Original Article

Ameliorative Effects of Vitamin C and Vanillin against Potassium Bromate Toxicity in Male Albino Rats: Biochemical, Hematological and Histological Study

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ABSTRACT

Introduction: Potassium bromate ($KBrO_3$) is a halogen that is widely existing in the environment and used mainly as a food additive. $KBrO_3$ causes severe damage to many tissues through ROS generation. Exogenous antioxidants are used to protect against and/or treat the KBrO3 toxicity.

Aim of the Work: To examine the treatment efficiency of vitamin C (Vit C) or/and vanillin against $KBrO_3$-induced biochemical, hematological, oxidative stress and hepatic and renal histological alterations in male albino rats.

Materials and Methods: Forty five adult male albino rats were categorized into 9 groups equally; Control, Vit C (30mg/kg), Vanillin (100mg/kg), Vit C + Vanillin, $KBrO_3$ (25mg/kg), KBrO3 withdrawal, $KBrO_3$ + Vit C, $KBrO_3$ +Vanillin and $KBrO_3$ +Vit C +Vanillin. Rats administrated $KBrO_3$, vitamin C and vanillin orally and daily for 10 weeks. Rats were sacrificed, blood and tissues were gathered and handled for biochemical, hematological and histological studies.

Results: $KBrO_3$ oral administration increased the serum levels of alanine amino transferase (ALT), aspartate amino transferase (AST), gamma glutamyl transferase (γ-GT), malondialdehyde (MDA), uric acid and creatinine and significantly decreased the levels of total protein (TP), super oxide dismutase (SOD), WBCs, RBCs, platelets and hemoglobin (Hb). $KBrO_3$ induced hepatic central vein congestion, hepatocytes necrosis, cellular infiltration, atrophy of the glomeruli, renal tubular epithelial cells necrosis and degeneration and infiltration of inflammatory cells. Combined vitamin C or/and vanillin administration attenuated the KBrO3-induced dysfunction by decreasing ALT, AST, γ-GT, MDA uric acid and creatinine levels' and elevating TP, SOD, WBCs, RBCs, platelets and Hb levels' and by improving the liver and kidney architectural lesions.

Conclusion: Vitamin C and Vanillin ameliorates the hematological markers, liver and kidney functional and histological alterations induced by KBrO3 through their antioxidant properties.

Received: 19 February 2023, **Accepted:** 10 May 2023

Key Words: Antioxidant, curcumin nanoparticles, radiation, reactive oxygen species, tongue.

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ISSN: 1110-0559, Vol. 47, No. 2

INTRODUCTION

Potassium bromate ($KBrO_3$) is a halogen generated from disinfecting water by using chlorine and ozone[1]. Mostly, bromate is used in bread-baking processes, cosmetic industries, cheese production and beer making[2,3,4]. The major cause of in *vivo* toxicity of $KBrO_3$ is oxygen reactive species (ROS) aggregation and oxidative stress[1,5]. This prompted oxidative stress leads to tissues' damage through modifications in the cellular critical molecules[6]. $KBrO_3$ was reported to induce tissues' toxicity and tumors in several animals and human[7].

Several antioxidants have a protecting or/and treating adequacy against $KBrO_3$-induced toxicity. Vitamin C (Vit C) is a highly effective water-dissolvable antioxidant. Vit C does not synthesized in human, so its sources are vegetables and fruits. Vit C is desired for collagen formation, maintaining healthy skin, gums and blood vessels, inorganic iron absorption, plasma cholesterol level reduction, and immune system inducment[8]. It protects the essential biological macromolecules from oxidative stress damage[9].

Natural products of medicinal plants possess hepatoprotective, antioxidant, chemotherapeutic, and anti-inflammatory properties[10]. Vanillin is a polyphenol compound isolated from Vanilla planifolia pod and bean. It is vastly utilized as a relish material in food, drinks, pharmaceutical products and perfumes[11]. Vanillin possess several biological properties; antioxidant, anti-inflammatory, antimutagenic and antitumor properties[12,13,14] and these properties are related to its dynamic ingredients[15]. Therefore, our study was designated to estimate Vit C or/and vanillin ability in treating $KBrO_3$ toxicity through evaluating the biochemical, oxidative and anti-oxidative, hematological markers and histological variations in adult male albino rats.

 DOI: 10.21608/ejh.2023.191687.1853

MATERIALS AND METHODS

Study design

Forty five adult male albino rats, their weights range from 130 to 150 gm were housed in the animal house of Faculty of Science, Damietta University, New Damietta under the standard conditions in neat fully aired plastic crates and had a loose access to typical diet and water throughout the experiment. All animals' proceedings were performed based on the National Institute of Health guide for the care and use of laboratory animals, and the protocol of the study was confirmed by our institute (5/3/1/3/2).

Rats were classified into 9 groups; each one had 5 rats and received one or more of $KBrO_3$, Vit C and vanillin orally and daily for 10 weeks.

Group1 (control): Rats served as a control group.

Group 2 (Vit C): Rats obtained 30mg/kg of Vit C[16].

Group 3 (Vanillin): Rats obtained 100 mg/kg of vanillin[17].

Group 4 (Vit C +Vanillin): Rats obtained a mixture of Vit C and vanillin.

Group 5 ($KBrO_3$): Rats obtained 25 mg/kg of $KBrO_3$[18].

Group 6 ($KBrO_3$ withdrawal): Rats obtained 25 mg/kg of $KBrO_3$ then $KBrO_3$ was withdrawn for 2 additional weeks.

Group 7 ($KBrO_3$+Vit C): Rats obtained 25mg/kg of $KBrO_3$, and then Vit C (30mg/kg) was administrated 2 hr later.

Group 8 ($KBrO_3$+Vanillin): Rats obtained 25mg/kg of $KBrO_3$, and then vanillin (100mg/kg) was administrated 2 hr later.

Group 9 ($KBrO_3$+Vit C+Vanillin): Rats received 25mg/kg of $KBrO_3$, and then a mixture of Vit C and vanillin was administrated 2 hr later.

Chemicals

The chemicals used in the present study are: $KBrO_3$ (Sigma Chemicals, Sigma, St Louis, MO), absolute ethanol and Xylene (Supelco Inc- Sigma-Aldrich, USA), vitamin C (Windmill vitamin C-1000mg, USA), Vanillin (powder, ReagentPlus®, Sigma-Aldrich USA), Eosine yellow (Alpha Chemika, India), Hematoxylin (solution, Techno Pharmchem, India) and PBS (liquid, ThermoFisher, USA).

Specimens' preparation

By the experiment end, rats were sacrificed after anesthetization by 50 mg/kg ketamine and 5 mg/kg xylazine intraperitoneally[19] and blood from heart were directly piled up. For rating hepatic and renal function parameters' values, the blood was let to curd at 37ºc for 10 min, centrifuged for 10 min at 3000rpm at room temperature then serum was gathered and preserved at -20ºc for further use. Blood aliquots were added to EDTA containing tubes and used immediately for the hematological assessment. Liver homogenates were prepared by homogenizing liver samples in 5-10 ml cold buffer per gram tissue then centrifuged for 15 min at 18000g (4°C) to estimate oxidative stress markers.

For the histological checking, liver and kidney samples' were taken and fixed in 10% buffered formalin and handled to paraffin blocks. Then 5µm sections were stained with hematoxylin/eosin (H&E)[20].

Biochemical assessment of hepatic function parameters

Important biochemical parameters including serum ALT, AST, γ-GT and TP were rated using GPT (ALT)-LQ (SPINREACT, Spain), GOT (AST)-LQ kit (SPINREACT, Spain), (γ-GT) kit (BioSystems, Spain) and total protein kit (SPINREACT, Spain), respectively.

Estimation of some oxidative stress markers

The liver supernatant of homogenate was used to measure spectrophotometrically the MDA and SOD levels using MDA and SOD kits (Biodiagnostic, Egypt), respectively.

Biochemical assessment of renal function parameters

Serum was used to measure uric acid and creatinine using Uric acid-LQ kit (SPINREACT, Spain) and CREATININE-J kit (SPINREACT, Spain), respectively.

Assessment of hematological parameters

The blood samples collected into a tube containing EDTA were used to preform complete blood count (CBC) using automated hematology analyzer (KT6400, Genrui Biotech, China).

Statistical analysis

For each measured parameter; the statistical significance of the differences among groups was determined using One-Way Analysis of Variance (ANOVA) followed by Post Hoc tests. When $P<0.05$, it is considered significant.

RESULTS

Liver biochemical parameters

No remarkable discrepancy in serum ALT (P=0.857, 1.000, 0.998), AST (P= 0.998, 1.000, 1.000), γ-GT (P=1.000, 1.000, 1.000), and TP (P=0.461, 0.973, 1.000) levels' (Figure 1) between control group and Vit C, vanillin, and Vit C and vanillin-treated groups, respectively. In $KBrO_3$-treated group, the serum ALT level was increased but not significantly (P=0.339), the AST and γ-GT levels' were notably increased (P=0.000 and 0.004), respectively, and the TP level was crucially declined (P=0.000) comparing to control (Figure 1). When comparing $KBrO_3$-treated and withdrawn group with the $KBrO_3$-treated group, the serum ALT and AST levels' were decreased but not significantly (P= 0.539 and 0.098), respectively, γ-GT was appreciably decreased (P= 0.037) and the

TP level was grow up but not significantly (*P*= 0.990) (Figure 1). Treated-rats with $KBrO_3$ and Vit C revealed no significant (*P*= 0.941 and 0.956) reduce in ALT and γ-GT levels', respectively, while the AST level was decreased significantly (*P*= 0.000) and the TP level was increased crucially (*P*= 0.000). Treatment with $KBrO_3$ and vanillin expressed no significant decrease (*P*= 0.655 and 0.584) in ALT and γ-GT values', respectively, a notable decrease in AST (*P*= 0.000) and a significant boost (*P*= 0.000) in the TP level (Figure 1). Combined treatment with $KBrO_3$, Vit C and vanillin caused significant (*P*= 0.391 and 0.499) diminution in ALT and γ-GT, respectively, a significant low in the AST (*P*= 0.000) and serious increase the TP level (*P*= 0.000) (Figure 1).

Oxidative and antioxidant parameters

No significant modifications (*P*=1.000 for each) in MDA level between control and Vit C, vanillin and Vit C and vanillin treated groups was appeared (Figure 2A). Compared with control, MDA level exposed noteworthy increase (*P*=0.000) in $KBrO_3$-treated group (Figure 2A). MDA levels' were significantly lessened (*P*=0.001, 0.000, 0.000, 0.000), respectively, in $KBrO_3$-treated and withdrawn, $KBrO_3$ and Vit C, $KBrO_3$ and vanillin and $KBrO_3$ and Vit C and vanillin-treated groups compared to $KBrO_3$-treated group (Figure 2A).

The SOD level as antioxidant activity marker, did not significantly (*P*=0.050, 0.658 and 0.861), respectively, differ between the control and Vit C, vanillin and Vit C and vanillin-treated groups (Figure 2B). In the $KBrO_3$-treated group, the SOD efficiency was significantly declined (*P*=0.000). While in $KBrO_3$-treated and withdrawn, $KBrO_3$ and Vit C, $KBrO_3$ and vanillin and $KBrO_3$ and Vit C and vanillin - treated groups, SOD value was markedly rised (*P*=0.001, 0.000, 0.000, 0.000), respectively, matched with the $KBrO_3$-treated group (Figure 2B).

Biochemical parameters

There was no notably change in the levels of uric acid (*P*= 1.000 for each) and creatinine (*P*=0.919, 1.000, 0.974), respectively, (Figures 2C,D) between the control and Vit C, vanillin, and Vit C and vanillin-treated groups. In $KBrO_3$-treated group, uric acid was significantly enhanced (*P*=0.000), while the creatinine level was increased but not significantly (*P*=0.662) (Figures 2C,D). Uric acid level in $KBrO_3$-treated and withdrawn, $KBrO_3$ and Vit C, $KBrO_3$ and vanillin, $KBrO_3$ and Vit C and vanillin treated groups, was significantly lowered (P=0.010, 0.014, 0.000, 0.000), respectively (Figure 2 C). Compared to $KBrO_3$-treated group, creatinine was diminished significantly (*P*=0.002) in $KBrO_3$ and Vit C-treated rats, and decreased but not significantly (*P*=0.183, 0.458, 0.223,), respectively, in $KBrO_3$ treated and withdrawn, $KBrO_3$ and vanillin, $KBrO_3$ and Vit C and vanillin treated groups (Figure 2 D).

Hematological parameters

No significant variances in the WBCs (*P*=1.000, 0.998, 0.956), RBCs (*P*= 0.933, 0.999, 1.000), platelet counts (*P*=1.000, 1.000, 1.000) and Hb (*P*=0.812, 0.932, 0.736) (Figure 3) between the control and Vit C, vanillin, and Vit C and vanillin treated groups, respectively, were detected. In $KBrO_3$-treated group, WBCs, RBCs, platelet counts and Hb concentration were significantly declined (*P*= 0.008, 0.031, 0.014, 0.000), respectively compared with control (Figure 3). In contrast to $KBrO_3$ treated group, the WBCs, RBCs and platelet counts were increased but not significantly (*P*= 0.980, 0.311, 0.477), respectively, while Hb concentration was markedly increased (*P*= 0.002) in $KBrO_3$ treated and withdrawn group (Figure 3). $KBrO_3$ and Vit C treated rats revealed no significant (*P*= 0.586, 0.722 and 0.395) increase in WBCs, RBCs and platelet counts, respectively, while the Hb concentration was significantly raised (*P*= 0.014). Treatment with $KBrO_3$ and vanillin increased but not significantly (*P*= 0.442 and 0.056) WBCs and RBCs, respectively, while the platelet count and Hb concentration was significantly mounted up (*P*= 0.030 and 0.000), respectively, (Figure 3). Treatment with $KBrO_3$ and Vit C and vanillin increased WBCs, RBCs and platelet count but not significantly (*P*= 0.107, 0.505 and 0.055), respectively, while the Hb level was significantly enhanced (*P*= 0.000) (Figure 3).

Histological results of liver

Checking H&E stained liver sections of control, Vit C, Vanillin and Vit C and vanillin treated rat groups showed similar histological structure which showed normal hepatic architecture. Hepatocytes were coordinated in cords raying out from central veins to the portal areas and isolated by sinusoids. Hepatocytes have vesicular nuclei at the center with eosinophilic cytoplasm. Some cells have binucleated nuclei. Blood sinusoids contain Kupffer cells (Figures 4A-D). Sections of $KBrO_3$-treated group expressed hepatic architectural abnormalities with congested and expanded central vein, sinusoids were infiltrated with inflammatory cells and sinusoidal spaces were filled with blood. Apparent increases in kupffer cells number were detected. Some necrotic hepatocytes and other with vacuolated cytoplasm were observed (Figures 4E,F). In $KBrO_3$ treated and withdrawn, $KBrO_3$ and Vit C, $KBrO_3$ and vanillin and $KBrO_3$ and Vit C and vanillin treated groups; the hepatic architecture restored its normality with some congested sinusoids and some dilated sinusoids with slight kupffer cells' presence. Hepatocytes are close to normal with normal euchromatic nuclei (Figures 4G-J).

Histological results of kidney

Checking H&E stained kidney sections of control, Vit C, Vanillin and Vit C and vanillin treated rat groups revealed normal renal cortex architecture. Typical glomeruli framed by Bowman's capsule and identical renal tubules were seen (Figures 5A-D). Rats treated with $KBrO_3$ showed atrophy of the glomeruli, glomerular tuft's congestion and expansion of the Bowman's space. Necrosis, degeneration and loss of the lining epithelium of the epithelial cells of the kidney tubules were observed. Also interstitial hemorrhage and interstitial cellular infiltration were observed (Figures

5E,F). In $KBrO_3$ treated and withdrawn and $KBrO_3$ and Vit C treated groups, renal Malpighian corpuscles and tubules restored their normal structure but some degenerative tubules, interstitial hemorrhage and interstitial infiltration were observed (Figures 5G,H). $KBrO_3$ and vanillin and $KBrO_3$ and Vit C and vanillin treated groups showed close to normal renal architecture (Figures 5I,J).

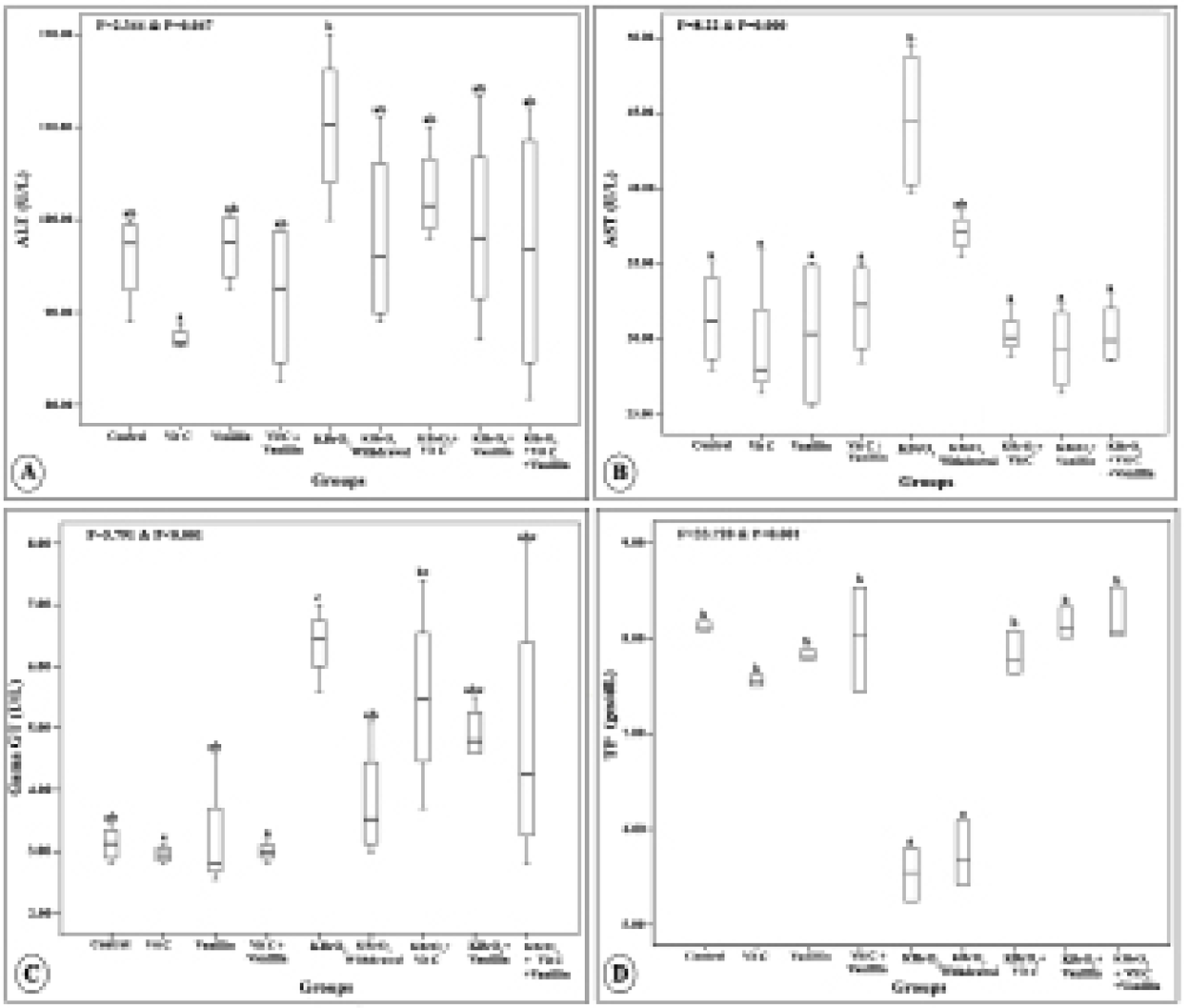

Fig. 1: Serum levels of liver function parameters in different rat groups. A: ALT, B: AST, C: γ-GT and D: TP. Bars represent standard errors. Values with same letter indicate no significant variation. Significant variation is represented by different letters.

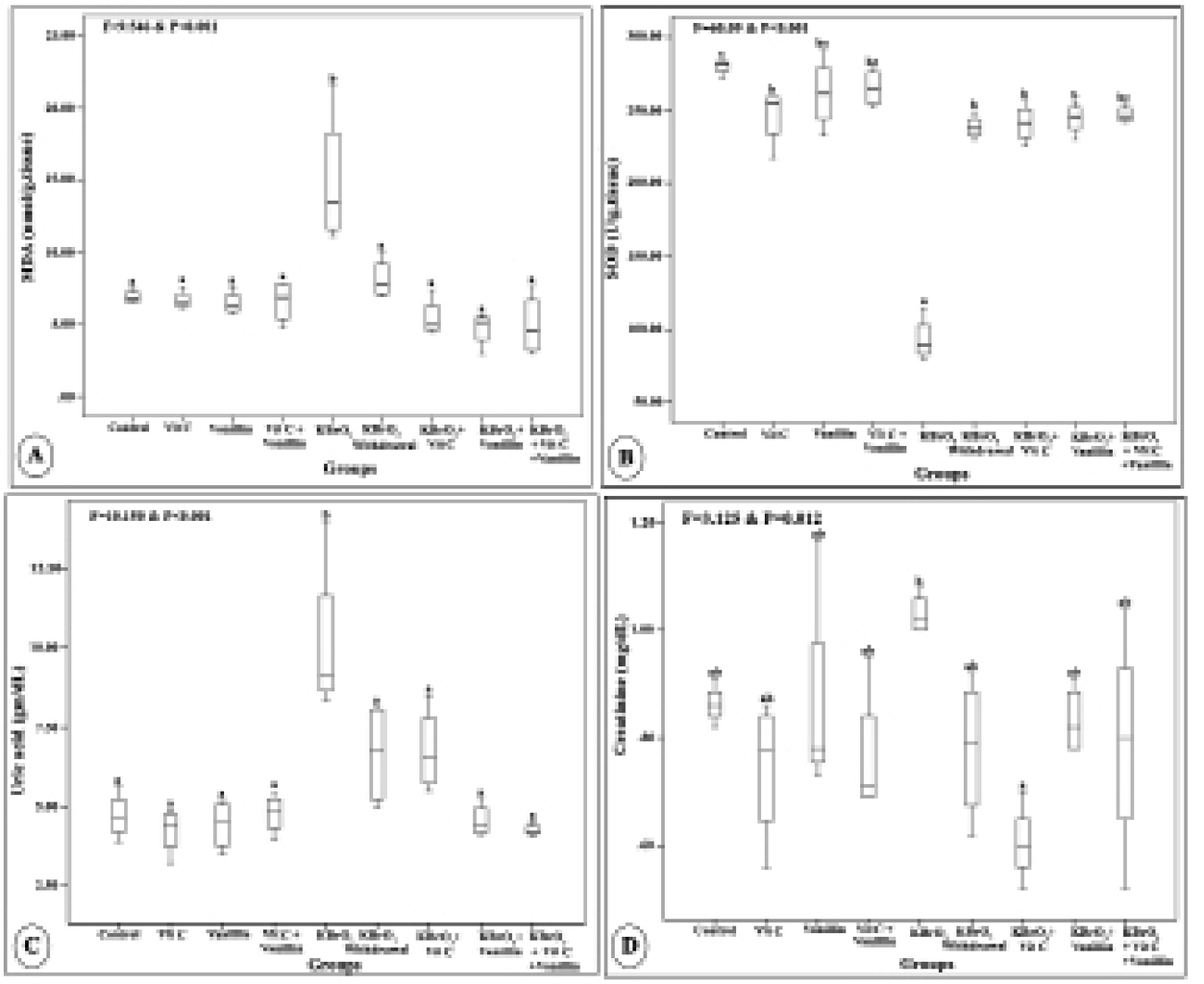

Fig. 2: Levels of some oxidative, antioxidant, and kidney function parameter in different rat groups. A: MDA, B: SOD, C: uric acid and D: creatinine. Bars represent standard errors. Values with same letter indicate no significant variation. Significant variation is represented by different letters.

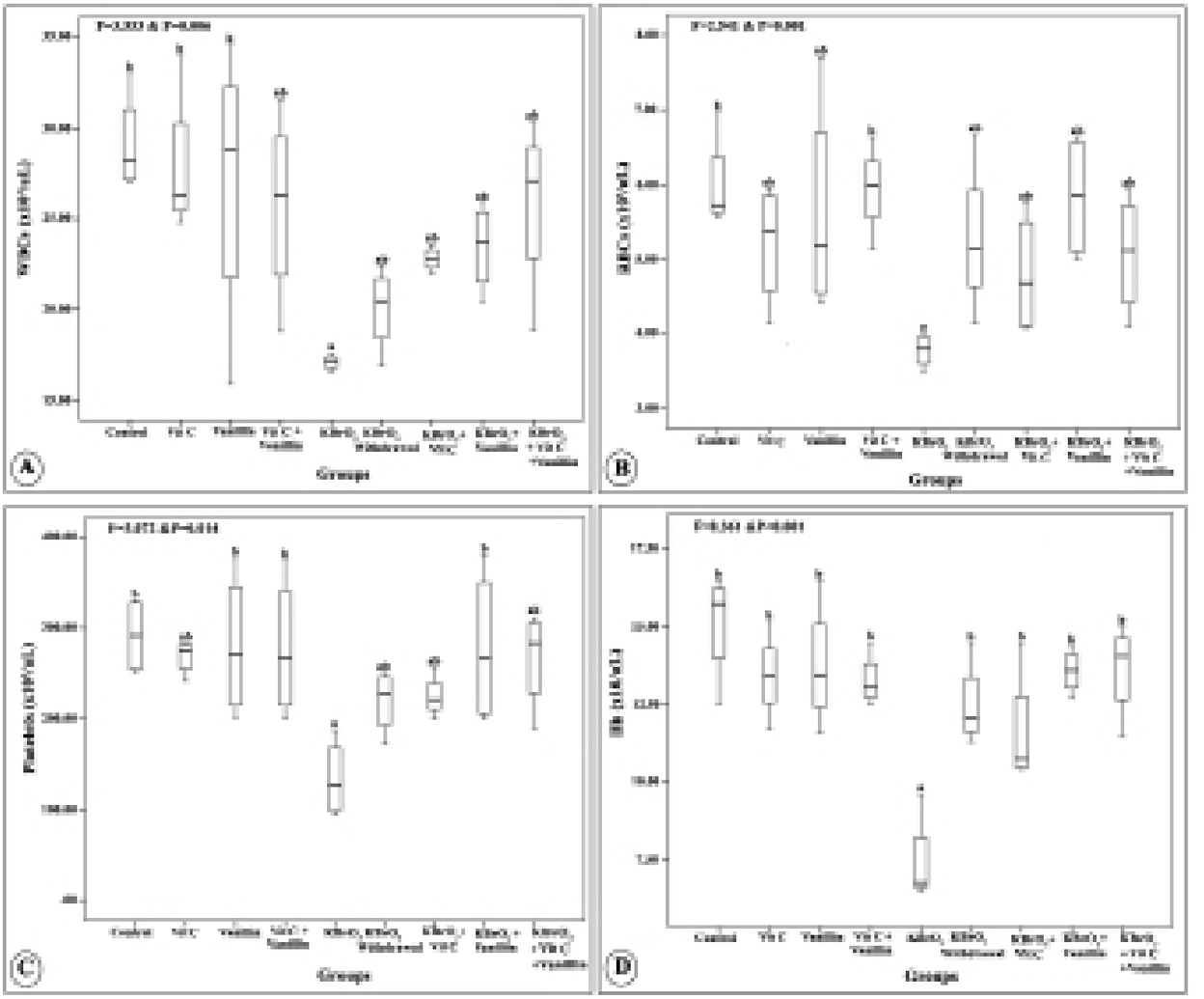

Fig. 3: Levels of hematological parameters in different rat groups. A: WBCs count, B: RBCs count, C: platelets count and D: Hb concentration. Bars represent standard errors. Values with same letter indicate no significant variation. Significant variation is represented by different letters.

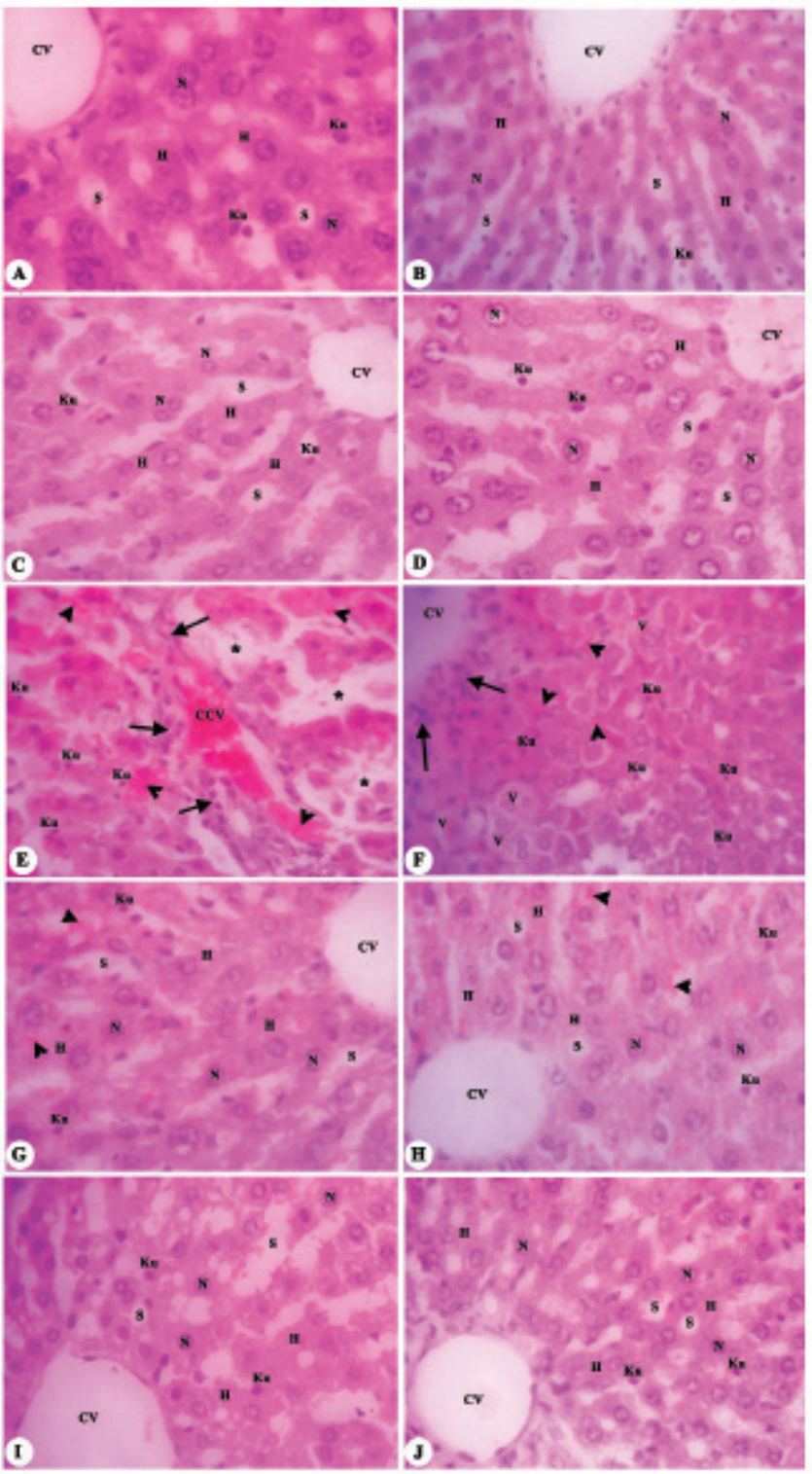

Fig. 4: Photomicrographs of liver sections of different rat groups (400 X). A: control group, B: Vit C-treated, C: vanillin-treated, D: Vit C and vanillin-treated, E&F: KBrO3-treated, G: KBrO3-treated and withdrawn, H: KBrO3 and Vit C-treated, I: KBrO3 and vanillin-treated, J: KBrO3 and Vit C and vanillin-treated. CV: central vein, CCV: congested central vein, H: hepatocyte, N: nucleus, S: sinusoid, Ku: kupffer cells, arrow: infiltration, arrow head: blood congestion, V: vacuolated cytoplasm, *: necrosis

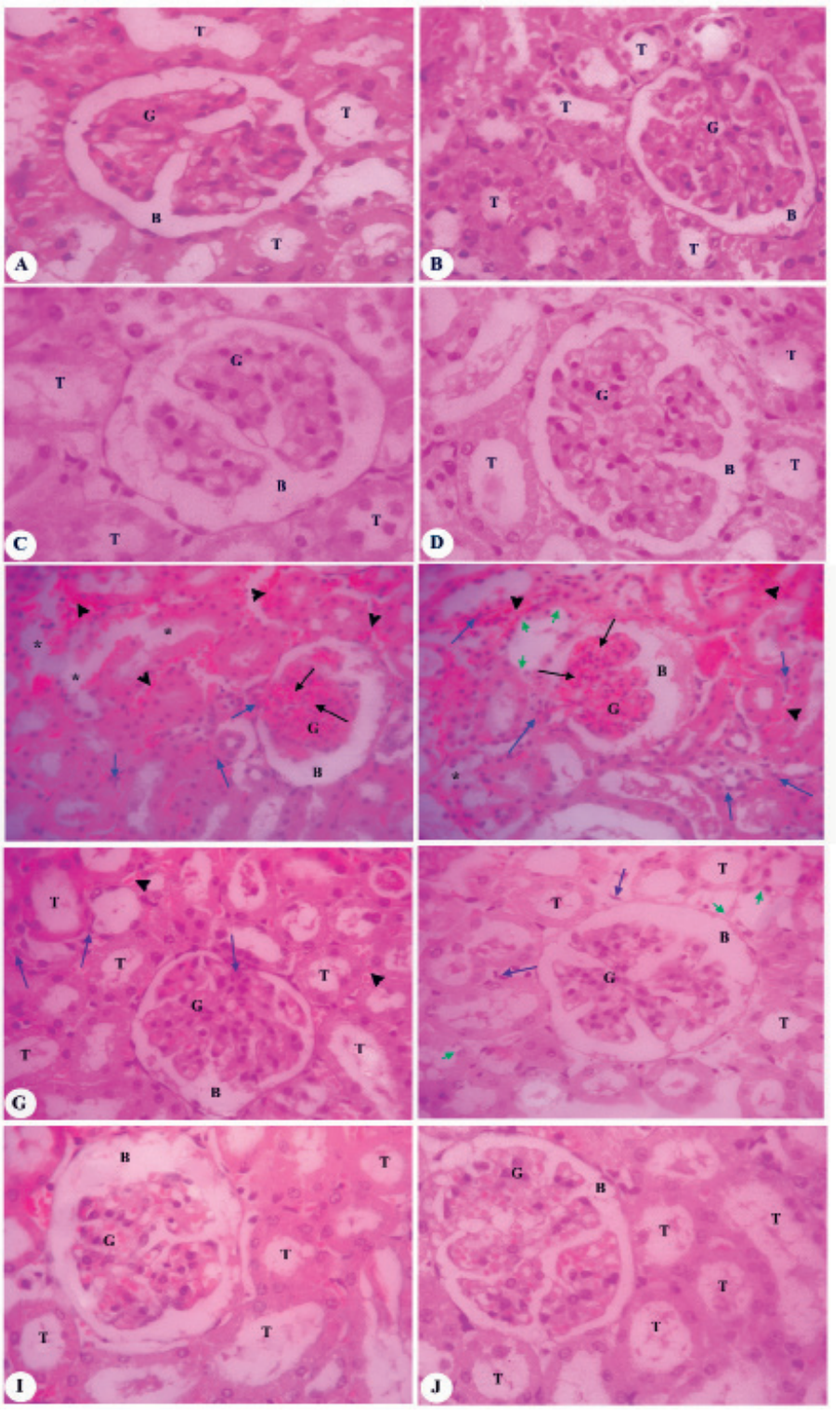

Fig. 5: Photomicrographs of kidney sections of different rat groups (400 X). A: control group, B: Vit C-treated, C: vanillin-treated, D: Vit C and vanillin-treated, E&F: KBrO3-treated, G: KBrO3-treated and withdrawn, H: KBrO3 and Vit C-treated, I: KBrO3 and vanillin-treated, J: KBrO3 and Vit C and vanillin-treated. G: glomeruli, B: Bowman's space, T: tubules, black arrow: glomerular tuft congestion, blue arrow: interstitial infiltration, green arrow: loss of the lining epithelium, arrow head: interstitial hemorrhage, *: necrosis.

DISCUSSION

Metabolism of certain drugs and toxic chemicals releases free radicals. Oxidative stress derived from disparity between the free radicals production and antioxidants disturbing cell functionality leading to tissue injury and various pathological states[21].

$KBrO_3$ is widely used in bread making, pharmaceuticals and cosmotic industries[4,22]. $KBrO_3$ biotransformation has virulent effects in *vivo* by outputting ROS, which desolate cellular homeostasis and tissues' architectural perfection[23,24].

Hepatic injury manipulates the hepatocytes' cell membrane constancy triggering seepage of the intracellular enzymes into circulation[25]. Clinically, the injury of the liver is investigated through measuring the biochemical parameters levels[26]. The high serum AST and ALT activities are often used as hepatic injury markers[21]. In recent study, $KBrO_3$ caused significant augmentation in AST and γ-GT levels, while ALT level was increased but not significantly and a crucial lowering in the TP level. The current outcomes are in harmony with previous studies[27-29].

$KBrO_3$ is a potent oxidant that promotes lipid peroxidation whose waste products damage cellular macromolecules. MDA is indicator for assessing peroxidation of lipids. The increased concentration of MDA and decreased antioxidants' levels trigger tissue spoil and failure of cell's antioxidants to hinder excess free radicals formation[29,30]. A significant elevation in the concentration of MDA and a notable reduction in SOD level in $KBrO_3$-treated group were observed in our study. The current results are compatible with the former studies[29,31-35] which revealed excess MDA and paucity of hepatic antioxidants (SOD, CAT, GPx, GST and GSH) in $KBrO_3$ treated animals.

Kidney is from the main and primary target organs of toxic substances[36]. $KBrO_3$ is highly toxic and hurtful to kidneys, brain and spinal cord[24]. It leads to renal tissue damage and haemolysis[37]. The renal functionality is indicated by appreciating creatinine, urea and uric acid levels[24,38,39]. Remarkable elevation in the serum concentration of uric acid and elevation but not significantly in creatinine in the current $KBrO_3$ treated group indicating reduction in glomerular filtration rate and impairment of kidney. These results are coincidence with the prior studies results[24,36,40,41].

$KBrO_3$ intake induces hematological changes. $KBrO_3$ caused a noteworthy drop in the count of WBCs, RBCs and platelets and in the Hb concentration in the ongoing study. Our results agree with the previous results of[1,42-46]. The decreased leucocytes and platelets counts could be owed to mutations in in these cells' DNA which resulted from oxidative stress induced by $KBrO_3$[47], hematopoiesis disturbance[43] and bone marrow suppression especially depression of megacaryocyte[48]. $KBrO_3$ toxic effects on bone marrow and hematopoietic organs lead to inability of them to release normal RBCs in the circulation[49,50] and also $KBrO_3$-induced oxidative stress damages RBC's membrane and impairs its deformability[44]. ROS oxidize ferrous ions to ferric causing methemoglobin formation and this resulted in reduction in Hb concentration[51]. Also $KBrO_3$ causes deficiency in iron, folic acid and vitamin B12 levels[1] which are desired for normal haematopoiesis, erythropoiesis and functional formation of haemoglobin and myoglobin[52,53].

In the existing study, $KBrO_3$ administration caused damage and deformity of the hepatic architecture. Central vein congestion, hepatic degeneration with inflammatory infiltration and congested sinusoids were observed. Cellular necrosis and vacuolated hepatocytes were also recorded. More activated Kupffer cells with obvious raise in their number were manifested. The histological changes detected in the ongoing study are similar to that recorded in[28,29,54] studies. Histological abnormalities in the kidney were detected in the $KBrO_3$-treated rats. Atrophy of the glomeruli with expansion of the Bowman's space, congestion of the glomerular tuft and renal tubules necrosis and loss of the lining epithelium were observed. Interstitial hemorrhage and interstitial inflammatory cells infiltration were recorded. The histological observations recorded in our study are consistent with[41,55,56]. Accumulation of ROS and toxins damages the mitochondria and lysosomes leading to proteolytic and apoptotic enzymes release into the cytoplasm that causes the cellular destruction and appearance of these histological changes[56].

Oxidative stress results from excess formation and incomplete elimination of reactive species from cells. To counteract the ROS adverse effects; cells have several defense mechanisms including antioxidative enzymes and small molecules such as Vit C and E, etc. Extra exogenous antioxidants are required to boost the cellular defense system in illness[57].

Vit C has the potency to effectively rake ROS, inhibits free radicals generation, protects bio-membranes from peroxide damage, reacts with superoxide directly and seeks for homeostasis[58-60]. In the ongoing study, $KBrO_3$ and Vit C administrated rats revealed drop in ALT, γ-GT and AST levels' and notably increased TP level. A serious decrease in MDA and a remarkable elevation in SOD were recorded in $KBrO_3$ plus Vit C treated rats. These results are consistent with[45,29,61] results. A significant relief in uric acid and creatinine levels' was recorded. Also treatment with Vit C improved the hematopoiesis indicated by the accretion in the WBCs, RBCs and platelets count and significant elevation in the Hb concentration. Vit C treatment improved the massive histological modulations induced by $KBrO_3$. The liver showed a reasonable level of integrity and normality except for congestion of some blood sinusoids. The damage of the kidney was also disappeared and the renal tissue returned to normal structure except for the interstitial infiltration and loss of lining epithelium of some renal tubules. This is in concord with the prior studies of[29,62-64]. These Vit C improvements are related to

its ability as antioxidant to combat free radical mechanism of $KBrO_3$.

Vanillin shows antioxidant, anticancer, antimicrobial, anti-inflammatory, hepatoprotective and cardioprotective activities[65]. Vanillin administration to $KBrO_3$-treated rats in our study improved biochemical parameters levels by lowering the ALT, γ-GT and AST levels and significantly increasing the TP level. Also MDA was remarkably decreased and SOD was markedly raised. Our results are in endorsement with the former studies[14,66-68].

Vanillin is a powerful chemopreventive factor against $KBrO_3$-mediated renal injury[67]. In the existing study, vanillin administration to $KBrO_3$-treated rats exposed a notable reduce in uric acid levels, decrease but not significant in creatinine level, enhance in the level of WBCs, RBCs, platelets count and Hb concentration. The current changes in the hematological parameters are in harmonization with[1] study.

Vanillin markedly improved $KBrO_3$ associated histopathological modulations in the ongoing study. Both liver and kidney tissues of rats treated with vanillin restored their normal structure and pathological alterations resulted from administration of $KBrO_3$ were faded. This is in harmony with the previous work of[6,14,44]. The hepatic, renal, hematological and histological improvements associated with vanillin administration illustrates its antioxidant activity, free radicals scavenging ability and its ability to stabilize cellular membranes. The vanillin antioxidant ability can be related to hydroxyl group (OH–) presence linked to aromatic ring that hemolytic fragments the O–H bond[69,70].

Combined administration with Vit C and vanillin to the $KBrO_3$ treated rats improved the biochemical and hematological parameters in our study. This improvement was illustrated by the drop in ALT, γ-GT and AST levels', noteworthy increase in TP level, significant dwindling in MDA level, remarkable rise in SOD level, significant lessening in uric acid level, decrease but not significant in the creatinine level, the elevation in the count of RBCs, WBCs and platelets and outstanding increase in the Hb concentration. Combination of Vit C and vanillin also ameliorated $KBrO_3$ toxicity and upgraded the histological variations in the hepatic and renal architecture.

The existing study showed that vanillin's ability and activity in ameliorating the toxicity of $KBrO_3$ is more than that of Vit C. The study of[53] approved the stronger activity of vanillin than that of Vit C in the 2,20 -azinobis 3-ethylbenzothiazoline-6-sulfonic acid (ABTS_þ)-scavenging and considerable activity in the 1-diphenyl-picrylhydrazyl (DPPH) radical-assay. This ability of vanillin result of the existing of functional groups such as phenolic, ether and aldehyde moieties[71,72].

CONCLUSION

Our study exposed that $KBrO_3$ induced hepatic, renal injury and hematological alterations by ROS generation and oxidative stress initiation. Severe histopathological modulations in the liver and kidney were related to $KBrO_3$ administration. It was proved that the treatment with Vit C and/or vanillin and with both vit C and vanillin together alleviated biochemical changes and hematological changes induced by $KBrO_3$, attenuated the hepatic oxidative injury by preventing oxidation of lipids and enhancing the defense mechanisms and markedly ameliorated the pathological variations in the liver and kidney.

CONFLICT OF INTERESTS

There are no conflicts of interest.

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الملخص العربى

التأثيرات التحسينية لفيتامين سي و الفانيلين ضد سمية برومات البوتاسيوم في ذكور الجرذان البيضاء: دراسة فسيولوجية و نسيجية

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المقدمة: برومات البوتاسيوم هي هالوجين موجود علي نطاق واسع في البيئة و يستخدم بصورة أساسية كمضاف غذائي. تسبب برومات البوتاسيوم ضررا بالغا للعديد من الأنسجة من خلال تكوين أنواع الأكسجين النشطة (ROS). تستخدم مضادات الأكسدة الخارجية للحماية من أو لعلاج سمية برومات البوتاسيوم.

الهدف من العمل: التحقق من الكفاءة العلاجية لفيتامين سي, أو/و الفانيلين ضد التغيرات الكيميائية الحيوية ،الدموية، التأكسدية والتركيبية الكبدية و الكلوية في ذكور الجرذان البيضاء.

المواد و الطرق: تم تقسيم ٤٥ من ذكور الجرذان البيضاء إلى ٩ مجموعات متساوية: المجموعة الضابطة ، فيتامين سي (٣٠ مجم/كجم), فانيلين (١٠٠ مجم/كجم), فيتامين سي + فانيلين, برومات البوتاسيوم (٢٥ مجم/كجم), انسحاب برومات البوتاسيوم، برومات البوتاسيوم + فيتامين سي, برومات البوتاسيوم + فانيلين و برومات البوتاسيوم + فيتامين سي + فانيلين. أعطيت الفئران برومات البوتاسيوم و فيتامين سي و الفانيلين عن طريق الفم يومياً لمدة ١٠ أسابيع. تم التضحية بالجرذان، جمع عينات الدم و الأنسجة و معالجتها لإجراء دراسات كيميائية حيوية، دموية و نسيجية.

النتائج: إعطاء برومات البوتاسيوم عن طريق الفم رفع مستويات, alanine amino transferase (ALT) aspartate amino transferase (AST), gamma glutamyl transferase (γ-GT), malondialdehyde (MDA)), حمض اليوريك uric acid و الكرياتينين creatinine و قلل بشكل ملحوظ مستويات البروتين الكلي (,(TP Super oxide dismutase (SOD), عدد خلايا الدم البيضاء (WBCs), عدد كرات الدم الحمراء (RBCs), و عدد الصفائح الدموية (platelets) و الهيموجلوبين (Hb). سببت برومات البوتاسيوم احتقان الوريد المركزي الكبدي، نخر الخلايا الكبدية، الارتشاح الخلوي، ضمور الكبيبات، تأكل و نخر الخلايا الطلائية الأنبوبية الكلوية و تسرب الخلايا الالتهابية. أدى تناول فيتامين سي أو الفانيلين أو كليهما معًا إلى تخفيف الخلل الوظيفي الناجم عن برومات البوتاسيوم عن طريق خفض مستويات ALT و AST و γ-GT و حمض اليوريك uric acid, MDA و الكرياتينين و رفع مستويات البروتين الكلي و SOD و عدد خلايا الدم البيضاء WBCs, عدد كرات الدم الحمراء RBCs, الصفائح الدموية و الهيموجلوبين و عن طريق تحسين التغيرات التركيبية في الكبد و الكلية.

الإستنتاج: يعمل فيتامين سي و الفانيلين على تحسين الدلائل الدموية، و التغيرات الوظيفية و النسيجية للكبد و الكلى المستحثة ببرومات البوتاسيوم من خلال خصائصهما المضادة للأكسدة.