Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 6, 2021, Pages. 6636 - 6645
Received 25 April 2021; Accepted 08 May 2021.

Histopathological Effect of Potassium Peroxymonosulfate in Albino Mice Treated with Vitamin C

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ABSTRACT

Background Disinfectants and surfactants are non-biodegradable contaminants that build up in bodies of water. Vegetation, planktons, fish, and zooplanktons absorb these disinfectants, which then enter the food web. Disinfectants introduced into aquatic systems accumulate in the food chain, causing a variety of harmful consequences and even mortality in aquatic creatures.

Objectives The present study aimed to evaluate the toxic effect of potassium peroxymono sulfateon the internal organs in albino mice.

Methodology : Eighty adult Swiss albino mice at the age of 7-8 weeks were divided in to four groups(20 mice per group), 1st group was administrate of potassium peroxymonosulfateorally with dose(1449.7 mg/kg,b.wt) daily for eight weeks, 2nd group was administrate of vitamin c (250 mg/kg, b.wt) orally at the same time for eight weeks , 3rd group was administrate of potassiumperoxymonosulfate(as sam 1st group and at the same time vitamin c as 2nd group orally for eight weeks, 4th group considered as negative control group. All of the animals were put to sleep, and portions of liver, kidney, intestine, heart, spleen, and brain. were removed for histological analysis. **Results**: our data reveal that the toxic effect of potassiumperoxymonosulfateinthe liver characterized by necrosisof hepatocytes with mitotic division nuclei .dilated central vein with mononuclear cells aggregation in portal area around portal vein and bile duct. Congestion of blood vessels with marked vacuolar degeneration of hepatocytesThe results reveal that vitamin C has an effect on the liver that is characterized by mononuclear cells aggregation around central vein and around portal area with proliferation of kuffers cells. The microscopic section of the kidney showed mononuclear cells infiltration in the glomeruli and between renal tubules. The microscopic section of the lung showed mononuclear cells infiltration in the interalveolar septa. The microscopic section of the intestine hyperplasia of goblet cells and mild mononuclear cell infiltration in the lamina properia, and mucosal gland hyperplasia of lymphoid tissue. Results showed that the effect potassiumperoxymonosulfate and vitamin c in the kidney showed necrosis with acute cellular swelling of renal tubules and inflammatory cells in the lumen of renal tubules.

Keywords: peroxymonosulfate , vitamin c , liver ,kidney **,** Brian

INTRODUCTION

Disinfectants and cleaning agents prepared with potassium peroxymonosulfate have been shown to be more effective than chlorine-based disinfectants and cleaning agents against a variety of infectious microorganisms, including viruses and bacteria (Eleraky and Gasparini, 2002).and they have been used in the hygiene management of healthcare environments (Ogura and Doidge, 2015).This drug is particularly effective against a wide range of infectious pathogens. Furthermore, the US Environmental Protection Agency (EPA) claims that potassium peroxymonosulfate-based disinfectants (PPD) are efficient against norovirus, methicillin-resistant Staphylococcus aureus (MRSA), hepatitis B virus, and hepatitis C virus.(Environmental Protection Agency, 2014).Disinfectants and surfactants are non-biodegradable contaminants that build up in bodies of water. Vegetation, planktons, fish, and

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zooplanktons absorb these disinfectants, which then enter the food web. Disinfectants introduced into aquatic systems accumulate in the food chain, causing a variety of harmful consequences and even mortality in aquatic creatures. (Summarwar ,2013). Disinfectant use has resulted in a number of issues, including fungicide resistance and potentially detrimental consequences on human health (Phillips *et al*., 2008).

As a result, innovative solutions that are successful in reducing mycotic diseases while still being safe for fish and the environment are still urgently needed. (Khosravi*et al*.,2012). Disinfection has a number of drawbacks, including the generation of potentially harmful disinfection by-products (DBPs) such trihalomethanes (THMs) and haloacetic acids (HAAs) 7. (2017, Bianco). The interaction of chlorine with natural organic materials produces this generation.Many THMs have been found as genotoxic mutagens that can be harmful to aquatic life and even people, with some of them being carcinogenic. (Ruales-Lonfat*et al*., 2016). For the formation of sulfate, free radicals, peroxymonosulfate is a unique chemical oxidant. Potassium peroxymonosulfate, often known as oxone, is the most common salt form of peroxymonosulfate.

In terms of radical generation, activated peroxymonosulfate has recently been proven to be more efficient than hydrogen peroxide and persulfate (Rastogi*et al*., 2009) .ROS have been linked to a wide range of diseases, including arthritis and connective tissue disorders, as well as carcinogenesis, aging, physical damage, infection, and acquired immunodeficiency syndrome (Kumar, 2013). oxidative stress is linked to pathological diseases that lead to cardiovascular problems, such as hypertension, hypercholesterolemia, and diabetes. (Kumar,2012). The predominant cytolytic and haematolytic activity of detergents (surfactants) is related to degradation of cell membrane integrity, mitochondrial activities, and cellular metabolism (Swenson and Ho-Yeon , 1992). The severity of the poisonous impact is determined by the agent's concentration and chemical properties, such as the length of the alkane chain and unsaturations (Swenson *et al*., 1992).cute and chronic detergent toxicity has been studied in vitro (Menard *et al*., 2011), ex vivo on tissues of experimental animals, and in vivo utilizing several animal models (Johnson, 2004). Advanced oxidation techniques based on the formation of sulfate radicals have been shown to be successful in degrading a variety of resistant micro pollutants in aqueous solutions, including hormones.(Brienza,2014), Pharmaceuticals (Zhang, 2014), pesticides, and pool water decontamination (Anipsitakis, 2008) are only a few examples.

Vitamin C can be found in abundance in a variety of natural foods, including fresh fruits and vegetables. Vitamin C is a potent antioxidant with the potential to donate a hydrogen atom and generate the ascorbylfree radical, which is generally stable. Antioxidant vitamins such as vitamin E, vitamin C, and -carotene have been shown to reduce oxidative damage and the risk of certain chronic diseases (Rouhier*et al*., 2008; Verma*et al*., 2007). Vitamin C is a water-soluble antioxidant that has been shown to neutralize reactive oxygen species (ROS) and lessen oxidative stress (Rouhier*et al*.,2008; Verma*et al*., 2007). Vitamin C is a powerful reducing agent and free radical scavenger in biological systems (Duarte *et al*., 2005, Jasim*et al*.,2019 a).Vitamin C is a water-soluble antioxidant that has been shown to neutralize reactive oxygen species (ROS) and lessen oxidative stress (Rouhier*et al*.,2008; Verma*et al*., 2007). Vitamin C is a powerful reducing agent and free radical scavenger in biological systems (Duarte *et al*., 2005). It works as the initial line of defense against oxidative stress, protecting lipid membranes and proteins. Vitamin C, as a water soluble molecule, can neutralize free radicals and prevent free radical damage both within and outside the cells. Vitamin C is a great supply of electrons for free radicals looking for a way to re-establish their stability. Vitamin C can provide free radicals electrons and hence reduce their reactivity. (Rouhier*et al*., 2008; Bindhumol*et al*., 2003) .

MATERIALS AND METHODS

Eigty mice aged 7-8 weeks and weighted ranged from 30-35gm,In this study, animals from the College of Vet. Med./University of Baghdad's animal house were used. They were housed and cared for in a traditional animal facility under strict temperature control (20±5^{o}C). Pellets were

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provided to the animals, as well as water. Each group of mice was kept in a plastic cage with hard-wood chip bedding for the duration of the study.maintain a clean environment, the bedding was changed on a regular basis.

Preparation of potassium peroxymonosulfate

Dissolve1.4497mg of potassium peroxymonosulfate in 10ml distal water to prepare concentration14.497mg/ml and to be given at dose volume of 0.1ml/10g B.W.

Preparation of vitamin C

Dissolve 250mg of vitamin c in 10ml distal water to prepare concentration25mg/ml and to be given at dose volume of 0.1ml/10g B.W.

Experimental design

Eighty adult swiss albino mice at the age of 7-8 weeks were divided into four groups. the1st group (n=20) mice were administrated orally with (1/10ld50 1449.7 mg/kg body weight)of potassium peroxymonosulfate daily for 8 weeks. 2nd group (n=20) mice were administrated (250 mg/kg, b.wt) vitamin c daily for 8 weeks. the 3rd group (n=20) mice were treated in the same route with the vitamin c 250 mg/kg, b.wt./ daily for 8 weeks and the same time treated with (1/10ld50 1449.7 mg/kg body weight) of potassium peroxymonosulfate the 4th group (n=20) considered as control negative. pieces of liver and kidney ,intestine,spleen ,heart and brine for standard histological investigation, they were fixed in 10% normal buffer formalin for 72 hours (luna, 1968).

RESULT AND DISCUSSION

Histopathological changes of animals treated with potassium peroxymono sulfate at 8 weeks post treatment the main lesion in liver characterized by shows odematous material in the dilated central vein with necrosis of hepatocyte (figure 1) ,also in kidney shows mononuclear cells infiltration and hemorrhagic area in addition to necrosis of renal tubules (figure 2) ,additionally in the shows focal lymphocytic aggregation with hyperplasia ofepithelial cell of bronchi and increased thickness of interalveolar septa due to congested capillaries blood vessels in addition few RBCs (figure 3),also in intestine show hyperplasia epithelial cell of mucosal gland with increase mucinesecreation with marked mononuclear cells infiltrations edematous material and sub mucosa and congestion of blood vessels (figure 4) ,also in alterations in the histopathology of animals treated with potassium peroxymono sulfate and treated at same time with vitamin c at 8 weeks post treatment the main lesion in liver characterized byshows necrosis with vaccular degeneration of hepatocyteand congestion central vein (in figure 5), also in kidneyshows atrophy of glomerulei with necrosis and acute cellular swelling of renal tubules in addition to mononuclear cells between renal tubules and around glomerula with Buman space ,in addition to inflammatory cells in the lumen of renal tubules (in figure 6) ,also in lungshows hyperplasia of the epithelial cells of bronchiol with increased thickness of interalveolar connective tissuein addition to infiltration of the inflammatory cells(in figure 7), also in intestineshowhyperplasi of lymphoid tissueandcongestedof blood vessels(in figure 8).also in the animals after administrated vitamin c,the main lesion in liverc shows mononuclear cells aggregation around portal area with proliferation of kuffers cells (in figure 9),also in kidney shows mononuclear cells infiltration in the glomerulei and between renal tubules (in figure 10). Histopathological changes of animals 4th group that considered control (negative group) No important microscopic findings have been found.

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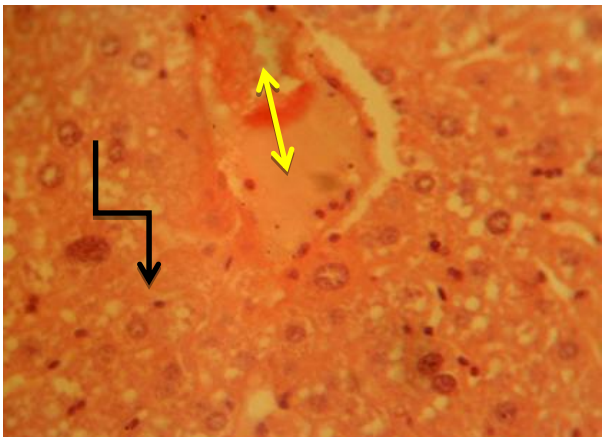
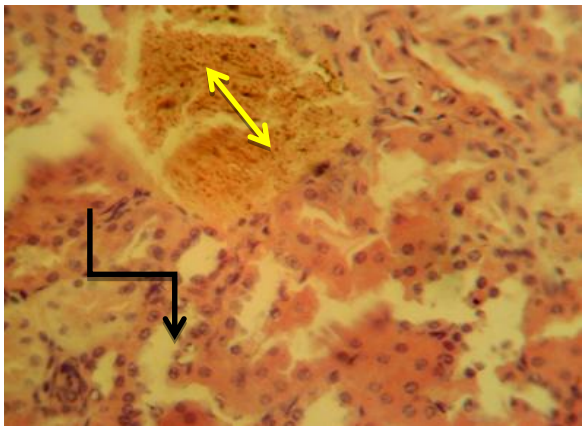
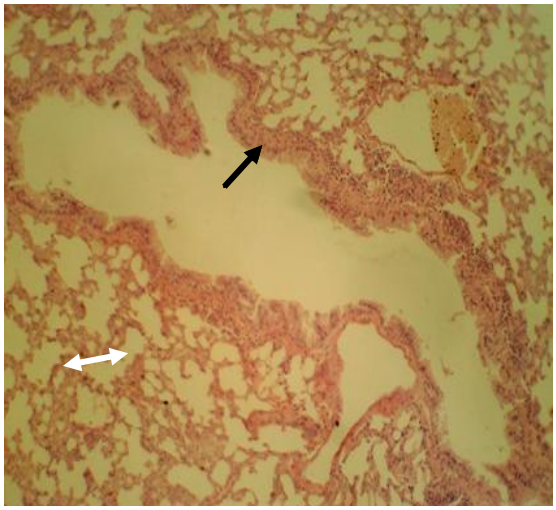


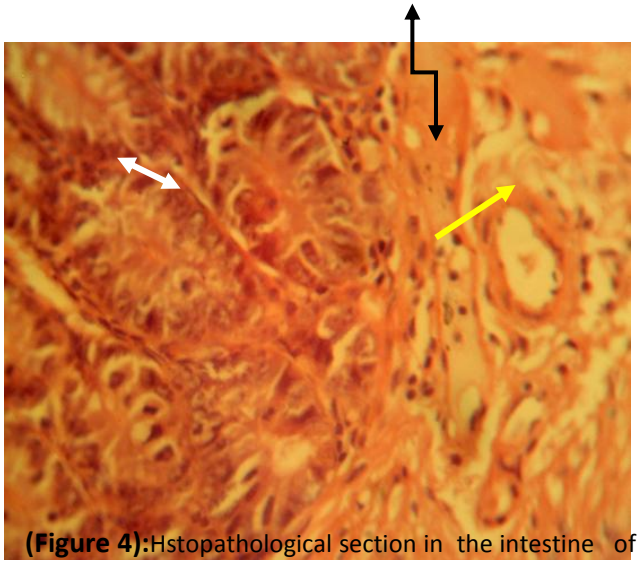
(Figure1): Histopathological section in the liver e of animal at 8 weeks post-treatment with potassium peroxymonosulfate (1.4497mg/kg b.w) shows odematous material in the dilated central vein(yellow arrow) with necrosis ofhepatocyte(nlack arrow) (H&E stain 40X)



(Figure 2): Histopathological section in the kidney of animal at 8 weeks post-treatment with potassium peroxymonosulfate (1.4497mg/kg b.w) shows mononuclear cells infiltration and hemorrhagic area(yellow arrow in addition to necrosis (black arrow) of renal tubules (H&E stain40X).



(Figure 3): Histopathological section in the lung of animal at 8 weeks post-treatment with potassium peroxymonosulfate (1.4497mg/kg b.w) shows focal lymphocytic aggregation with hyperplasia ofepithelial cell of bronchi(black arrow) and increased thickness of interalveolar septa(white arrow)due to congested capillaries blood vessels in addition few RBCs (H&E stain 10X).



(Figure 4): Hstopathological section in the intestine of animal at 8 weeks post-treatment with potassium peroxymonosulfate(1.4497mg/kg b.w) show hyperplasia epithelial cell of mucosal gland with increase mucinesecreation(white arrow) with marked mononuclear cells infiltrations edematous material and sub (black arrow)mucosa andcongestion of blood vessels (yellow arrow) (H&E stain40X).

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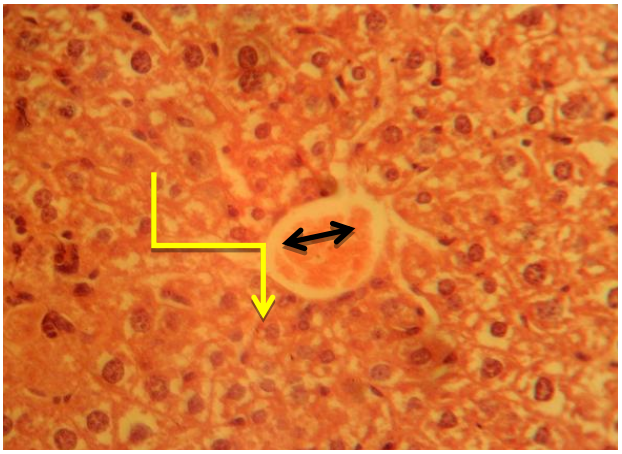
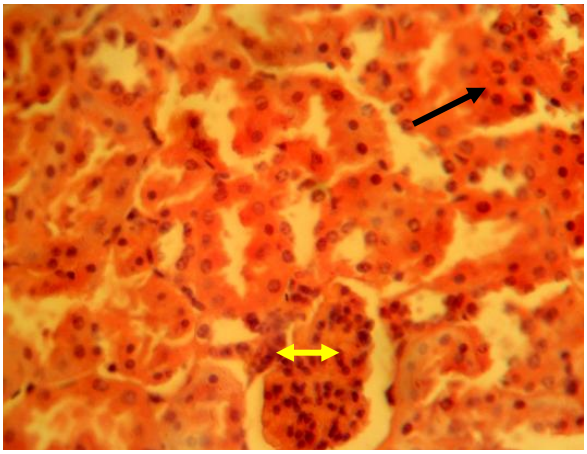
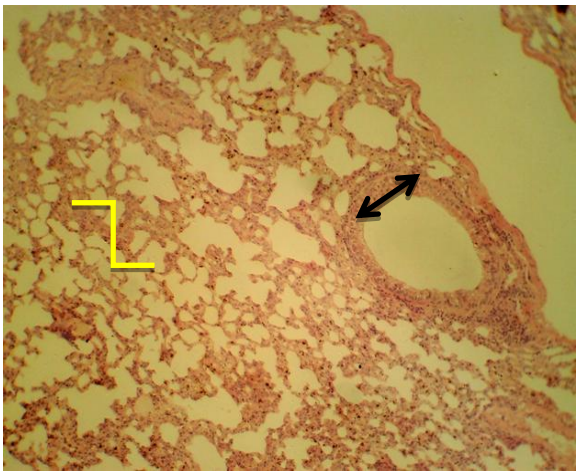


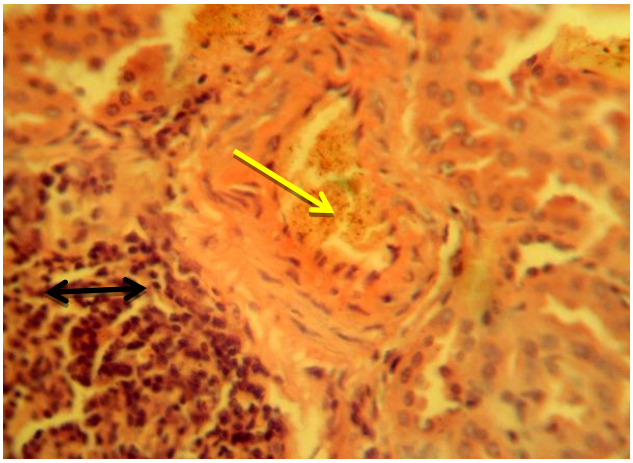
(Figure 5):Histopathological section in the liver of animal at 8 weeks post-treatment with potassium peroxymonosulfate and vitamin c shows necrosis with vaccular degeneration of hepatocyte(yellow arrow) and congestion central vein(black arrow) (H&E stain40X)



(Figure 6): Histopathological section in the kidney of animal at 8 weeks post-treatment with potassium peroxymonosulfate and vitamin c shows atrophy of glomerulei with necrosis and acute cellular swelling of renal tubules in addition to mononuclear cells between renal tubules and around glomerula with Buman space(yellow arrow) ,in addition to inflammatory cells in the lumen of renal tubules(black arrow)(H&Estain40X)



(Figure 7): Histopathological section in the lung of animal at 8 weeks post-treatment with potassium peroxymonosulfate and vitamin c shows hyperplasia of the epithelial cells of bronchiol with increased thickness of interalveolar connective tissue(black arrow) in addition to infiltration of the inflammatory cells(yellow arrow) (H&E stain10X)



(Figure 8):Histopathological section in the intestine of animal at 8 weeks post-treatment with potassium peroxymonosulfate and vitamin c show hyperplasi of lymphoid tissue(black arrow) and congestedof blood vessels(yellow arro (H&E stain40X)

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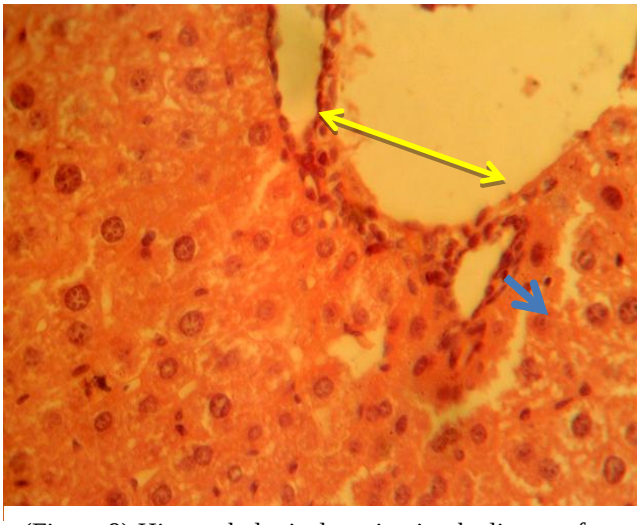
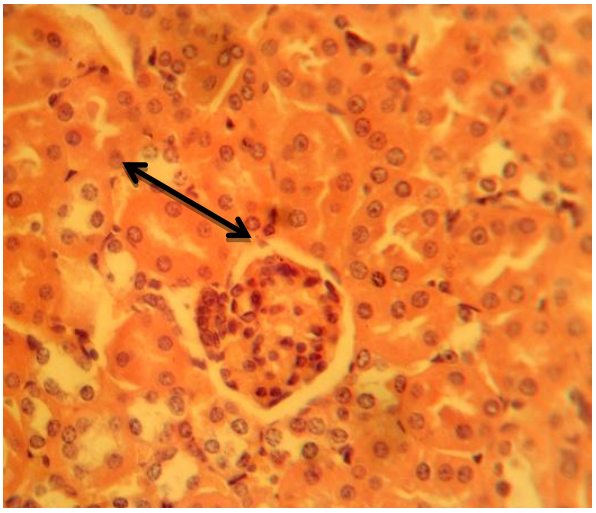


(Figure 9):Histopathological section in the liver e of animal at 8 weeks post-treatment with vitamin c shows mononuclear cells aggregation around portal area(yellow arrow) with proliferation ofkuffers cells(blue arrow) (H&E stain40X)



(Figure 10):Histopathological section in the kidney of animal at 8 weeks post-treatment with vitamin c shows mononuclear cells infiltration in the glomerulei and between renal tubules(black arrow) (H&E stain40X)

Detergents, including biodegradable detergents, have been found to cause poisoning and osmoregulatory imbalances in aquatic life, particularly when present in concentrations that exceed metabolic requirement. Such xenobiotic chemicals are known to be one of the most common terrestrial and aquatic pollutants because they are persistent and mobile in soil and water.(Cox, 1998). The gills, kidney, liver, skin, heart, and brain have all been observed to be severely damaged by the detergent effluents. The goal of this study is to figure out how much oxidative and neurological damage synthetic detergent SDS causes in the brain.In order to stabilize the organism under stress, bodily processes are adjusted to resist the influence of pollutants/stressors. Due to the functional detoriation of antioxidants, oxidative stress is a critical expression of a multi-step system that culminates in an imbalance between pro-oxidant and antioxidant defense mechanisms., or an excessive buildup of superoxide radicals, or both, resulting in tissue injury (Kavitha and Rao, 2009) .
Exposure to certain pollutants, such as SDS, has been shown to produce reactive oxygen species (ROS), which can induce organ damage (Livingstone,2001). The levels of oxidative stress were measured using MDA, a lipid peroxidation marker. Although the effect did not depend on the duration of the exposure, the considerable increase in MDA level indicated the production of super oxide radicals in fish exposed to SDS. The SOD-CAT system works by inhibiting the generation of oxy-radicals.decrease in the activity of the SOD-CAT system was most likely a reaction to toxicant stress, and failed to offset the negative effects of enhanced super oxide molecule production (Pandey*et al*., 2003). (John *et al*.,2001). Long-term toxicant exposure hindered SOD and CAT activities in catfish tissues, which could be related to a flux of superoxide radicals resulting in an increase in cellular peroxide molecule (Zhang *et al*.,2008). GSH plays an important role in cellular antioxidant defense and metabolic pathway adjustment activities., GST decreased the amounts of xenobiotic compounds in the aquatic system, while GPx catalyzes H2O2 reduction and protects against lipid peroxidation (Li ZH *et al*., 2010). They all work together to provide a robust line of defense against oxidative stress caused by xenobiotic contaminants (Basha*et al*.,2012).

In another investigation, kidney impairment caused by detergent-processed potassium peroxymonosulfate therapy was examined by assessing urine indicators of renal function. Renal dysfunction is linked to changes in these biochemical markers. Increased plasma concentrations of these products would come from renal disorders that produced a decline in GFR (George *et al*.,2020). As a result, as the filtration rate decreases, the plasma concentrations of urea and creatinine rise. The treated groups had considerably greater urea levels than the positive and negative control groups in this study.This is consistent with (Shama and Wasma's ,

2011) work, which found a substantial increase in plasma urea in rats fed a methanol extract of cassava for two weeks. When compared to the control rats, the detergent treated rats had considerably higher urine concentrations of these excretory products.The detergent-treated animals' renal photomicrographs revealed a disturbed cortical structure with diffuse tubule loss, an inflammatory cell infiltrate in the interstitium, and some intact glomeruli.

This suggests that the higher plasma urea in the potassium peroxymonosulfate-treated groups is due to enhanced urea secretion by renal cells and/or higher urea production by the kidneys.Because urea is one of their consequences, skeletal muscle metabolism and protein catabolism are linked.These findings are consistent with those of (Fakhouri and Fremeaux-Bacchi,2007), who stated that renal damage was most likely caused by the direct toxic action of detergent components (especially borate) on renal tubular epithelial cells and endothelium, which was exacerbated by hypovolaemia and the resulting reduction in renal toxin excretion.The severe detergent-related endothelial injury also caused thrombotic microangiopathy, with low schistocytes on peripheral smear and low platelets, which further complicated the picture, especially given the history of hamburger consumption.The present finding revealed different pathological lesions in the intestine, may be due to cytotoxic effect of detergent these result agreement with(Ogunbileje and Akinosun,2011), who reported the detergent solution which caused multi organs injuries. Intestinal metaplasia is associated with the transformation of the stomach lining and in the earlier stages, the replaced epithelium resembles the small intestine(Madhulima,2016) .The pathological lesions that were recorded in the intestine may be due to the direct effects of potassium peroxymonosulfate on intestinal mucosa which lead to stimulate goblet cells activity to produce large amount of mucin in order to remove or diluted the toxic effects of potassium peroxymonosulfate,Because the function of villi is so important, and the damage to this site in this situation is so severe, the extent of gastrointestinal disorders may easily be attributed to detergents. Surf appears to have obstructed the paracellular channels generated at the connections between intestinal cells for the passage of ions and other water soluble substances to the lamina propia. (Ogochukwu and Joseph,2009).Maciorowski (Travlos et al.,1996) also found that the effect of anionic surfactants on mollusk intestine injury was reversible.Treatment of animals with vitamin C In the current investigation, modest damages were observed in the internal organs of rats given vitamin C; these findings could imply that vitamin C's antioxidant activity protects soft tissues from the detrimental effects of free radicals created as a result of heavy salt poisoning(Jasim*et al*.,2019 b) .The alpha tocopheroxyl radical, which is formed when exogenous radical oxidants interact with alpha tocopherol, is an example. Low-density lipoprotein cholesterol (LDL) cholesterol (LDL) cholesterol (LDL) cholesterol ((LDL). The tocopheroxyl radical has the ability to be converted to alpha tocopherol by ascorbate4) (Neuzil*et al*., 1997). Reactions between iron and copper that are mediated by transition metals. For example, Fenton chemistry can lead to the creation of additional radicals when iron is reduced by ascorbate (Carr and Frei, 1999).Reduced iron, on the other hand, may be an endpoint reaction: for example, reduced iron may be the optimal state for intestinal absorption (Hallberg,1995; Lynch , 1997).

Acknowledgement

extend my sincere thanks, appreciation and respect to the College of Veterinary Medicine, Baghdad University for their continuous support, and I thank the physiology and toxicology department for providing full support and conducting the selected tests inside the branch.

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