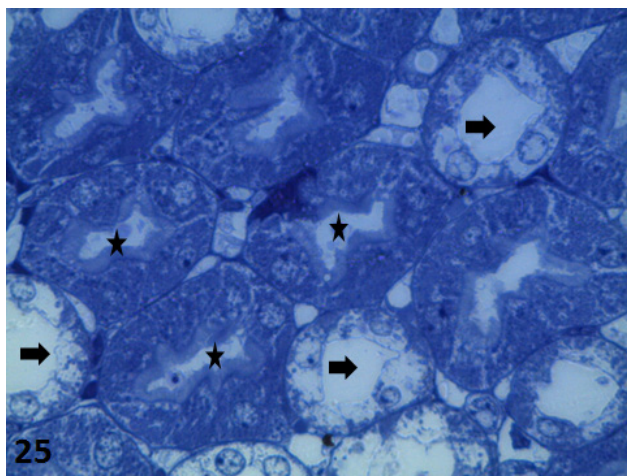


Fig. 25: A Photomicrograph of the kidney (group VI) stained by toluidine blue. , some PT cells appear increased intensity of the stain with basophilic granules with intact brush border (star) and other destructed brush border with vacuolated cytoplasm (arrows). (×1000)

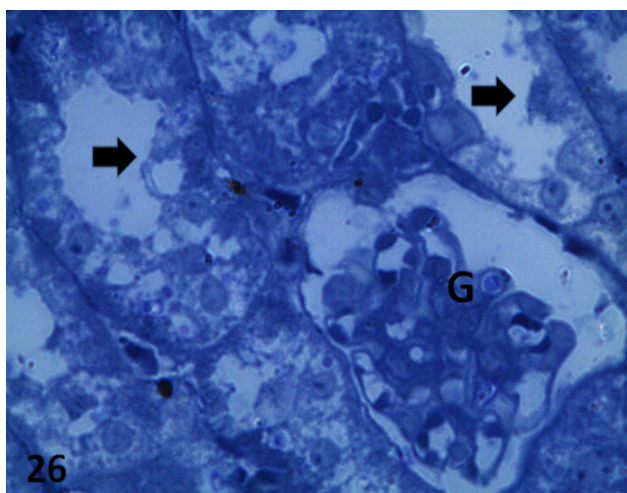


Fig. 26: A Photomicrograph of the kidney (group VI) stained by toluidine blue. There is intact parietal layer of Bowman's capsule but still mild widening of space of Bowman's capsule, destructed cells with vacuolated cytoplasm (arrows). (×1000)

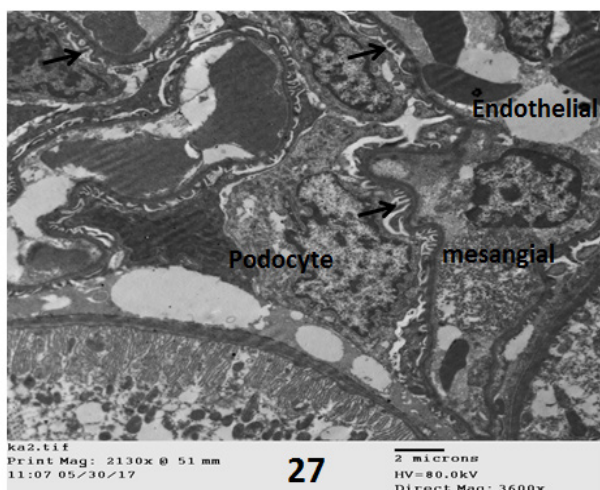


Fig. 27: An electromicrograph of the kidney (group VI) showing: podocyte with feet processes (arrow), endothelial cell of glomerular capillaries and mesingal cells. (×3600)

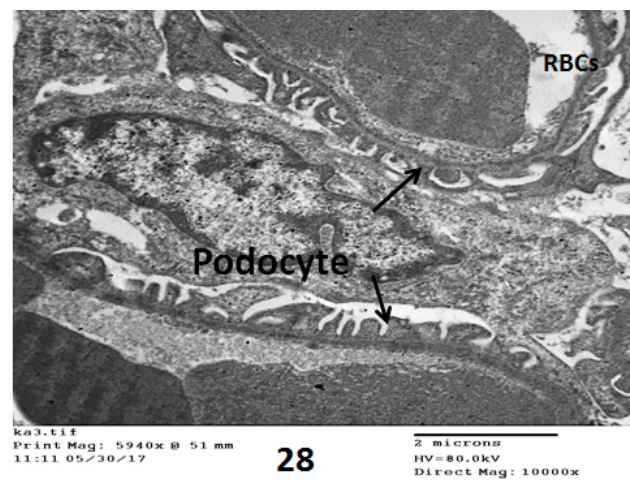


Fig. 28: A magnified part of previous section showing: podocyte with feet processes resting on thick basement membrane with lamina densa and lamina rara in between (arrow). (×1000)

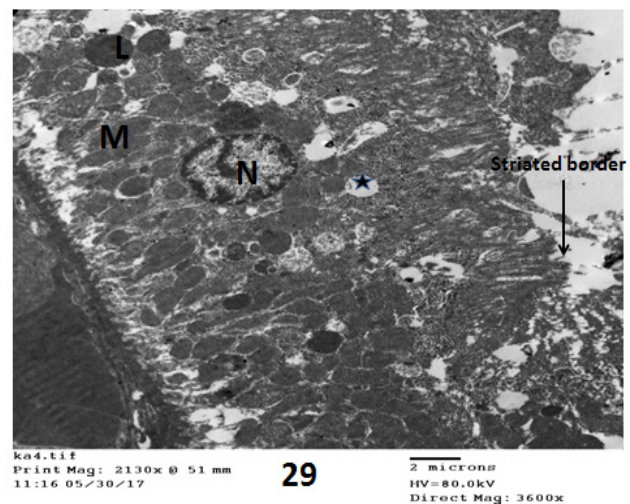


Fig. 29: An electromicrograph of the kidney (group VI) showing: PT with partially intact microvilli of brush border and some basal infolding with small dense basal mitochondria (M), small rounded euchromatic nucleus (N), numerous lysosomes (L) and intercellular junction (star). (×3600)

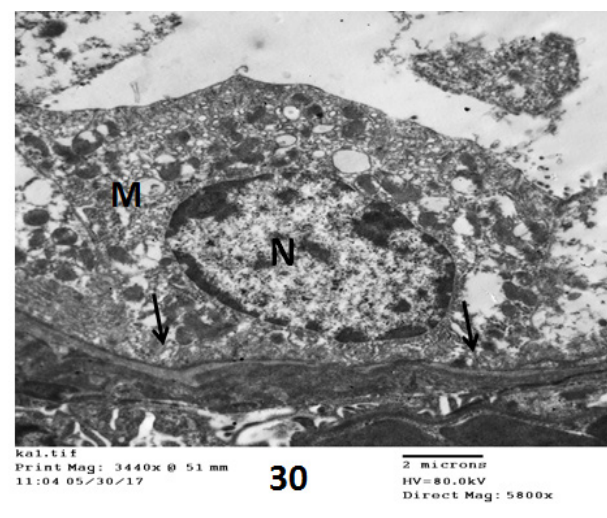


Fig. 30: An electromicrograph of the kidney (group VI) showing: DT loss of basal infolding (arrows) but mitochondria (M) and nucleus (N) similar to control. (×5800)

DISCUSSION:

This study revealed that MSG induced histological changes in cortical renal tubules of rats as destruction in lining epithelial cell and loss brush border. This could be explained by oxidative damage that initiated by reactive oxygen species (ROS) causing impairment of membrane function. MSG has a toxic effect on many body organs by altering ionic permeability of membranes and induces persistent depolarization^[13]. Balasubramanian *et al.*^[14] added that process of cellular necrosis involves disruption of membrane's structural and functional integrity.

The vacuolation in the cytoplasm of renal tubules described as a kind of cellular defensive mechanism against injurious substances^[15]. In addition Chevillat^[16] explained that these vacuoles are responsible for collecting the injurious elements and preventing them from interfering with the biological activities of these cells.

We observed interstitial cellular infiltration between the renal tubules and glomerulus with fat globules this result confirmed that activation of macrophages occurs in the presence of MSG material as strong antigens. Mehrotra and Shah^[17] described inflammatory cells around central vein of liver treated by MSG. Moreover, Hummdi^[18] reported that the macrophages destroyed the causes of damage and injured tissues.

Bowman's space increased with destructed partial layer of Bowman's capsule and atrophic glomerulus. Similar finding was reported by Eweka^[19] who showed varying degrees of cytoarchitectural distortion as well as reduction in the number of renal corpuscles in the MSG treated groups.

Furthermore, these changes might be secondary to depletion of carbohydrates in the cytoplasm of renal tubules as confirmed with PAS stain results. This correspondence with other studies suggested that disturbances in carbohydrate metabolism caused by modifying the activities of the enzymes of glycolytic pathway, gluconeogenesis and the oxidation of phosphorylation^[20,21].

The present study demonstrated that activated caspase 3 showed strongly positive cytoplasmic reaction in renal tubules and glomerular capillaries, this indicated apoptosis occurred in the cytoplasm with shrunken cells in MSG treated group. This was in line with Roset *et al.*^[22] who revealed that caspase 3 was significantly increased while Bcl-2 significantly depressed in the rats treated by MSG in both the hepatic and testicular tissues. In the other study showed that MSG induced cell death via apoptotic mechanism in thymocyte cultures by using Annexin marker^[23]. Also, according to Green^[24] mentioned that MSG depressed the activities of antioxidant enzymes, then free radicals accumulated in the body induced the lipid peroxidation of the membrane. So oxidative damage could occur in mitochondria and cause the release of proapoptotic proteins into the cytosol, which resulted in cellular apoptosis.

Obtained results are in agreement with Schelman *et al.*^[25] who indicated that glutamate receptors may be the result of apoptosis and necrosis depending on the severity of stimulation induced by MSG. This explained by Kanki *et al.*^[26] as glutamate induced Ca²⁺ influx and disruption of the inner transmembrane potential of the mitochondria, which resulted in opening the mitochondria permeability transition pore and procaspases are released into the cytosol which results in apoptosis. According to Walker and Lupien^[27] the circulating of MSG was dissociated in sodium (Na⁺) and L-glutamate which crosses the peritoneal cells and the bloodstream then transformed into glutamine which cause damage of cells. In addition, Farombi^[12] reported that MSG has been to increase oxidative stress causing hepatotoxic and nephrotoxic effects and this agree with our results.

The ultrastructure results of our study revealed degenerative changes in the form of thickening of glomerular capillaries basement membrane and foot processes of podocyte were segmentally fused. These results agree with Kumar^[28] who stated that adiponectin deficiency caused podocyte dysfunction in mice through oxidative damage. The most prominent alternation was destructed apical microvilli of P.T, loss basal infolding, and destroyed cristae of mitochondria, dilated RER, some chromatinolytic and other pyknotic nuclei. Similar results have been demonstrated by Nayanatara *et al.*^[11] who stated that MSG led to nuclear, cytoplasmic damage and loss of functional efficiency of the cells as signs of apoptosis and this agree with our results by immunohistochemistry examination.

In our study, we demonstrated group treated by vitamin C and MSG showed an improvement in histological changes in comparison with a group of rats received MSG only. It has been established ascorbic acid is an antioxidant and has the ability to scavenge radicals of oxidative stress induced by MSG^[29]. These results agreement with Barros *et al.*^[30] who reported that vitamin C led to a marked reduction in the histopathological degeneration in tissues by toxic agents. Pavlovic *et al.*^[23] found that treatment with ascorbic acid may prevent the MSG-induced cytotoxicity in rat thymocytes by up-regulating Bcl-2 protein expression. Farombi^[12] reported that application of vitamin C protect cells against oxidative cell death by complete suppression of ROS and had a modulator effects on MSG in the liver and kidney of rats.

CONCLUSION:

The results of this study add our understanding of MSG induced the histological, immunohistochemical and ultrastructure changes resulting in an apparent kidney injury. The ascorbic acid can ameliorate these effects.

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الملخص العربي

التأثيرات الوقائية المحتملة لفيتامين سي مع جلوتاميد أحادي الصوديوم المسبب لسمية الكلي لذكور الفئران البيض

إيمان البدري رجب

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المقدمة: جلوتاميد أحادي الصوديوم هو ملح الصوديوم للحمض الأميني الجلوتاميك , و يستخدم على نطاق واسع كمادة مضافة للغذاء لتحسين مذاق الطعام و على الرغم من تحسينه المذاق أشارت التقارير إلى أنه سام للإنسان والحيوانات التجريبية. وقد أظهرت الدراسات أن الجلوتامات في جرعات عالية تسبب تغيرات وتلف للخلايا وضرر تأكسدي في مختلف أجهزة الجسم. تعتبر الكلي عضو مهم لتقييم الأضرار الناتجة عن العلاج ولذلك تم دراسته هستولوجياً .

حمض الأسكوربيك هو فيتامين سي له تأثير مضاد للأكسدة يمنع الإنتاج الزائد للشوارد الحرة الناتج عن تلف الخلايا الناتج عن السموم . لذلك من الممكن أن يكون له تأثير واقئ ضد السمية الناتجة عن جلوتاميد أحادي الصوديوم ونظراً لأن حمض الأسكوربيك و جلوتاميد أحادي الصوديوم من الممكن تواجدهما معاً في نفس الوجبة فمن المهم دراسة التأثير الوقائي المحتمل لحمض الأسكوربيك من أضرار جلوتاميد أحادي الصوديوم.

أهداف البحث: دراسة تأثير جلوتاميد أحادي الصوديوم على كلي الفئران البيضاء البالغة والتأثير الوقائي المحتمل لحمض الأسكوربيك.

أدوات وطرق البحث: استخدمت مادة جلوتاميد أحادي الصوديوم و حمض الأسكوربيك.

الفئران و العلاج: أجريت التجربة علي اربعين من ذكور الفئران البيضاء و التي تتراوح اوزانها ما بين 190 الى 200 جرام مقسمة إلى اربع مجموعات, كل مجموعة تحتوي على عشرة فئران:

المجموعة الأولى: هي المجموعة الضابطة.

المجموعة الثانية: وقد تم علاجها بمادة حمض الأسكوربيك 500 مجم لكل كجم لمدة 4 اسابيع.

المجموعة الثالثة: وقد تم علاجها بمادة جلوتاميد أحادي الصوديوم و ذلك بالحقن داخل التجويف البروتوني بجرعة 4 ميليغرام/ كيلوغرام /يوم وذلك لمدة 4 اسابيع.

المجموعة الرابعة : وقد تم علاجها بمادة حمض الأسكوربيك 500 مجم لكل كجم لمدة اسبوع ثم جلوتاميد أحادي الصوديوم و ذلك بالحقن داخل التجويف البروتوني بجرعة 4 ميليغرام/ كيلوغرام /يوم متزامناً مع حمض الأسكوربيك بالحقن داخل التجويف البروتوني يوماً لمدة 4 اسابيع بنفس الجرعة السابقة.

و في نهاية مدة البحث ذبحت الفئران , استؤصل الكلي منها, ثم جهزت العينات وصبغت الشرائح, و فحصت بواسطة الميكروسكوب الضوئي والالكتروني.

النتائج: وقد أظهرت العينات تأثير مادة جلوتاميد أحادي الصوديوم على كلي الفئران على مستوى التغيرات النسيجية على هيئة وجود ضمور في خلايا الانابيب الكلوية و كان هناك زيادة في عدد الخلايا الميتة مقارنة بالمجموعة الضابطة. كما اظهر الفحص بالميكروسكوب الالكتروني تجوف داخل سيتوبلازم وتضخم الميتوكوندريا, كما ظهرت بعض الانوية صغيرة الحجم مطموسة والبعض به تجمع طرفي للكروماتين. بينما اظهرت المجموعة الرابعة تحسن ملحوظ الى درجة ما في تركيب الكلي وقلة عدد الخلايا الميتة.

ونستنتج من هذه الدراسة أن استخدام مادة جلوتاميد أحادي الصوديوم له تأثير سلبي علي الكلي وأن حمض الأسكوربيك له تأثير وقائي من الآثار السلبية لجلوتاميد أحادي الصوديوم.